

# PHOTONICS WEST

TECHNICAL PROGRAM

**BIOS**

**LASE**

**OPTO**

THE MOSCONE CENTER  
SAN FRANCISCO, CALIFORNIA, USA

Conferences + Courses: 1-6 February 2020  
BIOS Expo: 1-2 February 2020  
Photonics West Exhibition: 4-6 February 2020

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**SPIE.** PHOTONICS  
WEST

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ADVANCING LIGHT.

# PHOTONICS WEST 2020

THE PREMIER EVENT FOR THE  
BIOMEDICAL OPTICS, PHOTONICS,  
AND LASER INDUSTRIES

**Conferences & Courses:** 1-6 February 2020

**Photonics West Exhibition:** 4-6 February 2020

**BiOS Expo:** 1-2 February 2020

**The Moscone Center, San Francisco, California, USA**

Cutting-Edge Research

Two Exhibitions

Industry Program

Training and Education

New in 2020!

**SPIE AR, VR, MR Co-located Conference**

**[spie.org/pw](https://www.spie.org/pw)**  
**#photonicswest**

## SPIE.

SPIE is the international society for optics and photonics, an educational not-for-profit organization founded in 1955 to advance light-based science, engineering, and technology. SPIE provided more than \$5 million in support of education and outreach programs in 2019.

SPIE would like to express its deepest appreciation to the symposium chairs, conference chairs, program committees, session chairs, and authors who have so generously given their time and advice to make this symposium possible.



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# Welcome to the world's leading photonics technologies event.

Every year over 22,000 attendees come to hear the latest research and find the latest devices and systems to enable advancements in biomedical optics, biophotonics, scientific and industrial lasers, optoelectronics, microfabrication, MOEMS-MEMS, displays, and more.

## Photonics West events take place in the following locations:

Moscone North, Moscone South, Moscone West, InterContinental Hotel, Marriott Marquis Hotel, and Park Central Hotel. Check locations for each program listing.

## Conferences:

 Three cutting-edge technical areas, featuring 5,200 presentations

### **BIOS** pp. 128–280

Topics include biomedical optics, photonic therapeutics and diagnostics, neurophotonics, tissue engineering, translational research, tissue optics, clinical technologies and systems, biomedical spectroscopy, microscopy, imaging, nano/biophotonics.



### **LASE** pp. 282–331

Topics include laser source engineering, nonlinear optics, laser manufacturing, laser micro-/nanoengineering, 3D fabrication, materials processing, and more.



### **OPTO** pp. 333–454

Topics include optoelectronic materials and devices, photonic integration, displays and holography, nanotechnologies in photonics, advanced quantum and optoelectronic applications, semiconductor lasers and LEDs, MOEMS-MEMS, and optical communications.

## Application tracks focus on key technologies

### **Brain/Neuro Research p. 100**

The development of innovative technologies that will increase our understanding of brain function.

### **Translational Research p. 108**

Including the latest photonics technologies, tools, and techniques with high potential to impact healthcare.

### **3D Printing p. 119**

Highlighting papers that showcase innovative ways to apply this multidimensional/multidisciplinary technology.



### **Courses** pp. 73–80

Take advantage of face-to-face instruction from some of the biggest names in industry and research.



### **Two World-Class Exhibitions**

Meet top suppliers, gain industry insights, and discover new possibilities.



pp. 24–27



**Plenary Presentations . pp. 12-18**

Don't miss these world-class speakers talking on the latest directions and most promising breakthroughs.

**Technical Events . . . . . pp. 20-22**

Join your peers and colleagues at the poster sessions, special sessions, and other group discussions around focused technical topics.

**Professional Development Workshops . . . . . pp. 35-39**

SPIE can help with lifelong learning and career development. Workshops and presentations will help you hone valuable job skills.

**Social/Membership/ Student Events. . . . . pp. 40-46**

Join your colleagues and make new connections at these relaxed events, including the All-Symposium Welcome Reception—an event not to be missed.

**Industry Program . . . . . pp. 48-71**

These sessions offer valuable information and networking opportunities for everyone—from engineers to CEOs looking for insights and new opportunities.

**SPIE AR, VR, MR co-located event . . . . . pp. 81-95**

See the #1 event for XR hardware. SPIE Photonics West full conference registration includes access to this exciting event. Activities take place at Moscone West.

## Get your badge bling

**Fun, free ribbons to add to your badge**

A great ice breaker and a fun way to introduce yourself to your colleagues. Try out one or several.

**Available at the Information Desk Exhibition Level**

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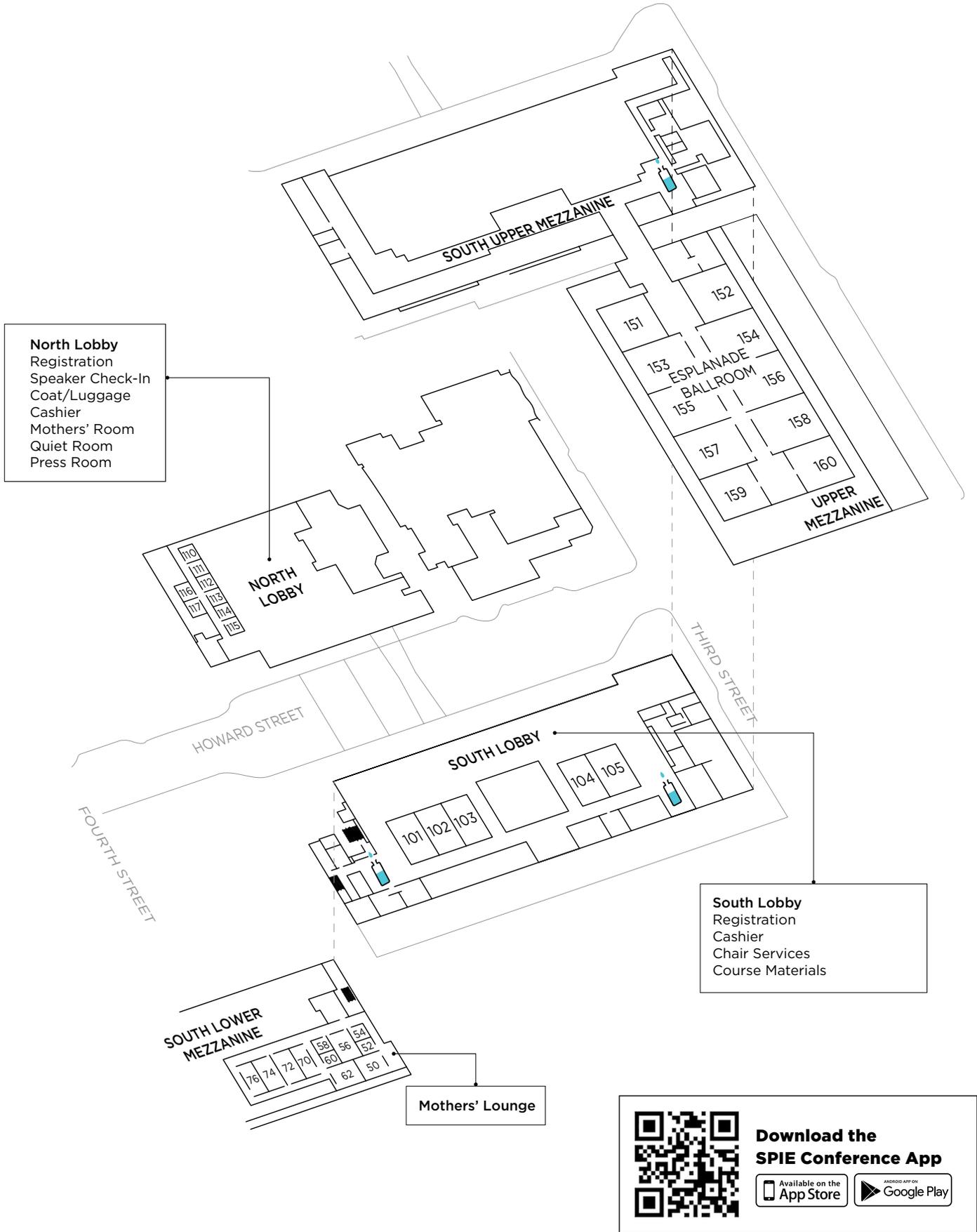
**GENERAL INFORMATION . . . . . pp. 527-530**

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Food and Beverage · Onsite Services · Parking and Car Rental

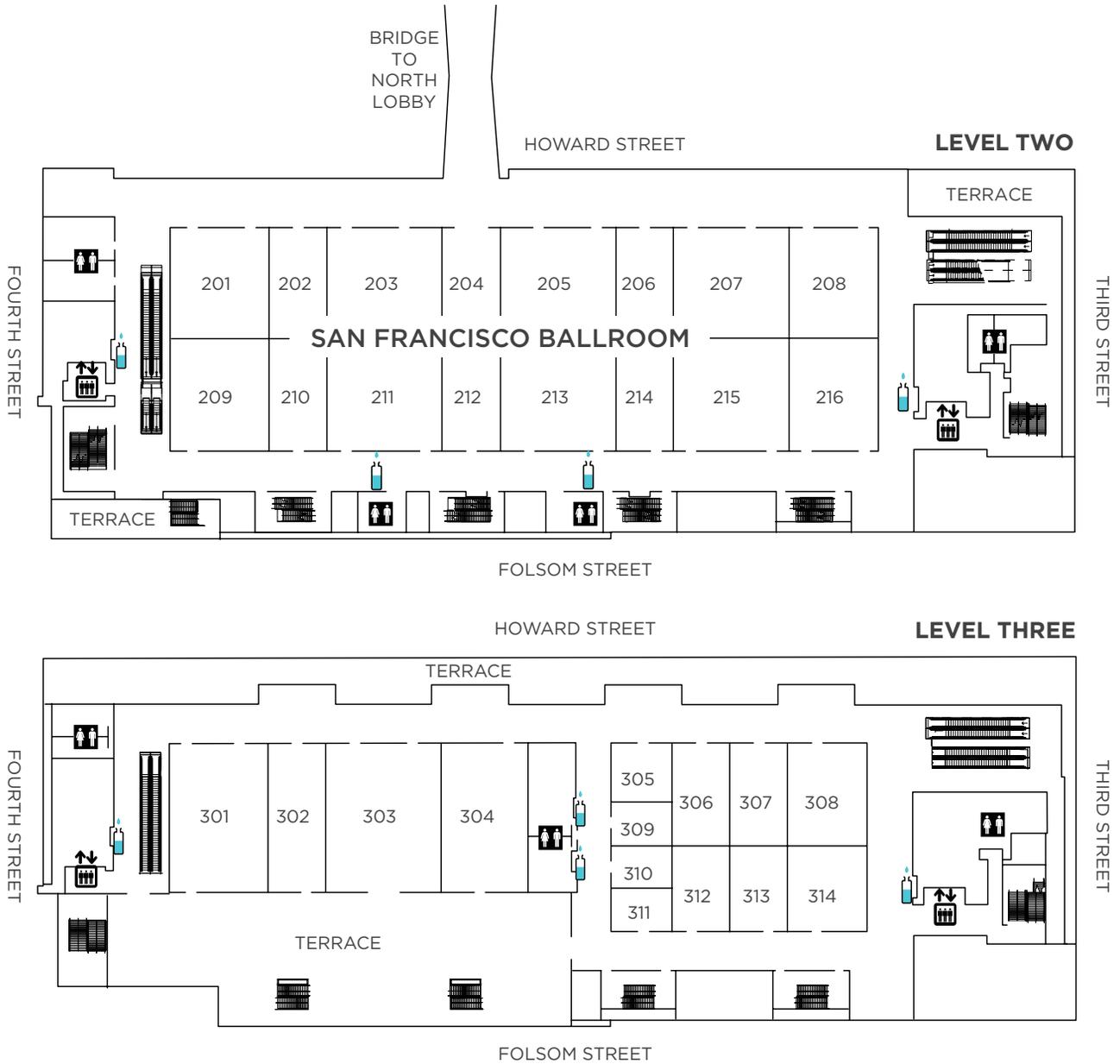
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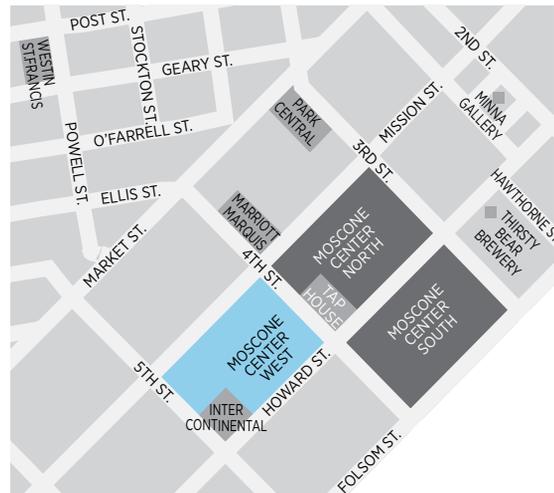
# THE MOSCONE CENTER NORTH/SOUTH LOBBIES AND MEZZANINES



# MOSCONE CENTER SOUTH LEVELS TWO AND THREE



**Water filling stations:**  
 Stop by Level Two or  
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 each day before 9:30 AM  
 to receive your free  
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# THE MOSCONE CENTER WEST

## Events in Moscone West

**SPIE.AR|VR|MR**

**SPIE. PHOTONICS WEST**

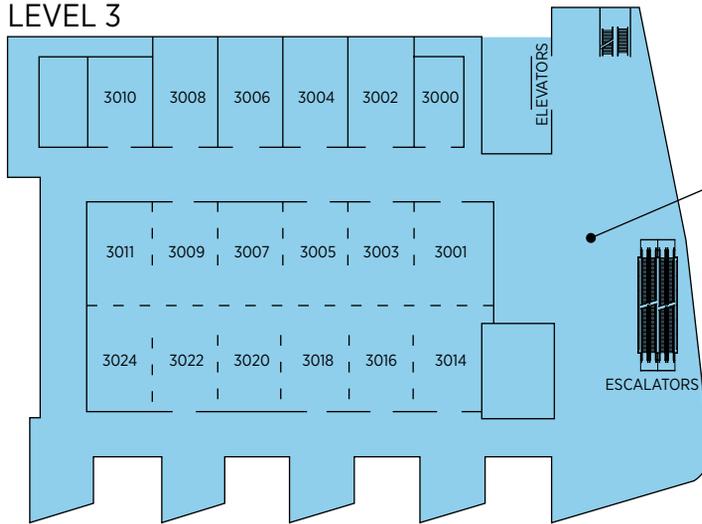
POSTER SESSIONS  
Sunday, Monday, Tuesday, Wednesday

ENTREPRENEUR PROGRAM

STARTUP CHALLENGE

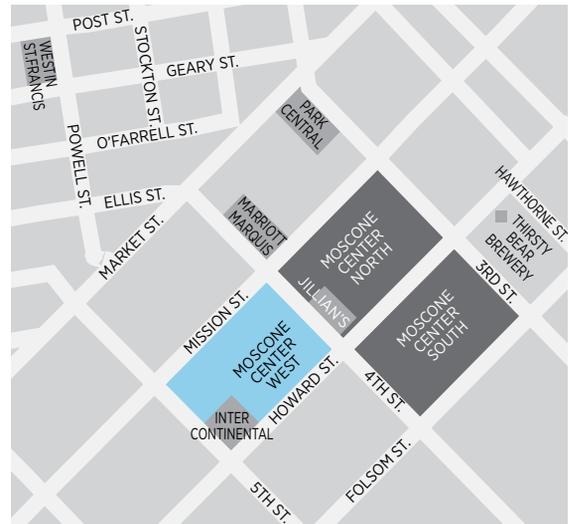
INDUSTRY WORKSHOPS

### LEVEL 3

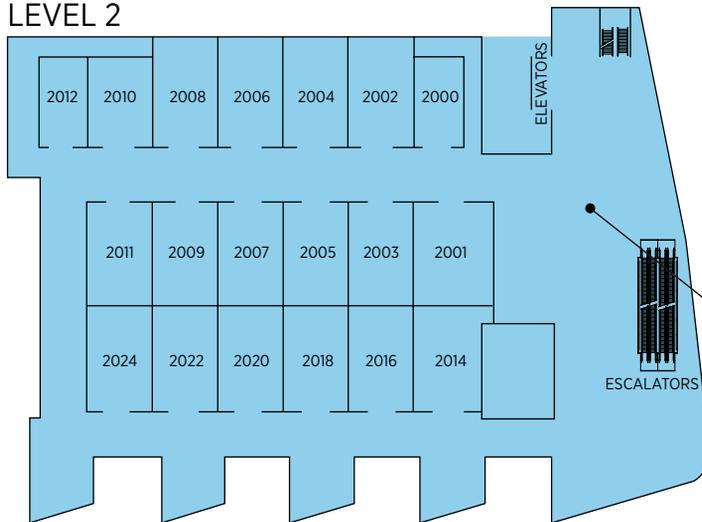


**LEVEL 3 LOBBY:**  
POSTERS

### STREET MAP



### LEVEL 2



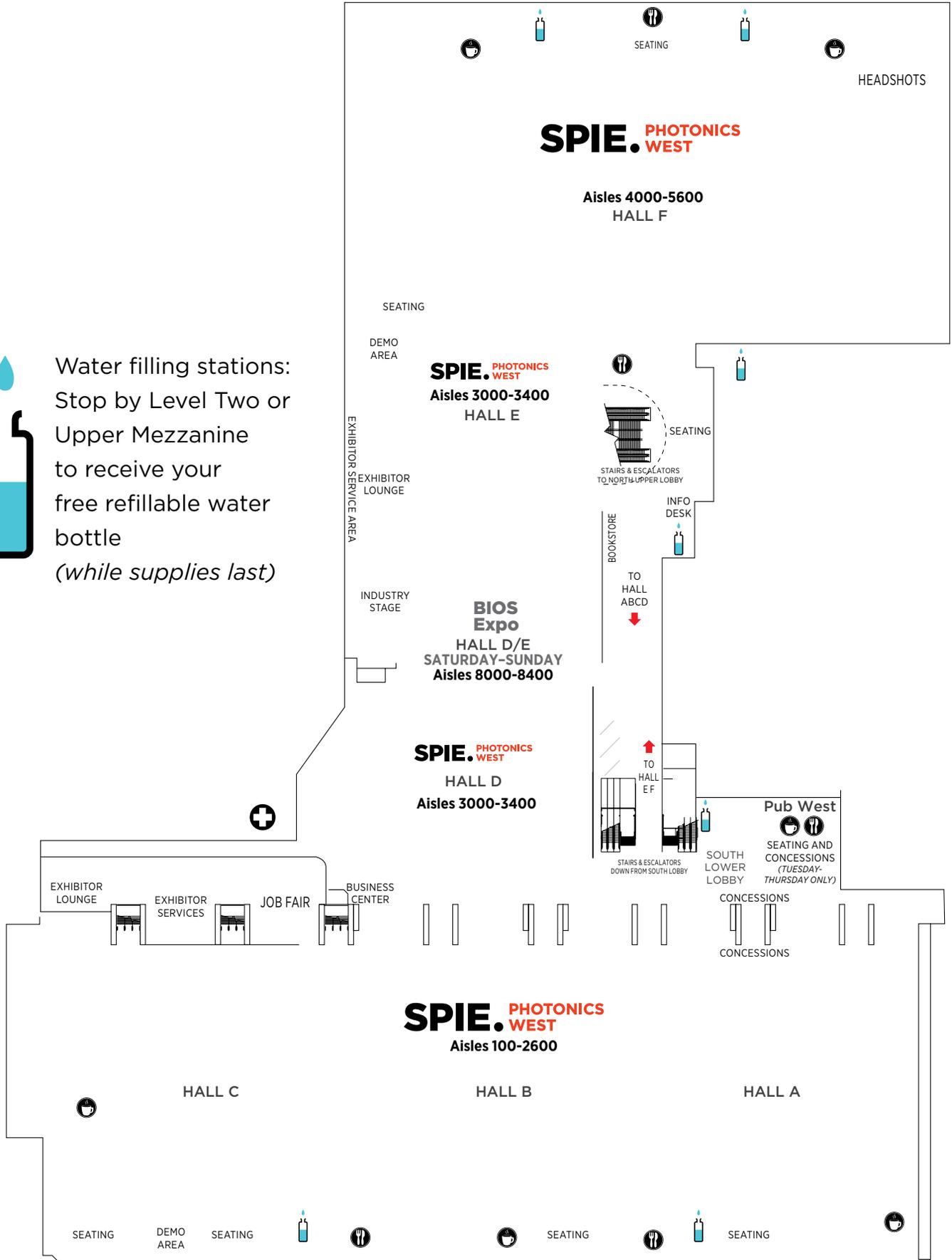
**SPIE.AR|VR|MR**  
**LEVEL 2 LOBBY:**  
REGISTRATION  
COAT CHECK & LUGGAGE

# THE MOSCONE CENTER NORTH AND SOUTH EXHIBITION LEVEL

MISSION STREET

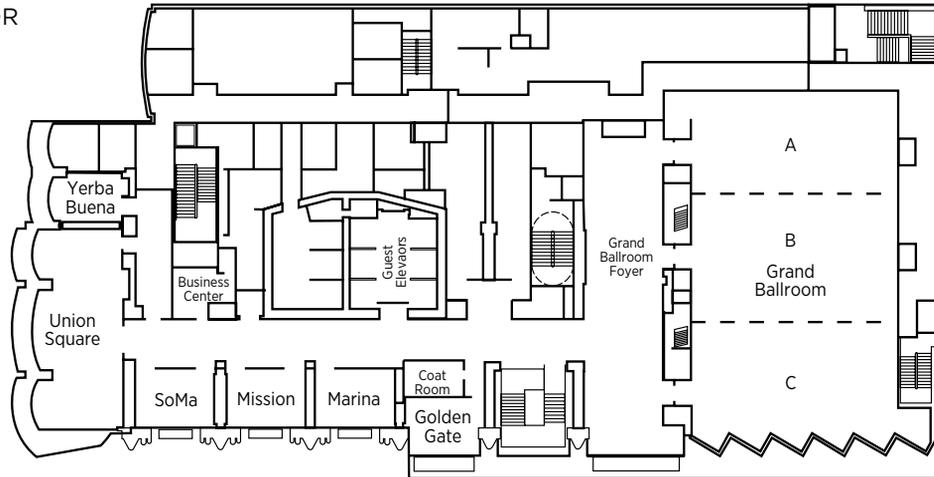


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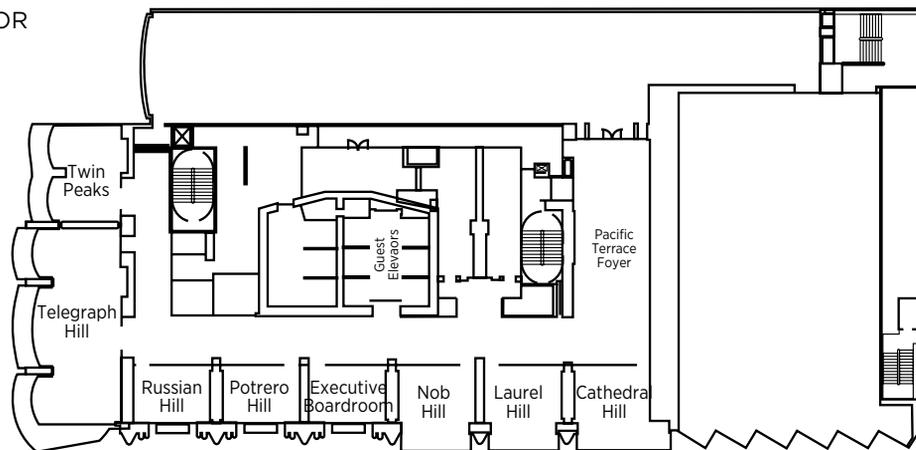


# INTERCONTINENTAL HOTEL

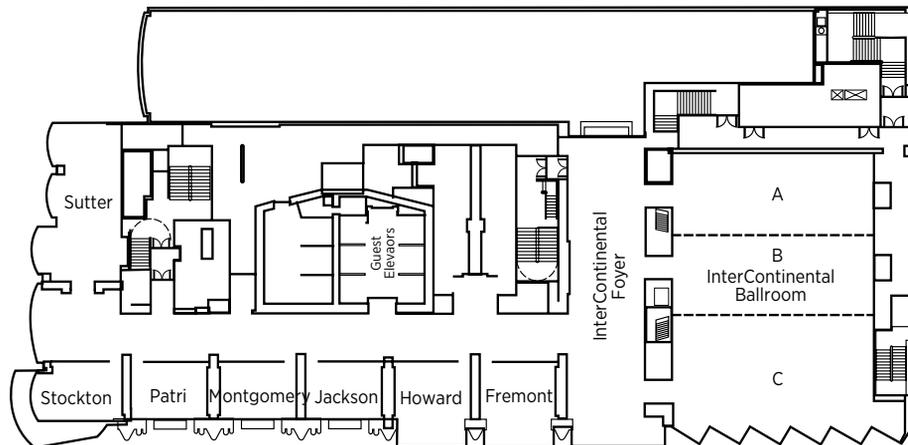
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FIFTH FLOOR



Edge Welded



Hydroformed



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4055**

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and precision  
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## BIOS Hot Topics

Don't miss these world-class speakers reporting on major breakthroughs and opportunities in healthcare technology.

Saturday 1 February 2020 • 7:00 PM - 9:30 PM • Location: Room 206/214 (Level 2 South)

7:00 PM - 7:05 PM:



### Welcome and Opening Remarks

BIOS 2020 Symposium Chair  
**Jennifer Barton**, The Univ. of Arizona (USA)



BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM - 7:10 PM:

### Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President



### Presentation by

**Steven Jacques**,  
Univ. of Washington (USA);  
2020 Britton Chance Biomedical Optics Award Winner

7:30 PM - 7:35 PM:



### Hot Topics Facilitator Remarks

**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM - 7:45 PM:



### Optical Coherence Tomography from Research to Clinical Practice

**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM - 7:55 PM:



### Computational Microscopy

**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM - 8:05 PM:



### Seeing Early Cancer in a New Light

**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM - 8:15 PM:



### Multiscale QPI

**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM - 8:25 PM:



### Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures

**Muyinatu A. Lediju Bell**,  
Johns Hopkins Univ. (USA)  
*Journal of Biomedical Optics*  
Speaker

8:25 PM - 8:35 PM:



### Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives

**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM - 8:45 PM:



### Imaging the Proteome in Living Cells

**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM - 8:55 PM:



### X-Induced Photodynamic Therapy

**Shawn Chen**, NIH/NBIB (USA)

8:55 PM - 9:05 PM:



### AI Cell Sorting

**Keisuke Goda**, Univ. of Tokyo (Japan)

# COMMUNITY SUPPORT

## Helping You Create The Future

In 2019, SPIE provided over \$5 million in community support including scholarships and awards, outreach and advocacy programs, travel grants, public policy, and educational resources.

We are an educational, not-for-profit organization that contributes a significant percentage of revenue, every month, every year, without a separate fundraising campaign or administrative foundation.

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## PLENARY PRESENTATIONS



### Neurotechnologies Plenary

Sunday 2 February 2020 • 3:30 PM - 5:30 PM  
Location: Room 206/214 (Level 2 South)

This session will highlight the breadth of exciting advances occurring in the field of neurophotonics and provide a unique forum for communication and networking for leaders and innovators in the neurophotonics community.



Brain 2020 Symposium Chair  
**David Boas,**  
Boston Univ. (USA)



Brain 2020 Symposium Chair  
**Elizabeth Hillman,**  
Columbia Univ. (USA)

#### PRESENTATIONS:



**New Tools for Optical Recording of Neuronal Function**  
**Robert Prevedel,**  
European Molecular Biology Lab. (Germany)



**Volitional Control of Neuromodulators as a Novel Form of Neural Interface**  
**David Kleinfeld,**  
Univ. of California, San Diego (USA)



**Wearable Functional Near Infrared Spectroscopy**  
**Audrey Bowden,**  
Vanderbilt Univ. (USA)



**Noninvasive Monitoring of Intracerebral Pressure**  
**Jana Kainerstorfer,**  
Carnegie Mellon Univ. (USA)



**The Role of NIBIB in Neuro-Technology Development**  
Bruce Tromberg,  
National Institutes of Health (USA)

### BiOS Sunday Plenary

Sunday 2 February 2020 • 7:15 PM - 8:00 PM  
Location: Room 206/214 (Level 2 South)

#### Welcome and Award Presentation



**John G. Greivenkamp,**  
Univ. of Arizona (USA),  
2020 SPIE President

#### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

The SPIE Biophotonics Technology Innovator Award is presented for extraordinary achievements in biophotonics technology development that show strong promise or potential impact in Biology, Medicine, and Biomedical Optics. The award targets achievements that span disciplines and may include elements of basic research, technology development, and clinical translation.



The 2020 recipient is **Nirmala Ramanujam**, Duke University, Durham, North Carolina, United States, in recognition of her development of disruptive low-cost, high-performance technologies to enable see and treat paradigms for cervical cancer prevention

#### Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells



**Eric Betzig,**  
Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

# Meet the Editors

Talk directly with our editors about trends in the industry or becoming a contributor.



An accomplished journalist and editor, **Michael Wheeler** oversees Photonic Media's editorial operations — spanning print, web, and podcasts — as editor-in-chief. He also serves as editor of *Vision Spectra*, chronicling advancements in the rapidly expanding machine vision/inspection sector.



**Susan Petrie** is senior editor of *Photonics Spectra* and has two decades of experience with print and digital publications. She has a Master of Fine Arts in writing from Bennington College.



Senior editor **Douglas Farmer** has been a journalist for nearly 20 years, winning awards for health and education reporting. He has a master's degree in journalism from Ball State University. He is editor of *EuroPhotonics* and *BioPhotonics* magazines.



## Photonics West

Wednesday, February 5, 3:00 p.m.

Booth 658/659

# PLENARY PRESENTATIONS



## OPTO Plenary

Monday 3 February 2020 • 8:00 AM - 10:05 AM

Location: Room 207/215 (Level 2 South)

8:00 AM - 8:05 AM:



### Welcome and Opening Remarks

OPTO 2020 Symposium Chair  
**Sailing He**, KTH Royal Institute of Technology (Sweden)  
and Zhejiang Univ. (China)



OPTO 2020 Symposium Chair  
**Yasuhiro Koike**, Keio Univ. (Japan)

8:05 AM - 8:45 AM:



### The Future of Optical Components and Materials in the Fibre

**David Payne**, Optoelectronics Research Ctr., The Univ. of Southampton (United Kingdom)

**Professor Sir David Neil Payne** CBE FRS FREng is Director of the Optoelectronics Research Centre at the University of Southampton UK. His work has had a great impact on

telecommunications and laser technology over the last forty years. The vast transmission capacity of today's internet results directly from the erbium-doped fibre amplifier (EDFA) invented by David and his team in the 1980s. His pioneering work in fibre fabrication in the 70s resulted in almost all of the special fibres in use today including fibre lasers. With US funding, he led the team that broke the kilowatt barrier for fibre laser output to international acclaim and now holds many other fibre laser performance records. He has published over 650 Conference and Journal papers. As an entrepreneur David's activities have led to a cluster of 11 photonics spin-out companies in and around Southampton. He founded SPI Lasers PLC, which was acquired by the Trumpf Corporation of Germany. He is an Emeritus Chairman of the Marconi Society and a foreign member of the Russian Academy of Sciences, the Indian National Science Academy and the Indian Academy of Engineering. David is a fellow of the Royal Society and the Royal Academy of Engineering.

8:45 AM - 9:25 AM:



### Efficient Light Emission from Hexagonal SiGe

**Erik Bakkers**, Eindhoven Univ. of Technology (Netherlands)

Silicon and germanium cannot emit light efficiently due to their indirect bandgap, hampering the development of Si-based photonics. However, alloys of SiGe in the hexagonal phase are predicted to have a direct band gap. In this work, we demonstrate the realization of this new material and the direct band gap properties. We show efficient light emission up to room temperature accompanied by a short radiative lifetime, the hallmarks of a direct band gap material. The band gap energy is tunable in the range of 0.35 till 0.7eV opening a plethora of new applications. We finally discuss possible routes to integrate this material in Si- technology.

**Erik Bakkers**, after obtaining his PhD in nanoelectrochemistry at the University of Utrecht, started working at Philips Research in Eindhoven in 2000. He started his own research group, and the team focused on nanowires - lines of material with a width of several tens of nanometers - an area he continues to research, looking at integration into semiconductors in particular. In 2010, his growing interest in fundamental research resulted in Erik joining the Technical University of Eindhoven as well as Delft Technical University as part-time professor in the Quantum Transport group. His current interest is in Quantum Materials, to detect and manipulate Majorana states, and in Hexagonal Silicon, to demonstrate and exploit the predicted direct band gap in this material. He has received the Technical Review award from MIT, VICI grant, ERC CoG, ERC, AdG, and the Science AAAS Newcomb Cleveland Prize.

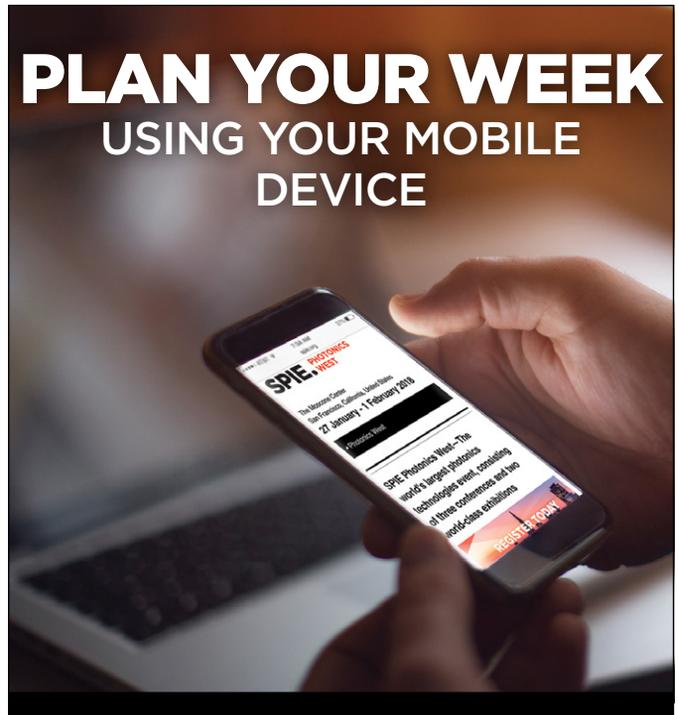
9:25 AM - 10:05 AM:



**Product Design for the Next Wave of Computing**  
**Trond Wuellner**, Google (USA)

As Moore's Law shows signs of strain and mobile growth begins to slow globally, what comes next? How do emerging technologies challenge our long-held assumptions about computing and the products we build? Do the challenges of a threatened environment require new thinking about consumption and sustainability? In this talk, I'll lay out a vision for the future of computing and what it means for how we build products, user experiences, and the technologies and innovations that power our growth.

**Trond Wuellner** received his Masters in Business Administration from the Massachusetts Institute of Technology Sloan School of Management in 2007. He's worked as a Product Manager in the High Tech industry for more than 15 years with a focus on leading high performance teams on innovative products and technologies. At Google, Trond has played key roles in the development of Chrome OS, Google WiFi, Google Pixelbook and presently serves as a Director of Product within the company's Devices and Services group. He's been awarded more than 15 patents, won prestigious design awards from iF, Red Dot and Spark and is an active mentor and advisor in the startup community.



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# PLENARY PRESENTATIONS



## LASE Plenary

Monday 3 February 2020 • 3:30 PM - 5:40 PM

Location: Room 207/215 (Level 2 South)

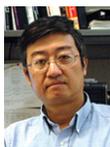
3:30 PM - 3:35 PM:



### Welcome and Opening Remarks

LASE 2020 Symposium Chair

**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland)



LASE 2020 Symposium Chair

**Xianfan Xu**, Purdue Univ. (USA)

3:35 PM - 3:40 PM:



### Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award

**Henry Helvajian**, The Aerospace Corp. (USA)

3:40 PM - 4:20 PM:



### VCSEL: Born Small and Grown Big

**Kenichi Iga**, Tokyo Institute of Technology (Japan)

The surface emitting laser (VCSEL) is brightening in everybody's mobile device, every car, and every home. Industrially, we are in a period of rapid growth. Attention is drawn to the trend as a light source supporting the physical layer of AI and IoT technology. This is a talk from the invention of the surface emitting laser by the author to research, peening development, and recent strides toward expansion of applications. New technical and business areas have been now generated in the area of such as high-speed LANs, parallel optical interconnects, computer mice, laser printers, face recognition systems, LiDARs, and various optical sensors. The total sales are reaching over 2000 M\$ headed by data-coms, recognition sensors, and power applications.

**Kenichi Iga** received Dr. Eng. from Tokyo Institute of Technology in 1968. He worked as the Professor and retired in 2001 and served as the 26th President (2007-2012). He first proposed a surface emitting laser (VCSEL) and received IEEE/LEOS William Streifer Award, IEEE/OSA John Tyndall Award, IEEE Daniel E. Noble Award, and Franklin Medal with the Bower Award.

4:20 PM - 5:00 PM:



### **Compact Terahertz Driven Electron and X-ray Sources**

**Franz X. Kärtner**, Deutsches Elektronen Synchrotron (Germany) and Univ. Hamburg (Germany)

Approaches towards a linear terahertz accelerator technology for compact electron and X-ray sources are discussed. The use of very high frequencies enables operation of accelerators at higher field strength with lower energetic driver pulses. First experimental results on laser based high energy terahertz generation, terahertz guns and accelerators are demonstrated. The high acceleration fields and gradients possible in terahertz devices enable novel electron bunch manipulations, bunch diagnostic and promise ultimately fully coherent X-ray production from compact sources. Latest experimental results in the implementation of electron and X-ray sources based on this technology will be discussed. Franz X. Kärtner heads the Ultrafast Optics and X-rays Group at the Center for Free-Electron Laser Science at DESY and is Professor of Physics at Universität Hamburg. His research interests include ultrashort pulse generation and its use in strong-field physics, precision timing, as well as novel x-THz based electron and X-ray sources. He is a fellow of OSA and IEEE.

5:00 PM - 5:40 PM:



### **Accelerators on a Chip: A Path to Attosecond Science**

**Robert L. Byer**, Stanford Univ. (USA)

The Accelerator on a Chip International Program (ACHIP) funded by the Moore Foundation is an accelerator science program with the goal of demonstrating a laser driven accelerator on a chip. To date the international collaboration has demonstrated greater than 850MeV/meter acceleration gradient in a fused silica grating structure and has demonstrated the first accelerators based on silicon. Recent progress includes focusing and bunching of electrons to sub-femtosecond duration and demonstration an integrated silicon photonics accelerator based on inverse design principles.

A prototype accelerator that fits into a shoe box has been demonstrated. The next steps include using that accelerator for scientific studies. The ACHIP international collaboration involves more than one dozen faculty members, 25 graduate students, and a dozen staff members from Europe, the USA and Asia.

**Robert L. Byer** has conducted research and taught classes in lasers and nonlinear optics at Stanford University since 1969. He has made extraordinary contributions to laser science and technology including the demonstration of the first tunable visible parametric oscillator, the development of the Q-switched unstable resonator Nd:YAG laser, remote sensing using tunable infrared sources and precision spectroscopy using Coherent Anti Stokes Raman Scattering (CARS). Current research includes precision laser measurements in support of the detection of gravitational waves and laser "Accelerator on a chip".

# MEMBERSHIP



## What Do These People Share?

**They share ideas, possibilities, and passion that lead to personal success, technological advancements, and better lives for all.** They share curiosity, knowledge, and expertise that impact science, engineering, medicine, and industry. And they share a connection with SPIE.

These people connect with SPIE around our common mission to advance light-based research and technologies for the betterment of the human condition. They are part of a global community that includes researchers, engineers, educators, students, investors, entrepreneurs, and policy-makers.

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## PLENARY PRESENTATIONS



### Nano/Biophotonics Plenary

Tuesday 4 February 2020 • 10:30 AM - 11:30 AM

Location: Room 207 (Level 2 South)

#### Plasmonics Nanoparticles for Use in Theranostics



**Michel Meunier**

Polytechnique Montréal (Canada)

Plasmonic nanoparticles such as gold, silver or their alloys are interesting nanomaterials for their applications in therapeutics and diagnostics in nanomedicine. In this presentation, I will present recent developments performed in this field at Polytechnique. A new method for delivering exogenous biomolecules into targeted cells using an ultrafast laser and plasmonic nanoparticles will be presented. The technique of plasmon-mediated laser nanosurgery has been used to effectively perform gene transfection in various living cells and delivery of biomolecules in vivo in animal model for ophthalmic applications. This technology has been also used for locally stimulating neurons to control neuronal activity and cell signaling. Moreover, alloy nanoparticles have been synthesized using an improved seeded-growth approach. These spectrally distinctive plasmonic nanoparticles are used as biomarkers to perform quantitative multiplexed 3D imaging of cells and tissues. Our techniques show promises of innovative tools for basic research in biology and medicine as well as effective alternative technologies that could be adapted to the therapeutic, diagnostic, theranostics tools of the clinic.

**Michel Meunier** obtained a PhD from MIT in 1984. In 1985, he began his career at Polytechnique Montréal and he was promoted to full professor in 1993. Holder of a Canada Research Chair Tier 1 and co-founder of LTRIM Technologies, Michel Meunier is also a laureate, in 2006, of a Synergy Award for Innovation. He is a Fellow of the Canadian Academy of Engineering, as well as OSA and SPIE. In 2016, he won the Guy Rocher Award for his excellence in teaching at the university level. His intense research activities focus on the development of new optical nanomaterials, nano-optical devices and laser technology for nanomedicine applications. He has published more than 380 articles and supervised more than 120 graduate students and postdoctoral fellows. Since June 1st 2019, he is the Head of the Engineering Physics department.



# The largest conference of OPTICS and PHOTONICS in Japan and one of the largest and most prestigious events in the field worldwide.

 OPTICS & PHOTONICS International Congress  
**OPIC 2020**

**20-24 April 2020**  
**Yokohama, Japan**

## Plenary Speakers



### Gérard Mourou

*Professor, École polytechnique  
Palaiseau, France*

**“Passion Extreme Light”**



### Berthold Schmidt

*CTO Laser Technology, TRUMPF  
Lasertechnik GmbH, Germany*

**“Market Perspectives and  
Applications driven by Laser  
Intensity and Functionality”**

**ALPS** ..... The 9th Advanced Lasers and Photon  
Sources

**BISC**..... The 6th Biomedical Imaging and Sensing  
Conference

**HEDS** ..... International Conference on High Energy  
Density Science 2020

**ICNN** ..... International Conference on Nano-  
photonics and Nano-optoelectronics 2020

**IoT-SNAP** ... IoT Enabling Sensing/Network/AI and  
Photonics Conference 2020

**LDC** ..... Laser Display and Lighting Conference  
2020

**LEDIA**..... The 8th International Conference on  
Light-Emitting Devices and Their  
Industrial Applications

**LSC**..... Conference on Laser and Synchrotron  
Radiation Combination Experiment 2020

**LSSE** ..... Laser Solutions for Space and the Earth  
2020

**OMC** ..... The 7th Optical Manipulation and  
Structured Materials Conference

**OPTM** ..... Optical Technology and Measurement for  
Industrial Applications 2020

**OWPT** ..... Optical Wireless and Fiber Power  
Transmission Conference 2020

**PLD** ..... Pacific Rim Laser Damage 2020

**SLPC**..... The 4th Smart Laser Processing  
Conference

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and Applications 2020

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## TECHNICAL EVENTS



### Supercontinuum 50<sup>th</sup> Anniversary

Sunday 2 February 2020 • 10:00 AM - 5:15 PM  
Location: Room 160 (Upper Mezzanine South)



MODERATOR:  
**Angela Seddon**  
Univ. of Nottingham (United Kingdom)

This group of special sessions pays tribute to 50 years since the development of supercontinuum.

See Conference 11234: *Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis*

### CONF. 11251 PANEL

#### New Horizons in Clinical Applications of Label-Free Imaging and Sensing

Sunday 2 February 2020 • 10:40 AM - 12:20 PM  
Location: Room 305 (Level 3 South)

This panel is one of the highlights in the Label-Free Imaging and Sensing (LBIS) 2020 Conference in SPIE PW. LBIS2020 gathers scientists with different label-free technological backgrounds, but they all share the same interest: to better understand the future clinical needs. This special Q&A panel is therefore composed of panelists with clinical orientation, who will try to define the prospective horizons of the label-free field in the clinic.

Clinical routines can benefit from label-free imaging and sensing methods, but require a deep understanding of biomarkers, clinical workflows, and clinical study design, to achieve clinical acceptance. The discussion will cover findings of the panelists for translation. To close the gap between bench and bedside, the panel will discuss requirements for successful cooperation between engineers and clinicians.

PANEL MODERATOR:  
**Oliver Hayden**, Technische Univ. München (Germany)

PANELISTS:  
**Guillermo J. Tearney**, Massachusetts General Hospital (USA)  
**Jürgen Schnekenbürger**, Westfälische Wilhelms-Univ. Münster (Germany)  
**Pierre P. Marquet**, CERVO Brain Research Ctr. (Canada)  
**Seemantini K. Nadkarni**, Wellman Ctr. for Photomedicine (USA)

### Translational Research Lunchtime Forum

Sunday 2 February 2020 • 12:30 PM - 2:00 PM  
Location: Room 159 (Upper Mezzanine South)

SYMPOSIUM CHAIRS:



**Gabriela Apiou**  
Wellman Center for Photomedicine,  
Massachusetts General Hospital Research Institute,  
Harvard Medical School (USA)



**Aaron Aguirre**  
Massachusetts General Hospital (USA)

PROGRAM COMMITTEE:

**Darren Roblyer**, Boston Univ. (USA)

**Reginald Birngruber**, Univ. zu Lübeck (Germany)

Join your colleagues in a discussion of outcomes-based studies that can change the lives of patients. Select participants from the Translational Research virtual symposium will have the opportunity to present their methodology and findings. These speakers will demonstrate the use of optical/light-based techniques that are innovative and clever and can change the outcome for patients in a positive and life-giving way.

Boxed lunches will be provided to the first 100 forum attendees.

### CONF. 11239 PANEL

#### Biophotonics of Embryo Dynamics: Monitoring, Imaging, and Functional Control

Sunday 2 February 2020 • 5:00 PM - 5:40 PM  
Location: Room 102 (Level 1 South Lobby)

This panel discussion is part of Conference 11239: Dynamics and Fluctuations in Biomedical Photonics XVII.

PANEL MODERATOR:

**Martin J. Leahy**, National Univ. of Ireland, Galway

PANELISTS:

**Scott E. Fraser**, The Univ. of Southern California (USA)

**Mary E. Dickinson**, Baylor College of Medicine (USA)

**Chao Zhou**, Washington Univ. in St. Louis (USA)

**Andrew M. Rollins**, Case Western Reserve Univ. (USA)

**Michael W. Jenkins**, Case Western Reserve Univ. (USA)

**Brian E. Applegate**, The Univ. of Southern California (USA)

## FDA Policies and Procedures: What Academic Investigators and Small Business Should Know

Monday 3 February 2020 • 10:00 AM - 12:00 PM  
Location: Room 306 (Level 3 South)



WORKSHOP CHAIR: **Ramesh Raghavachari**,  
U.S. Food and Drug Administration (USA)

Come hear speakers from industry and regulatory agencies share their perspectives and advice on incorporating regulatory requirements into product development and how to achieve successful regulatory strategies. In addition, small business owners will gain valuable business perspectives concerning 3rd party review and regulatory approval for medical devices. The event will also include a panel discussion focused on communications with FDA.

**Supporting the development of safe, innovative, and beneficial digital health technologies**

**Srikanth Vasudevan**, U.S. Food and Drug Administration

**Accelerating patient access to innovative, safe, and effective medical devices: How regulatory science at the FDA helps pave the way**  
**Zane Arp**, U.S. Food and Drug Administration

**Overcoming Regulatory Challenges for Emerging Photoacoustic Imaging Devices**

**William C. Vogt**, U.S. Food and Drug Administration

**Title Forthcoming**

**Rahul S. Singh**, Farus LLC

## PANEL DISCUSSION

### Patient-Centered Studies, Humanitarian Devices, and Photonics for Vulnerable Populations

Monday 3 February 2020 • 2:40 PM - 3:00 PM  
Location: Room 312 (South Level 3)

## PANEL DISCUSSION

### Prospects and Future of Microfluidics

Monday 3 February 2020 • 5:20 PM - 6:20 PM  
Location: Room 158 (Upper Mezzanine South)

## VECSELs 10<sup>th</sup> Anniversary Panel: Future Directions for Research and Applications

Tuesday 4 February 2020 • 4:00 PM - 5:20 PM  
Location: Room 208 (Level 2 South)



MODERATOR: **Jennifer E. Hastie**  
Univ. of Strathclyde (United Kingdom)

PANELISTS:

**Juan L. Chilla**, Coherent, Inc. (USA)

**Arnaud Garnache**, Univ. de Montpellier (France)

**Mircea Guina**, Tampere Univ. (Finland)

**Ursula Keller**, ETH Zurich (Switzerland)

**Jerome V. Moloney**, Wyant College of Optical Sciences (USA)

**Wolfgang Stolz**, NAsP III/V GmbH (Germany)

## Holography

Tuesday 4 February 2020 • 7:30 PM - 9:00 PM

Location: InterContinental Hotel, InterContinental B (5th Floor)

SESSION CHAIR: **Hans I. Bjelkhagen**, Glyndŵr Univ. (United Kingdom) and Hansholo Consulting Ltd. (United Kingdom)

The Holography Technical Group is involved with the whole record of research, engineering, recording materials, and applications of holography. The main fields of interest are display holograms, commercial and artistic, holographic optical elements (HOEs), holographic interferometry and holographic non-destructive testing (HNDT), computer-generated holography (CGH), electro and digital holography, holographic microscopy, and holographic data storage (HDS).

This meeting will focus on recent developments and directions, in particular, in regard to new materials, color display holography, digital holography, CGHs and HOEs.

## Innovation Awards in Quantum Sensing, Nano Electronics, and Photonics

Tuesday 4 February 2020 • 7:30 PM - 9:00 PM

Location: InterContinental Hotel, InterContinental A (5th Floor)



SESSION CHAIR: **Manijeh Razeghi**  
Northwestern Univ. (USA)

SPIE announces the Innovation Award in Quantum Sensing and Nano Electronics and Photonics at SPIE Photonics West OPTO. These awards will recognize the outstanding scientific contribution of investigators who present the most notable recent discoveries with broad impact in the areas of quantum sensing, nano electronics, and photonics. These discoveries should be innovative in that they represent a new paradigm or way of thinking which will have a broad impact in their respective field. Participants will give a 15-minute presentation in this Tuesday evening session chaired by Prof. Manijeh Razeghi. The winner(s) will be announced at the end of the session and will be awarded a commemorative plaque.

## Laser Communications

Tuesday 4 February 2020 • 7:30 PM - 9:00 PM

Location: InterContinental Hotel, InterContinental C (5th Floor)

SESSION CHAIRS:



**Hamid Hemmati**  
ViaSat, Inc. (USA)



**Don Boroson**  
MIT Lincoln Lab. (USA)

This technical event on Laser Communications will hold its informal annual meeting in conjunction with the Free-Space Laser Communications conference. All professionals involved in theory and applications of free-space laser communications, remote sensing and supporting technologies are invited to participate in an open discussion on a variety of topics related to the challenges and advancement of the field. Attendees are invited to bring suggestions for discussion topics.

# TECHNICAL EVENTS

## Optics and Electro-Optics Standards Council (OEOSC)

Location: InterContinental Hotel, Stockton Room (5th Floor)

The technical and business meetings of the Optics and Electro-Optics Standards Council (OEOSC) are open to anyone with an interest in standards for the optics industry.

Sunday 2 February 2020

### ASC OP TF7 - LASERS

10:00 AM - 11:45 AM

### ASC OP TF2 - SURFACE IMPERFECTIONS

1:30 PM - 3:15 PM

### ASC OP TF4 - DRAWINGS

3:30 PM - 4:30 PM

Monday 3 February 2020

### ASC OP TF3 - WAVEFRONT

8:30 AM - 9:30 AM

### ASC OP BUSINESS MEETING

10:00 AM - 11:45 AM

### ANNUAL TAG BUSINESS MEETING

1:30 PM - 3:15 PM

### OEOSC BOARD AND MEMBERSHIP MEETING

3:30 PM - 5:30 PM

## Workshop on Experimental Methods of Complex Light

Wednesday 5 February 2020 • 1:40 PM - 3:10 PM

Location: Room 211 (Level 2 South)

In this special session we will cover the experimental techniques of controlling optical light fields that are central to a wide variety of novel scientific advances. In small workgroups attendees will get hands on training in four fundamental procedures and introductions to equipment that could be integrated into their future research. The session will be designed to accommodate both students and experienced researchers with a passion to learn new skills.

The four topics that will be focused on will be:

- wavefront control using digital holography
- 3D printing and its application to experimental optics
- optical manipulation of matter
- sensing of phase and intensity of optical fields.

Attendees will gain from the session new skills, complete a critical evaluation of used technologies, such as spatial light modulators, example control code or design files to support their future research activities.

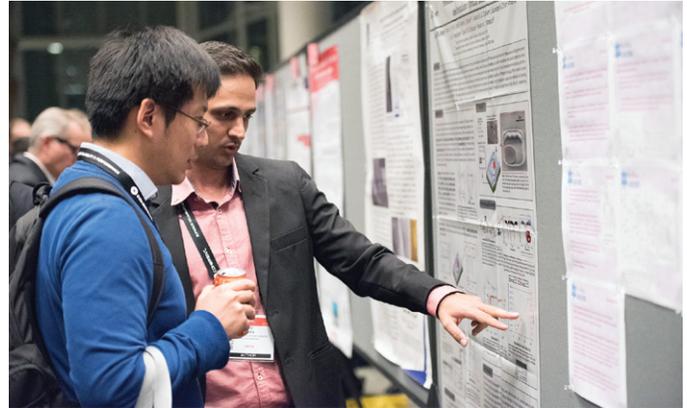
INSTRUCTORS:

**Alasdair Clark**, Univ. of Glasgow (United Kingdom)

**Andrew Forbes**, Univ. of Witwatersrand (South Africa)

**Martin Lavery**, Univ. of Glasgow (United Kingdom)

**Daryl Preece**, Univ. of California, Irvine (USA)



## Poster Sessions

See maps, p. 6

### BIOS POSTER SESSIONS (with Select OPTO conferences)

Location: Moscone Center, Level 3 West

Sunday 2 February 2020. . . . . 5:30 PM - 7:00 PM

Poster Setup. . . . . 10:00 AM - 4:30 PM

Monday 3 February 2020 . . . . . 5:30 PM - 7:00 PM

Poster Setup. . . . . 10:00 AM - 4:30 PM

### LASE POSTER SESSION (with Select BIOS conferences)

Location: Moscone Center, Level 3 West

Tuesday 4 February 2020. . . . . 6:00 PM - 8:00 PM

Poster Setup. . . . . 10:00 AM - 5:00 PM

### OPTO POSTER SESSION

Location: Moscone Center, Level 3 West

Wednesday 5 February 2020. . . . . 6:00 PM - 8:00 PM

Poster Setup. . . . . 10:00 AM - 5:00 PM

Conference attendees are invited to attend the Photonics West poster sessions. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field. Authors of poster papers will be present to answer questions concerning their papers. Attendees are required to wear their conference registration badges to the poster sessions.

Poster authors, view poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>.

## Free Product Demonstrations

Half-hour presentations on the exhibition floor.

**BiOS Expo: p. 25**

**Photonics West: p. 26**



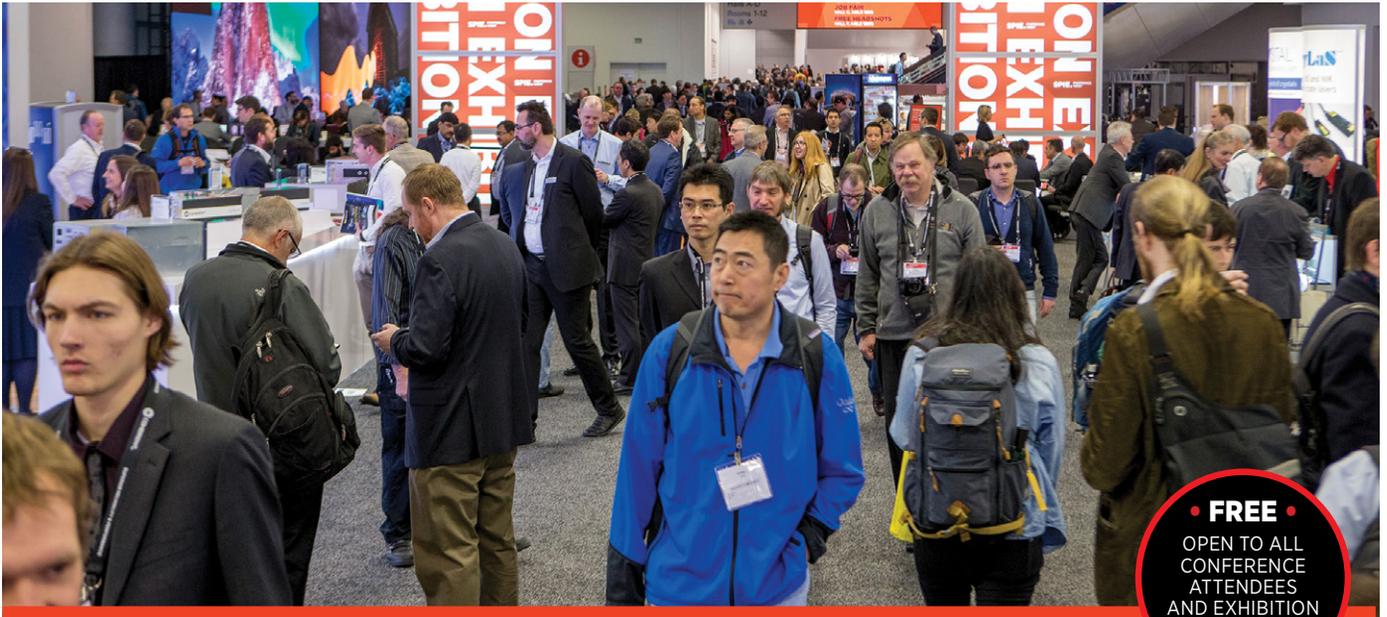
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More companies exhibit at Photonics West than any other exhibition in North America. Meet top suppliers, make the right connections, and discover new possibilities.



### BIOS EXPO

200 Companies  
Location: Hall DE

**SATURDAY 1 FEBRUARY**..... 10:00 AM - 5:00 PM  
**SUNDAY 2 FEBRUARY**..... 10:00 AM - 4:00 PM

BiOs Expo, the world's largest biomedical optics and biophotonics exhibition, starts the Photonics West week. Find the latest technologies from more than 200 companies supplying biomedical research and healthcare solutions.

#### FEATURED TECHNOLOGIES

- Biomedical Optics Components, Products, Instrumentation, and Applications
- Lasers
- Molecular Imaging
- Therapeutic Lasers
- Nano/Biophotonics
- Biosensors
- Spectroscopic/Microscopic Imaging



### PHOTONICS WEST EXHIBITION

1,350 Companies  
Location: Hall ABCDEF

**TUESDAY 4 FEBRUARY**..... 10:00 AM - 5:00 PM  
**WEDNESDAY 5 FEBRUARY** ..... 10:00 AM - 5:00 PM  
**THURSDAY 6 FEBRUARY** ..... 10:00 AM - 4:00 PM

Photonics West exhibition is the premier photonics and laser event. Find the latest components, devices, and systems for your research or business needs.

#### FEATURED TECHNOLOGIES

- Lasers and Other Light Sources
- Laser Accessories, Laser Systems
- Cameras and CCD Components
- Fiber Optic Components, Equipment, Systems
- Optical Components
- Communication
- Optical Detectors
- High Speed Imaging and Sensing
- Optical Materials and Substrates
- IR Sources and Detectors
- Electronic Imaging Components
- Optical Coatings
- Lenses and Filters
- Positions and Mounts
- Metrology

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# BiOS Product Demonstrations

	Saturday 1 February	Sunday 2 February
TIME	HALL E	
10:30 AM	<p><b>Anyone Can Build One Spectrometer!</b> Thomas Rasmussen <b>Ibsen Photonics A/S</b> Dr. Thomas Rasmussen will share insights on the differences between single unit and volume production of spectrometers that are useful in deciding which approach works best for instrument production.</p>	
11:30 AM	<p><b>Full Stack Compact Fluorescence Microscopy for Instrument Development: From Optics to Control Serve</b> Chris Shumate, Ph.D. <b>Etaluma, Inc.</b> Etaluma offers compact, high performance fluorescence optics, LED control, and XYZ motion through a unified software interface for OEM integration of high quality imaging automation.</p>	<p><b>High Performance Optical Filters</b> Isabell Goetz <b>Optics Balzers Jena GmbH</b> High performance optical filters for demanding applications in the Biophotonics market.</p>
12:30 PM	<p><b>Introduction to Corning® Varioptic® Lenses</b> Glenn-Iv Plaine <b>Corning Incorporated</b> This demonstration will introduce the technology behind Corning® Varioptic® Lenses, our extensive product line, and the many applications that could benefit from Corning's liquid lens solutions.</p>	
1:30 PM	<p><b>CYBERDYNE AcousticX: Towards Clinical Translation of LED-Based Photoacoustic Imaging</b> Dr. Mithun Kuniyil Ajith Singh <b>Cyberdyne, Inc.</b> Latest version of our LED-based photoacoustic/ultrasound imaging system (AcousticX) will be introduced. Capabilities will be demonstrated using several clinical/preclinical imaging examples.</p>	<p><b>SpectroWave: Compact All-Fiber Supercontinuum Source with High Stability</b> Philip Westergaard <b>OFS</b> An all-fiber NIR supercontinuum light source is presented. The source is compact and features a broad spectrum with high stability.</p>
2:30 PM	<p><b>Continuously Variable Filters for Applications in Spectroscopy, HSI and Fluorescence Diagnostics</b> Oliver Pust <b>Delta Optical Thin Film A/S</b> We present advances in variable filter technology, with focus on performance, features and benefits. You will see recent examples of how continuously variable filters are used in several applications.</p>	
3:30 PM	<p><b>XI - A Smart, Deep Learning Enabled Raman Spectrometer for Unknown Material ID</b> Lynn Chandler <b>CloudMinds Technology Inc.</b> XI is the world's first handheld Raman to adopt cloud data platform and deep learning analysis. This Prism Award winning device enables faster and more accurate identification for unknown materials.</p>	

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## PROMOTIONAL PARTNERS

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Media publication  
optics.org

# Photonics West Exhibition

## Product Demonstrations

	Tuesday 4 February	Wednesday 5 February	Thursday 6 February
TIME	HALL ABC		
10:30 AM	<p><b>Polaris-M 2.0 Why Polarization Is Critical in Design</b> Dr. Russell Chipman <b>Airy Optics, Inc.</b></p> <p>The importance of complete Polarization analysis will be discussed and demonstrated utilizing Polaris-M 2.0. Introducing new functions and features, Polarization Films Library, Import/Export functions.</p>	<p><b>OptiSPICE Tanner Plugin</b> Cem Bonfil <b>Optiwave Systems Inc.</b></p> <p>The seamless integration of OptiSPICE optical models into the Tanner EDA enables the simulation of complex optoelectronic circuits, from schematic or mask layout, within a single design environment.</p>	<p><b>How OFDR Is Redefining Optical Component Characterization</b> David Potter <b>General Photonics Corp.</b></p> <p>New OFDR measurement solutions provide a comprehensive approach to passive component characterization, delivering unprecedented insight into component performance and unmatched test speed.</p>
11:30 AM	<p><b>Introducing the ZIVA Light Engine</b> Iain Johnson <b>Lumencor, Inc.</b></p> <p>Presentation of performance characteristics and applications of the ZIVA light engine, comprising 7 independently addressable diode laser sources optimized for coupling into narrow bore optical fiber.</p>	<p><b>High-Performance Entangled Photon-Pair Source</b> Jerome Prieur <b>AUREA Technology</b></p> <p>We demonstrated the first worldwide industrial high-brightness and high visibility entangled photon-pair source for Quantum information technologies.</p>	
12:30 PM	<p><b>OEwaves, Inc.</b> Patrick McNamara <b>OEwaves, Inc.</b></p> <p>OEwaves, Inc. transforms novel microwave photonic technologies, from concept to the marketplace, enabling new capabilities in radar, fiber optic sensing, LIDAR, and test and measurement systems.</p>	<p><b>100 W CW or Pulsed Raman Laser Fiber</b> Jeff Nicholson <b>OFS</b></p> <p>An overview of the world of Diffractive Optics and innovations in application fields such as glass cutting, material processing, and 3D sensing.</p>	
1:30 PM	<p><b>Get to Market Faster with OpticsBuilder from Zemax</b> Lisa Clauson <b>Zemax, LLC</b></p> <p>OpticsBuilder, from Zemax, streamlines your workflows, getting your product to market faster with lower costs. Automatically create optical CAD drawings, measure optical performance and easily export.</p>	<p><b>Diffractive Optics Advancements and Innovative Applications</b> Karen Goldberg <b>HOLO/OR Ltd.</b></p> <p>An overview of the world of Diffractive Optics and innovations in application fields such as glass cutting, material processing, and 3D sensing.</p>	<p><b>FREE HEADSHOTS</b></p> <p><b>Hall F • Aisle 5600</b></p> <p>Tuesday 4 February 10:00 AM - 5:00 PM</p> <p>Wednesday 5 February 10:00 AM - 5:00 PM</p> <p>Thursday 6 February 10:00 AM - 4:00 PM</p> <p><b>Get your FREE Professional Portrait taken during Photonics West</b></p> <p>Whether you are looking to update your SPIE profile, social media pics, or a photo for your family, take advantage of this free service offered by SPIE. Dress professionally and even come back each day to get multiple styles of pictures.</p> <p>These are free for every attendee, exhibitor, instructor, student, or exhibition visitor.</p> <p>SPONSORED BY</p> <p><b>SPIE. CAREER CENTER</b></p>
2:30 PM	<p><b>Seize the Power of NIR with NIRvana HS InGaAs Cameras</b> Michael Melle <b>Teledyne Princeton Instruments</b></p> <p>The new NIRvana HS offers an exciting, truly innovative set of world-class performance features to meet the increasingly diverse needs of today's scientific, industrial, and medical communities.</p>	<p><b>Crystal Material Manufacturing in Optical Component / Instant Clear View System / SMD LD</b> Simon Huang / Anson Kuo / Dr. Chunwei Mi <b>Taiwan Pavilion</b></p> <p>High-end Projector Lens, Telescope Lens, Rifle Scope Lens, Lens elements / Instant Clear View System &amp; Related Camera Lens / Laser Diode &amp; Laser Module, etc. presented by 3 companies of Taiwan Pavilion.</p>	
3:30 PM	<p><b>Optical Filters for Multispectral Imaging</b> Isabell Goetz <b>Optics Balzers</b></p> <p>Manufacturing of high performance patterned optical filters for multi-spectral imaging applications.</p>	<p><b>Intelligent DMD Headlight / Advanced Technologies on Optical Component / High Efficiency Dicing Blade</b> Dr. Kenneth Li / Wei Cheng, Lai / Jinn P. Chu <b>Jasper Display Corp.</b></p> <p>HD-ADB Headlight, Single LD Module, LiDAR Module, Color Filter / Aspheric Lenses, Fresnel Lens, HMD/AR/VR, Lens for Cars / Super Diamond Saw Blade etc. presented by 3 companies of Taiwan Pavilion.</p>	
4:30 PM	<p><b>Accurate Remote Monitoring Systems – Environmental Emissions Detection</b> Yonathan Dattner <b>LUXMUX Technology Corp.</b></p> <p>Luxmux introduces the ARMS Smart Pole, Multiple Gas Detection System engineered to be a Continuous Remote Emissions Monitoring System. Capabilities: CH<sub>4</sub>, CO<sub>2</sub>, H<sub>2</sub>O, NH<sub>3</sub>, CO, NO, NO<sub>2</sub>, SO<sub>2</sub>, N<sub>2</sub>O, H<sub>2</sub>S, O<sub>3</sub></p>		

TIME	Tuesday 4 February	Wednesday 5 February	Thursday 6 February
	HALL EF		
11:00 AM	<p><b>MY Polymers Optimized Re-coating Materials</b> Ron Zohar <b>MY Polymers Ltd.</b> Optimized Re-Coating materials improves the reliability of Combiners, Strippers, etc. For example: Flexible Re-Coatings reduce stress during thermal cycling, resulting in higher reliability.</p>	<p><b>Fast Swept Source for Optical Sensors</b> Donald Kebort <b>Freedom Photonics</b> Freedom Photonics is launching a new product at Photonics West, a fast swept source to support advanced optical sensors at infrared wavelengths from 1265 nm to 1670 nm.</p>	<p><b>Transforming Optical Structure Technology Through Innovative System Integration</b> Martin Rost <b>PLX Inc.</b> Developed by PLX Inc., Monolithic Optical Structure Technology (M.O.S.T.™) is a unique optical innovation that combines all of the elements of a complex optical setup into a single monolithic unit.</p>
12:00 PM	<p><b>Optical Filters for Satcom</b> Jason Palidwar <b>Iridian Spectral Technologies Ltd.</b> Optical satellite communications rely on space qualified, highly uniform filters to provide wavelength selectivity in formats such as solar rejection windows to beam steering dichroic filters.</p>	<p><b>Taiko, High-End Picosecond Diode Laser</b> Guillaume Delpont <b>PicoQuant Photonics North America, Inc.</b> PicoQuant expands the capabilities of the Taiko PDL M1 with a new Max Power Mode to operate any laser diode with an increased level of power and with a broader range of diodes in the visible range.</p>	
1:00 PM	<p><b>FREE Your Mind – FORM Your Optics</b> Lutz Reichmann <b>asphericon</b> Join us for a journey through the world of freeform optics: from the demanding land of design, to the environment of materials, the area of manufacturing and the summit of system integration</p>	<p><b>Evaluating the Latest Technological Displays Using New Progressive Display Color Analyzer CA-410</b> Mitch Eguchi <b>Konica Minolta Sensing Americas</b> New progressive instrument for AR/VR microdisplays and curved OLED displays for Lxxy/u'v', VESA/JEITA flicker using the New CA-410 probes to measure 2.1mm, 4mm and viewing angle characteristics.</p>	
2:00 PM	<p><b>Anyone Can Build One Spectrometer!</b> Dr. Thomas Rasmussen <b>Ibsen Photonics</b> Dr. Thomas Rasmussen will share insights on the differences between single unit and volume production of spectrometers that are useful in deciding which approach works best for instrument production.</p>	<p><b>Continuously Variable Filters for Applications in Spectroscopy, HSI and Fluorescence Diagnostics</b> Oliver Pust <b>Delta Optical Thin Film A/S</b> We present advances in variable filter technology, with focus on performance, features and benefits. You will see recent examples of how continuously variable filters are used in several applications.</p>	<p><b>Mode-Locked Lasers: Control of Repetition Rate &amp; Carrier Envelope Offset</b> Kevin Knabe <b>Vescent Photonics Inc.</b> Vescent offers mode-locked lasers with tight control over <i>f</i>rep and <i>f</i>CEO, forming the engine of a frequency comb which in turn is becoming indispensable for quantum metrology, timing and spectroscopy.</p>
3:00 PM	<p><b>XI<sup>2</sup> - A Novel Cloud AI Raman with MEMs Scanning Mirror for Area Sampling</b> Lynn Chandler, Ph.D. <b>CloudMinds Technology Inc.</b> CloudMinds' XI<sup>2</sup> is a cloud AI Raman device specifically designed for area sampling. Equipped with MEMs scanning mirror, XI<sup>2</sup> can scan Raman signal from an area of heterogenous samples in seconds.</p>	<p><b>Optotune's 2D Mirror Platform Enables Innovations</b> Dr. David Leuenberger <b>Optotune Switzerland AG</b> Optotune's 2D mirror is the ideal choice for applications that require large deflections in a compact form factor. It is used in automotive (LiDAR, ADAS), Vision, Biometrics, Diagnostics and more.</p>	
4:00 PM	<p><b>Low Latency NPI and Collaborative Manufacturing for Photonics</b> Evan Heuners <b>Palomar Technologies, Inc.</b> Low latency NPI and collaborative manufacturing emphasizes collaboration between photonics developers and contract manufacturers to reduce time to market and cost for new product introductions.</p>	<p><b>High-Throughput Event Timer MultiHarp 150</b> Torsten Langer <b>PicoQuant Photonics North America, Inc.</b> Applications and features of PicoQuant's newest generation of multi-channel event timers with sub-nanosecond deadtime, high data throughput, and remote synchronization in fiberoptic networks.</p>	

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OPTICS & PHOTONICS International Exhibition



# OPIE '20

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## LASER EXPO

- Laser Lighting - Display / Optical wireless power supply zone  
- Optical fiber zone

## LENS EXPO

## IR + UV EXPO

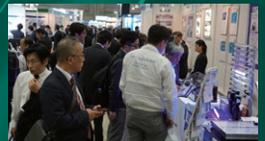
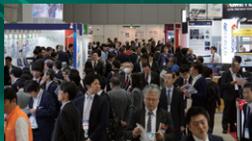
## Industrial Camera & Advanced Imaging EXPO

## Space & Astronomical Optics EXPO

## Positioning EXPO

Total Projected Participation - Exhibitors 500 - Attendees 20,000

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**20-24 April, 2020**

- **ALPS 2020** : The 9th Advanced Lasers and Photon Sources
- **BISC 2020** : The 6th Biomedical Imaging and Sensing Conference
- **HEDS 2020** : International Conference on High Energy Density Science 2020
- **ICNN 2020** : International Conference on Nano-photonics and Nano-optoelectronics 2020
- **IoT-SNAP 2020** : IoT Enabling Sensing/Network/AI and Photonics Conference 2020
- **LDC 2020** : Laser Display and Lighting Conference 2020
- **LEDIA 2020** : The 8th International Conference on Light-Emitting Devices and Their Industrial Applications
- **LSC 2020** : Conference on Laser and Synchrotron Radiation Combination Experiment 2020
- **LSSE 2020** : Laser Solutions for Space and the Earth 2020
- **OMC 2020** : The 7th Optical Manipulation and Structured Materials Conference
- **OPTM 2020** : Optical Technology and Measurement for Industrial Applications 2020
- **OWPT 2020** : Optical Wireless and Fiber Power Transmission Conference 2020
- **PLD 2020** : Pacific Rim Laser Damage 2020
- **SLPC 2020** : The 4th Smart Laser Processing Conference
- **XOPT 2020** : International Conference on X-ray Optics and Applications 2020

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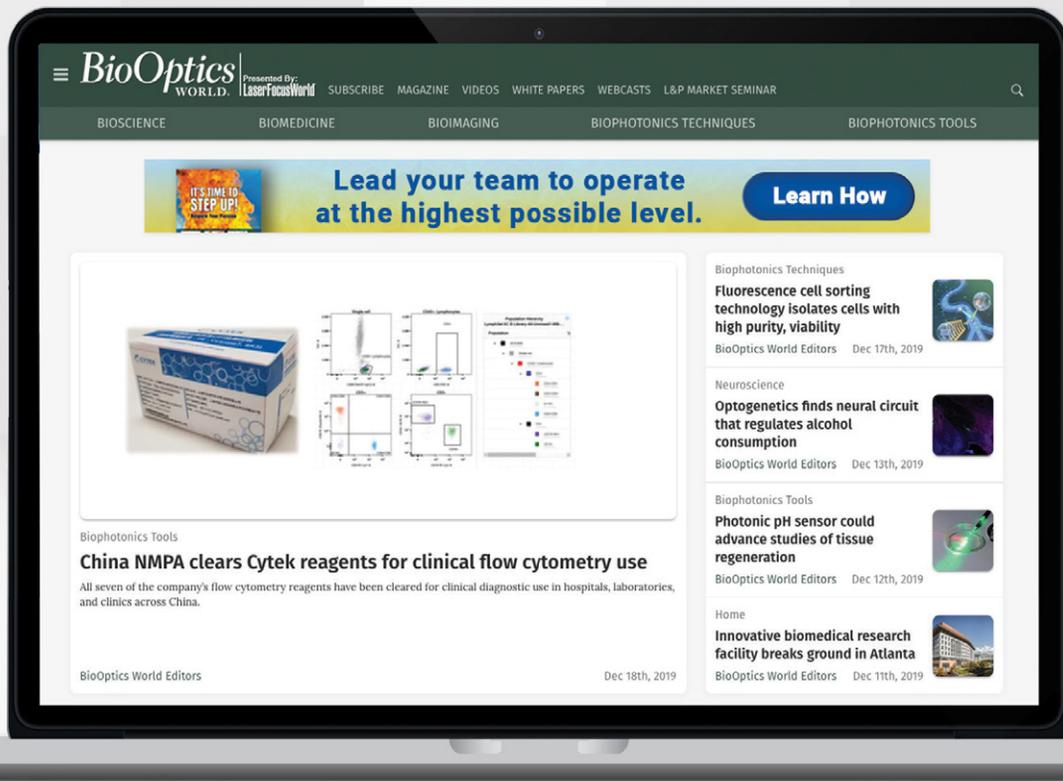
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## Professional Development Events

Spend some time focusing on your career development while you're at Photonics West. Workshops and presentations will help you hone valuable job skills.

### Facilitator Training Session

Saturday 1 February 2020 • 6:00 PM - 9:00 PM  
Location: InterContinental Hotel, Howard Room (5th Floor)

#### Invitation Only

Getting the best out of your team or volunteer group often depends on hearing input from many voices. Join this interactive training to learn how to more effectively facilitate and lead groups of diverse members. This event begins with a networking dinner. Facilitators of the Student Chapter Leadership Workshop are required to attend.

### Genuine Networking

Sunday 2 February 2020 • 1:30 PM - 4:30 PM  
Location: Park Central Hotel, Franciscan I (3rd Level)

#### Open to those with a paid registration badge.

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

Successful networking is critical to any career, but scientists and engineers tend to find it harder than most. This is because we are trained to let facts and data speak for themselves, and not look for the things that our audience will really connect with. This workshop will begin to train the participants to see their interactions with others as opportunities rather than obstacles.

LEARNING OUTCOMES: This course will enable you to:

- recognize many of the common stereotypes about networking that may be preventing you to be an effective networker.
- describe why networking is the best way to get a job.
- list 6 steps to developing a network based on genuine connections, not superficial contacts.
- describe themselves more effectively so that they can develop genuine connections quickly and productively..

INTENDED AUDIENCE: This course is intended for scientists and engineers at all experience levels, whether they be students or are well into their careers, who find networking to be tedious, boring, or even worse, a total waste of time.



**INSTRUCTOR: David M. Giltner** is the author of the book *Turning Science into Things People Need*, and is an internationally recognized speaker and mentor for early career scientists and engineers seeking careers in industry. He has spent the last 20 years commercializing photonics technologies in a variety of roles for several companies including JDS Uniphase and Ball Aerospace. Through his time in the private sector, David learned how to function well in both highly technical and business circles, and has often functioned as an interpreter to help these two worlds communicate more productively. David has a BS and PhD in physics and holds six patents in the fields of laser spectroscopy and optical communications.

## PROFESSIONAL DEVELOPMENT

### Developing Systems for Optimal Productivity

Sunday 2 February 2020 • 1:30 PM - 4:30 PM  
Location: Park Central Hotel, Franciscan II (3rd Level)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

By understanding the principles of systems thinking, it is possible to identify both helpful and harmful habits and routines of our lives to make small, incremental changes that improve personal productivity. Such changes have the power to reduce stress and improve overall satisfaction.

Through this workshop, participants will create a customized system that will increase their productivity by establishing goals, decreasing errors, auditing for optimization, and tracking their progress. This workshop will also encourage participants to lean into failure, improve motivation, and maintain or improve current systems with the least amount of effort. Participants will walk away from the workshop with a plan to implement immediately as well as a duplicable process, templates, and guidelines for future systems building projects.

LEARNING OUTCOMES: This workshop will enable you to:

- identify the Nine Rules of Productivity and define which ones will be most fruitful to prioritize.
- design a simple, personalized system to help reach a professional or personal goal using the Steps of Construction.
- demonstrate how to diagnose and fix failure points with system audits using the Steps of Optimization.

INTENDED AUDIENCE: This workshop is intended for students, early career professionals, and others who are interested in developing productivity systems to help them achieve their goals and optimize results in the classroom, lab, or workplace.



INSTRUCTOR: **Tyler Tervooren** is the founder of Riskology, a leadership training company for introverts. Riskology's courses have educated thousands of leaders at small businesses and Fortune 500 companies alike, and Tyler's blog is read by over a million people each year.

### Designing Your Own Career Path in the Private Sector

Monday 3 February 2020 • 9:00 AM - 12:00 PM  
Location: Park Central Hotel, Franciscan I (3rd Level)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

Many students pursue STEM degrees because they excel in the subject matter, but often have little idea exactly what career paths they may ultimately pursue. Engineers typically imagine becoming a design engineer at a large and well-known engineering company, and scientists often imagine becoming a research professor. Relatively few of these "traditional" career options are available, however, and few graduates have the tools or the training to design a career path to any other destination. This workshop will give participants five clear steps to design a career path that will be both rewarding and exciting. It will include many stories to help illustrate how these steps can be implemented practically.

LEARNING OUTCOMES: This workshop will enable you to:

- list the 5 key steps to designing their own rewarding career path in the private sector.
- evaluate your strengths in terms of skills, knowledge, and most importantly, attributes.

- follow three steps to defining their career target and utilize several new ways to research this target.
- understand how to navigate the hidden job market to find that opportunity that fits them well.

INTENDED AUDIENCE: This workshop is intended for graduate and undergraduate students in science and engineering programs who are planning to pursue careers in the private sector. Scientists and engineers who are already working in industry but find themselves unsure where to take the next step in their careers will also find this course very helpful.



INSTRUCTOR: **David M. Giltner** is the author of the book *Turning Science into Things People Need*, and is an internationally recognized speaker and mentor for early career scientists and engineers seeking careers in industry. He has spent the last 20 years commercializing photonics technologies in a variety of roles for several companies including JDS Uniphase and Ball Aerospace. Through his time in the private sector, David learned how to function well in both highly technical and business circles, and has often functioned as an interpreter to help these two worlds communicate more productively. David has a BS and PhD in physics and holds six patents in the fields of laser spectroscopy and optical communications.

### The Craft of Scientific Writing: A Workshop on Technical Writing

Monday 3 February 2020 • 9:00 AM - 12:00 PM  
Location: Park Central Hotel, Franciscan II (3rd Level)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

his course provides an overview on writing a scientific paper. The course focuses on the structure, language, and illustration of scientific papers.

LEARNING OUTCOMES: This course will enable you to:

- account for the audience, purpose, and occasion in a scientific paper
- logically structure the introduction, middle, and ending of a scientific paper
- make your language clear, energetic, and fluid
- avoid the most common mechanical errors in scientific writing

INTENDED AUDIENCE: This material is intended for anyone who needs to write about scientific research. Those who either have not yet written a paper or have written several papers will find this course valuable.



INSTRUCTOR: **Kathryn Kirsch** is a mechanical engineer who has been active in teaching effective scientific communication strategies for the past nine years. She has co-taught courses on the assertion-evidence slide design and technical writing in both academic and industrial settings. She also volunteers as a speaker consultant for the regional TED conference held each year at Penn State. Outside of her communications workshops, Katie works as an optimization engineer at KCF Technologies, Inc. in State College, PA. She received her B.S. ('11), M.S. ('13), and Ph.D. ('17) degrees at Penn State.

## PROFESSIONAL DEVELOPMENT

### Communicating with Confidence

Monday 3 February 2020 • 1:30 PM - 4:30 PM  
Location: Park Central Hotel, Franciscan I (3rd Level)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

Join us for a session on how to command attention and get your point across in a variety of professional settings from networking at events to your next business meeting.

LEARNING OUTCOMES: This workshop will enable you to:

- utilize frameworks that yield clear and concise communication in a variety of situations
- adjust your delivery style to boost credibility and confidence
- reduce nervousness associated with public speaking

INTENDED AUDIENCE: Those who are interested in improving their communication skills.



INSTRUCTOR: **Christine Haas** has over ten years of experience working at the intersection of communication and science. Since founding Christine Haas Consulting, LLC in 2012, Christine has traveled the world teaching courses to clients in industry, government, and academia on presentation skills, storytelling, slide design, and technical writing. She received

her MBA in marketing and international business from Drexel University, and her BA in English and film from Dickinson College.

### Resumes to Interviews: Strategies for a Successful Job Search

Monday 3 February 2020 • 1:30 PM - 4:30 PM  
Location: Park Central Hotel, Franciscan II (3rd Level)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

This course reviews effective strategies and techniques for a successful job search such as: compiling resumes, writing cover letters, and interviewing tips. The primary goal of the course is to provide creative and proven techniques for new college graduates and professionals to plan and conduct their job search and secure a job. Creative and comprehensive job search techniques will be discussed as well as actual resume and interviewing examples and tips. Anyone who is getting ready to enter the work force who wants to answer questions such as, “when and how do I start my job search?,” “what kind of cover letter and resume gets noticed?” or “how do I sell myself in an interview?” will benefit from taking this course.

LEARNING OUTCOMES: This course will enable you to:

- start and create your job search plan
- create an online networking presence
- build and write effective cover letters and resumes that get noticed
- avoid common resume and cover letter mistakes
- interview with confidence

INTENDED AUDIENCE: Graduate students, new graduates, and early-career professionals who wish to learn more about creating a job search plan, writing an effective cover letter and resume that gets you noticed, and techniques for successful interviews.



INSTRUCTOR: **Heather Welch** has been in human resources and corporate recruiting for more than 20 years. She has extensive experience with both in-house corporate environments as well as outside agency environments. Heather is currently the Sr. Recruiter for DRS Daylight Solutions in San Diego, and also a member of SHRM, IEEE, and SWE.

### Essential Skills for a Career in Industry

Tuesday 4 February 2020 • 9:00 AM - 12:00 PM  
Location: Park Central Hotel, Franciscan I (3rd Level)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

Working in industry is very different than academia. An advanced degree in science and engineering gives you many technical skills that are valuable in the private sector, but there are a lot of important aspects of working in a company that aren't taught in school. This course gives you the industry primer you need.

The workshop will start with an overview of the five most important ways that working in industry is different than the academic research environment STEM graduate students are trained in. Next, we will cover five habits that scientists and engineers who are successful in industry learn quickly. We will also cover some basics of company finance, how projects are managed in industry, and some tricks for keeping your projects on schedule.

LEARNING OUTCOMES: After completing this workshop, attendees will be able to

- describe five ways that technical work in industry is different than academic research
- list the five habits that scientists and engineers who are successful in industry learn quickly
- explain a corporate financial statement and point out where engineering/R&D fits into the profit model
- describe why making decisions quickly is so important in industry, and explain a new technique for making a decision when the ‘right’ answer is not clear
- list the key elements of a typical industry development project, and describe tactics for keeping it on schedule

INTENDED AUDIENCE: This workshop is intended for graduate students in science and engineering programs who are looking to pursue careers in industry. Scientists and engineers who are already working in industry and want to accelerate their career progress will also find this course very helpful.



INSTRUCTOR: **David M. Giltner** is the author of the book *Turning Science into Things People Need*, and is an internationally recognized speaker and mentor for early career scientists and engineers seeking careers in industry. He has spent the last 20 years commercializing photonics technologies in a variety of roles for several companies including JDS Uniphase and Ball Aerospace. Through his time in the private sector, David learned how to function well in both highly technical and business circles, and has often functioned as an interpreter to help these two worlds communicate more productively. David has a BS and PhD in physics and holds six patents in the fields of laser spectroscopy and optical communications

# PROFESSIONAL DEVELOPMENT

## Transforming Technical Presentations

Tuesday 4 February 2020 • 9:00 AM - 12:00 PM

Location: Park Central Hotel, Franciscan II Room (3rd Floor)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

In this era of infinite content, cutting through clutter to provide a clear and engaging message sets you apart. This course provides the building blocks for scientists and engineers to create effective scientific presentations that will engage their audiences in technical content, rather than bury them. Through a dynamic blend of lecture, discussion, video analysis, and exercises, participants will walk away with immediately applicable strategies for content organization and slide design. These strategies, backed by extensive cognitive science research, will transform how scientists think about their work and the message they share.

**LEARNING OUTCOMES:** After completing this course, attendees will be able to:

- adapt to the level of detail needed for their audience
- apply principles to maximize audiences' retention and unlock the power of storytelling
- explore the problem with traditional slides and led clarity to technical information with assertion-evidence slide design
- create more meaningful visual companions to important data and learn which data and content to omit

**INTENDED AUDIENCE:** This material is intended for anyone who needs to present scientific content and research. Presenters of all experience levels will find this course valuable.



**INSTRUCTOR: Christine Haas** brings over ten years of experience working at the intersection of communication and science. She's held positions as the director of marketing for Drexel's College of Engineering and director of operations for the dean of engineering at Worcester Polytechnic Institute. Now, as principal of Christine Haas Consulting, LLC and director of the Engineering Ambassadors Network, she continues to work with scientists and engineers across industry, government, and higher education to deliver training on presentations and technical writing. Christine received her MBA in marketing from Drexel University and her BA in English from Dickinson College.

## Salary Negotiation Workshop

Tuesday 4 February 2020 • 1:30 PM - 4:30 PM

Location: Park Central Hotel, Franciscan I Room (3rd Floor)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

Gain confidence in your negotiation style through facilitated discussion and role-play. Explore useful negotiation skills for a new job, raise, or promotion.

Participants will learn:

- how to identify and articulate their personal value
- how to develop an arsenal of persuasive responses and other strategies to use when negotiating
- how to conduct objective market research to benchmark a target salary and benefits
- how to develop a plan to achieve your goals

**INTENDED AUDIENCE:** Any paid attendee who would like to improve their salary negotiation skills.



**INSTRUCTOR: Sabine Gedeon** is the Founder and CEO of Empowered By Purpose. She serves as the Chief Transformation Officer, offering Coaching & Consulting services to ambitious, mission-driven leaders. Starting out as a Career Coach back in 2016, Sabine focused on helping women advance in their careers in the areas of salary negotiations and networking. With over 14 years' experience serving as an HR professional, Coach and Advisor to leaders in Fortune 100 companies, and within her own practice, Sabine' has helped hundreds of professionals breakthrough barriers, uncover or build their leadership capabilities, and experience growth in their lives, careers, and businesses.

## Grant Writing from the Ground Up

Tuesday 4 February 2020 • 1:30 PM - 4:30 PM

Location: Park Central Hotel, Franciscan II Room (3rd Floor)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

All research requires funding. That truth means that proposal writing is an essential skill for all scientists and engineers, whether in academia or industry. Unfortunately, most early career professionals are uncomfortable "selling" their research. This workshop addresses "grant phobia" by teaching attendees how to align research with funding opportunities, develop firm project plans, and communicate effectively to reviewers.

**LEARNING OUTCOMES:** This workshop will enable you to:

- Align research objectives to the funding opportunity
- Develop a research plan with clear objectives
- Structure the proposal for clarity
- Choose effective illustrations and figures

**INTENDED AUDIENCE:** All scientists and engineers seeking to improve the quality of their research proposals.



**INSTRUCTOR: Damon Diehl** is a professional writer specializing in scientific content. He has a doctorate in optics from the University of Rochester and a bachelor's degree in physics from the University of Chicago. His grant-writing course is based on two decades of academic and industrial research experience. Over 90% of the scientific grants he has written have been funded, and every client that he has worked with has won funding within two tries.

## Charting a Course in the Photonics Industry

Tuesday 4 February 2020 • 4:30 PM - 5:30 PM  
 Location: Park Central Hotel, Stanford Room (3rd Floor)

**Open to those with a paid registration badge.**  
**No advance registration required.**

### SHAPE YOURSELF FOR A FUTURE IN PHOTONICS

This panel discussion will help you explore potential career pathways in the world of optics and photonics. Get solid advice on how you can translate your knowledge, abilities, and interests into meaningful work. Whether you end up in academia, industry, or start your own company, getting a clear picture of the options from experienced leaders will help you better manage your career trajectory.



**MODERATOR:**  
**Ryan Shelton**  
 CEO & Co-founder,  
 PhotoniCare

#### PANELISTS:



**Barbara Buades**  
 CEO & Co-founder,  
 MEETOPTICS



**Dan Christensen**  
 Global Sales Manager,  
 Life Science Research OEM



**Apurva Jain**  
 Sr. Director of Engineering,  
 Lumotive



**Sarah Lukes**  
 CEO & Founder,  
 Agile Focus Designs



**Samuel Serna**  
 Assistant Professor,  
 Bridgewater State University



Take part in the SPIE Career Summit, our professional development programming at Photonics West 2020. Workshops and sessions will cover a range of topics, from strategies for a successful job search to transforming technical writing and presentations. Hone your career skills and learn valuable insights into preparing to work in optics and photonics.

### Networking, Workshops, and Presentations

TIME	EVENT	PAGE
<b>Sunday 2 February 2020</b>		
1:30 PM - 4:30 PM	Genuine Networking	p. 35
1:30 PM - 4:30 PM	Developing Systems for Optimal Productivity	p. 36
8:00 PM - 9:30 PM	SPIE Career Lab Meetup	p. 42
<b>Monday 3 February 2020</b>		
8:00 AM - 9:00 AM	Career Summit Networking Breakfast	p. 43
9:00 AM - 12:00 PM	Designing Your Own Career Path in the Private Sector	p. 36
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9:00 AM - 12:00 PM	Essential Skills for a Career in Industry	p. 37
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5:00 PM - 6:30 PM	Career Summit Networking Social	p. 43

GO ONLINE FOR EVENT INFORMATION:  
[spie.org/PWCareerSummit](https://spie.org/PWCareerSummit)



## Student Events

Students—make new friends and extend your network while at Photonics West. Learn what other young researchers are doing to get involved and build a career.

### Student Chapter Leadership Workshop

Sunday 2 February 2020 • 8:00 AM - 12:00 PM

Location: Park Central Hotel, Metropolitan II (2nd Level)

**Open to those with a paid student registration badge.**

Join SPIE student chapter leaders from around the world for this half-day leadership workshop. The workshop will start with breakfast, followed by a morning session on mindful leadership and chapter management.

Please email [students@spie.org](mailto:students@spie.org) to register by Friday, 10 January.

### 3-Minute Poster Presentations

*Sponsored by Journal of Biomedical Optics and Neurophotonics*

Monday 3 February 2020 • 4:00 PM - 5:30 PM

Location: Moscone Center, Level 3 West

Students who have been selected to present a poster in one of the BIOS poster sessions will be presenting 3-minute rapid-fire overviews of their poster research. Presentations will be judged on content and presentation effectiveness by representatives from the Editorial Boards of the Journal of Biomedical Optics and Neurophotonics.

The top three presentations will receive cash prizes. Awards will be announced during the Monday night poster session. These awards are sponsored by the *Journal of Biomedical Optics* and *Neurophotonics*.

### Lunch with the Experts - A Student Networking Event

Tuesday 4 February 2020 • 12:30 PM - 1:30 PM

Location: InterContinental Hotel,  
InterContinental Ballroom (5th Floor)

**Open to those with a paid student registration badge.**

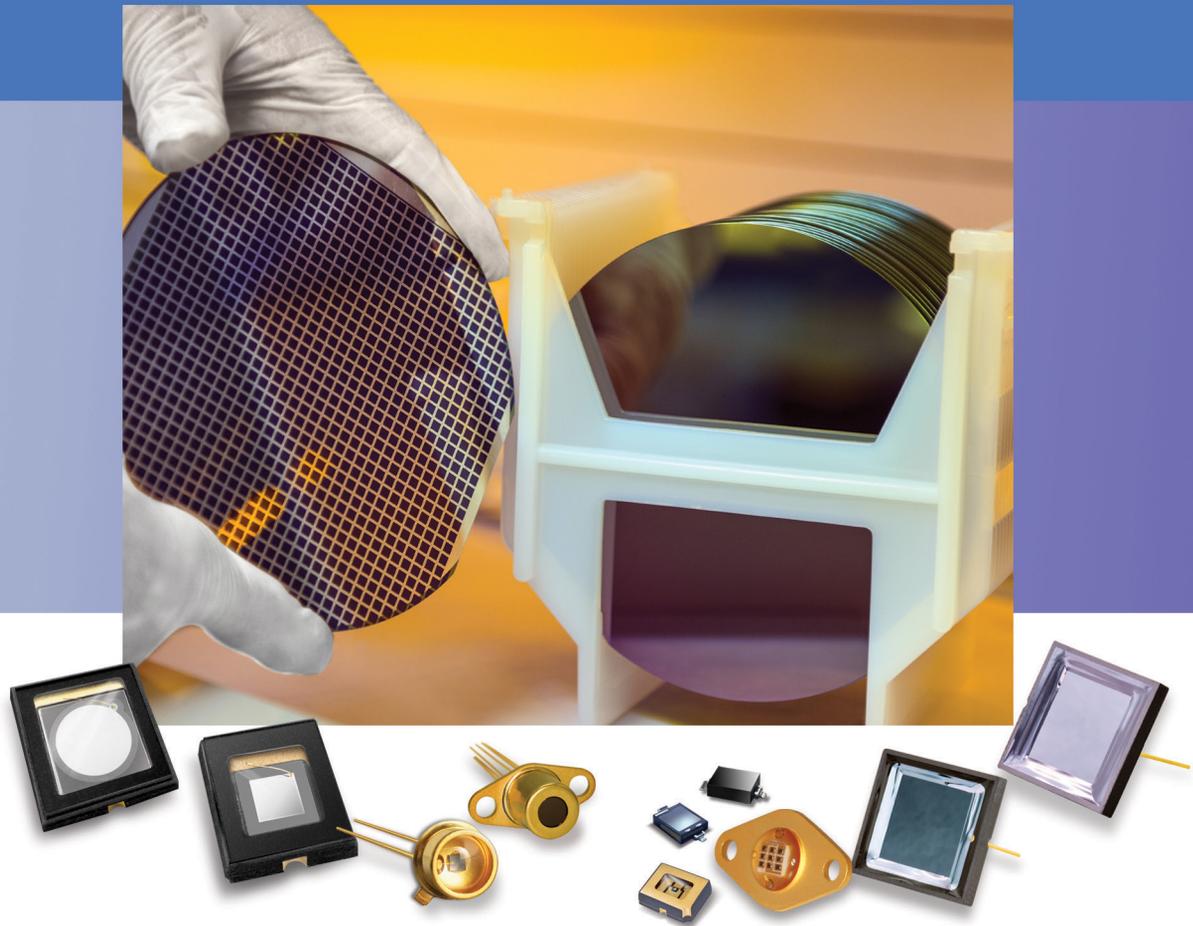
**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

Enjoy a casual meal with colleagues at this engaging networking opportunity. This event features experts willing to share their experience and wisdom on career paths in optics and photonics and an award presentation for SPIE scholarships and MKS Instruments Grant winners.

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## Social and Networking Events

Join your colleagues at these relaxed events, including the All-Symposium Welcome Reception – an event not to be missed!

### Wikipedia Edit-a-thon

Sunday 2 February 2020 • 5:00 PM - 7:00 PM  
 Location: Park Central Hotel, Franciscan I (3rd Floor)

**Open to the public.**

Bring your laptop and join us in editing Wikipedia pages about inspiring women, ethnic, or racial minority scientists.

Wikipedia is the fifth most popular website in the world, with more than 32 million views a day. Unfortunately fewer than 18% of the English-language biographies are about women. The stats for ethnic and racial minorities are no better.

During the event, a dedicated diversity activist will teach you how to edit Wikipedia pages. You will then have an opportunity to work together to research and write biographies of scientists from under-represented groups who inspire you. No previous experience is needed!

Create a Wikipedia account before you arrive to make the most out of your time with us! Tips on how to do so are may be found here: [wikihow.com/Create-a-Wikipedia-Account](http://wikihow.com/Create-a-Wikipedia-Account)

Do you have suggestions for pages to create? Let us know! You can find us on Twitter @WomenInOptics.

### SPIE Career Lab Meetup

Sunday 2 February 2020 • 8:00 PM - 9:30 PM  
 Location: 21st Amendment Brewery, 563 2nd Street

**Open to SPIE Career Lab members who have a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

The SPIE Career Lab is a community for people connected to optics & photonics to help each other with professional advice, questions, and opportunities. Members of this community are invited to this special onsite meetup to network and prepare for an exciting week at the conference.

### Career Summit Networking Breakfast

Monday 3 February 2020 • 8:00 AM - 9:00 AM  
 Location: Park Central Hotel, Metropolitan I/II (2nd Level)

**Open to those with a paid registration badge.**

**No advance registration is required. However, seating is limited and will be granted on a first-come, first-served basis.**

Start your conference day off with a tasty breakfast and an informal networking opportunity. This is a chance to get to know your peers as well as connect with volunteer leadership of SPIE while discussing table topics on areas that interest you.

Early Career Professionals and students are encouraged to attend!

## SOCIAL AND NETWORKING EVENTS

### Equity, Diversity, and Inclusion Presentation and Reception

Monday 3 February 2020 • 5:00 PM - 6:30 PM

Location: InterContinental Hotel, InterContinental Ballroom B (5th Floor)

**Open to those with a paid registration badge.**

Join us for a thought-provoking presentation and stay after to discuss topics with your colleagues during the reception. The first 50 attendees will receive a free copy of *Superior: The Return of Race Science* by author and speaker, Angela Saini.

### GENDER, RACE, AND POWER

Drawing from her two most recent books, Angela explores the ways in which bias and prejudice are perpetuated in science, and the historical backdrop to today's inequality.



**Angela Saini** is an award-winning British science journalist and broadcaster. She regularly presents science programmes on the BBC, and her writing has appeared in *New Scientist*, the *Guardian*, the *Sunday Times*, and *Wired*. Her latest book is *Superior: the Return of Race Science*. Her previous book, *Inferior: How Science Got Women Wrong*, was published in 2017 to widespread critical acclaim and has been translated into eleven languages. Angela has a Masters in Engineering from the University of Oxford and was a Fellow at the Massachusetts Institute of Technology.

### Photonics West Welcome Reception

Monday 3 February 2020 • 7:00 PM - 8:30 PM

Location: Marriott Marquis Hotel, Yerba Buena Ballroom (Lower Level)

**All paid conference attendees are welcome.**

**Please wear your conference badge.**

### IMAGINING THE FUTURE

Enjoy delicious San Francisco-inspired cuisine and celebrate the outstanding visionaries of the past that inspired the present day and future applications of optics and photonics. Enjoy some fun and nostalgia!

### Whiskey Tasting at the SPIE Booth

Tuesday 4 February 2020 • 1:00 PM - 5:00 PM

Wednesday 5 February 2020 • 1:00 PM - 5:00 PM

Thursday 6 February 2020 • 12:00 PM - 4:00 PM

Location: Hall D, Booth #3126

Sample specialty whiskeys while chatting with colleagues at SPIE Booth #3126. Co-sponsored by [optics.org](http://optics.org).

### Meet the Authors Event

Tuesday 4 February 2020 • 2:00 PM - 3:00 PM

Location: Moscone West, Level 2 Lobby

Come and meet Joseph Goodman, father of modern Fourier Optics, a field which enabled many of the optical technologies used today in AR/VR. SPIE will be publishing Joe's new edition on "Speckle Phenomena in Optics". This is a unique opportunity to get to chat with Joe and have all of your previous "Goodman Books" autographed. Bernard Kress, for whom Joe was a terrific mentor, will be signing also his own new book on "Optical Architectures for AR,VR and MR headsets."

See page 91 for more details.

### Career Summit Networking Social

Tuesday 4 February 2020 • 5:00 PM - 6:30 PM

Location: Park Central Hotel, MaSo Restaurant

**Open to participants of the SPIE Career Summit.**

**Participants will receive a ribbon during workshops at the Summit.**

**Please wear this ribbon for entry into the networking social.**

Come grab a drink and meet others from the SPIE Career Summit in a relaxed atmosphere. Upon entry, you will be asked to identify your special interest area on a sticker and will be given a networking card with a unique question on it. Your job is to ask this question to someone you haven't met before. Every five minutes, a tone will sound and you will switch cards with the person with whom you are speaking and move on to find a new contact and begin a new discussion with your new question. At 6 pm, the speed-networking segment will end and you are invited to continue discussions with the people you found most interesting. Prepare your business cards and elevator pitch!

### LGBTQ+ Social

Tuesday 4 February 2020 • 6:30 PM - 7:30 PM

Location: Keystone Social House, 68 4th Street

**Open to those with a paid registration badge.**

Come join us in Keystone's Private Dining Room to socialize and network with other LGBTQ+ and allies in the optics and photonics community.

# SCIENCE IS FOR EVERYONE

## EQUITY

Is access to opportunities, fair treatment, and advancement for all people; it's about eliminating barriers that prevent full participation.

## DIVERSITY

Includes all the ways in which people differ—identity markers such as race, ethnicity, gender, ability, sexual orientation, and more.

## INCLUSION

Goes beyond diversity: it's the act of creating an environment where everyone feels welcomed, respected, supported, and valued.



[spie.org/inclusion](http://spie.org/inclusion)

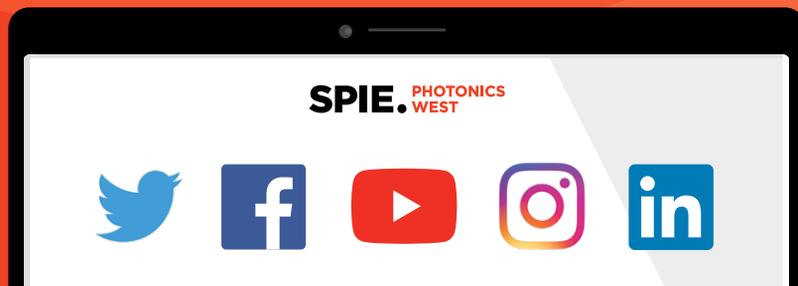


## Equity, Diversity, and Inclusion Events

SPIE believes that bringing together people from different backgrounds, experiences, and perspectives supports innovation through a variety of ideas, and solves challenges faced by our world.

TIME	EVENT	PAGE
<b>Saturday 1 February 2020</b>		
12:00 PM - 1:00 PM	Lunch & Learn: Equity in Industry	p. 57
<b>Sunday 2 February 2020</b>		
12:00 PM - 1:00 PM	Lunch & Learn: Managing Unconscious Bias	p. 59
5:00 PM - 7:00 PM	Wikipedia Edit-a-thon	p. 42
<b>Monday 3 February 2020</b>		
5:00 PM - 6:30 PM	Equity, Diversity, and Inclusion Presentation and Reception	p. 43
6:30 PM - 7:30 PM	Executive Women's Meetup	p. 70
<b>Tuesday 4 February 2020</b>		
12:00 PM - 1:00 PM	Lunch & Learn: Creative, Inclusive Cultures	p. 60
6:30 PM - 7:30 PM	LGBTQ+ Social	p. 43
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12:00 PM - 1:00 PM	Lunch & Learn: Diversity in the Workplace	p. 63

## #PhotonicsWest



# CHIPS TO SUB-SYSTEMS THAT SOLVE DEMANDING REQUIREMENTS

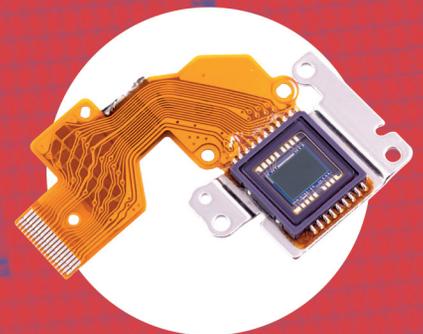
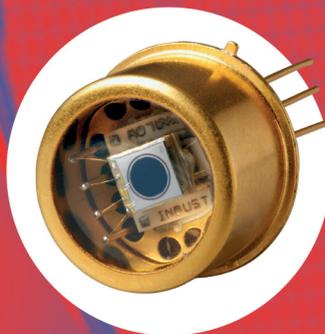
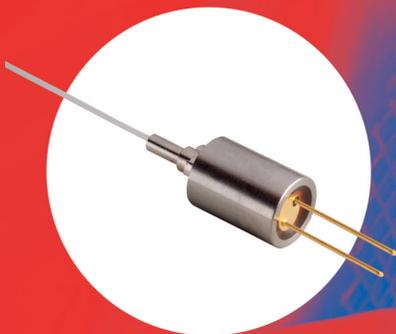
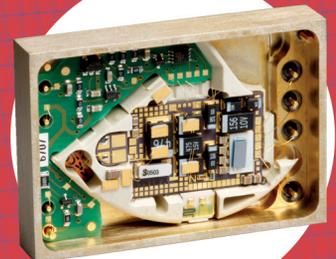
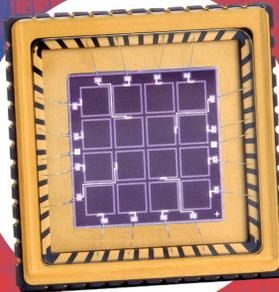
AEROSPACE

DEFENSE

MEDICAL

SECURITY

INDUSTRIAL



SILICON & InGaAs PHOTODETECTORS  
POSITION SENSORS  
MULTI-CHIP MODULES

AVALANCHE PHOTODIODES  
HYBRIDS  
FLEX CIRCUITS

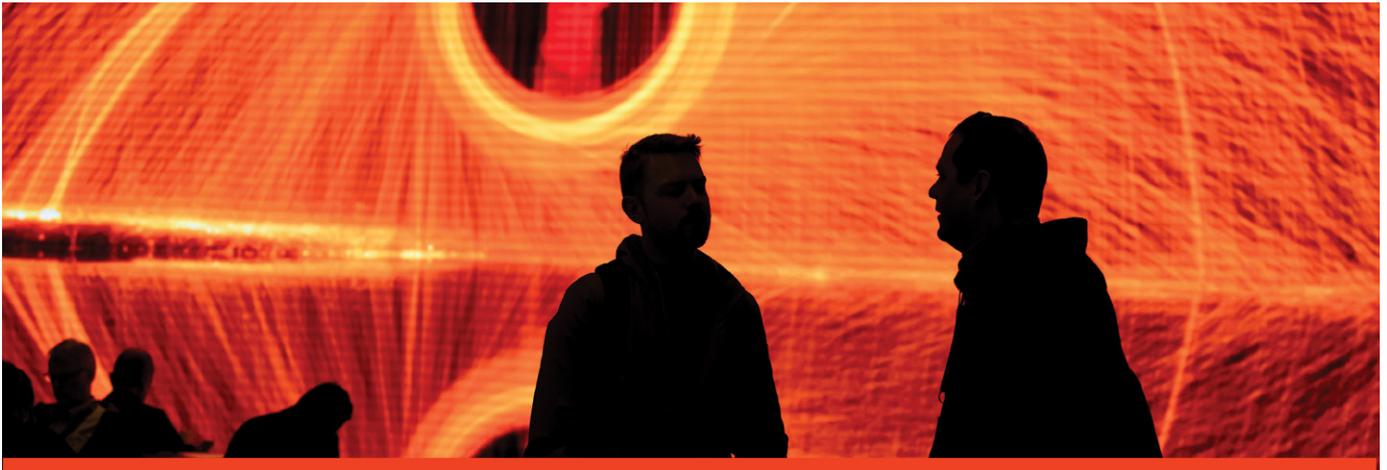
LASER DIODES  
FLIPCHIP  
CHIP-ON-CERAMIC

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## SPIE Membership Events

Your SPIE Membership is a valuable asset; join other SPIE members in these informal get-togethers. Make new connections and renew old friendships.

### SPIE Fellow Member Luncheon

Monday 3 February 2020 • 12:00 PM - 1:30 PM

Location: InterContinental Hotel,  
InterContinental Ballroom (5th Floor)

#### **For SPIE Fellows Only**

All Fellow Members of SPIE are invited to join your colleagues for an SPIE hosted lunch. The new SPIE Fellows attending Photonics West will be introduced and recognized. Please join us for this informal gathering and a chance to interact with other Fellows. Fellow Members planning to attend are asked to RSVP to Brent Johnson (brentj@spie.org).

FELLOWS LUNCHEON PRESENTATION:



#### **Innovation in Ultrafast or Ultrafast Innovation?**

##### **Ursula Keller**

Physics Department,  
ETH Zurich (Switzerland)

SPIE Fellow Ursula Keller is the recipient of the 2020 SPIE Gold Medal, which is the highest honor the Society bestows. For nearly three decades, the research of Ursula Keller, a professor of physics at ETH Zurich, has defined the revolution in ultrafast science and technology. She pioneered the semiconductor saturable absorber mirror (SESAM), which quickly became ubiquitous in useful ultrashort pulse laser systems. From 1993 onwards, with the research group that she built at ETH Zurich, she has led international state-of-the-art developments in ultrafast science through a comprehensive program of research, ranging from the technological development of SESAMs to shape and withstand millijoule femtosecond laser pulses, to fundamental science with the demonstration of the attoclock.

PRESENTATION OF 2020 SPIE EARLY CAREER ACHIEVEMENT AWARD - ACADEMIC

The SPIE Early Career Achievement Award is presented in recognition of significant and innovative technical contributions in the engineering or scientific fields of relevance to SPIE.



PRESENTED TO:

##### **Gordon Wetzstein**

Stanford University, Stanford, California (USA)

Gordon Wetzstein is the second of two 2020 recipients of the SPIE Early Career Achievement Award - Academic focus - in recognition of outstanding contributions to computational imaging and display technologies.

### SPIE Senior Member Breakfast

Tuesday 4 February 2020 • 8:00 AM - 9:00 AM

Location: InterContinental Hotel,  
InterContinental Ballroom (5th Floor)

#### **For SPIE Senior Members Only**

All Senior Members of SPIE are invited to join your colleagues for this SPIE-hosted buffet breakfast. Please join us for this informal gathering and a chance to interact with other Senior Members. Please plan to wear your yellow Senior Member ribbon for entry into this event. A special invitation is also made for members of the SPIE Board of Directors to attend this breakfast. Senior Members planning to attend are asked to RSVP to Brent Johnson (brentj@spie.org).

### SPIE After-Dinner Member Reception

THE PLACE FOR SPIE MEMBERS TO CONNECT

Tuesday 4 February 2020 • 8:00 PM - 9:30 PM

Location: 715 Harrison Street, San Francisco

#### **For SPIE Members Only**

SPIE Members are invited to the 715 Harrison. Enjoy cocktails, dessert, coffee and a special ice cream treat. Please note: this reception is limited to SPIE Members only and the 715 Harrison is only open to attendees aged 18 or over. Please wear your registration badge and Member ribbon and bring a valid ID. If you join as an SPIE Member onsite, please bring your registration receipt. Dress is casual or business attire.

# SEE WHAT'S NEW AT PG&O



## Introducing Finished Infrared Optics

PG&O now offers the finest in precision finished infrared optical components for a variety of commercial and defense applications. Our infrared substrates include calcium fluoride, germanium, magnesium fluoride, silicon, zinc selenide, and zinc sulfide and operate from 0.75  $\mu\text{m}$  (NIR) to 15  $\mu\text{m}$  (LWIR). Call today for more information.

**See us at  
BiOS #8351  
Photonics West #4883**

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[www.pgo.com](http://www.pgo.com) / 714.540.0126 / [info@pgo.com](mailto:info@pgo.com)

# SPIE Industry Program



## Gain important industry insights

Hear from leading experts, see the latest innovations, and connect with the right people. The SPIE Photonics West Industry Program has something for everyone—from engineers and CEOs to startups and venture capitalists.

### SIX DAYS, SIXTY EVENTS



**SPIE Entrepreneur Program and Venture Summit** p. 49  
Where entrepreneurs and potential business partners meet



**Job Fair** p. 34  
Connecting recruiters and potential employees



**Startup Challenge** p. 54  
Entrepreneurs compete for over \$85,000 in cash and prizes



**Industry Special Events** p. 68  
Make time during the week for these special events.



**Industry Stage** p. 56  
Free sessions taking place on the show floor



**Prism Awards** p. 71  
Honoring the best new optics and photonics products on the market



**Industry Workshops** p. 64  
Presentations from top companies sharing their solutions

# SPIE ENTREPRENEUR PROGRAM AND VENTURE SUMMIT

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12:00 PM – 1:00 PM	Startup Strategy Lunch	p. 50
1:15 PM – 2:15 PM	Building a Team to Build Your Business Panel Discussion	p. 50
2:30 PM – 3:30 PM	Investment: Milestones and Money Panel Discussion	p. 50
3:30 PM – 5:45 PM	Risk 2 Value Course	p. 50
<b>Monday 3 February 2020</b>		
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11:30 AM – 12:00 PM	Fireside Chat with Phil Greenhalgh, Wave Optics	p. 52
12:00 PM – 1:00 PM	SPIE Venture Summit Networking Lunch	p. 53
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<b>Wednesday 5 February 2020</b>		
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<b>SPIE STARTUP CHALLENGE</b>		
<b>Wednesday 5 February 2020</b>		
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9:30 AM – 11:00 AM	SPIE Startup Challenge Finals—Healthcare	p. 55
11:30 AM – 12:00 PM	Healthcare—Pitch Review	p. 55
12:30 PM – 1:30 PM	SPIE Startup Challenge – Past Winners Panel	p. 55
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## Connect with the experts

### 2020 Entrepreneur Program Network

Hear from an impressive line-up of experts leading powerful events at this inaugural program. Network with these leaders, plus meet investors, entrepreneurs, educators, and other important people leading the next deep tech innovations.

### Healthcare Keynote

Saturday 1 February 2020 • 1:30 PM - 2:00 PM  
Location: Industry Stage, Hall DE (Exhibit Level)  
*See p. 57 for details.*

### Healthcare Founders Panel

Saturday 1 February 2020 • 2:00 PM - 3:00 PM  
Location: Industry Stage, Hall DE (Exhibit Level)  
*See p.57 for details.*

### Healthcare Investors Panel

Saturday 1 February 2020 • 3:15 PM - 4:15 PM  
Location: Industry Stage, Hall DE (Exhibit Level)  
*See p. 58 for details.*

## SPIE ENTREPRENEUR PROGRAM - SUNDAY

### Startup with Purpose

Sunday 2 February 2020 • 9:00 AM - 12:00 PM  
Location: Room 2024 (Level 2 West)

#### WHAT DO YOU DO? WHO DO YOU DO IT FOR? WHY DO THEY CARE?

*Open to Startup Challenge teams and paid badge holders.*

Answering these simple questions is the basis for beginning startup strategy. Beyond the competition pitch, answering these fundamental questions in an interactive, rapid feedback environment will help you focus on your story and get you ready for the numerous conversations and discussions you will have during the week at Photonics West. Startup Challenge Semi-finalists are highly encouraged to attend, but anyone wanting to test an idea for a business is welcome by joining the Entrepreneurship Program.

#### FACILITATORS:



**Farzin Samadani**  
National Instructor  
for NSF I-Corps  
Program (USA)



**Viktor Brandtneris**  
Principal,  
Brandtneris  
Consulting Group  
Inc and NSF I-Corps  
(USA)

# SPIE ENTREPRENEUR PROGRAM AND VENTURE SUMMIT

## Startup Strategy Lunch

Sunday 2 February 2020 • 12:00 PM - 1:00 PM  
Location: Room 2020/2022 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

Now on its third cohort, the Luminate Accelerator is the world's only optics and photonics startup accelerator. Join this event for a facilitated lunch discussion with Sujatha Ramanujan, Managing Director of Luminate on key success factors for high tech hardware startups.



**SPEAKER:**  
**Sujatha Ramanujan**  
Managing Director,  
Luminate Accelerator (USA)

## Building a Team to Build Your Business Panel Discussion

Sunday 2 February 2020 • 1:15 PM - 2:15 PM  
Location: Room 2020/2022 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

"Leaders of companies that go from good to great start not with "where" but with "who." They start by getting the right people on the bus, the wrong people off the bus, and the right people in the right seats. And they stick with that discipline—first the people, then the direction—no matter how dire the circumstances." - Jim Collins. Indeed, most investors will tell you that they back teams, not ideas or business models. Join this panel discussion to learn how to identify gaps and make good strategic hires with the limited resources in your startup.



**MODERATOR:**  
**Sujatha Ramanujan**  
Managing Director,  
Luminate Accelerator (USA)

**PANELISTS:**



**Nicholas Durr**  
Founder, PlenOptika  
and Assistant  
Professor, Johns  
Hopkins Univ. (USA)



**Mike Hildebrandt**  
Strategy & Business  
Development  
Executive in Emerging  
Technologies (USA)



**Supriya Jaiswal**  
Founder and CEO,  
Astrileux Corp. (USA)



**Cather Simpson**  
Professor of Physics  
& Chemical Sciences  
The Univ. of  
Auckland (New  
Zealand) and  
Founder, Engender  
Technologies (New  
Zealand)

## Investment: Milestones and Money Panel Discussion

Sunday 2 February 2020 • 2:30 PM - 3:30 PM  
Location: Room 2020/2022 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

In seeking outside funding to scale a company, most founders make the mistake of not connecting the money raised to the milestones they intend to achieve. This panel discussion brings financial experts, investors, and founders together for a conversation about how to speak the same language around risk and value for technology startup.



**MODERATOR:**  
**Farzin Samadani**  
National Instructor for  
NSF I-Corps Program (USA)

**PANELISTS:**



**John Dexheimer**  
President,  
Lightwave Advisors  
(USA)



**Frank Levinson**  
General Partner,  
Phoenix Ventures  
(USA)



**Jerry Panagrossi**  
Executive  
Director,  
Renevo Capital  
Limited (USA)



**Chris Rowan**  
Founder,  
Arscientia (USA)



**Cather Simpson**  
Professor of Physics  
& Chemical Sciences  
The Univ. of Auckland  
(New Zealand) and  
Founder, Engender  
Technologies (New  
Zealand)

## Risk 2 Value Course

Sunday 2 February 2020 • 3:30 PM - 5:45 PM  
Location: Room 2020/2022 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

Investors in your company need to know how you will use the money they put in to increase the value of the company and eliminate risks to continued growth. Learn techniques that financial experts use to make this estimate so you can speak more effectively to potential investors.

**INSTRUCTORS:**



**Chris Rowan**  
Founder,  
Arscientia (USA)



**Doug Komen**  
Investor,  
Arscientia Advisors  
(USA)

# SPIE ENTREPRENEUR PROGRAM AND VENTURE SUMMIT

## SPIE ENTREPRENEUR PROGRAM - MONDAY

### Customer Discovery with NSF I-Corps Instruction

Monday 3 February 2020 • 9:00 AM - 12:00 PM  
Location: Room 2024 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Photonics West is an amazing laboratory for customer discovery training. Learn about the wide variety of customers you might encounter, identify decision-makers among them, and have the conversations that will guide your business development. This is part one of the two part NSF IMPACT program that may help your team qualify for I-Corps funding.

INSTRUCTORS:



**Farzin Samadani**  
National Instructor  
for NSF I-Corps  
Program (USA)



**Viktor Brandtneris**  
Principal,  
Brandtneris  
Consulting Group  
Inc and NSF I-Corps  
(USA)

### Startup Mentoring and Networking Lunch

Monday 3 February 2020 • 12:00 PM - 1:30 PM  
Location: Room 2020/2022 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Day 2 of the Entrepreneur Program is all about mentoring and networking. This informal lunch is open to the participants in the Entrepreneur Program and the volunteer mentors and judges from the Startup Challenge so that teams can meet and network. Have your 1 minute introduction ready!

### Office Hours — Startup Teams and Mentors

Monday 3 February 2020 • 1:30 PM - 5:00 PM  
Location: Rooms 2020/2022 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Mentors from a variety of backgrounds and expertise areas - Regulatory, Intellectual Property, Pitching, Investing, and Business Strategy—will take 20 minute meetings with Startup Challenge teams and Entrepreneur program participants. Advance sign-up is required to schedule meetings with mentors.

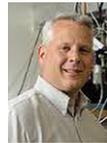
## FDA Regulatory Shark Tank

Monday 3 February 2020 • 2:00 PM - 3:00 PM  
Location: Room 2024 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Your product and business strategy may depend a lot on the regulatory pathway and the claims you wish to make. Join members of the US Food and Drug Administration for an interactive and example-filled look at how to navigate different FDA approval pathways. With the goal of accelerating patient access to medical devices while ensuring device safety and efficacy, the FDA encourages companies to get early feedback on their plans. Examples and questions will be handled in an open forum to encourage information sharing.

PANELISTS:



**Zane Arp**  
Director, Division of  
BioMedical Physics,  
U.S. Food and Drug  
Administration (USA)



**Kyle Myers**  
Director, Division  
of Imaging,  
Diagnostics, and  
Software Reliability,  
U.S. Food and Drug  
Administration (USA)



**Daniel Hammer**  
Deputy Director,  
Division of  
Biomedical Physics,  
U.S. Food and Drug  
Administration (USA)

## SPIE ENTREPRENEUR PROGRAM - WEDNESDAY

### IMPACT Program Debrief

Wednesday 5 February 2020 • 7:45 AM - 9:00 AM  
Location: Room 2024 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Startup Challenge teams report back on customer and mentor discovery meetings. This is part 2 of the 2 part NSF IMPACT program that may help your team qualify for I-Corps funding. This debrief session is required for I-Corps qualification.

INSTRUCTORS:



**Farzin Samadani**  
National Instructor  
for NSF I-Corps  
Program (USA)



**Viktor Brandtneris**  
Principal,  
Brandtneris  
Consulting Group  
Inc and NSF I-Corps  
(USA)

**See maps of Moscone West  
on pp. 5-6**

# SPIE ENTREPRENEUR PROGRAM AND VENTURE SUMMIT

## SPIE VENTURE SUMMIT EVENTS - TUESDAY

### Pre-Seed Stage Deep Tech Pitches

Tuesday 4 February 2020 • 8:00 AM - 10:00 AM  
Location: Room 2024 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

Startup Challenge semi-finalists in deep tech (imaging, semiconductors, lasers, displays, telecommunications, AR/VR and all things optics-related) pitch their business to a panel of expert judges and compete to move on to the Startup Challenge finals. Ideal for angel and early stage investors to increase their view on the latest deep tech advances from around the world.

Semi-finalist teams are announced in January and listed online.

### Pre-Seed Stage Healthcare Pitches

Tuesday 4 February 2020 • 8:00 AM - 10:00 AM  
Location: Room 2011 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

Startup Challenge semi-finalists in healthcare pitch their businesses to a panel of expert judges and compete to move on to the Startup Challenge finals. Ideal for angel and early stage investors to increase their view on the latest healthcare advances from around the world.

Semi-finalist teams are announced in January and listed online.

### Seed Stage Deep Tech Semi-Finals

Tuesday 4 February 2020 • 10:00 AM - 12:00 PM  
Location: Room 2024 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

Startup Challenge semi-finalists in deep tech (imaging, semiconductors, lasers, displays, telecommunications, AR/VR and all things optics-related) pitch their business to a panel of expert judges and compete to move on to the Startup Challenge finals. Ideal for angel and early stage investors to increase their view on the latest deep tech advances from around the world.

Semi-finalist teams are announced in January and listed online.

### Seed Stage Healthcare Semi-Finals

Tuesday 4 February 2020 • 10:00 AM - 12:00 PM  
Location: Room 2011 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

Startup Challenge semi-finalists in healthcare pitch their businesses to a panel of expert judges and compete to move on to the Startup Challenge finals. Ideal for angel and early stage investors to increase their view on the latest healthcare advances from around the world.

Semi-finalist teams are announced in January and listed online.

### Demos & Startup Alley

Tuesday 4 February 2020 • 10:00 AM - 5:00 PM  
Location: Room 2020/2022 (Level 2 West)

Meet with the entrepreneurs featured in the Startup Challenge. See the prototypes and talk with the entrepreneurs to explore potential partnerships, investment, or sales.

### Welcome and Fireside Chat with Laurent Daudet of LightOn

Tuesday 4 February 2020 • 11:00 AM - 11:30 AM  
Location: Room 2020/2022 (Level 2 West)

**Open to Startup Challenge teams and paid badge holders.**

#### SPIE VENTURE SUMMIT WELCOME AND OVERVIEW

Followed by a one-one discussion with Laurent Daudet, CTO and Co-founder, interviewed by Evan Nisselson, LDV Capital. LightOn develops a light-based technology required to accelerate large scale artificial intelligence computations. With AI being built into thousands of applications, specialized low-power optical computing chips could change the landscape of ubiquitous AI. With a recent \$3.3M Seed round close, LightOn brings unique advantages in this area that were unexpected just a few years ago. How did they get there? What is next for this Paris-based startup?

Join us for this one-one interview with Laurent Daudet, CTO and Co-founder, interviewed by Evan Nisselson, LDV Capital



**Laurent Daudet**  
CTO and Co-founder  
LightOn (France)



**Evan Nisselson**  
General Partner  
& Founder, LDV  
Capital (USA)

### Fireside Chat with Phil Greenhalgh, Wave Optics

Tuesday 4 February 2020 • 11:30 AM - 12:00 PM  
Location: Room 2020/2022 (Level 2 West)

WaveOptics, a company that develops core optical components for augmented reality (AR) displays, has closed its series C round of funding at \$39 million. How did they get there? What is next? What is your advice to any tech startup out there?

Join us for this one-one interview with Phil Greenhalgh, CTO of Wave Optics, interviewed by Evan Nisselson, LDV Capital



**Phil Greenhalgh**  
CTO  
Wave Optics (USA)



**Evan Nisselson**  
General Partner &  
Founder,  
LDV Capital (USA)

# SPIE ENTREPRENEUR PROGRAM AND VENTURE SUMMIT

## SPIE Venture Summit Networking Lunch

Tuesday 4 February 2020 • Time: 12:00 PM - 1:00 PM  
Location: Room 2020/2022 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Hosted and facilitated networking lunch for the SPIE Venture Summit. Teams from the Startup Challenge will have the chance to network with investors and experts. Tour prototypes and demos from high tech startups in the competition.

## SPIE Venture Summit Keynote

Tuesday 4 February 2020 • 1:00 PM - 1:30 PM  
Location: Room 2020/2022 (Level 2 West)

Evan Nisselson shares his perspective on "45 Billion Cameras by 2022 will fuel business opportunities" with the SPIE Venture Summit.

*Open to Startup Challenge teams and paid badge holders.*

Venture Summit Keynote speaker, Evan Nisselson, is the founder of LDV Capital, a thesis-driven early stage venture fund investing in people building visual technology businesses. LDV has been investing in pre-seed and seed stage teams (focusing on computer vision, machine learning and artificial intelligence to analyze visual data) across North America and Europe since 2012.



KEYNOTE SPEAKER:  
**Evan Nisselson**  
General Partner & Founder,  
LDV Capital (USA)

## M&A Trends in Photonics - Data and Discussion

Tuesday 4 February 2020 • 1:30 PM - 2:30 PM  
Location: Room 2020/2022 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Mergers and acquisitions are the primary drivers of exits among technology startups. There is a small community of experts that tracks activity in the optics and photonics technical domain. Through a series of presentations and discussion, they will map out trends in the mergers and acquisitions of photonics-enabled companies.



MODERATOR:  
**Chris Rowan**  
Founder, Arscientia (USA)

PANELISTS:



**Mike Powell**  
Managing Director  
and Partner  
Renevo Capital  
Limited (USA)



**Linda Smith**  
President,  
CERES Technology  
Advisors (USA)



**Danny Piper**  
Mergers and  
Acquisitions  
Principal  
NewCap Partners  
Inc. (USA)

## Investing in Photonics Panel Discussion

Date: Tuesday 4 February 2020 • 2:45 PM - 3:45 PM  
Location: Room 2020/2022 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Most investors shy away from the long timelines and uncertain outcomes of hardware startups. Yet, the prospects for developing a ubiquitous commercial technology on scale of the transistor is well within the realm of possibility in photonics. This panel discussion brings together active investors in the photonics space to discuss emerging trends, common problems, and how founders can build successful companies.



MODERATOR:  
**Sujatha Ramanujan**  
Managing Director,  
Luminate Accelerator (USA)

PANELISTS:



**Frank Levinson**  
General Partner,  
Phoenix Ventures  
(USA)



**Jerry Panagrossi**  
Executive Director,  
Renevo Capital  
Limited (USA)



**Evan Nisselson**  
General Partner &  
Founder,  
LDV Capital (USA)



**Laura Smoliar**  
Founding Partner,  
Berkeley Catalyst  
Fund (USA)

## Series A/B Pitches

Tuesday 4 February 2020 • 4:00 PM - 5:00 PM  
Location: Room 2020/2022 (Level 2 West)

*Open to Startup Challenge teams and paid badge holders.*

Companies raising later funding rounds in both the healthcare and deep tech spaces will pitch in this final event of the SPIE Venture Summit. Improve your deal flow from valuable, high tech companies with this event. Ideal for all investors looking for opportunities to invest in companies with market traction using technologies like imaging, semiconductors, lasers, displays, telecommunications, AR/VR and healthcare from around the world.

Companies pitching will be listed online in January.



**CLOSING REMARKS**  
**Evan Nisselson**  
General Partner & Founder,  
LDV Capital (USA)

## Venture Summit Closing Reception

Tuesday 4 February 2020 • 5:00 PM - 6:00 PM  
Location: Room 2020/2022 (Level 2 West)

The SPIE Venture Summit wraps up with a reception shared with the co-located AR/VR conference.



With over \$85,000 in cash, prizes, and promotion at stake,  
this is an event not to be missed.

See and hear pitches for the "best of the best" new photonics businesses. This pitch competition is a lively, interactive event showcasing the power of entrepreneurs to move photonics technology to the global marketplace. The top two entrepreneurs from each semi-final track—healthcare and deep tech will have just five minutes each to pitch their businesses to a team of expert judges.

The top pitch presenter will go home with \$10,000 in cash from JENOPTIK and \$5,000 of equipment from Edmund Optics. Join fellow business development, investment, and product managers to scout new talent and see what the future of entrepreneurship in photonics looks like.

The event will conclude with a networking reception where you can meet the presenters and fellow attendees involved in photonics entrepreneurship. Go to the Startup Challenge website for details on presenters, logistics, prizes, and sponsors: [spie.org/startup](http://spie.org/startup)

AWARD PRESENTER:



**John Greivenkamp**  
2020 SPIE President  
and Professor, Univ. of  
Arizona (USA)

STARTUP CHALLENGE JUDGES:



**Mark Enright**  
Senior Director Silicon  
Valley Applications Center,  
JENOPTIK (Germany)



**Marc Himel**  
Director of Inside Sales  
and Customer Success,  
MKS Instruments (USA)



**Zhenlin Li**  
Investment Director,  
Photon Fund (China)



**Andrew Lynch**  
Director of Sales - Americas,  
Edmund Optics (USA)



**Evan Nisselson**  
General Partner & Founder,  
LDV Capital (USA)



**Sam Rubin**  
General Manager,  
Thorlabs Imaging Systems (USA)



**Lars Sandstrom**  
Precision Optics Engineer,  
Senior Business Manager,  
Edmund Optics (USA)

Founding Partner



Strategic Partner



Lead Sponsors



Supporting Sponsors



Open to all attendees.

## STARTUP CHALLENGE

**WEDNESDAY 5 FEBRUARY**

Location: Room 2003 (Level 2 West)

**FINAL PITCHES**

Healthcare 9:30 AM - 11:30 AM

Deep Tech 1:30 PM - 3:30 PM

**AWARDS AND RECEPTION**

4:00 PM - 5:00 PM

### Startup Challenge Keynote - Healthcare 2030

9:00 AM - 9:30 AM

Evan Nisselson opens the Startup Challenge with a perspective on "Healthcare in 2030: Doctor-directed, patient-owned and powered by visual technologies."

Evan is the founder of LDV Capital, a thesis-driven early stage venture fund investing in people building visual technology businesses. LDV has been investing in pre-seed and seed stage teams (focusing on computer vision, machine learning and artificial intelligence to analyze visual data) across North America and Europe since 2012.

KEYNOTE SPEAKER:



**Evan Nisselson**  
General Partner & Founder,  
LDV Capital (USA)

### Past Winners Panel

12:30 PM - 1:30 PM

Join past winners of the SPIE Startup Challenge for a discussion of key factors in their successful journey from lab to launch and beyond.

PANELISTS:



**Leslie Kimerling**  
CEO and Co-Founder,  
Double Helix Optics  
(USA)



**Matthias Wagner**  
CEO,  
Cellino Biotech  
(USA)



**Ryan Shelton**  
Co-founder & CEO,  
PhotoniCare (USA)



**Cathie Simpson**  
Professor of  
Physics & Chemical  
Sciences, The  
Univ. of Auckland  
(New Zealand) and  
Founder, Engender  
Technologies

## HEALTHCARE FINALS

### SPIE Startup Challenge Finals—Healthcare

9:30 AM - 11:30 AM • Location: Room 2003 (Level 2 West)

Six Startup Challenge finalists pitch their ideas for transformational products in the healthcare arena. Expect to see amazing ideas in rapid cancer detection, wearables-based health screening, single cell-imaging and printing, neurologic therapy, and drug discovery. Healthcare is a multi-trillion dollar business being transformed by photonics in innovative ways; join your colleagues for a view of the future.

### Healthcare—Pitch Review

11:30 AM - 12:00 PM

Expert analysis of the pitches, the markets they represent, and prospects for growth in this area.

Lunch and networking follow.



MODERATOR:  
**Sujatha Ramanujan**  
Managing Director,  
Luminate Accelerator (USA)

## DEEP TECH FINALS

### SPIE Startup Challenge Finals—Deep Tech

1:30 PM - 3:30 PM • Location: Room 2003 (Level 2 West)

Enabling technology? Try ubiquitous technology. Six Startup Challenge finalists pitch their hardware solutions for transformational B2C and B2B products. Expect to see amazing ideas in quantum computing, imaging and communication in hostile environments, optical fabrication, spectroscopy, and advanced manufacturing. Numerous multi-billion dollar industries are being transformed by photonics in innovative ways; join your colleagues for a view of the future.

### Deep Tech—Pitch Review

3:30 PM - 4:00 PM

Expert analysis of the pitches, the markets they represent, and prospects for growth in this area.

Awards Ceremony for the Startup Challenge follows immediately.

## SPIE Startup Challenge: Awards & Reception

4:00 PM - 5:00 PM

Awards for the winners of the Healthcare and Deep Tech Startup Challenge will be presented by SPIE President John Greivenkamp and representatives of the SPIE Startup Challenge sponsors.

A reception and winners celebration concludes the event. Stay after and network with the winners, judges, and VCs.

[SPIE.ORG/STARTUP](http://SPIE.ORG/STARTUP)

# BIOS EXPO INDUSTRY STAGE



## Expo Industry Stage

Take time to attend the industry sessions on the exhibit floor during BIOS Expo and the Photonics West Exhibition. These sessions will showcase the latest developments in a wide range of topics from Photonics in Healthcare to Lasers in Manufacturing.

*Free for all attendees*

TIME	EVENT	PAGE
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<b>Saturday 1 February 2020</b>		
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12:00 PM – 1:00 PM	Lunch & Learn: Equity in Industry	p. 57
1:30 PM – 2:00 PM	Healthcare Keynote	p. 57
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<b>Sunday 2 February 2020</b>		
10:15 AM – 12:00 PM	Photonics in Healthcare	p. 58
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<b>PHOTONICS WEST INDUSTRY STAGE</b>		
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<b>Wednesday 5 February 2020</b>		
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<b>Thursday 6 February 2020</b>		
10:15 AM – 10:45 AM	Industry Update: Trends and Outlook	p. 63
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12:00 PM – 1:00 PM	Lunch & Learn: Diversity in the Workplace	p. 63

## Advances in Optical Coherence Tomography

Saturday 1 February 2020 • 10:30 AM - 12:00 PM  
Location: Industry Stage, Hall DE (Exhibit Level)

### OCT NOW: ADVANCED COMPONENTS AND BOUNDARY-BUSTING APPLICATIONS

Now in its third decade of development, optical coherence tomography (OCT) is proving its power as an imaging technique with a growing list of applications in biomedicine. Extensive development activity is driving continued advances and fueling healthy growth (at a compound annual rate of almost 9% since 2018) in a global market projected to reach \$1.5 B by 2023. This growth seems likely to continue as acceptance of OCT becomes more widespread and novel developments increase its ability to enable researchers and practitioners to produce important outcomes for patients. This session will look at novel system design, improved capabilities, and applications in ophthalmology, otology, cardiology, and more, along with the technological advances that are enabling OCT innovation.

Join us to hear about some of the leading advances in OCT, with unique insight from industry experts on this fast-evolving technique.



**CHAIR:**  
**Barbara Gefvert**  
Editor-in-Chief, *BioOptics World* (USA)

**SPEAKERS:**

### OPHTHALMIC OPTICAL COHERENCE TOMOGRAPHY - TRANSFORMING PATIENT CARE



**Tilman Schmall**  
Scientist, Carl Zeiss Meditec (USA)

In this talk we examine how OCT continues to transform patient care by ever increasing imaging speed, imaging depth and image quality. With fields of view approaching that of ultra-wide field fundus cameras and OCT Angiography providing non-invasive capillary contrast, optical coherence tomography systems have become versatile ophthalmic diagnostic tools indispensable in everyday clinical practice. We provide an overview of state of the art ophthalmic OCT and point out directions for how future OCT systems will continue to revolutionize eye care.

### THROUGH THE CURTAIN: OCT-ENHANCED EAR EXAMS REMOVE THE GUESSWORK



**Ryan Shelton**  
Co-founder & CEO, PhotoniCare (USA)

This talk presents a re-engineering of OCT technology for production of a handheld tool that for the first time enables objective, quantitative, and non-invasive assessment of middle ear infections, the leading cause of hearing loss, surgeries, and antibiotic use in children. The current gold standard has an accuracy of only 50%, resulting in poor outcomes and treatment strategies. PhotoniCare's OCT-enabled TOMi Scope is the only technology that looks directly at the disease, showing potential as a vast improvement over the current standard of care. The presentation will discuss device design and operation, as well as potential for further development.

IMPROVING CARDIAC OUTCOMES WITH PHOTONIC IMAGING



Barry Vuong

Senior Scientist / Engineer, SpectraWAVE Inc., (USA)

High-resolution visualization of coronary plaques using intravascular optical coherence tomography (IVOCT) has been proven to be a powerful tool to improve stenting, and may assist in vulnerable plaque detection. However,

identification of potentially vulnerable lipid core- plaques is difficult with IVOCT and/or standard of care tools.

In April, 2019, the FDA approved a near-IR spectroscopy (NIRS) device for the detection of high risk coronary plaques. SpectraWAVE is using telecom inspired fiber optic components and systems to add NIRS to IVOCT in a single compact and affordable new instrument. This combined technology provides simultaneous information about the microstructure and composition of coronary plaques permitting improved stenting and detection vulnerable plaques.

AFFORDABLE OCT IMAGING



Adam Wax

Founder & Chief Science Officer, Lumedica (USA)

This presentation reveals the work—including engineering, development and distribution—to make OCT affordable for researchers and educators, clinicians, and OEMs. It briefly reviews operation of the technology, applications, commercial outcomes, and potential future directions.

ADVANCED COMPONENTS AND SUBSYSTEMS FOR NEXT-GENERATION OCT



Shahid Islam

Lead VCSEL Applications Scientist, Thorlabs, Inc. (USA)

For the last two decades, Thorlabs has delivered novel, reliable and application-oriented components to the OCT community. This talk provides a summary of recent progress at Thorlabs with emphasis on MEMS-VCSEL light source technology for sweep-mode switchable kHz-to-MHz A-scan rate OCT and meter-depth range imaging, efforts towards miniaturization and cost reduction of OCT components and systems, and new OCT research applications. It will discuss how these advances enable next-generation OCT for OCT researchers and developers, for original equipment manufacturers (OEMs), and for application end users without detailed knowledge of OCT.

Lunch & Learn: Equity in Industry

Saturday 1 February 2020 • 12:00 PM - 1:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

This panel will seek to highlight the way that seeking equity in pay, treatment, and status can be affected at different points in one's career. Ideally, we would like to have 3 - 4 panelists at different career stages in industry, specifically biomedical industry since we are hosting this on Saturday which is during BIOS

First 50 to attend will receive a free boxed lunch.

SPEAKERS:



Mary Lou Jepsen

Founder of Open-water and former exec at Google and Facebook (USA)



Simi George

Senior COE Leader at AXA (USA)



Shahida Imani

CEO of Chromacity (United Kingdom)

Healthcare Keynote

Saturday 1 February 2020 • 1:30 PM - 2:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

"Engineering the Future of Health" - Dr. Bruce Tromberg will kick off this session on translating laboratory science and engineering in healthcare into both positive patient outcomes and viable businesses.



KEYNOTE:

Bruce Tromberg

Director of the National Institute of Biomedical Imaging and Bioengineering (NIBIB) at the National Institutes of Health (NIH) (USA)

Healthcare Founders Panel

Saturday 1 February 2020 • 2:00 PM - 3:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Advances in healthcare are increasingly enabled by optics. Join founders of growing startup companies in the Healthcare space for a discussion of the current challenges and opportunities in the healthcare landscape. Whether you are looking for a perspective on prototype testing, patient trials, regulatory hurdles, or just plain market traction, you will get valuable insights from these successful founders.



MODERATOR:

Farzin Samadani

National Instructor for NSF I-Corps Program (USA)

PANELISTS:



Brit Berry-Pusey

Founder, Avenda Health (USA)



Oliver Hvidt

CEO and Co-founder, NorLase (Denmark)



Ryan Shelton

CEO and Co-founder, PhotoniCare (USA)



Adam Wax

Founder & Chief Science Officer, Lumedica (USA)



Christy Sheehy

Founder and CEO, C. Light Technologies (USA)

## BIOS EXPO INDUSTRY STAGE

### Healthcare Investors Panel

Saturday 1 February 2020 • 3:15 PM - 4:15 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Investors in healthcare companies have a tolerance for the risk of long timelines and health efficacy and safety evaluations. Hear from active investors what they look for in a healthcare company to fund and how founders can improve the outcomes of their business.



MODERATOR:

**Farzin Samadani**

National Instructor for NSF I-Corps Program (USA)

PANELISTS:



**Faz Bashi**

Venture Affiliate Partner, Boston Millennia Partners (USA)



**Nick Mourlas**

Sr. Director New Ventures, Johnson & Johnson Innovation (USA)



**Todd Merchak**

Program Specialist at National Institutes of Health, National Institutes of Health (USA)



**Kerry Rupp**

General Partner, True Wealth Ventures / NSF I-Corps (USA)

### Photonics in Healthcare

Sunday 2 February 2020 • 10:15 AM - 12:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Photonics-based methods are helping to meet the increasing worldwide demand for rapid, accurate, personalised and cost-effective healthcare interventions – including imaging, diagnostics and therapy. Biophotonics is also instrumental to the analysis of processes at the molecular level, enabling a greater understanding of the origin of diseases, and hence allowing prevention and new treatments.

Attend this session to learn from industry experts as they discuss topics that include the selection and optimisation of image sensors specifically for medical imaging applications, fluorescence and spectral methods for image-guided surgery, fiber-based solutions for medical imaging, the use of acousto-optic elements for advanced microscopy, and the role of photonics in manufacturing of cell-based therapies.



CHAIR:

**Tom Harvey**

Healthcare Photonics Lead, CPI Centre for Healthcare Photonics (United Kingdom)

SPEAKERS:

#### MAKING THE INVISIBLE VISIBLE WITH MULTISPECTRAL AND FLUORESCENCE IMAGE-GUIDED SURGERY



**Richelle Hovelling**

Manager Research & Trials, Quest Medical Imaging (The Netherlands)

The prism-based imaging technique of the Quest Spectrum surgical platform enables surgeons to create contrast between biological tissues that are indistinguishable with the naked eye. The contrast in fluorescence image guided surgery is created by using fluorescent tracers to visualize biological structures. Due to the imaging in the near-infrared, just outside the spectrum visible to the human eye, the system can provide information for tumor localization or tissue per-

fusion, to give the surgeon real-time information and to improve their decision-making-process during open and minimal invasive surgery. Insight into the prism-based camera system for medical imaging will be given together with an overview of the current and future applications of fluorescence and (multi)spectral image-guided surgery. Case examples will be used to demonstrate the impact of these imaging techniques in the medical field.

#### IMAGE SENSORS FOR MEDICAL APPLICATIONS – SPECIFIC NEEDS AND APPLICATIONS



**Stefan Beyer**

Manager Product Development Medical Applications, Berliner Glas (Germany)

Image sensors belong to the core components in many medical devices such as endoscopic and intraoral cameras. However, the leading sensor manufactures target high volume applications with specifications which are often different from the requirements in medical applications. Tailored solutions for medical devices are often produced in lower quantities having special demands regarding the optic design, spectral response and size. The presentation gives an overview on aspects for sensor choice and enhanced functionality. Emphasis is put on the chief ray angle design of micro lens arrays in CMOS sensors and options to replace protective windows by customized coated windows. A high precision alignment tool for multi-chip camera systems is presented and some aspects for sensor alignment will be presented.

#### DO DIM THINGS: WHY LOW LIGHT IMAGING CAPABILITIES ENABLE ADVANCES IN RESEARCH AND MEDICINE



**Stephanie M. Fullerton**

Life Science Marketing Manager, Hamamatsu Corporation (USA)

The past decade of camera development ushered in a new era of low light imaging that was previously unfathomable. EMCCDs enabled the first precision localization super resolution experiments. These cameras, along with highly sensitive PMTs, were part of the story of the 2014 Nobel Prize in Chemistry. From EMCCDs we progressed to scientific CMOS. These cameras are now the workhorse for PCR, digital pathology whole slide imaging and low-cost gene sequencing. As the go-to technology for almost every advanced microscopy technique, they are applied to elucidating the inner workings of cells, the connectivity and activity of the brain, the mysteries of embryogenesis and the pathology of disease. As research progresses and optical designs become refined, the technical advances in the lab will make their way into the clinic, both as data-driven treatments and diagnostic instruments. Understanding what CMOS, and particularly low noise scientific CMOS, brings to the table for imaging is beneficial to every investigator since this insight may stimulate new ideas for previously untestable questions and undeveloped devices.

#### THE USE OF ACOUSTO-OPTICS IN ADVANCED MICROSCOPY



**Andrew Robertson**

Senior Vice President, Gooch & Housego (United Kingdom)

High resolution, confocal microscopes illuminate their object with laser beams. Instead of recording the whole image in one step, these microscopes scan the object point by point. High end instruments operate with multiple lasers & wavelengths and some versions now utilise supercontinuum sources. The need to carefully control both the illumination, reflection and any generated fluorescence signals is critical. Acousto-optics provides the capability of very rapidly manipulating the wavelength and amplitude of light through the interaction of acoustic waves with laser light within acousto-optic crystals in a completely electronic manner. Acousto-optic deflectors can also be ar-

ranged and driven to enable the rapid focus and tilt of optical wavefronts, enabling high-speed 3D random access microscopy. The potential to be able to combine continuous axial and lateral scanning using acousto-optics enables line scanning in any direction at high speed and the scan can be aligned to match biological structures. The wide use of acousto-optics in modern high resolution, advanced microscopy is discussed.

### THE DIGITAL TWIN: A CALL FOR NEW SENSORS FOR BIOREACTORS



**Paul C. Goodwin**

Science Director,  
GE Healthcare, Life Sciences (USA)

A bioreactor is vessel for large-scale biological reactions. The bioreactor must provide for the complete nourishment, gas exchange, temperature control, and homeostasis that would normally be provided by a complete organism. Most current bioreactors provide for relatively basic sensing and control of the cell culture medium. Common sensors include temperature, pH, and dissolved oxygen and most control systems regulate temperature, pH and gas exchange through PID (Proportional-Integral-Derivative) control. A number of studies have demonstrated that improved cell viability and production can be achieved by more thorough sensing and modelling of the bioreactor system. Improvements in sensors, complex system modelling, and control technology create an opportunity for improved bioreactors capable of delivering consistent, predictable results even in complex culturing conditions like the autologous cell cultures required for cell-based therapies such as immunotherapy and regenerative medicine. To this end, GE is developing new modelling methods to understand not only average batch regulation but complete modelling of individual batches. This modelling of every batch we refer to as the Digital Twin. By creating a Digital Twin of the bioreactor, we will be able to improve both adaptive and predictive control of processes through in silico modelling to deliver improved outcomes for our customers.

### ADVANCED FIBER SOLUTIONS FOR BIOMEDICAL PHOTONICS IN THE 0.3-16 μM RANGE



**Viacheslav Artyushenko**

President,  
art photonics GmbH (Germany)

Review of the latest progress reached in specialty fiber optics of a broad spectral range: 0.3-16μm. The most advanced fiber solutions for minimal invasive laser medicine and biomedical diagnostics using IR-imaging and key spectroscopy methods will be presented with hot examples of new applications: multi-spectral tissue diagnostics to detect tumor margins for its surgery removal, minimal invasive laser angioplasty, inter-corporal InfraRed-imaging of tissue during RFA procedures in heart, etc. Spectral fiber sensing for label free analysis of tissue composition enables to differentiate malignant and normal tissue to secure minimal invasive, but complete tumor removal. Comparison of key spectral methods of Raman scattering, fluorescence, diffuse NIR-reflection & MIR-absorption spectroscopy was made to select the most specific, sensitive and accurate method or to combine them for tumor surgery navigation. Clinical examples of this approach will be presented for oral, colon and other organ cancers. Progress with new development of flexible cables for medical CO<sub>2</sub>- and CO-lasers will be presented describing comparison of PIR-fiber and Hollow Waveguide based cables to enable the possibility to develop new smart laser medical systems.

### HOW HYPERSPECTRAL SENSING TECHNOLOGIES CAN HELP ENABLING WEARABLES FOR HEALTH DIAGNOSTICS



**Ward van der Tempel**

Co-founder and Product Director,  
Spectricity (Belgium)

In the past decade we have seen several wearables introduced that can measure certain health-related parameters.

Fitness wearables and skin patches that monitor optical heart rate, for instance are readily available. Significant advances have also been made on integrating heart rate variability and ECG measurements into smart watches. Other important health-related parameters, however, cannot yet reliably be integrated into a wearable device. Continuous measurement of oxygen saturation with medical grade accuracy at parts of the body other than the finger or ear lobe, for example, is not available from a wearable. Similarly, skin hydration measurement is not yet available in a wearable device. In this presentation we will explain recent advances in using hyperspectral sensing to measure parameters such as oxygen saturation and skin hydration for integration into small wearables. Actual results will be shown on Spectricity's optical sensors with a size of only a few square mm. We will explain how this patented CMOS hyperspectral filter technology can help with the manufacture of really compact patch and strap wearables that should be able to measure oxygen saturation and skin hydration with medical grade accuracy.

### Lunch & Learn: Managing Unconscious Bias

Sunday 2 February 2020 • 12:00 PM - 1:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Join us for a one-hour session on how to manage unconscious bias and share ideas with others in the community. First 50 to attend will receive a free boxed lunch.

### Artificial Intelligence in Medical Imaging

Sunday 2 February 2020 • 1:30 PM - 4:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Artificial Intelligence / deep learning is a modern machine learning approach that has seen tremendous innovation in the last few years. Specifically, it has revolutionized the field of computer vision—making practical technologies out of what seemed like science fiction just a few years ago. There is a general sense of optimism that these same technologies may be fruitfully applied in medical imaging to improve accuracy and efficiency of reading services.



SESSION CHAIR:

**Kyle Myers**

U.S. Food and Drug Administration (USA)

SPEAKERS:



**AI-AIDED BREAST CANCER DIAGNOSIS:  
FROM LAB TO PRODUCT**

**Maryellen Giger**

Professor of Radiology/Medical Physics, University of Chicago, and Co-founder Quantitative Insights, recently sold to Paragon Biosciences as Qlarity Imaging (USA)



**HEARTFLOW: AI FOR DIAGNOSIS AND  
PLANNING TREATMENTS FOR HEART DISEASE**

**Charles A. Taylor**

CTO, HeartFlow (USA)



**APPLICATIONS OF ARTIFICIAL INTELLIGENCE  
TECHNOLOGY ON NEUROLOGY**

**Myungjae Lee**

Executive VP and Chief Strategy Officer, JLK Inspection and CEO of FLIFEX. (Korea and USA)

PANEL TO FOLLOW

# PHOTONICS WEST INDUSTRY STAGE

## Photonic Integration Forum

Tuesday 4 February 2020 • 10:30 AM - 12:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Growing bandwidth and storage demands in data centers, cloud computing, and communications networks are pressuring incumbent technology for data handling, switching speeds, scalability, energy consumption, and cost, motivating the scale-up of optics and integrated photonics deeper into systems.

Optical networking components based on integrated photonics and wafer-scale processing will cut cost and energy, boost speed, and allowing architects to redesign servers, connections, racks, and data centers that move data at lightspeed. Applications of photonic integrated circuits are now spreading innovation beyond optical networking toward computation and into market segments including healthcare, the internet of things, and sensing.

Learn from industry leaders at the forefront of photonic integration as they share expert perspectives on the commercialization of photonic integrated circuits using materials spanning silicon photonics, silicon nitride, polymers, and indium phosphide integration platforms – and their emerging applications.



MODERATOR:

**Peter Hallett**

Director of Marketing and Industry Relations,  
SPIE (USA)

SPEAKERS:



**Sylvie Menezo**

CEO & CTO,  
Scintil Photonics  
(France)



**Philippe Absil**

3D and Optical  
Technologies  
Department Director,  
imec (Belgium)



**Michael Hochberg**

CTO,  
Elenion (USA)



**Peter De**

**Dobbelaere**

Vice President of  
Engineering  
Luxtera (USA)

## Lunch & Learn: Creative, Inclusive Cultures

Tuesday 4 February 2020 • 12:00 PM - 1:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Join us for a one-hour training on how to create a more inclusive culture and promote a safe environment for sharing ideas. First 50 to attend will receive a free boxed lunch.

## Building an Industry: The Commercialization of Quantum Technology

Tuesday 4 February 2020 • 1:30 PM - 4:30 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Commercial applications of quantum technology are projected to create a market exceeding \$40 billion in global revenues by 2044. Areas of emerging opportunities include imaging, secure communications, simulation, navigation, timekeeping, and computing to name a few. This potential is attracting huge investment from both government and industry. State-funded investment initiatives total more than \$8 billion worldwide, while industry investment includes both major corporations like Honeywell, IBM, Intel, and Alibaba as well as SMEs and startups. Private investment in quantum technology is also soaring, with venture capital spending in 2019 of more than \$250 million and the creation worldwide of tens of startup companies hoping to exploit the technology.

Attend this half-day forum and find out more about the industrial applications of quantum technology and where the industry stands. How do industry leaders address the challenges of commercializing quantum technology-based solutions?

Learn from expert speakers who share their perspectives on development of quantum-enabled applications and products, as well as the creation of an ecosystem that facilitates supply chain development.



MODERATOR:

**Stephen G. Anderson**

Director, Industry Development,  
SPIE (USA)

SPEAKERS:

### THE INDUSTRY QUANTUM CONSORTIUM (QED-C) ONE YEAR IN



**Joseph S. Broz**

Executive Director and Governing Board Chairman, The  
Quantum Economic Development Consortium (QED-C),  
and Vice President, SRI International (USA)

This talk will focus on the progress made by the QED-C in its first year of operation, and highlights from the quantum industry.

### THE QUANTUM-ENABLED INDUSTRY IN THE UK: A VISION FOR THE FUTURE



**Sara Diegoli**

QuantIC Programme Manager, QuantIC; Strategic Projects  
Manager, University of Glasgow (United Kingdom)

QuantIC was one of four Quantum Technology Hubs funded as part of the UK National Quantum Technology Programme.

Launched in December 2014 by the UK Government, the UK

National Programme aims to accelerate the commercialization of quantum technologies for the benefit of the UK economy and society. One of the first national investments in this field, the UK QT Programme has brought together academia, government and industry to achieve a common goal, establishing a new model to stimulate bottom-up technology-driven innovation. The UK Programme has been emulated by other initiatives across the globe and the international competition is intensifying. Half-way into the delivery of our ten-year vision, we reflect upon the journey so far and present an ambitious vision for the future of a quantum-enabled industry in the UK.

COMMERCIALIZING QUANTUM CLOCKS & SENSORS



**Jamil Abo-Shaeer**  
CEO,  
Vector Atomic (USA)

Laboratory atomic sensors have transformative performance gains over conventional technologies. Optical atomic clocks now reach precision below 1 part in 10<sup>18</sup>. Despite a 25-year heritage, however, high-performance laser-based atomic devices have yet to transition to the real world. Size, power, cost, and reliability of laboratory devices is primarily driven by complexity of the laser system. Commercializing quantum sensors will require telecom-style laser integration and robustness. This is a significant challenge for several reasons: atomic sensors operate at diverse wavelengths (267-950 nm) and have more stringent power (>40 mW), linewidth (<1 MHz), and optical isolation (>50 dB) requirements than telecom lasers. This talk will cover applications for quantum sensors, critical challenges for commercialization, and efforts to address these challenges.

TUNNELING THROUGH BARRIERS TO QUANTUM COMMERCIALIZATION



**Mark Tolbert**  
CEO,  
Toptica Inc. (USA)

Laser sources have been noted as one of the greatest difficulties to allowing quantum commercialization. The path to compact, robust laser solutions enabling quantum growth is less a need for scientific development and more of one of industry standardization, collaboration, consolidation and investment. This presentation will focus on the obstacles related to faster commercialization of quantum and how those obstacle can be overcome.

QUANTUM ATOMIC COMMERCIALIZATION FOR RESEARCH AND DEPLOYED APPLICATIONS



**Maximilian A Perez**  
Director, Government Programs,  
ColdQuanta Inc. (USA)

As commercial market pull begins to take over from decades of quantum atomic technology push, engineering challenges become increasingly clear. As a leader in the commercialization of quantum technologies for both deployed and research applications, ColdQuanta has responded to the very different needs of the two spaces. Size, weight and power reduction is critical for most deployed applications. In these cases, ColdQuanta has focused on the volume reduced of critical component and subsystem technologies, especially vacuum and optical. In research applications, flexibility and performance is the key to finding a commercial niche. Here ColdQuanta has focused on adapting technologies to the unique needs of quantum researchers and developers. To accommodate both markets, ColdQuanta has taken a two-pronged approach to quantum system commercialization with compact systems using specialized user interfaces for well-defined applications and larger quantum instruments with flexible interfaces for research application.

Lasers in Manufacturing

Wednesday 5 February 2020 • 10:00 AM - 12:00 PM  
Location: Industry Stage, Hall DE (Exhibit Level)

In today's advanced manufacturing arena the role of laser-based solutions continues to gain ground. The ever-growing range of laser-based manufacturing solutions includes additive manufacturing, laser-based micromachining, welding and cutting to name a few. Other advances include developments like sources that are tailored to a specific application. To remain competitive in this environment, manufacturers must also embrace adjacent technologies such as computing, robotics, and automation as well as materials development.

This session will explore the current state of laser-based manufacturing and likely future developments. Listen to industry experts share their views about the current state-of-the art in laser-based manufacturing.



CHAIR:  
**Michelle L. Stock**  
President, MLStock Consulting (USA)

SPEAKERS:

HIGH POWER AND HIGH PRECISION LASER MANUFACTURING FROM UV TO IR: STATE OF THE ART AND FUTURE CHALLENGES



**Arnold Gillner**  
Department Manager Micro Technology,  
Fraunhofer-Institut für Lasertechnik (Germany)

Laser manufacturing with laser cutting, welding, drilling, additive processing and many other processes is an important part of current production technology. With the development of new laser sources with adapted wavelengths and pulse durations higher productivity and higher precision can be achieved for many applications in automotive industry, electronics, medical industry and others. Lasers as a fully digital technology approach allows not only mass production but also single part production with highest efficiency and quality. Even more, with the use of AI-based process control a fully digitized process chain can be achieved.

LASER BASED FMM SOLUTION FOR HIGH RESOLUTION OLED DISPLAY



**Chi-Woo Kim**  
President,  
APS Holdings (Korea)

Manufacturing fine metal mask (FMM) is one of the biggest hurdles to realize UHD grade AMOLED displays for smartphone and augmented reality (AR). We have developed the state-of-the-art material and processing technology to achieve 800ppi or higher resolution FMMs. The Invar thinning and the thermal damage-free laser ablation process realized us achieving the FMM for UHD displays.

ELECTRIC VEHICLES - ENABLING THE CHANGE WITH THE USE OF LASERS



**Anthony Prugar**  
Region Sales Manager / Industry Manager eMobility,  
TRUMPF (USA)

The automotive industry is nearing an inflection point as eMobility disrupts what has been the standard for over 100 years. Shifting consumer attitudes, improved battery economics and positive regulation have led to huge investments in electrification by OEM's and tiered suppliers in which lasers will play a critical role.

# PHOTONICS WEST INDUSTRY STAGE

## ADVANCED METAL PROCESSING ENABLED BY FIBER LASERS WITH PROGRAMMABLE BEAM QUALITY



### Dahv Kliner

Vice President of Fiber Laser Technology, nLIGHT (USA)

Different materials processing applications require different laser spot sizes, divergences, and beam shapes. Conventional lasers have fixed beam properties, and available approaches to varying the beam increase system size, cost, and complexity and/or degrade performance and reliability. Most tools thus employ a fixed-beam laser, resulting in nonoptimized performance, lack of manufacturing flexibility, or the requirement to purchase multiple tools. A new fiber laser, Corona, provides rapidly tunable beam characteristics directly from the output fiber using an all-fiber mechanism. Corona's broad range of beam sizes and shapes and real-time programmability enable adjustments on-the-fly and optimization of each process step. Results for metal cutting and welding will be presented.

## Lunch & Learn: Growth Mindset Leadership

Wednesday 5 February 2020 • 12:00 PM - 1:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Join us for a one-hour session on how to employ a growth mindset to enhance leadership skills. First 50 to attend will receive a free boxed lunch.

## Photonics Mobility Forum

Wednesday 5 February 2020 • 1:30 PM - 4:30 PM

Location: Industry Stage, Hall DE (Exhibit Level)

This session highlights the growing role of optics and photonics in today's autonomous systems marketplace. Photonics-based sensing--such as forward- and rear-facing cameras (IR and visible), lidar, and sensor fusion--is essential to autonomous mobility. Other relevant optical technologies include adaptive lighting based on LEDs or lasers, light-based communications (Li-Fi), advanced displays, and in-cabin monitoring.

Attend this half-day forum to learn from industry experts about the opportunities and challenges presented by these emerging markets and how optical and photonics fits into the overall landscape of autonomous mobile systems.

Speakers will be asked to participate in a short panel for Q&A at the end of the session.



SESSION CHAIR:

### Markus Arzberger

Director of Product Management, OSRAM Opto Semiconductors (Germany)

SPEAKERS:

## AUTONOMOUS MOBILITY (CIS, FIR, LIDAR, RADAR, AI)



### Dimitrios Damianos

Analyst, Yole Développement (France)

Autonomous Driving (AD) is the current megatrend in mobility, changing drastically the traditional automotive landscape and business models. There are two ways that

AD can be accomplished:

- The ADAS way: traditional car makers which sell cars for the grand public that will keep increasing their level of autonomy (LV 1-2-3-4-5), at an affordable cost; currently they are at LV2.

- The robotic car way: companies that do not manufacture cars but have other business models and challenge conventional auto-makers by offering fleets of already fully autonomous cars (corresponding to ADAS LV4 or LV5). These are expensive for the average consumer to own and will be used as a service (robo-taxis); the so-called Transport as a Service (TaaS).

In order for AD to be accomplished, various sensors must be used in cars: CIS, FIR, LIDAR, Radar. Additionally, for the tremendous amount of data gathered from these sensors, proper computing platforms (AI) are needed to make sense of the information.

In this session, the relevant market data and forecasts will be analyzed for the aforementioned sensors and computing platforms as well as a global overview of the business will be outlined.

## TAKING MACHINE PERCEPTION BEYOND 3D



### Mehdi Asghari

Founder and CEO, SiLC (USA)

In this talk we will review different 3D imaging technologies and discuss the merits and challenges of a coherent approach. In particular, integration of a 1550 nm FMCW

architecture in silicon photonics will be detailed, together with some recent progress in the area.

## PHOTONIC INTEGRATED CIRCUITS FOR LIDAR



### Marcus Dahlem

Principal Member of Technical Staff, imec (Belgium)

Emerging LiDAR systems focus on reducing their dependence on mechanical scanning devices. Over the past years, optical phased arrays (OPAs) have gained visibility for this application. In this talk, we present an overview of automotive LiDAR systems (ToF and FMCW) and the building blocks required for their enablement through OPAs. In that perspective, we focus on imec's developments of industrial-grade integrated photonic platforms (Si/SiN) to support on-chip optical beamformers. In particular, we demonstrate 2D beam steering enabled by wavelength sweeping and phase shifting. We address all devices and platform metrics specific to OPAs for LiDAR (e.g. coherence length or phase errors), and present recent progress on laser integration, low-power phase shifters (e.g. liquid crystal and thermal), as well as on-chip calibration schemes (e.g. integrated detectors and compact interferometers). These building blocks are key enablers of compact and low-cost solid-state LiDAR systems.

## DRIVING AUTONOMY- CHALLENGES AND REWARDS



### Robert Baribault

Principal Architect, System Architecture LeddarTech (Canada)

In this session, we will open the door to the factors that influence the roadmap to autonomous vehicles. We will explore the challenges in technology, the automotive industry and society, and provoke thoughtful solutions that will inevitably lead to rewards both for society and industry.

## THE EVOLVING BIFURCATION OF LIDAR TECHNOLOGY IN ADAS AND AV VEHICLES



### Rajeev Thakur

Director Automotive Programs Velodyne Lidar (USA)

The automotive industry is increasingly cognizant of the different value propositions that LiDAR technology offers for autonomous vehicles (L4/L5) and vehicles with Advanced

Driver Assistance Systems (ADAS). The value of lidar in ADAS still remains

to be tapped – even though the technology is available and mature. The AV market continues to march on with lidar offering the range and resolution that it is uniquely suited to provide. This presentation makes a case for recognizing the current value of lidar in ADAS and clarifying the different requirements for lidar in AV Vs ADAS and the challenges faced in the eco-system. The presentation also shines a light on the role of NCAP standards in guiding the industry.

LASER LIGHT SOURCES MOBILITY APPLICATIONS



Paul Rudy
Co-Founder, CMO and SVP of Business Development,
SLD Laser (USA)

We provide a description on the rapidly expanding capabilities of laser light technology, including bright, safe, precision illumination sources with the ability to sense and communicate. Specifically, we describe recently commercialized UL certified white light sources with more than 10x the brightness, range, and beam contrast compared to LEDs. Additionally, we describe novel fiber delivered and fiber emissive light sources, with elegant maintenance and enhanced thermal management, as well as spatially dynamic beam spot-light control, enabling high precision beam shaping. Lastly, we present on recent demonstrations of laser light capability that deliver more than 20 gigabit per second data rates for LiFi communication applications from safe white light spotlights, as well as sources that enable precision 2D and 3D sensing. Such laser light sources have applications in mobility applications including automotive, avionics, drones, rail, and marine applications.

Industry Update: Trends and Outlook

Thursday 6 February 2020 • 10:15 AM - 10:45 AM

Location: Industry Stage, Hall DE (Exhibit Level)



SPEAKER:
Stephen G. Anderson
Director, Industry Development,
SPIE (USA)

Stephen Anderson, SPIE Industry Development Director will present an update of the core optics and photonics components industry profile from SPIE including the most recent data for 2018 and projections for 2019. This in-depth study of the core optics and photonics components industry examines recent industry performance and provides insight on current trends and the outlook into 2020.

Based on a multi-year evaluation of more than 3,000 companies in over 50 countries, this global industry profile has become a key resource for investors, business leaders, and government representatives who need a clear picture of the worldwide photonics industry, its size, and economic impact. The SPIE industry profile has found use supporting business strategies, guiding investment decisions, and in the development of national policies to drive funding, business success and economic growth.

Public Policy Update: Export Control, Advocacy, and More

Thursday 6 February 2020 • 10:45 AM - 11:15 AM

Location: Industry Stage, Hall DE (Exhibit Level)



SPEAKER:
Jennifer Douris O'Bryan
Director, Government Affairs,
SPIE (USA)

Jennifer Douris O'Bryan, SPIE Government Affairs Director will provide an update on advocacy and public policy issues affecting the optics and photonics community, both in the U.S. and internationally. Her presentation will address, for example, regulatory changes

that could affect growth in emerging fields of technology, impact of the trade war between the U.S. and China, and new CFIUS Export and foreign investment policy requirements for foreign investment.

Jennifer has extensive experience working with members of the U.S. Congress, where she has advised on technology, defense, and appropriations policy. She also works closely with industry representatives to develop proposals to make needed changes to international export control regulations through submission to the Wassenaar Arrangement. Jennifer is currently Chair of the Sensors and Instrumentation Technical Advisory Committee (SITAC) within the US Department of Commerce.

Prism Awards Winners Panel

Thursday 6 February 2020 • 11:30 AM - 12:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Come hear from past Prism Award winners and a surprise 4th panelist—who just learned the night before that they won!

Hear how these winning companies developed innovative products and successful teams, along with other fun stories.



MODERATOR:
Pamela Robertson
Industry Program Manager,
SPIE (USA)

PAST WINNERS AND PANELISTS:



Dahv Klinner
VP, Fiber Laser
Technology at
nLIGHT,
2019 Winner (USA)



Paul Rudy
Co-Founder,
CMO and SVP of
Business Development,
SLD Laser,
2018 Winner (USA)



Michael Withford
Co-Founder and
CEO of Modular
Photonics,
2019 Winner
(Australia)



Christopher
Haimberger
Technology Manager,
TOPTICA Photonics,
2019 Winner (USA
and Germany)

Surprise panelist

2020 Prism Award Winner
(announced Wednesday evening, 5 February)

PRESENTED BY SPIE AND THE



Lunch & Learn: Diversity in the Workplace

Thursday 6 February 2020 • 12:00 PM - 1:00 PM

Location: Industry Stage, Hall DE (Exhibit Level)

Open to all registered attendees. No advance registration is required. First 50 to attend will receive a free boxed lunch.

Join us for a panel discussion on how to recruit, retain, and advance diversity in the workplace.

# INDUSTRY WORKSHOPS



## Industry Workshops

Take time to attend the Industry Workshops on Wednesday at Photonics West. These workshops are the perfect training ground to learn about a variety of topics, from the basics of lasers to How to Design Using OpticStudio. These sessions range from 30 minutes to full-day workshops.

*Free to attend*

TIME	WORKSHOP	PAGE
<b>Wednesday 5 February 2020</b>		
8:00 AM - 5:00 PM	Photodetectors, Light Sources and Spectrometers—Introduction and Future Technologies	p. 64
8:30 AM - 10:00 AM	Basics of Laser Material Processing	p. 65
8:30 AM - 12:00 PM	Latest Trends in Micro LED Displays Forum	p. 65
10:00 AM - 12:00 PM	How to Design and Package a Maksutov Telescope Using OpticStudio and a New Solution from Zemax	p. 66
10:30 AM - 12:00 PM	Optical Replication—A Cost-effective Method for Volume Production of Freeform Optics and Aspheres	p. 66
1:00 PM - 2:30 PM	Multi-Element Lens Design for Manufacturability	p. 66
1:30 PM - 2:45 PM	Diffraction/Metasurfaces: Seamless from Function to Structure Simulation in VirtualLab Fusion	p. 67
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## Photodetectors, Light Sources and Spectrometers—Introduction and Future Technologies

Wednesday 5 February 2020 • 8:00 AM - 5:00 PM

Location: Room 2004 (Level 2 West)

8:00 AM - 9:45 AM

### TOPIC #1 - INTRO TO PHOTODETECTORS



#### Slawomir Piatek

Technical Consultant (USA)

Abstract: Photodetectors are essential components in a vast array of modern scientific and commercial instruments and devices; technological progress will make them even more ubiquitous. Understanding their opto-electronic properties, regimes of operation, circuit requirements, and noise characteristics is essential to a practitioner to make a proper photodetector selection for a given application. The purpose of this presentation is to provide guidance in this process by discussing the above considerations for the four most common point photodetectors: photomultiplier tube, photodiode, avalanche photodiode, and silicon photomultiplier.

9:45 AM - 10:00 AM

### BREAK

10:00 AM - 11:00 AM

### TOPIC #2 - GENERAL IMAGE SENSORS & SPECTROMETERS



#### John Gilmore

Business Development Manager, Hamamatsu (USA)

Abstract: Part of this presentation's purpose is for attendees to understand the technology limits of image sensor solutions such as back-thinned CCDs, CMOS passive pixel with variable integration, CMOS active pixel sensors, and InGaAs image sensors. By knowing the detector technology, we can apply that to spectrometers to quickly assess instrumentation capabilities. There are many spectrometers on the market for various spectroscopy applications. In this presentation, you can learn what's unique about Hamamatsu spectrometers. We are not just a run-of-the-mill supplier; we are uniquely positioned to provide every aspect of spectrometer technology. Hamamatsu is well-known as a quality sensor (CCD, CMOS) provider, and now also for MEMS/MOEMS solutions including transmission gratings and nano-imprinted surface-enhanced substrates (SERS) and micro-spectrometers. We combine these unique technologies to manufacture portable Raman and other optical modules. To cover the NIR, many are turning towards MEMS-FPI tunable filters, the MEMS-FTIR engine, or compact InGaAs-based thin flat spectrometers, forming low-cost handheld spectroscopy solutions. We will introduce specialized products including the award-winning, grating-based micro-spectrometer (C12880MA) and the smallest grating-based spectrometer in the world, our new surface mount spectrometer (SMD series, C14384MA-01). We cover a broad spectral range from UV to NIR, and miniaturization and low cost modules are part of recent development themes at Hamamatsu. We will continue to work closely with customers, new and existing, and together we will create the spectroscopy solutions for the next generation.

11:00 AM - 12:00 PM

### TOPIC #3 THE FUTURE OF PHOTON COUNTING TECHNOLOGIES (FROM MPPC/SIPM TO SPPC/SPAD)



#### Koei Yamamoto

Director of Solid State and Laser Division Hamamatsu (USA)

Abstract: More than 10 years have passed since Hamamatsu started developing the MPPC, which is a part of the SiPM family. The most important feature is its photon counting capability due to its high gain and low noise, but the MPPC has many additional features such as compact size, low operating voltage, robustness, high detection efficiency, and immunity to magnetic fields. Over the years, various types of MPPC technology and devices have been developed for applications in academic research, precise measurement, medicine, and industry, for example. Our most successful developments include the MPPC coupled with a scintillator for high energy physics and for TOF-PET for cancer detection. Recent developments resulted in covering different wavelength regions such as VUV, VIS, and NIR, to make the MPPC suitable for a wider range of applications. Recently, there's been popular demand for NIR-enhanced MPPCs in distance measurement applications in the automotive industry. In addition to developing the detectors, Hamamatsu also developed ASIC, power supplies, and modules using these components to make it easy for customers to design their systems. In this presentation, we will discuss new devices we call "Hybrid MPPC SPAD." In these new devices, the 1D or 2D MPPCs are connected to specially-designed photon-counting ASICs through wire bonding or bump bonding. We also recently developed the 2D InGaAs MPPC with ASIC, which is an infrared-sensitive SPAD. Some of the modules will be introduced in this presentation.

Open to all attendees.

## INDUSTRY WORKSHOPS

12:00 PM - 1:00 PM

### LUNCH

1:00 PM - 2:15 PM

#### TOPIC #4 - A GUIDE TO THE COMPLEX WORLD OF LIGHT SOURCES



**Eric Mesa**  
Light Source Technical Engineer,  
Hamamatsu (USA)

**Mohamed Shahen**  
Laser Technical Expert  
(USA)

Abstract: Light-generating devices use many different technologies to generate light over a broad spectrum range and with varying characteristics. We discuss the main defining characteristics of devices that generate light such as wavelength, spectral width, temporal structure, and intensity, among others. After understanding the light characteristics necessary to help choose one device over another, attendees will learn about the different device technologies for light generation and will also understand the unique value as well as the limitations of each device type.

2:15 PM - 3:15 PM

#### TOPIC #5 - OVERVIEW OF MID-INFRARED (MIR) TECHNOLOGIES: MERITS, APPLICATIONS, AND NEW DEVELOPMENTS



**Gary Spingarn**  
MIR Marketing Engineer

**Naota Akikusa**  
Light Source Designer,  
Hamamatsu (USA)

Abstract: Mid-infrared measurements have recently become a hot topic in the photonics industry and for good reason: so much valuable information lies within materials' interactions with longer wavelengths. Capabilities and complexity have been huge roadblocks in the market, and this presentation will explain that things are beginning to change. Innovations have brought new, attractive options to the table for detectors and light sources alike. There will be a discussion of the advantages of mid-infrared techniques, some popular applications, and infrared devices such as detectors and semiconductor lasers.

3:15 PM to 3:30 PM

### BREAK

3:30 PM to 5:00 PM

#### TOPIC #6 - AUTOMOTIVE LIDAR: CONCEPTS, CHALLENGES, AND FUTURE OF PHOTONICS TECHNOLOGY



**Jake Li**  
Business Development Manager,  
Hamamatsu (USA)

**Koei Yamamoto**  
Director of Solid State and Laser Division,  
Hamamatsu (USA)

Abstract: The first part of the presentation will introduce different LiDAR concepts, mainly direct time of flight (TOF) and indirect TOF, frequency modulated continuous wave (FMCW). The discussion will focus on the benefits and challenges of different TOF or FMCW LiDAR concepts in the market today, the optical design challenges that are key drivers for development of each LiDAR concept, and the challenges of the industry moving from LiDAR concepts to future automotive production.

The second part of the presentation will continue the discussion in detail, specifically the optical challenges of TOF LiDAR concepts from a design perspective and how Hamamatsu plans to address these challenges through improvement of photonics technology. We will cover topics such

as the critical photonics components including photodetectors (Silicon or InGaAs APD, MPPC, and SPAD) and light sources (PLDs) for various LiDAR concepts. We will discuss the component level requirements and how to overcome challenges such as crosstalk, high NIR sensitivity, improving capacitance and noise, auto-grade packaging and customization. We will correlate how the technology improvements at the optical component level will help improve some LiDAR systems parameters, such as longer detection range, simplified circuit design, lower power consumption, and more.

#### Basics of Laser Material Processing

Wednesday 5 February 2020 • 8:30 AM - 10:00 AM  
Location: Room 2009 (Level 2 West)



INSTRUCTOR:  
**Jean-Philippe Lavoie**  
Coherent (USA)

Learn the basics of lasers and laser applications in this interesting and valuable workshop. This session is especially valuable to non-laser engineers and project managers who need to know what to expect from their laser systems.

- Discuss what happens when a laser beam hits a material
- Review process threshold and process window
- Discussions of how you can optimize a process. Including examples of marking and ablation / engraving or cutting
- Discussion around some common things that can go wrong
- Additional examples of successful laser applications

#### Latest Trends in Micro LED Displays Forum

Wednesday 5 February 2020 • 8:30 AM - 12:00 PM  
Location: Room 2007 (Level 2 West)

MicroLED was the latest tech buzzword a few years ago, but today it stands poised to be the next big thing in consumer electronics. Join this forum and get the latest on the trends in large, and small, displays.

PRESENTATIONS:



##### NEXT GENERATION MICRO LED DISPLAY TECHNOLOGY

**Falcon Liu**  
PlayNitride (Taiwan)



##### THE TRENDS OF MICRO LED TECHNOLOGY

**Fang Yen-Hsiang**  
Industrial Technology Research Institute (Taiwan)



##### APPLICATION OF ULED IN SMART HEADLAMP LIGHTING

**Jeffrey Li**  
Director of Applications  
Jasper Display (Taiwan)



##### LOW COST AND PRACTICAL TECHNOLOGY TO MANUFACTURE MICRO-LED DISPLAYS: SELF-ALIGN FLUIDIC ASSEMBLY

**Jong-Jan (JJ) Lee**  
Founder and CEO,  
eLux (USA and Taiwan)

Located in Moscone West, see maps pp. 5-6

## INDUSTRY WORKSHOPS

### How to Design and Package a Maksutov Telescope Using OpticStudio and a New Solution from Zemax

Wednesday 5 February 2020 • 10:00 AM - 12:00 PM  
Location: Room 2008 (Level 2 West)

INSTRUCTORS:



**Lisa Clauson**  
Associate Product Manager,  
Zemax, LLC (USA)



**Esteban Carbajal**  
Senior Opto-Mechanical Engineer,  
Zemax, LLC (USA)

Zemax enables optical design teams to design, communicate, and collaborate on building optical products right the first time. Optical engineers can continue to rely on OpticStudio for reliable and accurate calculations. With Zemax's new solution, CAD users can load the design with flawless and fast creation of CAD objects. They can package their design and perform stray light and interference checks with their mechanical components considered, and they can create an optical drawing within seconds. By maintaining the fidelity of the optical design throughout the design process, optical design teams can create a complete, reliable model of a product.

Learn how Zemax is improving the engineering design process for all members of an optical design team with OpticStudio and Zemax's new solution. This talk will provide awareness and understanding of the tools Zemax provides to streamline engineering design workflow and give time back to the engineers.

LEARNING OUTCOMES: In this workshop, we will demonstrate how to:

- Optimize a sequential design in OpticStudio for conversion to non-sequential mode
- Prepare the file for CAD
- Load an optical design into SOLIDWORKS
- Package your optics with accurate geometry
- Run a stray light analysis with optomechanical components
- Analyze, and validate your complete optomechanical design
- Create an optical drawing in seconds

SPONSORED BY:

**Zemax**

### Optical Replication—A Cost-effective Method for Volume Production of Freeform Optics and Aspheres

Wednesday 5 February 2020 • 10:30 AM - 12:00 PM  
Location: Room 2010 (Level 2 West)



SPEAKER:  
**David Cook**  
General Manager,  
Spectrum Scientific (USA)

Constraints in traditional manufacturing techniques have historically been a primary factor in the limited integration of freeform mirrors into optical systems. Non-diffraction limited usages such as energy distribution and illumination applications were predominant due to these constraints.

Now with state-of-the-art deterministic methods of optical manufacturing, it is possible to produce imaging quality aspheric and freeform mirrors. The optical replication manufacturing methods are successfully meeting the demands for large volume, high fidelity optical requirements. This workshop will explore the capabilities and advantages replication technologies offer for the production of freeform mirrors.

- Discussion of Freeform Optics and Optical Replication
- Advantages and Limitations of Using Freeform Optics
- Comparison of various current manufacturing methods
- Benefits of using optical replication techniques for high volume aspheric manufacturing
- Key Factors in the Design-to-Manufacturing-to-Metrology Relationships

SPONSORED BY:



### Multi-Element Lens Design for Manufacturability

Wednesday 5 February 2020 • 1:00 PM - 2:30 PM  
Location: Room 2009 (Level 2 West)



SPEAKER:  
**Katie Schwertz**  
Senior Design Engineer,  
Edmund Optics (USA)

This workshop will cover the challenges and best practices of designing manufacturable lens assemblies. Understanding the background of how a multi-element lens assembly is manufactured and assembled provides invaluable insights into details that should be taken into consideration in the design and tolerancing stages. Taking extra time early on to consider these details can improve performance and yield, while reducing costs in the long run.

SPONSORED BY:



## Diffractive/Metasurfaces: Seamless from Function to Structure Simulation in VirtualLab Fusion

Wednesday 5 February 2020 • 1:30 PM - 2:45 PM

Location: Room 2009 (Level 2 West)

INSTRUCTORS:



**Stefan Steiner**

LightTrans International UG (Germany)



**Site Zhang**

LightTrans International UG (Germany)

Both diffractive and metasurfaces are drawing growing interest in modern optics applications. They are defined as thin structured layers etched into or deposited onto a surface, usually a flat one. What distinguishes them are the characteristics of the surface building blocks: conventional gratings in the case of diffractive surfaces, metagratings for metasurfaces. By spatially varying the local grating parameters, the surface can be used to produce a smooth change in the incident wavefront phase, amplitude, polarization, or a combination thereof.

The design workflow of diffractive/metasurfaces can be briefly summarized as:

- 1) Functional (usually wavefront phase) design for the element (regardless whether diffractive or metasurface)
- 2) Analysis of the influence of the construction parameters of the structure building blocks (including metagratings)
- 3) Arrangement of spatially chirped gratings on the surface

VirtualLab Fusion, unlike most other optical simulation software, enables the complete workflow within a single software platform in a seamless manner. The functional design can be directly generated from VirtualLab Fusion, e.g., the in-built iterative Fourier transform algorithm (IFTA) helps define the initial grating phase transmission. Existing designs in binary 2 surface format from Zemax OpticStudio® can be imported as well. Then, the building block grating parameters can be rigorously analyzed and optimized with the in-built FMM, and be used to compose the whole surface. The designed diffractive or metasurfaces can be finally included in an optical system and one can perform a full physical optics simulation which accounts for all the electromagnetic effects occurring in the system.

LEARNING OUTCOMES:

- Rigorous analysis and design of conventional gratings as well as metagratings using FMM / RCWA.
- Transfer from wavefront phase (e.g. binary 2 surface in Zemax OpticStudio®) to diffractive/metalens structures.
- Fast physical optics modeling of system with diffractive/ metasurfaces including all electromagnetic effects.

INTENDED AUDIENCE: Optical engineers, designers, researchers and students interested in diffractive/metasurfaces and holographic optical elements (HOEs).

SPONSORED BY:



## Market Outlook & Implication for Sales & Marketing

Wednesday 5 February 2020 • 1:30 PM - 3:00 PM

Location: Room 2010 (Level 2 West)



INSTRUCTOR:

**Michele Nichols**

Launch Team Inc. (USA)

Join this session to learn drivers in the industries you serve, and how you can position your company and capabilities to meet the needs of emerging customer needs. Launch Team president Michele Nichols will address market outlook, regulatory and customer requirements that will impact sales and marketing, and today's winning strategies for companies from start-up to global market leaders. Bring your questions and specific challenges for actionable take-aways.

## Invention to Impact

Wednesday 5 February 2020 • 3:00 PM - 4:15 PM

Location: Room 2010 (Level 2 West)



SPEAKER:

**Anna Brady-Estevez**

Program Director for Blockchain, DAGs, Chemical, and Environmental Tech, National Science Foundation SBIR (USA)

Innovation programs at the National Science Foundation (NSF) advance ideas from the lab to the marketplace to strengthen America's economy, health, and security. The Division of Industrial Innovation and Partnerships (IIP) in the Engineering Directorate leads several programs to translate fundamental research into market solutions. IIP supports researchers with promising technologies, as well as funding high-tech startups. Learn about the NSF's central role in accelerating the growth of the national ecosystem and hear about specific funding opportunities.

SPONSORED BY:



## Key Legal Issues Facing the Optics Industry

Wednesday 5 February 2020

Time: 3:00 PM - 5:00 PM

Location: Room 2007 (Level 2 West)



SPEAKER:

**Kerry Scarlott**

BakerHostetler (USA)

Don't miss this important, and free, access to legal insight and information from this optics-background legal team. Bring your questions, from IP law to export control issues.

This session is aimed at both experienced entrepreneurs and those just starting out in the optics and photonics industry. The session will cover information that anyone must know while operating in this space. Bring your questions.

# INDUSTRY SPECIAL EVENTS



## Industry Special Events

Make time in the week for these special events. From a Laser Marketplace Seminar to the Prism Awards, these sessions will provide valuable information and networking opportunities for anyone looking for the latest industry insights, trends, and winning companies.

*Some events require a separate registration. See individual events for details.*

EVENT	REGISTRATION INFO	PAGE
<b>Global Photonics Markets Workshop</b>	Invitation only	p. 68
<b>Lasers &amp; Photonics Marketplace Forum</b> —new partnership with SPIE in 2020	Separate registration required	p. 68
<b>IMEC Healthcare Industry Forum—Photonics for Life Sciences</b>	Invitation only	p. 69
<b>Photonics Cluster Reception:</b> leaders from regional optics and photonics clusters are welcome	RSVP required	p. 70
<b>Women Executives Meet-Up:</b> talk shop, connect, and network	RSVP required	p. 70
<b>Optics and Photonics Technician Shortage: Solutions and Opportunities</b>	Space is limited. RSVP	p. 70
<b>Startup Challenge Finale and Awards</b>	Free to attend but RSVP	p. 70
<b>Prism Awards—</b> The "Oscars of Photonics"	Tickets required	p. 70

## Global Photonics Markets Workshop

Sunday 2 February 2020 • 2:00 PM - 5:00 PM

Location: Room 3000 (Level 3 West)

***This event is invitation only. If you are interested in attending, please email [stephena@spie.org](mailto:stephena@spie.org)***

If you are currently or have been involved in efforts to measure the size and impact of the photonics business activity in your region or country, attend this workshop to meet with and learn from your colleagues in other regions who are also involved in understanding the economic impact of photonics and the generation of key supporting statistics and analysis.

This workshop will provide a forum for sharing experiences and discussing the lessons learned from those who have done this before. You can learn directly from your peers ... What are the problems to expect? How did others solve them? What are the best practices? How best to leverage such analysis?

The discussion will range from tips about how to structure databases and source data, questions to ask in a survey, to running apportionment meetings and bigger debates such as whom to include in the industry and how to leverage such exercises for maximum impact.

The workshop will be led jointly by Stephen Anderson, Director of Industry Development at SPIE, and Dr. John Lincoln (Harlin Ltd & UK Photonics Leadership Group). Both have worked on sizing the photonics industry globally and regionally for the past six years.

## Lasers & Photonics Marketplace Seminar

Monday 3 February 2020 • 8:00 AM - 5:00 PM

Location: InterContinental Hotel, Grand Ballroom (3rd Floor)

***Registration for the Marketplace Seminar is handled separately by Laser Focus World: <https://endeavor.swoogo.com/lpms2020>***

Join us for the only executive-level event held in partnership with SPIE and part of the official Photonics West program. The 32nd Annual Lasers & Photonics Marketplace Seminar offers global photonics-industry executives, analysts, and investors market data, strategic insights, and guidance, with exclusive content and invaluable, high-level networking opportunities. The networking includes a breakfast, lunch and a high-profile post-Seminar reception.

This year SPIE has joined in partnership with Laser Focus World, which produces the Seminar, to provide even more understanding of the international business climate, trade challenges, investment flows, and emerging technology trends and opportunities.

Speakers and panelists range from senior executives at some of the largest photonics companies such as II-VI, Hamamatsu, MKS Instruments, and Trumpf, to CEOs of startups and technical experts in fast changing markets such as precision optics and VCSELs. Registration for the Marketplace Seminar is handled separately by Laser Focus World. View the agenda online.

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# INDUSTRY SPECIAL EVENTS

## imec Technology Forum (ITF) Photonics

Monday 3 February 2020 • 12:00 PM - 5:30 PM

Location: Marriott Marquis, Golden Gate B-C

*The event is invitation only. Email [innovation@spie.org](mailto:innovation@spie.org) to learn more.*

Artificial intelligence and cloud computing are driving an exponentially growing demand for optical interconnect bandwidth. From the datacenter network down to the chip level, silicon photonics is a prime technology to scale optical interconnects to the desired bandwidth density, power and cost.

But silicon photonics can enable applications far beyond datacenter interconnects. Think about biophotonics-on-chip, a relatively new research domain that will be very important for diagnostics, therapy and follow up. It will enable doctors to analyze tissue samples without having to use big (fluorescence) microscopes, and to study tissue samples without using big spectrometers. The key is to integrate optical circuits (out of silicon) with electronic ones. With these photonic-electronic hybrid chips, one can make revolutionary healthcare solutions with the main characteristic of being compact, smart, low-cost and easy to use.

Integrated optical spectral sensing solutions can benefit an even wider range of applications and markets, including precision agriculture, food analysis or colorimetric applications for industrial and consumer markets. ITF Photonics 2020 will focus on the versatility of integrated silicon photonics technology and on its potential for a broad variety of application domains - including cloud computing, data centers, artificial intelligence, healthcare, agriculture and food analysis.

### SCHEDULE:

1:00 PM - 1:30 PM:

**Coffee and Registration**

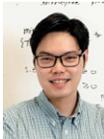
1:30 PM TO 1:50 PM:

**Opening and Welcome  
Bert Gyselinckx, imec (USA)**



### PHOTONICS ENABLING THE FUTURE OF AI

1:50 PM - 2:10 PM:



**Towards Chip-Based Quantum Cryptographic Devices  
Charles Lim, Assistant Professor of ECE and CQT, NUS (USA)**

2:10 PM - 2:30 PM:



**Silicon Photonics Technology for Scaling AI and the Cloud  
Philippe Absil, VP R&D, Head of the 3D and Silicon Photonics Technologies Dpt, imec (Belgium)**

2:30 PM - 2:50 PM:



**Next-Generation Micro-Photonic Transdermal Biosensor Technology for Main Biomarker and Monitoring  
Augustinas Vizbaras, CTO, Head of Chip & Sensor Technology, Brolis Sensor Technology (Lithuania)**

### PHOTONICS FOR IMAGING

2:50 PM - 3:10 PM:



**Low-Cost / High-Resolution, Small Pitch, Short-Wave Infrared Image Sensors and Systems**

**Pawel Malinowski, Program Manager User Interfaces & Imagers, imec (Belgium)**



**and  
Orges Furxhi, R&D Manager, Camera Systems and Computational Imaging, imec (Belgium)**

3:10 PM - 3:30 PM:



**How Hyperspectral Sensing Technologies Can Help Enabling Wearables for Health Diagnostics  
Carl Smets, CEO, Spectricity (USA)**

3:30 PM - 4:00 PM:

**Coffee break**

### PHOTONICS FOR HEALTH

4:00 PM - 4:20 PM:



**Photonics for Sensing  
Cary Gunn, Founder & CEO, Genalyte**

4:20 PM - 4:40 PM:



**Integrating Biophotonics on Chip  
Pol Van Dorpe, Scientific Director, Life Science Technologies, imec (Belgium)**

4:40 PM - 5:00 PM:

**Keynote TBC**

5:00 PM - 5:20 PM:



**Silicon Photonics for Medical Applications  
Roel Baets, Ghent University and Group Leader Photonics Research Group, imec (Belgium)**

### ADVANCING YOUR INNOVATION WITH PHOTONICS

5:20 PM - 5:40 PM:



**imec IC-Link services for Silicon Photonics - with CMOS Integration  
Wes Hansford, Senior Strategic Partnerships Manager, imec (Belgium)**

### CLOSING TALK

5:40 PM - 6:00 PM:



**Advanced Photonics for Beam Forming & Sensing  
Philippe Soussan, Program Director Optical Beam Forming, imec (Belgium)**

6:00 PM - 7:00 PM:

**Closing Reception & Demos**

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IN COOPERATION  
WITH  
**SPIE.**

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## INDUSTRY SPECIAL EVENTS

### Photonics Cluster Reception

Monday 3 February 2020 • 5:00 PM - 6:30 PM

Location: InterContinental Hotel, InterContinental A (5th Floor)

Leaders from regional optics and photonics clusters are invited to join this SPIE-hosted reception. Connect with your peers while enjoying drinks and appetizers, compare notes, and hear an update from your peers abroad on efforts to raise awareness of photonics in their homeland, as well as a brief report on the SPIE Photonics Industry Analysis project.

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### Executive Women's Meetup

Monday 3 February 2020 • 6:30 PM - 7:30 PM

Location: InterContinental Hotel, Fremont Room (5th Floor)

**Female executives interested in attending may email [mega@spie.org](mailto:mega@spie.org) for more information.**

This is an invitation-only event for women executives in the optics, photonics, and photonics-enabled community to meet up, talk shop, network, and enjoy a glass of wine.

This event follows the Equity, Diversity, and Inclusion Presentation and Reception.

### Optics and Photonics Technician Shortage: Solutions and Opportunities

Tuesday 4 February 2020 • 5:15 PM - 6:30 PM

Location: Marriott Marquis, Golden Gate C

**Space is limited so please RSVP to [krisindap@spie.org](mailto:krisindap@spie.org).**

Join us for this happy hour networking event that will bring together employers interested in increasing the number of technicians in the pipeline and colleges that are training technicians. Hear short presentations on activities that are helping to increase the technician pool and meet technician program instructors at information tables during the networking time. Presenters will include Norman Hodgson from Coherent Inc., Trenton Berg from the Montana Photonics Industry Alliance and Jim VanKouwenberg from Optimax.

### SPIE Startup Challenge: Awards & Reception

Wednesday 5 February 2020 • 4:00 PM - 5:00 PM

Location: Room 2003 (Level 2 West)

Awards for the winners of the Healthcare and Deep Tech Startup Challenge will be presented by SPIE President John Greivenkamp.

A reception and winners celebration concludes the event. Stay after and network with the winners, judges, and VCs.

### PRISM Awards Ceremony and Banquet

Wednesday 5 February 2020 • 6:00 PM - 10:00 PM

Location: Marriott Marquis Hotel, Yerba Buena Ballroom (Lower Level)

***Ticket information or other questions, email [innovation@spie.org](mailto:innovation@spie.org)***

The Prism Awards is celebrating 12 years—once again we will recognize the best new products that use optics and photonics to make the world a better place.

Finalists announced mid-November. See p. 71.

Winners announced on 5 February, the Wednesday evening of SPIE Photonics West 2020. This gala has become the largest gathering of CEOs and VIPs in the photonics industry.

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See next page for Prism finalists➔

# 2020 Prism Awards Finalists

WINNERS WILL BE ANNOUNCED AT SPIE PHOTONICS WEST 2020  
WEDNESDAY 5 FEBRUARY 2020 • 6:00 PM - 10:00 PM

## COMMUNICATION

**AUREA Technology**  
**Cailabs**  
**Innolume**

## ENERGY / EFFICIENCY

**Innovations in Optics**  
**Osram Opto**  
**Prisma Photonics**

## HEALTHCARE

**Modulight**  
**Norlase**  
**PhotoniCare**

## LIFE SCIENCES

**CellOptic**  
**Hamamatsu**  
**TERA-print**

## MANUFACTURING

**Inspekto**  
**IPG Photonics**  
**TRUMPF Lasertechnik**

## QUALITY CONTROL

**CCS & EFFILUX**  
**CloudMinds**  
**Si-Ware Systems**

## SAFETY & SECURITY

**Allied Vision Technologies**  
**Ophir Optronics Solutions/  
MKS Instruments**  
**Pendar Technologies**

## TRANSPORTATION

**LeddarTech**  
**Outsight**  
**TriLumina**

## VISION TECHNOLOGY

**Leica Geosystems**  
**LetinAR**  
**WaveOptics**

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**PRISM20  
AWARDS20**

**SPIE.**Education



## SPIE COURSES



**Get the most out of your  
conference experience.**

**Take a course at  
SPIE Photonics West.**

Not enough time to add a course to your schedule?  
Schedule customized group training at your facility.  
Or take an SPIE online course at your desk.  
Contact [education@spie.org](mailto:education@spie.org) to learn more.

**[spie.org/courses](https://spie.org/courses)**



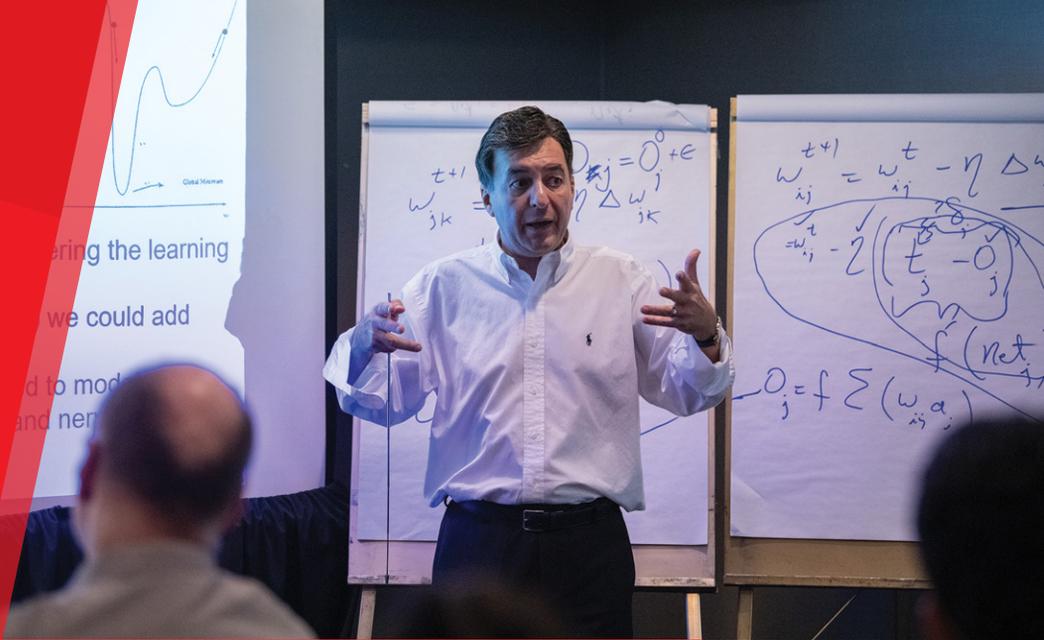
SPIE is accredited by the International Association for Continuing Education and Training (IACET) and is authorized to issue the IACET CEU.

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# PHOTONICS WEST COURSES

## SEE SPIE CASHIER TO REGISTER

SPIE Student Members receive significant discounts on courses.



## REGISTER EARLY

Courses and workshops have limited seating and can sell out.

For the most up-to-date information on courses and workshops including pricing, course descriptions, and scheduling, please refer to our website: [spie.org/pw](http://spie.org/pw)

To preview course materials, visit the Course Materials Desk onsite in Moscone South

## Continuing Education Units



SPIE is accredited by the International Association for Continuing Education and Training (IACET) and is authorized to issue the IACET CEU.

## Build on your expertise

Stay competitive and advance your career with training and professional development courses. Learn current approaches, earn CEUs, and get personal instruction from leading experts.

65 courses.  
Money-back guarantee.

## New Courses in 2020

- Mirror System Design with Freeform Surfaces
- Introduction to Magnetic Random Access Memory (MRAM)
- Photodetectors – A Practical Selection Guide
- Industrial Ultrafast Lasers for Micro-Processing and Applications
- Modern Optical Measurements: An Introduction with Practical Applications
- Optical Measurements for (Automotive) Displays & Lighting
- Problems in Autonomous Vehicle Imaging Systems
- Medical Laser-Tissue Interactions
- Biomedical Image Analysis: An Introduction
- Meta-Lenses

## MONEY-BACK GUARANTEE

We are confident that once you experience an SPIE course for yourself you will look to us for your future education needs. However, if for any reason you are dissatisfied, we will gladly refund your money. We just ask that you tell us what you did not like.

*SPIE reserves the right to cancel a course due to insufficient advance registration.*

# COURSE INDEX

See Daily course schedule for Member / Non-member Prices, pages 76-80.  
For SPIE student prices see course descriptions online.

**SEE SPIE CASHIER TO REGISTER**

SPIE Student Members  
receive significant discounts on courses.

## Advanced Quantum and Optoelectronic Applications

- SC1191 Sun **Quantum Sensors** (*Lanzagorta, Venegas-Andraca*)  
8:30 am to 12:30 pm
- SC1273 Wed **Introduction to Magnetic Random Access Memory (MRAM) : Fundamentals, Current Status, and Emerging Device Concepts** (*Khalili*)  
1:30 pm to 5:30 pm

## Basic 2-Hour Courses for Sales, Marketing, and Industry

- SC1234 Sun **Introduction to VR, AR, MR and Smart Eyewear: Market Expectations, Hardware Requirements and Investment Patterns** (*Kress*) 8:30 am to 10:30 am
- SC1170A Mon **A Hands-On Introduction to Optics** (*Diehl*)  
10:30 am to 12:30 pm
- SC1224 Mon **Fundamentals of Optical Engineering** (*Vogt*)  
1:30 pm to 3:30 pm
- SC1170B Mon **A Hands-On Introduction to Optics** (*Diehl*)  
3:30 pm to 5:30 pm

## Biomedical Spectroscopy, Microscopy, and Imaging

- SC1291 Mon **Biomedical Image Analysis: An Introduction** (*Bohndiek*) 8:30 am to 12:30 pm
- SC1260 Tue **Optical Super Resolution and Extended Depth of Focus** (*Zalovsky*) 1:30 pm to 5:30 pm

## Clinical Technologies and Systems

- SC312 Sun **Principles and Applications of Optical Coherence Tomography** (*Fujimoto*) 1:30 pm to 5:30 pm

## Displays and Holography

- SC1096 Sun **Head-Mounted Display Requirements and Designs for Augmented Reality Applications** (*Browne, Melzer*) 8:30 am to 5:30 pm
- SC1234 Sun **Introduction to VR, AR, MR and Smart Eyewear: Market Expectations, Hardware Requirements and Investment Patterns** (*Kress*)  
8:30 am to 10:30 am
- SC1218 Wed **Optical Technologies and Architectures for Virtual Reality (VR) , Augmented Reality (AR) and Mixed Reality (MR) Head-Mounted Displays (HMDs)** (*Kress*) 8:30 am to 5:30 pm

## Imaging

- SC1222 Sun **Deep Learning and Its Applications in Image Processing** (*Nasrabadi*) 8:30 am to 5:30 pm
- SC1288 Tue **Problems in Autonomous Vehicle Imaging Systems** (*Grant*) 8:30 am to 12:30 pm
- SC504 Tue **Introduction to CCD and CMOS Imaging Sensors and Applications** (*Crisp*) 1:30 pm to 5:30 pm
- SC1231 Wed **Designing and Specifying Digital Cameras** (*Baldwin*) 8:30 am to 12:30 pm

## Laser Safety

- SC1256 Mon **Basic Laser Safety** (*Barat*) 10:30 am to 12:30 pm
- SC1257 Mon **Laser Lab Design, Do's and Don'ts** (*Barat*)  
1:30 pm to 3:30 pm

## Laser Sources

- SC748 Sun **High-Power Fiber Sources** (*Nilsson*)  
8:30 am to 5:30 pm
- SC752 Sun **Solid State Laser Technology** (*Hodgson*)  
8:30 am to 5:30 pm
- SC1174 Mon **Improving Laser Reliability: an Introduction** (*Grossman, Asbury*) 8:30 am to 5:30 pm
- SC1180 Tue **Passive and Active Fiber Optics** (*Paschotta*)  
8:30 am to 5:30 pm
- SC972 Wed **Basic Laser Technology: Fundamentals and Performance Specifications** (*Sukuta*)  
8:30 am to 12:30 pm

## Macro Applications

- SC1144 Tue **Laser Systems Engineering** (*Kasunic*)  
8:30 am to 5:30 pm

## Metrology and Standards

- SC212 Mon **Modern Optical Testing** (*Wyant*)  
8:30 am to 12:30 pm
- SC1287 Tue **Optical Measurements for (Automotive) Displays & Lighting** (*Blankenbach, Reichel*)  
8:30 am to 12:30 pm
- SC1286 Tue **Modern Optical Measurements: An Introduction with Practical Applications** (*Reichel, Blankenbach*)  
1:30 pm to 5:30 pm
- SC700 Wed **Understanding Scratch and Dig Specifications** (*Aikens*) 8:30 am to 12:30 pm
- SC1017 Wed **Optics Surface Inspection Workshop** (*Aikens*)  
1:30 pm to 5:30 pm

## Micro/Nano Applications

- SC1285 Mon **Industrial Ultrafast Lasers for Micro-Processing and Applications** (*Hodgson*) 8:30 am to 12:30 pm

## MOEMS-MEMS in Photonics

- SC454 Tue **Fabrication Technologies for Micro- and Nano-Optics** (*Suleski*) 8:30 am to 12:30 pm
- SC1125 Thu **Design Techniques and Applications Fields for Digital Micro-optics** (*Kress*)  
8:30 am to 12:30 pm

## Nano/Biophotonics

- Tue SC1186 **Fluorescence Sensing and Imaging: Towards Portable Healthcare** (*Levi*) 1:30 pm to 5:30 pm

## Nanotechnologies in Photonics

- SC1252 Wed **Meta-Lenses** (*Tsai*) 8:30 am to 12:30 pm

**Neurophotonics, Neurosurgery, and Optogenetics**

SC1126 Mon **Neurophotonics** (*Levi, Dufour*) 1:30 pm to 5:30 pm

**Nonlinear Optics and Beam Guiding**

SC931 Sun **Applied Nonlinear Frequency Conversion** (*Paschotta*) 8:30 am to 5:30 pm

SC047 Sun **Introduction to Nonlinear Optics** (*Fisher*) 1:30 pm to 5:30 pm

SC744 Tue **Fiber Frequency Combs and Applications** (*Fermann*) 8:30 am to 12:30 pm

**Optical Materials and Fabrication**

SC1086 Tue **Optical Materials, Fabrication and Testing for the Optical Engineer** (*DeGroote Nelson*) 1:30 pm to 5:30 pm

**Optical Systems and Lens Design**

SC156 Sun **Basic Optics for Engineers** (*Poutous*) 8:30 am to 5:30 pm

SC690 Sun **Optical System Design: Layout Principles and Practice** (*Bentley*) 8:30 am to 5:30 pm

SC1277 Sun **Photodetectors: Theory, Practice, and Applications** (*Piatek*) 8:30 am to 12:30 pm

SC011 Sun **Design of Efficient Illumination Systems** (*Cassarly*) 1:30 pm to 5:30 pm

SC1272 Mon **Mirror System Design with Freeform Surfaces** (*Sasián*) 8:30 am to 12:30 pm

SC1247 Mon **Polarized Light and Optical Design** (*Chipman, Young*) 8:30 am to 5:30 pm

SC935 Tue **Introduction to Lens Design** (*Bentley*) 8:30 am to 5:30 pm

SC1199 Tue **Stray Light Analysis and Control** (*Fest*) 8:30 am to 5:30 pm

SC1232 Tue **Introduction to LIDAR for Autonomous Vehicles** (*Shaw*) 1:30 pm to 5:30 pm

SC1254 Wed **Fourier Optics** (*Popescu*) 8:30 am to 5:30 pm

SC003 Thu **Practical Optical System Design** (*Youngworth, Olson*) 8:30 am to 5:30 pm

**Optoelectronic Materials and Devices**

SC1277 Sun **Photodetectors: Theory, Practice, and Applications** (*Piatek*) 8:30 am to 12:30 pm

SC747 Sun **Semiconductor Photonic Device Fundamentals** (*Linden*) 8:30 am to 5:30 pm

SC1091 Sun **Fundamentals of Reliability Engineering for Optoelectronic Devices** (*Leisher*) 1:30 pm to 5:30 pm

**Optomechanics**

SC014 Sun-  
Mon **Introduction to Optomechanical Design** (*Vukobratovich*) 8:30 am to 5:30 pm

SC015 Mon **Fastening Optical Elements with Adhesives** (*Daly*) 8:30 am to 12:30 pm

SC010 Tue **Introduction to Optical Alignment Techniques** (*Castle*) 8:30 am to 5:30 pm

SC254 Wed **Integrated Opto-Mechanical Analysis** (*Genberg, Doyle*) 8:30 am to 5:30 pm

SC218 Thu **Advanced Composite Materials for Optomechanical Systems and Precision Machinery** (*Zweben*) 8:30 am to 5:30 pm

SC1085 Thu **Optomechanical Systems Engineering** (*Kasunic*) 8:30 am to 5:30 pm

**Photonic Integration**

SC1071 Sat **Understanding Diffractive Optics** (*Soskind*) 8:30 am to 5:30 pm

SC817 Wed **Silicon Photonics** (*Michel, Saini*) 1:30 pm to 5:30 pm

**Photonic Therapeutics and Diagnostics**

SC1221 Mon **Physiological Optics of the Eye for Engineers** (*Lakshminarayanan*) 8:30 am to 5:30 pm

**Professional Development**

SC1208 Mon **The Seven Habits of Highly Effective Project Managers** (*Warner*) 1:30 pm to 5:30 pm

**Semiconductor Lasers, LEDs, and Applications**

SC1146 Mon **Laser Diode Beam Basics, Characteristics and Manipulation** (*Sun*) 1:30 pm to 5:30 pm

SC1259 Tue **Introduction to Vertical-Cavity Surface-Emitting Lasers (VCSELs) and Applications** (*Choquette*) 1:30 pm to 5:30 pm

**Tissue Optics, Laser-Tissue Interaction, and Tissue Engineering**

SC029 Sun **Tissue Optics** (*Jacques*) 1:30 pm to 5:30 pm

SC1290 Mon **Medical Laser-Tissue Interactions** (*Verdaasdonk*) 8:30 am to 12:30 pm

**SEE SPIE CASHIER TO REGISTER**

SPIE Student Members receive significant discounts on courses.

SATURDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>Advanced Quantum and Optoelectronic Applications</b>					
	SC1191 <b>Quantum Sensors</b> ( <i>Lanzagorta, Venegas-Andraca</i> ) 8:30 am to 12:30 pm, \$420 / \$485			SC1273 <b>Introduction to Magnetic Random Access Memory (MRAM): Fundamentals, Current Status, and Emerging Device Concepts</b> ( <i>Khalili</i> ) 1:30 pm to 5:30 pm, \$420 / \$485	
<b>Basic 2-Hour Courses for Sales, Marketing, and Industry</b>					
	SC1234 <b>Introduction to VR, AR, MR and Smart Eyewear: Market Expectations, Hardware Requirements and Investment Patterns</b> ( <i>Kress</i> ) 8:30 am to 10:30 am, \$270 / \$295	SC1170A <b>A Hands-On Introduction to Optics</b> ( <i>Diehl</i> ) 10:30 am to 12:30 pm, \$270 / \$295			
		SC1224 <b>Fundamentals of Optical Engineering</b> ( <i>Vogt</i> ) 1:30 pm to 3:30 pm, \$270 / \$295			
		SC1170B <b>A Hands-On Introduction to Optics</b> ( <i>Diehl</i> ) 3:30 pm to 5:30 pm, \$270 / \$295			
<b>Biomedical Spectroscopy, Microscopy, and Imaging</b>					
		SC1291 <b>Biomedical Image Analysis: An Introduction</b> ( <i>Bohndiek</i> ) 8:30 am to 12:30 pm, \$465 / \$530	SC1260 <b>Optical Super Resolution and Extended Depth of Focus</b> ( <i>Zalevsky</i> ) 1:30 pm to 5:30 pm, \$420 / \$485		
<b>Clinical Technologies and Systems</b>					
	SC312 <b>Principles and Applications of Optical Coherence Tomography</b> ( <i>Fujimoto</i> ) 1:30 pm to 5:30 pm, \$420 / \$485				

The following workshops are intended for students and early career professionals. They are free to technical attendees. More information including course descriptions, day/time, and locations can be found online.

- Genuine Networking
- Developing Systems for Optimal Productivity
- SPIE Career Lab Meetup
- Career Summit Networking Breakfast
- Designing Your Own Career Path in the Private
- The Craft of Scientific Writing: A Workshop on Communicating with Confidence
- Resumes to Interviews: Strategies for a Successful Job Search
- Essential Skills for a Career in Industry
- Transforming Technical Presentations
- Salary Negotiation Workshop
- Grant Writing from the Ground Up
- Charting a Course in the Photonics Industry
- Career Summit Networking Social

# DAILY COURSE SCHEDULE

SATURDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>Displays and Holography</b>					
	SC1096 <b>Head-Mounted Display Requirements and Designs for Augmented Reality Applications</b> ( <i>Browne, Melzer</i> ) 8:30 am to 5:30 pm, \$695 / \$815			SC1218 <b>Optical Technologies and Architectures for Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) Head-Mounted Displays (HMDs)</b> ( <i>Kress</i> ) 8:30 am to 5:30 pm, \$685 / \$805	
	SC1234 <b>Introduction to VR, AR, MR and Smart Eyewear: Market Expectations, Hardware Requirements and Investment Patterns</b> ( <i>Kress</i> ) 8:30 am to 10:30 am, \$270 / \$295				
<b>Imaging</b>					
	SC1222 <b>Deep Learning and Its Applications in Image Processing</b> ( <i>Nasrabadi</i> ) 8:30 am to 5:30 pm, \$685 / \$805		SC1288 <b>Problems in Autonomous Vehicle Imaging Systems</b> ( <i>Grant</i> ) 8:30 am to 12:30 pm, \$465 / \$530	SC1231 <b>Designing and Specifying Digital Cameras</b> ( <i>Baldwin</i> ) 8:30 am to 12:30 pm, \$420 / \$485	
			SC504 <b>Introduction to CCD and CMOS Imaging Sensors and Applications</b> ( <i>Crisp</i> ) 1:30 pm to 5:30 pm, \$505 / \$570		
<b>Laser Safety</b>					
		SC1256 <b>Basic Laser Safety</b> ( <i>Barat</i> ) 10:30 am to 12:30 pm, \$310 / \$335			
		SC1257 <b>Laser Lab Design, Do's and Don'ts</b> ( <i>Barat</i> ) 1:30 pm to 3:30 pm, \$295 / \$320			
<b>Laser Sources</b>					
	SC748 <b>High-Power Fiber Sources</b> ( <i>Nilsson</i> ) 8:30 am to 5:30 pm, \$685 / \$805	SC1174 <b>Improving Laser Reliability: an Introduction</b> ( <i>Grossman, Asbury</i> ) 8:30 am to 5:30 pm, \$685 / \$805	SC1180 <b>Passive and Active Fiber Optics</b> ( <i>Paschotta</i> ) 8:30 am to 5:30 pm, \$685 / \$805	SC972 <b>Basic Laser Technology: Fundamentals and Performance Specifications</b> ( <i>Sukuta</i> ) 8:30 am to 12:30 pm, \$420 / \$485	
	SC752 <b>Solid State Laser Technology</b> ( <i>Hodgson</i> ) 8:30 am to 5:30 pm, \$685 / \$805				

SATURDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>Macro Applications</b>					
			SC1144 <b>Laser Systems Engineering</b> ( <i>Kasunic</i> ) 8:30 am to 5:30 pm, \$755 / \$875		
<b>Metrology and Standards</b>					
		SC212 <b>Modern Optical Testing</b> ( <i>Wyant</i> ) 8:30 am to 12:30 pm, \$455 / \$520	SC1287 <b>Optical Measurements for (Automotive) Displays &amp; Lighting</b> ( <i>Blankenbach, Reichel</i> ) 8:30 am to 12:30 pm, \$420 / \$485	SC700 <b>Understanding Scratch and Dig Specifications</b> ( <i>Aikens</i> ) 8:30 am to 12:30 pm, \$520 / \$585	
			SC1286 <b>Modern Optical Measurements: An Introduction with Practical Applications</b> ( <i>Reichel, Blankenbach</i> ) 1:30 pm to 5:30 pm, \$420 / \$485	SC1017 <b>Optics Surface Inspection Workshop</b> ( <i>Aikens</i> ) 1:30 pm to 5:30 pm, \$520 / \$585	
<b>Micro/Nano Applications</b>					
		SC1285 <b>Industrial Ultrafast Lasers for Micro-Processing and Applications</b> ( <i>Hodgson</i> ) 8:30 am to 12:30 pm, \$420 / \$485			
<b>MOEMS-MEMS in Photonics</b>					
			SC454 <b>Fabrication Technologies for Micro- and Nano-Optics</b> ( <i>Suleski</i> ) 8:30 am to 12:30 pm, \$420 / \$485		SC1125 <b>Design Techniques and Applications Fields for Digital Micro-optics</b> ( <i>Kress</i> ) 8:30 am to 5:30 pm, \$685 / \$805
<b>Nano/Biophotonics</b>					
			SC1186 <b>Fluorescence Sensing and Imaging: Towards Portable Healthcare</b> ( <i>Levi</i> ) 1:30 pm to 5:30 pm, \$420 / \$485		
<b>Nanotechnologies in Photonics</b>					
				SC1252 <b>Meta-Lenses</b> ( <i>Tsai</i> ) 8:30 am to 12:30 pm, \$420 / \$485	
<b>Neurophotonics, Neurosurgery, and Optogenetics</b>					
		SC1126 <b>Neurophotonics</b> ( <i>Levi, Dufour</i> ) 1:30 pm to 5:30 pm, \$420 / \$485			

# DAILY COURSE SCHEDULE

SATURDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>Nonlinear Optics and Beam Guiding</b>					
	SC931 <b>Applied Nonlinear Frequency Conversion</b> (Paschotta) 8:30 am to 5:30 pm, \$685 / \$805		SC744 <b>Fiber Frequency Combs and Applications</b> (Fermann) 8:30 am to 12:30 pm, \$420 / \$485		
	SC047 <b>Introduction to Nonlinear Optics</b> (Fisher) 1:30 pm to 5:30 pm, \$420 / \$485				
<b>Optical Materials and Fabrication</b>					
			SC1086 <b>Optical Materials, Fabrication and Testing for the Optical Engineer</b> (DeGroot Nelson) 1:30 pm to 5:30 pm, \$420 / \$485		
<b>Optical Systems and Lens Design</b>					
	SC156 <b>Basic Optics for Engineers</b> (Poutous) 8:30 am to 5:30 pm, \$725 / \$845	SC1272 <b>Mirror System Design with Freeform Surfaces</b> (Sasián) 8:30 am to 12:30 pm, \$420 / \$485	SC935 <b>Introduction to Lens Design</b> (Bentley) 8:30 am to 5:30 pm, \$780 / \$900	SC1254 <b>Fourier Optics</b> (Popescu) 8:30 am to 5:30 pm, \$685 / \$805	
	SC690 <b>Optical System Design: Layout Principles and Practice</b> (Bentley) 8:30 am to 5:30 pm, \$720 / \$840	SC1247 <b>Polarized Light and Optical Design</b> (Chipman, Young) 8:30 am to 5:30 pm, \$685 / \$805	SC1199 <b>Stray Light Analysis and Control</b> (Fest) 8:30 am to 5:30 pm, \$730 / \$850		SC003 <b>Practical Optical System Design</b> (Youngworth, Olson) 8:30 am to 5:30 pm, \$685 / \$805
	SC011 <b>Design of Efficient Illumination Systems</b> (Cassarly) 1:30 pm to 5:30 pm, \$420 / \$485		SC1232 <b>Introduction to LIDAR for Autonomous Vehicles</b> (Shaw) 1:30 pm to 5:30 pm, \$420 / \$485		
<b>Optoelectronic Materials and Devices</b>					
	SC1277 <b>Photodetectors: Theory, Practice, and Applications</b> (Piatek) 8:30 am to 12:30 pm, \$420 / \$485				
	SC747 <b>Semiconductor Photonic Device Fundamentals</b> (Linden) 8:30 am to 5:30 pm, \$685 / \$805			<p><b>SEE SPIE CASHIER TO REGISTER</b></p> <p>SPIE Student Members receive significant discounts on courses.</p>	
	SC1091 <b>Fundamentals of Reliability Engineering for Optoelectronic Devices</b> (Leisher) 1:30 pm to 5:30 pm, \$420 / \$485				

SATURDAY	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY
<b>Optomechanics</b>					
	SC014 <b>Introduction to Optomechanical Design</b> ( <i>Vukobratovich</i> ) 8:30 am to 5:30 pm, \$1,280 / \$1,510				
<b>SEE SPIE CASHIER TO REGISTER</b> SPIE Student Members receive significant discounts on courses.		SC015 <b>Fastening Optical Elements with Adhesives</b> ( <i>Daly</i> ) 8:30 am to 12:30 pm, \$420 / \$485	SC010 <b>Introduction to Optical Alignment Techniques</b> ( <i>Castle</i> ) 8:30 am to 5:30 pm, \$685 / \$805	SC254 <b>Integrated Opto-Mechanical Analysis</b> ( <i>Genberg, Doyle</i> ) 8:30 am to 5:30 pm, \$755 / \$875	SC218 <b>Advanced Composite Materials for Optomechanical Systems and Precision Machinery</b> ( <i>Zweben</i> ) 8:30 am to 5:30 pm, \$685 / \$805
					SC1085 <b>Optomechanical Systems Engineering</b> ( <i>Kasunic</i> ) 8:30 am to 5:30 pm, \$685 / \$805
<b>Photonic Integration</b>					
SC1071 <b>Understanding Diffractive Optics</b> ( <i>Soskind</i> ) 8:30 am to 5:30 pm, \$720 / \$840				SC817 <b>Silicon Photonics</b> ( <i>Michel, Saini</i> ) 1:30 pm to 5:30 pm, \$420 / \$485	
<b>Photonic Therapeutics and Diagnostics</b>					
		SC1221 <b>Physiological Optics of the Eye for Engineers</b> ( <i>Lakshminarayanan</i> ) 8:30 am to 5:30 pm, \$720 / \$840			
<b>Professional Development</b>					
		SC1208 <b>The Seven Habits of Highly Effective Project Managers</b> ( <i>Warner</i> ) 1:30 pm to 5:30 pm, \$420 / \$485			
<b>Semiconductor Lasers, LEDs, and Applications</b>					
		SC1146 <b>Laser Diode Beam Basics, Characteristics and Manipulation</b> ( <i>Sun</i> ) 1:30 pm to 5:30 pm, \$420 / \$485	SC1259 <b>Introduction to Vertical-Cavity Surface-Emitting Lasers (VCSELs) and Applications</b> ( <i>Choquette</i> ) 1:30 pm to 5:30 pm, \$420 / \$485		
<b>Tissue Optics, Laser-Tissue Interaction, and Tissue Engineering</b>					
	SC029 <b>Tissue Optics</b> ( <i>Jacques</i> ) 1:30 pm to 5:30 pm, \$420 / \$485	SC1290 <b>Medical Laser-Tissue Interactions</b> ( <i>Verdaasdonk</i> ) 8:30 am to 12:30 pm, \$420 / \$485			

# SPIE. AR | VR | MR

2-4 February 2020

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### Industry Talks and Panels

Must-see presentations, panel discussions, and insight from industry experts and disruptors.



### Expo + Demos

Meet with the biggest names in consumer electronics and XR startups, and try out their latest gear.



### Technical Conference

Hear the latest research to enhance the AR, VR, MR experience in a Head-Mounted Display.



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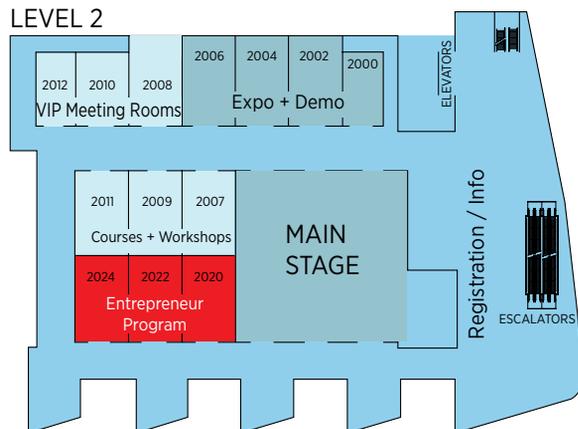
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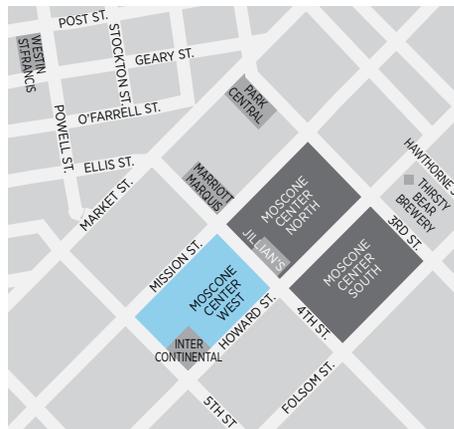
## SPIE.AR/VRMR

### MOSCONE WEST

#### LEVEL 2



### STREET MAP



# SUNDAY TECHNICAL PRESENTATIONS

## CONFERENCE 11310

Sunday 2 February 2020 • Proceedings of SPIE Vol. 11310

# Optical Architectures for Displays and Sensing in Augmented, Virtual, and Mixed Reality (AR, VR, MR)

*Conference Chairs:*



**Bernard C. Kress,**  
Microsoft Corp. (USA);



**Christophe Peroz,**  
Magic Leap, Inc. (USA)

*Program Committee:*

- Martin S. Banks,** Univ. of California, Berkeley (USA)
- Pablo Benítez,** Univ. Politécnica de Madrid (Spain)
- Julie L. Bentley,** Univ. of Rochester (USA)
- Michael P. Browne,** SA Photonics, Inc. (USA)
- Weichuan Gao,** Facebook Technologies, LLC (USA)
- Andreas G. Georgiou,** Microsoft Research Cambridge (United Kingdom)
- Hong Hua,** Wyant College of Optical Sciences, The Univ. of Arizona (USA)
- Mary Lou Jepsen,** Openwater (USA)
- Fernando Mendoza-Santoyo,** Centro de Investigaciones en Óptica, A.C. (Mexico)
- Jannick P. Rolland,** The Institute of Optics (USA)
- Zhujun Shi,** Harvard Univ. (USA)

## SUNDAY 2 FEBRUARY

### SESSIONS 1A - 1D RUN CONCURRENTLY.

**SESSION 1A**  
LOCATION: ROOM 2007  
(LEVEL 2 WEST)  
SUN 8:10 AM TO 10:10 AM

**Optical Design Challenge Presentations**  
Session Chair: **Weichuan Gao,**  
Facebook Technologies,  
LLC (USA)

Optical Design Challenge contestants will present their cutting-edge research as one of three required components of the challenge. The three components are: (1) abstract and manuscript submission; (2) on-site poster presentation (reviewed and scored); and (3) on-site "pitch" presentation (reviewed and scored).

The Student Optical Design Challenge consists of authors who are full-time students registered at an academic or research institute, performing their work either in an academic lab, a research institute or as an internship in an external company.

8:10 am: **A retinal-scanning-based near-eye display with diffractive optical element,** Chao Ping Chen, Wenbo Zhang, Yifan Lu, Jie Chen, Nizamuddin Maitlo, Shanghai Jiao Tong Univ. (China); Lantian Mi, Shanghai Jiao Tong Univ (China) . . . . . [11310-1]

**SESSION 1B**  
LOCATION: ROOM 2009  
(LEVEL 2 WEST)  
SUN 8:10 AM TO 10:10 AM

**Human Factors in AR/VR**

Session Chair: **Martin S. Banks,**  
Univ. of California, Berkeley (USA)

8:10 am: **Eyebox centering using chromatic aberrations of virtual reality head mounted displays,** Ryan Beams, Aldo Badano, Andrea S. Kim, U.S. Food and Drug Administration (USA) . . . . . [11310-7]

8:30 am: **Method for evaluating 3D display systems based on perceived retinal image,** Mohan Xu, Hong Hua, The Univ. of Arizona (USA) . . . . . [11310-8]

8:50 am: **Clearing key barriers to mass adoption of augmented reality with computer-generated holography,** Andrzej Kaczorowski, Alfred J. Newman, Alden O. Spiess, Omer A. Tastemur, Darran F. Milne, VividQ (United Kingdom) . . . [11310-9]

9:10 am: **Contributions of foveal and non-foveal retina to accommodation,** Vivek Labhishetty, Steven A. Cholewiak, Agostino Gibaldi, Martin S. Banks, Univ. of California, Berkeley (USA) . [11310-10]

9:30 am: **Augmented reality and human factors regarding the neurosurgical operating room workflow,** Nhu Q. Nguyen, Jillian Cardinell, Joel M. Ramjst, Dimitrios Androustos, Victor X. D. Yang, Ryerson Univ. (Canada) . . . . . [11310-11]

**SESSION 1C**  
LOCATION: ROOM 2011  
(LEVEL 2 WEST)  
SUN 8:10 AM TO 9:50 AM

**Improvement of Waveguide Combiners for AR**

Session Chair: **Zhujun Shi,**  
Harvard Univ. (USA)

8:10 am: **Eye box expansion using waveguide and holographic optical element for augmented reality head-mounted display,** Bongsu Shin, Sunil Kim, Samsung Advanced Institute of Technology (Korea, Republic of); Vladislav Druzhin, Polina Malinina, Sergey Dubynin, German Dubinin, SAMSUNG R&D Institute Russia (Russian Federation); Sergey Kopenkin, Andrey Putilin, P. N. Lebedev Physical Institute of the RAS (Russian Federation); Wontaek Seo, Chang-Kun Lee, Geeyoung Sung, Yun-Tae Kim, Samsung Advanced Institute of Technology (Korea, Republic of); Juwon Seo, Samsung Advanced Institute of Technology (Kosovo, Republic of); Jae-Seung Chung, Hong-Seok Lee, Sung-Hoon Hong, Samsung Advanced Institute of Technology (Korea, Republic of) . . . . . [11310-13]

8:30 am: **Waveguide-based see-through near-eye display with two-dimensional exit pupil expansion,** Wenbo Zhang, Shanghai Jiao Tong Univ. (China) . . . . . [11310-14]

**SESSION 1D**  
LOCATION: ROOM 2008  
(LEVEL 2 WEST)  
SUN 8:00 AM TO 9:00 AM

**Technology Trends in AR/VR**

Session Chair: **Hong Hua,** Wyant College of Optical Sciences (USA)

8:00 am: **Electronic see-through head mounted display with minimal peripheral obscuration,** Michael P. Browne, SA Photonics, Inc. (USA); Stan Larroque, SL Process (France) . . . . . [11310-45]

8:20 am: **Birds do it. Bees do it. A bio-inspired look at wayfinding and navigation tools for augmented reality,** James E. Melzer, Richard W. Madison, Thales Visionix, Inc. (USA) . . . . . [11310-42]

8:40 am: **Laser packaging architecture which overcomes challenges in AR imaging,** Ann Russell, OSRAM (USA) . . . . . [11310-79]

# SUNDAY TECHNICAL PRESENTATIONS

SESSIONS 1A - 1D RUN CONCURRENTLY.

## SESSION 1A CONTINUED SUN 8:10 AM TO 10:10 AM

### Optical Design Challenge Presentations

8:30 am: **Planar optics enables chromatic aberration correction in immersive near-eye displays**, Tao Zhan, Junyu Zou, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Xiaomin Liu, Zhengzhou Univ. (China) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Hao Chen, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and NanoScience Technology Ctr., Univ. of Central Florida (USA); Jilin Yang, Sheng Liu, Goertek Electronics, Inc. (USA); Yajie Dong, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and NanoScience Technology Ctr., Univ. of Central Florida (USA); Shin-Tson Wu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [11310-2]

8:50 am: **Design of foveated contact lens display for augmented reality**, Jie Chen, Lantian Mi, Jinghui Jiang, Haowen Liu, Chao Ping Chen, Wenbo Zhang, Nizamuddin Maitlo, Shanghai Jiao Tong Univ. (China). . . . . [11310-3]

9:10 am: **Variable zoom using rotating Toroidal lenses for AR glasses**, Megan M. Art, Michigan State Univ. (USA); Hossein Shahinian, Micro-LAM, Inc. (USA) . . . . [11310-4]

9:30 am: **Computing high quality phase-only holograms for holographic displays**, Praneeth Kumar Chakravarthula, The Univ. of North Carolina at Chapel Hill (USA) . . . . . [11310-5]

9:50 am: **A portable projection mapping device for single-stage cranioplasty**, Shuya Liu, Wei-Lun Huang, Austin Shin, Johns Hopkins Univ. (USA); Chad Gordon, Johns Hopkins University School of Medicine (USA); Mehran Armand, Johns Hopkins Univ. (USA) . [11310-6]

Coffee Break. . . . . Sun 10:10 am to 10:40 am

## SESSION 1B CONTINUED SUN 8:10 AM TO 10:10 AM

### Human Factors in AR/VR

9:50 am: **Evaluation of the effects of field-of-view in augmented reality for marine navigation**, Thomas Butkiewicz, Andrew H. Stevens, The Univ. of New Hampshire (USA) . . . . . [11310-12]

Coffee Break. . . . . Sun 10:10 am to 10:40 am

## SESSION 1C CONTINUED SUN 8:10 AM TO 9:50 AM

### Improvement of Waveguide Combiners for AR

8:50 am: **Distributed micro-reflector systems for HMD applications**, Adrian Stannard, DAQRI (USA) and DAQRI (United Kingdom). . . . . [11310-15]

9:10 am: **Innovative systematic design approach for lightguide devices for XR-applications**, Christian Hellmann, Wyrowski Photonics GmbH (Germany); Stefan Steiner, Roberto Knoth, Site Zhang, LightTrans International UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11310-16]

9:30 am: **Wide field of view multiplexed photopolymer consumer AR displays**, Jonathan D. Waldern, Alastair J. Grant, DigiLens Inc. (USA); Milan M. Popovich, Creative Physics Ltd. (United Kingdom). . . . . [11310-17]

Coffee Break. . . . . Sun 10:10 am to 10:40 am

SESSIONS 2A - 2C AND 3A RUN CONCURRENTLY.

<p><b>SESSION 2A</b>  <b>LOCATION: ROOM 2007 (LEVEL 2 WEST)</b>  <b>SUN 10:40 AM TO 11:00 AM</b></p> <p><b>Novel AR Optical Architectures</b></p> <p>Session Chair: <b>Weichuan Gao</b>, Facebook Technologies, LLC (USA)</p> <p>10:40 am: <b>Design and fabrication of a lightweight AR headset demonstrator using a buried Fresnel mirror combiner</b>, Axel Bodemann, Dirk Michaelis, Peter Schreiber, Torsten Harzendorf, Stephanie Fischer, Ralf Rosenberger, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) . . . . . [11310-19]</p>	<p><b>SESSION 2B</b>  <b>LOCATION: ROOM 2009 (LEVEL 2 WEST)</b>  <b>SUN 10:40 AM TO 12:00 PM</b></p> <p><b>Visual Comfort in AR</b></p> <p>Session Chair: <b>Hong Hua</b>, Wyatt College of Optical Sciences (USA)</p> <p>10:40 am: <b>Image analysis of varifocal geometrical lightguide head mounted display</b>, Miaomiao Xu, Hong Hua, The Univ. of Arizona (USA) . . . . . [11310-20]</p> <p>11:00 am: <b>How many views are required for an effective light field display?</b>, Steven A. Cholewiak, Emma Alexander, Vivek Labhishetty, Agostino Gibaldi, Laura Waller, Austin Roorda, Martin S. Banks, Univ. of California, Berkeley (USA) . [11310-21]</p> <p>11:20 am: <b>Screen door effect reduction using mechanical shifting for virtual reality displays</b>, Jilian Nguyen, Facebook Technologies, LLC (USA) and The Univ. of Arizona (USA); Jasmine Sears, Clinton Smith, Ziv Magoz, Facebook Technologies, LLC (USA) . . . . . [11310-22]</p> <p>11:40 am: <b>Adjustable lenses: how to overcome the vergence accommodation conflict</b>, Prashanthan Ganeswaran, Nick Rimmer, Graeme MacKenzie, Adlens Ltd. (United Kingdom); Caterina Ripamonti, Robert Lee, Cambridge Research Systems, Ltd. (United Kingdom); Eamonn O'Neill, Christof Lutteroth, Michael Proulx, Univ. of Bath (United Kingdom); Rob Stevens, Adlens Ltd. (United Kingdom) . . . . . [11310-23]</p> <p>Lunch Break . . . . . Sun 12:00 pm to 12:50 pm</p>	<p><b>SESSION 2C</b>  <b>LOCATION: ROOM 2011 (LEVEL 2 WEST)</b>  <b>SUN 10:40 AM TO 11:40 AM</b></p> <p><b>AR/VR Display Optics Measurements and Analysis</b></p> <p>Session Chair: <b>Jannick P. Rolland-Thompson</b>, The Ctr. for Freeform Optics (USA)</p> <p>10:40 am: <b>Standardized display image measurement methods for AR, VR, MR and comprehensive metrology tools for precise, repeatable and reproducible results</b>, Richard Austin, Bruce Denning, Monirul Hassan, Sonika Obheroi, Gavin Cook, Gamma Scientific (USA); John Penczek, Univ. of Colorado Boulder (USA). [11310-24]</p> <p>11:00 am: <b>Measuring and qualifying optical performance of AR/VR/MR device displays and addressing the unique visual requirements of transparent AR displays</b>, Eric Eisenberg, Jens Jensen, Radiant Vision Systems, LLC (USA) . . . . . [11310-25]</p> <p>11:20 am: <b>Measuring and qualifying optical performance of AR/VR/MR Device displays and addressing the unique visual requirements of transparent AR/MR displays</b>, Eric C. Eisenberg, Jens Jensen, Radiant Vision Systems, LLC (USA) . . . . . [11310-75]</p> <p>Lunch Break . . . . . Sun 11:40 am to 12:50 pm</p>	<p><b>SESSION 3A</b>  <b>LOCATION: ROOM 2007 (LEVEL 2 WEST)</b>  <b>SUN 11:00 AM TO 11:40 AM</b></p> <p><b>Sensors for AR/VR Headsets</b></p> <p>Session Chair: <b>Weichuan Gao</b>, Facebook Technologies, LLC (USA)</p> <p>11:00 am: <b>Eye-tracking for human-centered mixed reality: promises and challenges</b>, Aaron L. Gardony, U.S. Army Combat Capabilities Development Command Soldier Ctr. (USA) and Ctr. for Applied Brain and Cognitive Sciences, Tufts Univ. (USA); Robert W. Lindeman, Univ. of Canterbury (New Zealand); Tad T. Brunyé, U.S. Army Combat Capabilities Development Command Soldier Ctr. (USA) and Ctr. for Applied Brain and Cognitive Sciences, Tufts Univ. (USA) . . . . . [11310-27]</p> <p>11:20 am: <b>Qualitative and quantitative visual information detected by portable eye tracking technology</b>, Nuno Alão, Univ. de Lisboa (Portugal) . . . . . [11310-28]</p> <p>Lunch Break . . . . . Sun 12:00 pm to 12:50 pm</p>
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**Optical Design Challenge Pitches**  
**LOCATION: ROOM 2003 (LEVEL 2 WEST) • 12:50 PM TO 1:50 PM**  
 Optical Design Challenge contestants will give 10-minute pitches on their cutting edge research.

<p><b>POSTER SESSION</b>  <b>LOCATION: ROOM 2003 (LEVEL 2 WEST) • SUN 1:50 PM TO 2:50 PM</b></p> <p><i>Conference attendees are invited to attend the AR, VR, MR poster session on Sunday afternoon. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.</i></p> <p><b>Poster Setup:</b> 8:00 AM - 12:00 PM • View guidelines and set-up instructions at <a href="http://spie.org/AVRposter">http://spie.org/AVRposter</a></p>			
<p>Optical Design Challenge contestant posters</p>			
<p><b>A retinal-scanning-based near-eye display with diffractive optical element</b>, Lantian Mi, Chao Ping Chen, Wenbo Zhang, Yifan Lu, Jie Chen, Nizamuddin Maitlo (China) . . . . . [11310-1]</p> <p><b>Planar optics enables chromatic aberration correction in immersive near-eye displays</b>, Tao Zhan, Junyu Zou, Hao Chen, Jilin Yang, Sheng Liu, Yajie Dong, Shin-Tson Wu, (USA) and Xiaomin Liu (China) . . . . . [11310-2]</p> <p><b>A foveated intraocular display on contact lens for augmented reality</b>, Jie Chen, Lantian Mi, Jinghui Jiang, Haowen Liu, Chaoping Chen, Wenbo Zhang, Nizamuddin Maitlo (China) . . . . . [11310-3]</p>	<p><b>Variable zoom using rotating Toroidal lenses for AR glasses</b>, Megan Arlt and Hossein Shahinian (USA) . . . . . [11310-4]</p> <p><b>Computing high quality phase-only holograms for holographic displays</b>, Praneeth Kumar (USA) . . . . . [11310-5]</p> <p><b>A portable projection mapping device for medical augmented reality</b>, Shuya Liu, Wei-Lun Huang, and Mehran Armand (USA) . [11310-6]</p>	<p><b>Holographic AR display based on the cylindrical holographic optical element for wide viewing zone</b>, Yusuke Sando, Kazuo Satoh, Osaka Research Institute of Industrial Science and Technology (Japan); Daisuke Barada, Toyohiko Yatagai, Utsunomiya Univ. (Japan) . [11310-49]</p> <p><b>Ultracompact eye and pupil tracking device using VCSEL arrays and position sensitive detector</b>, Suguru Sangu, Tatsuya Shimokawa, Shu Tanaka, Ricoh Co., Ltd. (Japan) . . . . . [11310-50]</p>	<p><b>Virtual scalpel simulation in the VR and AR environments</b>, Larisa A. Zherdeva, Independent Researcher/ Developer (Russian Federation); Konstantin V. Cherepanov, Samara Univ. (Russian Federation); Denis A. Zherdev, Image Processing Systems Institute of the RAS (Russian Federation) and Samara Univ. (Russian Federation) . . . . . [11310-51]</p> <p><b>Eyeball camera based calibration and system performance verification for spatial computing systems</b>, Zhiheng Jia, Hyunsun Chung, Jeffrey Daiker, Sina Sedighi, Daniel Dominguez, Jeremy Grata, Hudson Welch, Magic Leap, Inc. (USA) . . . . . [11310-52]</p>

# SUNDAY TECHNICAL PRESENTATIONS

SESSIONS 4A - 4D RUN CONCURRENTLY.

**SESSION 4A**  
**LOCATION: ROOM 2007**  
**(LEVEL 2 WEST)**  
**SUN 3:00 PM TO 5:00 PM**

## AR Display Building Blocks

Session Chair: **Bernard C. Kress**, Microsoft Corp. (USA)

3:00 pm: **Utilisation of micron scale LED arrays as display projection light sources**, Kat Vinden, Samir Mezouari, Plessey Semiconductors Ltd. (United Kingdom) . . . . . [11310-29]

3:20 pm: **Holographic near-eye 3D display based on amplitude-only wavefront modulation**, Chenliang Chang, Wei Cui, Liang Gao, Univ. of Illinois (USA) . . . . . [11310-30]

3:40 pm: **Angular and spatial light modulation by single digital micromirror device for display applications**, Brandon Hellman, Ted Lee, Yuzuru Takashima, Wyant College of Optical Sciences (USA) . . . . . [11310-31]

4:00 pm: **High dynamic range near eye displays**, Yang Zhao, Nathan Matsuda, Xuan Wang, Marina Zannoli, Douglas Lanman, Facebook Reality Labs. (USA) . . . . . [11310-32]

4:20 pm: **A novel micro LED microdisplay platform for AR/MR that offers both high brightness and high efficiency with manufacturing scalability**, Vikas R. Dhurka, Vincent Lee, Brian R. Tull, Lumiod, Inc. (USA) . . . . . [11310-33]

4:40 pm: **Monolithic and heterogeneous integration of RGB micro-LED arrays with pixel-level optics array and CMOS image processor to enable small form-factor display applications**, Kameshwar Yadavalli, Chih-Li Chuang, Hussein S El-Ghoroury, Ostendo Technologies Inc (USA) . . . . . [11310-78]

**SESSION 4B**  
**LOCATION: ROOM 2009**  
**(LEVEL 2 WEST)**  
**SUN 3:00 PM TO 5:00 PM**

## Fabrication Processes, Materials, and Design Tools for AR

Session Chair: **Christophe Peroz**, Magic Leap, Inc. (USA)

3:00 pm: **Nanoimprint lithography for AR waveguides manufacturing**, Martin Eibelhuber, EV Group (Austria) . . . . . [11310-34]

3:20 pm: **Index-matched polymers for augmented reality applications**, Patrick Heissler, Markus Brehm, Isabel Pilottek, DELO Industrie Klebstoffe GmbH & Co. KGaA (Germany) . . . . . [11310-35]

3:40 pm: **High refractive index glass wafers for augmented reality – review of recent innovations enabling the ecosystem to implement the industry roadmap**, Ruediger Sprengard, Peter Nass, Frederik Bachhuber, Clemens Ottermann, Stefan Weidlich, Volker Dietrich, Berthold Lange, Volker Plapper, SCHOTT AG (Germany); Dirk Apitz, Ulf Brauneck, Alo Lo, SCHOTT Suisse SA (Switzerland); Helen Fang, Alex Wang, SCHOTT Glass Technologies Co., Ltd. (China) . . . . . [11310-36]

4:00 pm: **ALLVAR alloys for smaller and lighter optics**, James A. Monroe, Jay Zgarba, Jeremy S. McAllister, David Content, ALLVAR (USA) . . . . . [11310-37]

4:20 pm: **Physical-optics analysis of lightguides for augmented and mixed reality glasses**, Christian Hellmann, Wyrowski Photonics GmbH (Germany); Stefan Steiner, Roberto Knoth, Site Zhang, LightTrans International UG (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11310-38]

4:40 pm: **Fabrication of polymeric freeform lenses by magnetically assisted printing of liquid molds**, Mojtaba Falahati, Washington State University (USA) . . . . . [11310-76]

**SESSION 4C**  
**LOCATION: ROOM 2011**  
**(LEVEL 2 WEST)**  
**SUN 3:00 PM TO 4:20 PM**

## Applied AR/VR

Session Chair: **Rubén Mohedano**, Limbak 4PI S.L. (Spain)

3:00 pm: **VR archaeological museum with applying at student education processes**, Denis A. Zherdev, Image Processing Systems Institute of the RAS (Russian Federation) and Samara Univ. (Russian Federation); Evgeniy Y. Minaev, Samara Univ. (Russian Federation); Vladimir A. Fursov, Samara Univ. (Russian Federation) and Image Processing Systems Institute of the RAS (Russian Federation) . . . . . [11310-39]

3:20 pm: **The impact of color coding in Virtual Reality navigation tasks**, Yiran (Thea) Wang, Univ. of Alberta (Canada) . . . . . [11310-40]

3:40 pm: **XR methodology on precision imaging optimized in vivo system**, Hua Liu, Science and Technology on Electro-optic Control Lab. (China) . . . . . [11310-41]

4:00 pm: **Development tools with augmented reality (AR) for the industry**, Carlos Alberto Orta, Miguel Martin Cardenas Lopez, Luis Valentin Coronado, Gustavo Acevedo Ramirez, Centro de Investigaciones en Óptica, A.C. (Mexico) . . [11310-43]

**SESSION 4D**  
**LOCATION: ROOM 2008**  
**(LEVEL 2 WEST)**  
**SUN 3:00 PM TO 4:20 PM**

## New Technologies in VR

Session Chair: **Pablo Benítez**, Univ. Politécnica de Madrid (Spain)

3:00 pm: **Lynx: an untethered video see-through head-mounted display for mixed reality**, Stan Larroque, SL Process (France) . . . . . [11310-44]

3:20 pm: **Enhancing immersive experience through smart apparel**, Amir Servati, Zenan Jiang, Harishkumar Narayana, Texavie (Canada); Ayumi Imaizumi, Su Thida Htun, Sapna Srinivasan, Texavie (Canada); Saeid Soltanian, Frank Ko, Peyman Servati, The Univ. of British Columbia (Canada) . . . . . [11310-46]

3:40 pm: **Portal to knowledge: a virtual library using marker-less augmented reality system for mobile devices**, Yashas Joshi, Immersive & Creative Technologies Lab, Concordia University (Canada); Charalambos Poullis, Concordia Univ. (Canada) . . . . . [11310-48]

4:00 pm: **Universal electro-optically tunable metasurfaces for wavefront control**, Harry A. Atwater Jr., Caltech (USA) . . . . . [11310-77]

## Optical Design Challenge Awards and Reception

5:00 PM TO 6:30 PM • LOCATION: ROOM 2003 (LEVEL 2 WEST)

All conference attendees are welcome to enjoy refreshments and network with colleagues. Optical Design Challenge winners will be awarded: 1st, 2nd, and 3rd prizes.



## Hear from the leading experts in the field of AR, VR, MR at the 2020 Conference

Plan to attend and listen to over 40 keynotes providing the latest insights from the biggest names in the tech industry and up-and-coming XR companies.

### INDUSTRY TALKS AND PANELS

**LOCATION: ROOM 2003 (LEVEL 2 WEST)**

Monday 3 February 2020  
8:30 AM TO 6:30 PM

Tuesday 4 February 2020  
8:30 AM TO 6:30 PM

#### Monday Invited Industry Talks and Panels

8:30 AM		<b>Bernard Kress</b> Microsoft HoloLens <b>Opening address</b>	10:30 AM		<b>Marty Banks</b> UC Berkeley <b>Are Leads and Lags of Accommodation Real?</b>
8:50 AM		<b>Jerry Carollo</b> Google <b>Square Pegs Round Holes</b>	10:50 AM		<b>Jonghyun Kim</b> Nvidia <b>ModuAR: AR-convertible prescription glasses</b>
9:10 AM		<b>Edgar Auslander</b> Facebook <b>Perspectives on the role of AI in AR and VR</b>	11:10 AM		<b>Nataliya Kosmyna</b> MIT <b>AttentivU: a Wearable Pair of EEG and EOG Glasses for Real-Time Physiological Processing</b>
9:30 AM		<b>Gordon Wetzstein</b> Stanford University <b>Computational Eyeglasses and Near-eye Displays with Focus Cues</b>	11:30 AM		<b>Darran Milne</b> VividQ <b>Unlocking the key technical drivers needed to advance AR consumer wearables</b>
9:50 AM		<b>Ilmars Osmanis</b> LightSpace Technologies <b>Multi focal near eye AR display architecture to solve the vergence-accommodation problem</b>	<b>PANEL SESSION</b> , See p. 90 <b>MONDAY 3 FEBRUARY • 11:50 AM TO 12:30 PM</b> <b>What is the Potential Market for the AR, VR Industry?</b> <b>Tom Emrich</b> , 8th Wall, AR/Wearables Pioneer		
10:10 AM		<b>Kevin Zhong</b> DreamWorld Vision <b>Laser safety Considerations in Laser-related Head Mounted Displays</b>	12:35 PM		<b>Mikio Iwamura</b> NTT Docomo <b>A New Paradigm Begins with 5G and XR</b>

# INDUSTRY TALKS AND PANELS

## Monday Invited Industry Talks and Panels continued

12:55 PM		<b>Stefan Alexander</b> North <b>Smartglasses vs Mixed Reality: Hardware, Use Cases, and Convergence</b>
1:15 PM		<b>Chi Xu</b> nreal
1:35 PM		<b>Kai Jens Ströder</b> tooz technologies <b>Are Consumers Ready for Smart AR Glasses Mass adoption?</b>
1:55 PM		<b>Hiroshi Mukawa</b> SONY <b>Latency Compensation for Optical See-Through AR Headsets</b>
2:15 PM		<b>Michael Klug</b> Magic Leap
2:35 PM		<b>Mark Bolas</b> Microsoft
2:55 PM		<b>David Fattal</b> LEIA <b>The Beauty of Lightfields</b>
3:15 PM		<b>Nigel Burton</b> Realmax <b>Using Augmented Reality Glasses in Multi-User Shared Experiences</b>
3:35 PM		<b>Robert Schultz</b> Vuzix <b>Exceeding Expectations in AR Design</b>
3:55 PM		<b>Eugene Panich</b> Almalence <b>Achieving Eye-Clean Visual Fidelity: How Eye Tracking and Digital Lens Correction Enable a Breakthrough in VR/AR HMD Picture Clarity</b>
4:15 PM		<b>Ed Tang</b> Avegant <b>Foveation is Coming</b>

4:35 PM		<b>Klaus Melakari</b> Varjo <b>Immersive Mixed Reality</b>
4:45 PM		<b>Doug Lanman</b> Facebook Reality Labs <b>Display Systems Research at Facebook Reality Labs</b>
<b>PANEL SESSION</b> , See p. 90 MONDAY 3 FEBRUARY • 5:15 to 6 PM <b>How do we build the AR, VR World with Hardware?</b>		

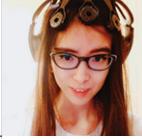
Reception to follow - Moscone West, Level 2 Lobby

## Tuesday Invited Industry Talks and Panels

8:30 AM		<b>Bernard Kress</b> Microsoft HoloLens <b>Opening Address</b>
		AWARD PRESENTATION <b>Pablo Benitez</b> LIMBAK <b>SPIE A. E. Conrady Award in Optical Engineering</b>
8:50 AM		<b>Mikihiko Sano</b> AGC <b>High Refractive Index Glass Substrates and Optical Components for AR/MR Devices</b>
9:10 AM		<b>Xavier Lafosse</b> Corning <b>High-Index Glass Substrates for Augmented Reality Displays</b>
9:30 AM		<b>Rüdiger Sprengard</b> SCHOTT <b>Guiding and Harnessing Light: High Index Waveguides and Optical Materials Enabling AR Devices</b>
9:50 AM		<b>Thomas Glinsner</b> EV Group <b>Enabling High Volume Manufacturing for AR Applications Using Nanoimprint Lithography</b>
10:10 AM		<b>Donna Qin</b> HOYA CANDEO <b>HOYA's Solutions for Wave-guide Related Market</b>
10:30 AM		<b>Omkaram Nalamasu</b> Applied Ventures

Tuesday Invited Industry Talks and Panels continued

10:50 AM		<b>Antti Sunnari</b> Despelix
11:10 AM		<b>Phil Greenhalgh</b> WaveOptics <b>Diffractive and Reflective Waveguides: A Game of Trade-Offs</b>
<b>PANEL SESSION</b> , See p. 90 TUESDAY 4 FEBRUARY • 11:30 AM to 12:15 PM <b>What It's Like to be a Start-Up in 2020</b> Christina Ingwalson, Health Scholars		
12:25 PM		<b>Iginio Padovani</b> BOSCH
12:45 PM		<b>Harry Atwater</b> California Institute of Technology <b>Electronically Tunable Metasurfaces for Reconfigurable Wavefront Control</b>
1:05 PM		<b>Soon-gi Park</b> LetinAR <b>PinMR: From Concept to Reality</b>
1:25 PM		<b>Jonathan Waldern</b> DigiLens <b>Electro-Optic Photopolymer Waveguide Technology for Compact Wide Field of View MR Glasses</b>
1:45 PM		<b>Zheng Yu</b> LingXi AR <b>Perspectives on Microdisplay Technology in AR Waveguide Optical Solutions</b>
2:05 PM		<b>Hakan Urey</b> CY Vision <b>Computational Holographic Displays for AR Glasses and AR-HUDs</b>
2:25 PM		<b>Rich Madison</b> Thales Visionix <b>Head Tracking for Roving AR</b>
2:45 PM		<b>Ronald Azuma</b> Intel

3:05 PM		<b>Stan Larroque</b> Lynx <b>Lynx: First Standalone Device for Video See-through Mixed Reality</b>
3:25 PM		<b>Kelly Peng</b> Kura AR <b>Gallium: High-Performance AR Through Multi-Disciplinary Inventions on Displays, Optics, and More</b>
3:45 PM		<b>Marcus Duell</b> EXALOS <b>Progress on RGB Superluminescent LEDs for AR/MR Display Applications</b>
4:05 PM		<b>Vincent Lee</b> Lumiode
4:25 PM		<b>Srinivasa Banna</b> Lumileds <b>MicroLED Technology for AR/VR Displays</b>
4:45 PM		<b>Mike Stover</b> Jasper Display <b>JDC Paving the Way for MicroLED Microdisplays to Get to Market</b>
5:05 PM		<b>Mike Browne</b> SA Photonics
<b>PANEL SESSION</b> , See p. 90 TUESDAY 4 FEBRUARY • 5:25 to 6:10 PM <b>Micro-LEDs: The Hot, New, Vital Building Blocks of AR, VR</b> Brian Schowengerdt, Magic Leap		

Reception to follow - Moscone West, Level 2 Lobby

# PANEL SESSIONS

## What is the Potential Market for the AR, VR Industry?

Monday 3 February 2020 • 11:50 AM - 12:30 PM

Location: Room 2003 (Level 2 West)

Attend the panel on potential markets moderated by Tom Emrich



MODERATOR:

**Tom Emrich**

8th Wall,

AR/Wearables Pioneer (USA)

## How Do We Build the AR, VR World with Hardware?

Monday 3 February 2020 • 5:15 PM - 6:00 PM

Location: Room 2003 (Level 2 West)

Do you think that optical solutions are developed with serious consideration of all relevant product needs and not just optical/display metrics?

Do you think that every big company will get their own homegrown optical solution (like Microsoft and ML) for better integration and productization? If not - what viable combo of display and optics solutions you see down the road for easy integration?

What optical features/metrics you are willing to compromise to deliver best comfortable and battery sufficient device?



MODERATOR:

**Svetlana Samoilova**

NewSight Reality (USA)

PANELISTS:



**Stefan Alexander**

Vice President  
Advanced R&D,  
North (USA)



**John Haddick**

Lenovo consult,  
prior CTO,  
ODG (USA)



**Jeri Ellsworth**

CEO at Tilt Five and  
founder,  
CastAR (USA)



**Yochay Danziger**

CTO,  
Lumus (Israel)

## What It's Like to Be a Start-Up in 2020

Tuesday 4 February 2020 • 11:30 AM - 12:15 PM

Location: Room 2003 (Level 2 West)

Join us live for our start-up-focused panel, where we will be looking at what it's like to grow a business in the current XR climate and the challenges start-ups have to overcome.



MODERATOR:

**Christina Ingwalson**

VP Marketing & Communications  
Health Scholars (USA)

PANELISTS:



**Marryam Chaudry**

CEO,  
XR2Lead (USA)



**Jeff Meador**

Founder,  
JMXR.pro (USA)



**Joe Connolly**

Founder,  
Sketchbox (USA)



**Amy Hedrick**

CEO,  
CleanBox Technology  
(USA)

## Micro-LEDs: The Hot, New, Vital Building Blocks of AR, VR

Tuesday 4 February 2020 • 5:00 PM - 6:00 PM

Location: Room 2003 (Level 2 West)

Lots of people are interested today in iLED arrays (Mini and Micro), but no one really seems to know which implementation will be best suited for AR, and when it will be ready for primetime (2022, 2023 or beyond?). Should they be on silicon backplane or rather on glass LTPS backplane? What about plastic backplane? Brian will ask these questions and more.



MODERATOR:

**Brian Schowengerdt**

co-founder  
Magic Leap (USA)

[Monday Evening Reception to follow](#)

[Tuesday Evening Reception to follow](#)

**Student Optical Design Challenge Pitches**

Sunday 2 February 2020 • 12:50 PM - 1:50 PM  
 Location: Room 2003 (Level 2 West)

Watch students from a variety of institutions present their cutting-edge research aimed at improving any aspects of the optics in virtual reality (VR), augmented reality (AR), and mixed reality (MR).

**Poster Session**

Sunday 2 February 2020 • 1:50 PM - 2:50 PM  
 Location: Room 2003 (Level 2 West)

Conference attendees are invited to attend the poster session on Sunday afternoon. Come view the posters, enjoy beverages, and ask questions. Authors of poster papers and Optical Design Challenge participants will be present to answer questions concerning their posters. Attendees are required to wear their conference registration badges to the poster session.

**Poster Set-Up: 8:00 AM - 11:50 AM**

**Extended Poster Viewing: 8:00 AM - 11:50 AM and 2:00 PM - 5:30 PM**

**Optical Design Challenge Awards and Reception**

Sunday 2 February 2020 • 5:00 PM - 6:30 PM  
 Location: Room 2003 (Level 2 West)

All conference attendees are welcome to enjoy refreshments and network with colleagues. Optical Design Challenge winners will be awarded: 1st, 2nd, and 3rd prizes.

**AR, VR, MR Reception: Monday Evening**

Monday 3 February 2020 • 6:00 PM - 7:00 PM  
 Location: Lobby (Level 2 West)

Network after the panel session.

**2020 SPIE A.E. Conrady Award in Optical Engineering**

Tuesday 4 February 2020 • 8:30 AM - 8:40 AM  
 Location: Room 2011 (Level 2 West)

The SPIE A. E. Conrady Award in Optical Engineering is presented in recognition of exceptional contributions in design, construction, testing and theory of optical and illumination systems and instrumentation.

Pablo Benitez, Universidad Politécnicade Madrid and LIMBAK, Madrid, Spain, is the 2020 recipient of the SPIE A.E. Conrady Award in Optical Engineering in recognition of pioneering discoveries in both Nonimaging and Imaging optics, including the simultaneous multiple surface (SMS) method of optical design for freeform surfaces.

The award will be presented by Bernard Kress, Microsoft HoloLens and SPIE President, John Greivenkamp.



**AWARD WINNER:**  
**Pablo Benitez**  
 Universidad Politécnicade Madrid;  
 co-founder and CTO, LIMBAK (Spain)

**Meet the Authors Event**

Tuesday 4 February 2020 • 2:00 PM - 3:00 PM  
 Location: Moscone West, Level 2 Lobby

Come and meet PJoseph Goodman, father of modern Fourier Optics, a field which enabled many of the optical technologies used today in AR/VR. SPIE will be publishing Joe’s new edition on “Speckle Phenomena in Optics”. This is a unique opportunity to get to chat with Joe and have all of your previous “Goodman Books” autographed. Bernard Kress, for whom Joe was a terrific mentor, will be signing also his own new book on “Optical Architectures for AR,VR and MR headsets”.



**Bernard Kress**  
 Partner Optical Architect  
 Microsoft / HoloLens (USA)

Over the past two decades, Bernard Kress has made significant scientific contributions as an engineer, researcher, associate professor, consultant, instructor, and author. He has been instrumental in developing numerous optical sub-systems for consumer and industrial products, generating IP, teaching and transferring technological solutions to industry. Application sectors include laser materials processing, optical anti-counterfeiting, biotech sensors, optical telecom devices, optical data storage, optical computing, optical motion sensors, digital displays systems, and eventually HUD and HMD displays (smart glasses, AR/MR/VR). Bernard has been specifically involved in the field of micro-optics, wafer scale optics, holography and nano-photonics. He has published half a dozen books and has more than 35 patents granted. He is a short course instructor for the SPIE and has been chair of various SPIE conferences. He is an SPIE fellow since 2013 and has been elected to the board of Directors of SPIE (2017-19). Bernard has joined Google [X] Labs in 2011 as the Principal Optical Architect on the Google Glass project, and is since 2015 the Partner Optical Architect at Microsoft on the HoloLens project.



**Joe Goodman**  
 Emeritus Professor of Electrical Engineering  
 Stanford University (USA)

Joseph W. Goodman received an A.B. Degree from Harvard, an M.S degree and Ph.D. degree, both from Stanford University in Electrical Engineering. After 4 years on the research staff at Stanford, he joined the faculty of the Department of Electrical Engineering. He chaired the department from 1989 to 1996, following which he served as Senior Associate Dean of Engineering until 1999. He retired from Stanford in January of 2001. Dr. Goodman is the author of the books Introduction to Fourier Optics (now in its 4th edition), Statistical Optics (now in its 2nd edition), Speckle Phenomena in Optics (now in its 2nd edition), and co-author of Fourier Transforms: An Introduction for Engineers. He is the author of more than 200 scientific and technical papers, and has been primary research supervisor for 49 Ph.D.s. He has received numerous awards from the I.E.E.E., the A.S.E.E., the O.S.A., the S.P.I.E., including the highest awards given by the latter two societies. Goodman was a co-founder of Optivision, Inc., ONI Systems (now part of Ciena), and served as a member of the board of directors of E-TEK Dynamics (now part of JDS Uniphase).

**AR, VR, MR Reception: Tuesday Evening**

Tuesday 4 February 2020 • 6:00 PM - 7:00 PM  
 Location: Lobby (Level 2 West)

Network after the panel session.



## AR, VR, MR Expo with hands-on demos of the latest XR gear

### NETWORK, CONNECT, AND SEE THE LATEST GEAR

Come to the Expo to meet with the biggest names in consumer electronics and up-and-coming XR companies. Whether you are looking for a job, want to talk about the next research developments, or just try out the latest AR, VR, MR hardware, this is the place you want to be.

### EXPO + DEMOS

LOCATION: ROOM 2004 (LEVEL 2 WEST)

Monday 3 February 2020  
10:00 AM TO 5:00 PM

Tuesday 4 February 2020  
10:00 AM TO 5:00 PM

### 2020 EXHIBITORS



## Courses and Workshops— A Week of Learning and Networking

### PERSONAL INSTRUCTION FROM LEADING EXPERTS

Take a course, or join a workshop, and get face-to-face instruction on some of the most popular sessions in optical design for AR, VR, and MR. Courses range from 2-hour to two-day formats. Workshops range from 30 minutes to 2 hours. Join your colleagues, meet new contacts, and learn from the best in the industry.

### COURSES

#### Head-Mounted Display Requirements and Designs for Augmented Reality Applications

SC1096 • Course Level: Introductory • CEU: 0.7  
\$695 Members • \$401 Student Members • \$815 Non-Members USD  
Sunday 8:30 am to 5:30 pm

#### Introduction to VR, AR, MR and Smart Eyewear: Market Expectations, Hardware Requirements and Investment Patterns

SC1234 • Course Level: Introductory • CEU: 0.2  
\$270 Members • \$193 Student Members • \$295 Non-Members USD  
Sunday 8:30 am to 10:30 am

#### Optical Technologies and Architectures for Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) Head-Mounted Displays (HMDs)

SC1218 • Course Level: Intermediate • CEU: 0.7  
\$685 Members • \$397 Student Members • \$805 Non-Members USD  
Wednesday 8:30 am to 5:30 pm

#### Design Techniques and Applications Fields for Digital Micro-optics

SC1125 • Course Level: Intermediate • CEU: 0.7  
\$685 Members • \$397 Student Members • \$805 Non-Members USD  
Thursday 8:30 am to 5:30 pm

SATURDAY-THURSDAY  
COURSES AND WORKSHOPS

REGISTER FOR COURSES  
AT THE SPIE CASHIER

### COURSES AT PHOTONICS WEST THAT MIGHT ALSO INTEREST YOU

#### Additional registration and fees required

- Saturday, all day: Understanding Diffractive Optics
- Monday, all day: Polarized Light and Optical Design
- Tuesday, all day: Introduction to Optical Alignment Techniques
- Wednesday, 8:30 AM - 12:30 PM: Meta-Lenses
- Wednesday, 8:30 AM - 12:30 PM: Designing and Specifying Digital Cameras

View the complete list of courses online.

### WORKSHOPS

#### Spatial Mapping of Refractive Index Modulation for Improved AR Holographic Waveguide Manufacture

Monday 3 February 2020 • 10:00 AM - 11:00 AM  
Location: Room 2009 (Level 2 West)

Come hear the CTO of DigiLens talk about their holographic waveguide display technology for augmented reality applications.



SPEAKER:  
**Jonathan Waldern**  
Founder, Chairman & CTO  
DigiLens

## WORKSHOPS

### Invention to Impact

Monday 3 February 2020 • 11:15 AM - 12:15 PM

Location: Room 2009 (Level 2 West)



SPEAKER:

**Anna Brady-Estevez**

Program Director for Blockchain, DAGs, Chemical, and Environmental Tech, National Science Foundation SBIR (USA)

Innovation programs at the National Science Foundation (NSF) advance ideas from the lab to the marketplace to strengthen America's economy, health, and security. The Division of Industrial Innovation and Partnerships (IIP) in the Engineering Directorate leads several programs to translate fundamental research into market solutions. IIP supports researchers with promising technologies, as well as funding high-tech startups. Learn about the NSF's central role in accelerating the growth of the national ecosystem and hear about specific funding opportunities.

SPONSORED BY:



### Building a Mass Manufacturing Capability for Augmented Reality Waveguides

Monday 3 February 2020 • 1:30 PM - 2:45 PM

Location: Room 2009 (Level 2 West)

WaveOptics patented diffractive waveguides have the broadest range of fields of view and can be readily customised for augmented reality smart glasses and headsets. WaveOptics' technology was designed with mass manufacture in mind. Our waveguides enable crisp, clear imagery, that can be manufactured affordably, at scale, even with a custom design. Striking this balance is key to unlocking the potential of augmented reality for the mass market. Our joint workshop with Goertek Optoelectronics, a leading manufacturer in the AR/VR industry, will focus on the core processing principles of WaveOptics technology and how WaveOptics and Goertek provide a volume manufacturing capability to meet the demands of any customer.

SPEAKERS:



**Phil Greenhalgh**

CTO,  
Wave Optics. (USA)



**Frank Rao**

General Manager of  
Optoelectronics  
Goertek (China)

### The Future of Traditional is Virtual: AR/VR/MR Technologies Moving into the Mainstream

Monday 3 February 2020 • 3:00 PM - 4:15 PM

Location: Room 2009 (Level 2 West)



SPEAKER:

**Andy Cochran**

The AV Club (USA)

### Smart Goggles for Swimming: Bringing AR into the Water

Monday 3 February 2020 • 4:30 PM - 5:30 PM

Location: Room 2009 (Level 2 West)

#### Designing augmented reality swimming goggles.



SPEAKER:

**Reynald Hoskinson**

VP Technology at FORM (USA)

Wearable fitness trackers have become ubiquitous, due in part to their low cost and simple use case. The predominant form factor for these trackers has been a band around the wrist. There are situations such as swimming, however, where a wrist-worn device is not very convenient because it requires you to stop your activity to consult the display. A near-to-eye display is an elegant solution to this problem, as almost all swimmers already wear eyewear in the form of goggles. Unlike fitness trackers, however, commercially available augmented reality displays are relatively expensive.

Google glass is above \$1000, Focals by North is currently \$599 USD, and more-feature rich platforms such as Microsoft HoloLens and Magic Leap One are more expensive still. Since swimming goggles are a relatively narrow application, consumers are unlikely to be very receptive to paying the kind of prices normally charged for gear designed for all occasions. On the other hand, focusing on a specific use case means that as augmented reality eyewear designers, we can pare down the functionality of the device to only what is needed to support our use cases. This talk will present work on a lower-cost (\$200 consumer price) augmented reality system for swimming.

### Design Considerations for Rapid Prototype Freeforms for AR/VR Applications

Tuesday 4 February 2020 • 8:00 AM - 9:00 AM

Location: Room 2009 (Level 2 West)



SPEAKER:

**Jessica DeGroote Nelson**

Director of Technology and Strategy  
Optimax Systems (USA)

Being first to market is critical in the commercial sector. This presentation will overview optical design considerations for freeform optics that can make a difference when trying to get rapid prototype optics for AR/VR applications.

SPONSORED BY:



### Market Outlook & Implications for Sales & Marketing

Tuesday 4 February 2020 • 9:30 AM - 12:30 PM

Location: Room 2007 (Level 2 West)



INSTRUCTOR:

**Michele Nichols**

Launch Team Inc. (USA)

Join this session to learn drivers in the industries you serve, and how you can position your company and capabilities to meet the needs of emerging customer needs. Launch Team president Michele Nichols will address market outlook, regulatory and customer requirements that will impact sales and marketing, and today's winning strategies for companies from start-up to global market leaders. Bring your questions and specific challenges for actionable take-aways.

**The Holographic Display of the Future, Today**

Tuesday 4 February 2020 • 10:30 AM - 11:45 AM  
 Location: Room 2009 (Level 2 West)



**SPEAKER:**  
**Aleksandra Pedraszewska**  
 COO  
 VividQ (United Kingdom)

**From Virtual to Indistinguishable: How Disruptive Technologies will Enhance our Simulated Experiences**

Tuesday 4 February 2020 • 12:00 PM - 1:30 PM  
 Location: Room 2009 (Level 2 West)

Seeing the invisible, feeling the untouchable, experiencing the impossible. The only limits to AR, VR and XR will be the ones set by our imagination. Because the technologies for truly immersive adventures are rapidly becoming available. Imec allows you a window into the future of VR/AR/XR by demonstrating the latest advancements in:

- IR and 3D imagers for AR/VR applications
- Novel on-glass processing techniques
- Haptic feedback

**SPEAKERS:**



**Denis Marcon**  
 Senior Business Development Manager, imec (Belgium)



**Jiwon Lee**  
 Senior Image Sensor Pixel Designer, imec (Belgium)



**Xavier Rottenberg**  
 Scientific Director and Group Leader Wave-based Sensors and Actuators, imec (Belgium)

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**Key Legal Issues Facing the Optics / Tech Industry**

Tuesday 4 February 2020 • 1:00 PM - 4:00 PM  
 Location: Room 2007 (Level 2 West)



**SPEAKER:**  
**Kerry Scarlott**  
 BakerHostetler (USA) Don't miss this important, and free, access to legal insight and information from this optics-background legal team. Bring your questions, from IP law to export control issues. This session is aimed at both experienced entrepreneurs and those just starting out in the consumer electronics world. The session will cover information that anyone must know while operating in this space. Bring your questions.

**You Can Have It All: A Novel Waveguide Technology**

Tuesday 4 February 2020 • 1:45 PM - 3:00 PM  
 Location: Room 2009 (Level 2 West)

Come hear Dr. Amitai speak on Oorym's latest waveguide technology.



**SPEAKER:**  
**Yaakov Amitai**  
 Founder and CTO, Oorym (Israel)

**Systematic Design Approach for Lightguide Devices for AR/VR Applications in VirtualLab Fusion**

Tuesday 4 February 2020 • 3:30 PM - 4:40 PM  
 Location: Room 2009 (Level 2 West)

Lightguides in combination with gratings are one beneficial approach to combine the virtual image with the light impinging from the real-world environment. The design and modeling of such lightguides is very different from traditional lens design and there is still a lot of room for new ideas and innovation. Such devices are quite complex due to the unavoidable handling of a large field of view and different wavelengths and, consequently, numerous parameters must be considered in order to obtain a functional device which provides good image quality. We present a systematic approach to design lightguide devices which combines the benefits of functional and parametric design and optimization strategies. We will discuss typical design tasks, with emphasis on the trade-off between uniformity and system efficiency in different examples.

The analysis of lightguide devices including the coupling gratings requires a physical-optics modeling approach that goes beyond traditional ray tracing. The Fast Physical Optics technique in VirtualLab Fusion automatically considers the polarization of the in-coupled light, performs a fully vectorial grating analysis, and accounts for coherence, interference and diffraction effects in the analysis: all within a single software platform. We will explain the modeling concepts and demonstrate analysis results based on systematic designs with respect to various merit functions.

**LEARNING OUTCOMES:**

- Construction and modeling of lightguide devices with grating regions for in- and out-coupling of light.
- Systematic design workflow for lightguide devices, from functional design to parametric optimization.
- Evaluation of the performance of the complete lightguide device for different fields of view.

**INTENDED AUDIENCE:** Optical engineers, designers, researchers and students interested in lightguide devices for AR/VR applications.

**INSTRUCTORS:**



**Stefan Steiner**  
 LightTrans International UG (Germany)

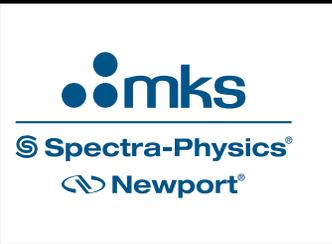
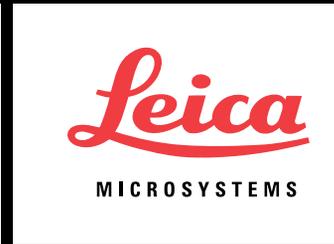
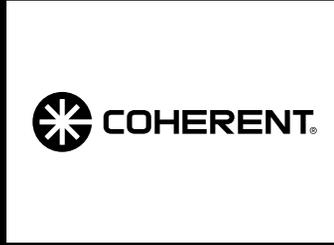


**Site Zhang**  
 LightTrans International UG (Germany)

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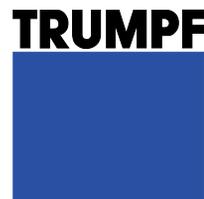
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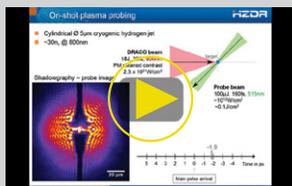
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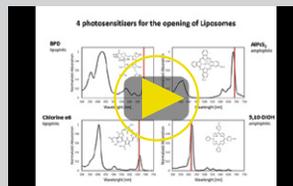
SEARCH >



16 August 2019

**Frontiers of applications of petawatt laser physics (Conference Presentation)**

[Ulrich Schramm](#)



23 August 2019

**Light-induced permeabilization of liposomes**

[Paula Enzian, et al.](#)



22 April 2019

**Chromatic line confocal technology in high-speed 3D surface-imaging applications**

[Karri Niemelä](#)

See the talks you missed.

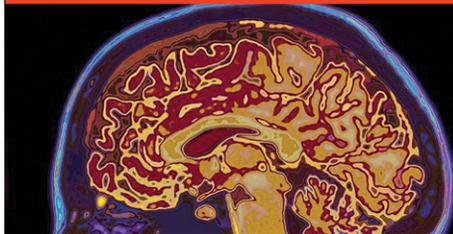
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# Applications Tracks

Learn about key technologies creating market opportunities and connect with people creating the future. Each track will highlight applicable papers—see conference listings for locations.



**Brain/Neuro Research, p. 100**      **Translational Research, p. 108**      **3D Printing, p. 119**



SPIE Brain 2020 will highlight papers that describe the development of innovative technologies that will increase our understanding of brain function.

- Clinical and Translational Neurophotonics, Optogenetics, and Optical Manipulation
- Clinical Technologies, Laser Tissue Interaction, and Tissue Engineering
- Spectroscopy, Microscopy, Imaging, Nanobiophotonics, and LASE
- Neurotechnology plenary speakers and details

SPIE Translational Research 2020 will highlight papers that showcase the latest photonics technologies, tools, and techniques with high potential to impact healthcare.

- Photonic Therapeutics and Diagnostics
- Neurophotonics, Neurosurgery, and Optogenetics
- Clinical Technologies and Systems
- Tissue Optics, Laser-Tissue Interaction, and Tissue Engineering
- Biomedical Spectroscopy, Microscopy, and Imaging
- Nano/Biophotonics

SPIE Applications of 3D Printing 2020 highlights papers that showcase innovative ways to apply this multidimensional/multidisciplinary technology.

- Additive Manufacturing
- Selective Laser Melting, Laser Sintering, Laser Photopolymerization
- Novel Materials, Protean Materials, and Laser Interactions
- Software that Increases Efficiencies and Speed
- In-situ Sensors or Probes to Verify and Quantify Additive Manufacturing Processes in Real Time
- Conformal Photonics/Electronics

**TRACK CHAIRS**



**David Boas**  
Boston Univ. (USA)



**Elizabeth Hillman**  
Columbia Univ. (USA)

**TRACK CHAIRS**



**Aaron Aguirre**  
Massachusetts General Hospital (USA)

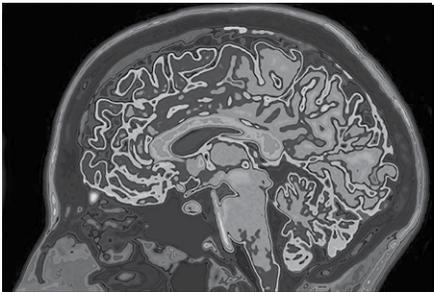


**Gabriela Apiou**  
Harvard Medical School, Wellman Ctr. for Photomedicine, Massachusetts General Hospital (USA)

**TRACK CHAIR**



**Henry Helvajian**  
The Aerospace Corp. (USA)



## BRAIN 2020

SPIE Brain 2020 will highlight papers that describe the development of innovative technologies that will increase our understanding of brain function.

- Clinical and Translational Neurophotonics, Optogenetics, and Optical Manipulation
- Clinical Technologies, Laser Tissue Interaction, and Tissue Engineering
- Spectroscopy, Microscopy, Imaging, Nanobiophotonics, and LASE

### SUNDAY SPECIAL EVENT:

Neurotechnologies Plenary Session, see page 12 for details.

### TRACK CHAIRS



**David Boas**  
Boston Univ. (USA)



**Elizabeth Hillman**  
Columbia Univ. (USA)

### Saturday 1 February 2020

#### Wearable time-domain near-infrared spectroscopy system

Paper 11237-1  
Author(s): Michele Lacerenza, Politecnico di Milano (Italy), et al.  
Conference 11237: Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables  
Session 1: Wearable Optical Sensing Techniques I  
Date and Time: 2/1/20 8:30 AM

#### Ambient noise reduction in cerebral NIRS based on frequency division multiplexing

Paper 11237-2  
Author(s): Shahbaz Askari, The Univ. of British Columbia (Canada), et al.  
Conference 11237: Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables  
Session 1: Wearable Optical Sensing Techniques I  
Date and Time: 2/1/20 8:50 AM

#### Probing the mechanisms of infrared neural stimulation with stimulated Raman scattering microscopy

Paper 11252-3  
Author(s): Wilson R. Adams, Vanderbilt Univ. (USA), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 1: CARS, SRS, Raman Innovation and Applications I  
Date and Time: 2/1/20 8:50 AM

#### Collaborative medical robot for OCT imaging motion compensation

Paper 11225-1  
Author(s): Robnier Reyes, Ryerson Univ. (Canada), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 1: Optical Spectroscopy: Pre-Clinical I  
Date and Time: 2/1/20 9:10 AM

#### Holographic display for optical retinal prosthesis: design and validation

Paper 11218-5  
Author(s): Shani Rosen, Technion-Israel Institute of Technology (Israel), et al.  
Conference 11218: Ophthalmic Technologies XXX  
Session 1: Imaging, Surgery, and Therapy: New Technologies I  
Date and Time: 2/1/20 9:15 AM

#### Optical modulation and functional mapping of cortical activities using molecular actuator-sensor

Paper 11227-3  
Author(s): Darryl Narcisse, Nanoscope Technologies, LLC (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 2: Optogenetics I  
Date and Time: 2/1/20 9:20 AM

#### Multiplanes line-scanning confocal microscopy for high-speed fluorescence imaging

Paper 11250-3  
Author(s): Jean-Marc Tsang, Boston Univ. (USA), et al.  
Conference 11250: High-Speed Biomedical Imaging and Spectroscopy V  
Session 1: High-Speed Volumetric Imaging  
Date and Time: 2/1/20 9:30 AM

#### Feasibility study of using optical coherence tomography for ex-vivo pituitary adenoma biopsies screening

Paper 11225-2  
Author(s): Fabian Placzek, Medizinische Univ. Wien (Austria), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 1: Optical Spectroscopy: Pre-Clinical I  
Date and Time: 2/1/20 9:30 AM

#### Going wireless: an optical imaging and optogenetics system for use in awake behaving primates

Paper 11227-4  
Author(s): Mykyta Chernov, Oregon Health & Science Univ. (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 2: Optogenetics I  
Date and Time: 2/1/20 9:40 AM

#### Combined low frequency EEG and NIRS measurement during hypoxic breathing

Paper 11237-5  
Author(s): Shahbaz Askari, The Univ. of British Columbia (Canada), et al.  
Conference 11237: Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables  
Session 1: Wearable Optical Sensing Techniques I  
Date and Time: 2/1/20 9:50 AM

#### Error-propagation approach to design of a CW NIRS instrument for deep layer measurements: neonate head application

Paper 11225-4  
Author(s): Paul Letendre, CEA-LETI (France), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 2: Optical Spectroscopy: Pre-Clinical II  
Date and Time: 2/1/20 10:40 AM

#### Accurate identification of the superficial layer for a NIRS short-channel approach: neonate cerebral oximetry application

Paper 11225-5  
Author(s): Paul Letendre, CEA-LETI (France), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 2: Optical Spectroscopy: Pre-Clinical II  
Date and Time: 2/1/20 11:00 AM

**Large-scale femtosecond holography for near simultaneous optogenetic neural modulation**

Paper 11227-8

Author(s): Meng Cui, Purdue Univ. (USA), et al.  
 Conference 11227: Optogenetics and Optical Manipulation 2020  
 Session 3: Optogenetics II  
 Date and Time: 2/1/20 11:30 AM

**Optical gearbox for kHz frame rate imaging**

Paper 11250-8

Author(s): Meng Cui, Purdue Univ. (USA), et al.  
 Conference 11250: High-Speed Biomedical Imaging and Spectroscopy V  
 Session 2: High-Speed Fluorescence Imaging  
 Date and Time: 2/1/20 11:45 AM

**Development of fiber-based all-optical system for neurovascular coupling mechanism study using optogenetics**

Paper 11227-10

Author(s): Minkyung Kim, Korea Institute of Science and Technology (Korea, Republic of), et al.  
 Conference 11227: Optogenetics and Optical Manipulation 2020  
 Session 3: Optogenetics II  
 Date and Time: 2/1/20 12:10 PM

**Effects of wavelength on transcranial laser stimulation: a Monte Carlo simulation study based on standard brain model**

Paper 11221-10

Author(s): Fenghua Tian, The Univ. of Texas at Arlington (USA), et al.  
 Conference 11221: Mechanisms of Photobiomodulation Therapy XV  
 Session 2: Modeling PBM Dosimetry  
 Date and Time: 2/1/20 12:20 PM

**High-precision in vivo ablation in mammalian brain with amplified femtosecond pulses**

Paper 11227-11

Author(s): Meng Cui, Purdue Univ. (USA), et al.  
 Conference 11227: Optogenetics and Optical Manipulation 2020  
 Session 3: Optogenetics II  
 Date and Time: 2/1/20 12:30 PM

**Optical mapping of effective brain networks during the tangram task**

Paper 11225-7

Author(s): Zhen Yuan, Univ. of Macau (Macao, China), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 3: Optical Spectroscopy: Clinical  
 Date and Time: 2/1/20 1:10 PM

**Effects of transcranial infrared laser stimulation on short-term memory of veterans with post traumatic stress disorder: a functional near-infrared spectroscopy study**

Paper 11225-8

Author(s): Vidhya Vijaykrishnan Nair, The Univ. of Texas at Arlington (USA), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 3: Optical Spectroscopy: Clinical  
 Date and Time: 2/1/20 1:30 PM

**Functional nanomeshes for scalable transparent microelectrode arrays**

Paper 11235-1

Author(s): Hui Fang, Northeastern Univ. (USA), et al.  
 Conference 11235: Microfluidics, BioMEMS, and Medical Microsystems XVIII  
 Session 1: Manufacturing I  
 Date and Time: 2/1/20 1:30 PM

**Simultaneous multiplane imaging with reverberation multiphoton microscopy**

Paper 11250-9

Author(s): Jerome Mertz, Boston Univ. (USA), et al.  
 Conference 11250: High-Speed Biomedical Imaging and Spectroscopy V  
 Session 3: High-Throughput Microscopy  
 Date and Time: 2/1/20 1:30 PM

**Validation of laser pulse shaping for increased sensitivity to brain blood flow using time-domain diffuse correlation spectroscopy during a hypercapnic challenge**

Paper 11225-9

Author(s): Stefan A. Carp, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 3: Optical Spectroscopy: Clinical  
 Date and Time: 2/1/20 1:50 PM

**iPSC-derived neuronal networks using holographic stimulation**

Paper 11227-12

Author(s): Felix Schmieder, TU Dresden (Germany), et al.  
 Conference 11227: Optogenetics and Optical Manipulation 2020  
 Session 4: Optogenetics III  
 Date and Time: 2/1/20 1:50 PM

**Monitoring cognitive effects of childhood ADHD using diffuse optical tomography**

Paper 11225-10

Author(s): Zephaniah Phillips, Korea Univ. (Korea, Republic of), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 3: Optical Spectroscopy: Clinical  
 Date and Time: 2/1/20 2:10 PM

**Intraoperative functional and metabolic brain mapping using hyperspectral imaging**

Paper 11225-11

Author(s): Charly Caredda, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante, Univ. Claude Bernard Lyon 1 (France), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 4: Operative and Post Op Therapy  
 Date and Time: 2/1/20 2:30 PM

**Assessment of neuropathology of Alzheimer's disease brain with high-resolution, label-free multi-harmonic generation microscopy**

Paper 11251-13

Author(s): Sandeep Chakraborty, National Taiwan Univ. (Taiwan), et al.  
 Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
 Session 3: Autofluorescence, Nonlinear, and Multiphoton Imaging  
 Date and Time: 2/1/20 2:45 PM

**5-ALA induced PpIX fluorescence guided surgery of gliomas: comparison of expert and machine learning based models**

Paper 11225-13

Author(s): Bruno Montcel, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante (France), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 4: Operative and Post Op Therapy  
 Date and Time: 2/1/20 3:10 PM

**Cross-polarization OCT for detection white matter tracts during brain tumor surgery**

Paper 11225-15

Author(s): Konstantin S. Yashin, Privolzhsky Research Medical Univ. (Russian Federation), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 4: Operative and Post Op Therapy  
 Date and Time: 2/1/20 4:20 PM

**Improved charging rates by laser perforating polypyrrole electrodes: towards use as in vivo microelectronic and micromechanical devices**

Paper 11225-16

Author(s): Yuta Dobashi, Univ. of Toronto (Canada), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 4: Operative and Post Op Therapy  
 Date and Time: 2/1/20 4:40 PM

**Ex vivo assessment of the optical characteristics of human brain and tumour tissue**

Paper 11251-19

Author(s): Jonathan Shapey, Univ. College London (United Kingdom), et al.  
 Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
 Session 3: Autofluorescence, Nonlinear, and Multiphoton Imaging  
 Date and Time: 2/1/20 4:45 PM

**Preliminary ex vivo and in vivo evaluation of laser bonding in dura mater**

Paper 11225-17

Author(s): Francesca Rossi, Consiglio Nazionale delle Ricerche (Italy), et al.  
 Conference 11225: Clinical and Translational Neurophotonics 2020  
 Session 4: Operative and Post Op Therapy  
 Date and Time: 2/1/20 5:00 PM

# BRAIN APPLICATIONS

## **Investigation of in vitro human Spatially targeted in-vivo optical manipulation and gene delivery in retina guided by optical coherence tomography**

Paper 11227-20  
Author(s): Sanghoon Kim, Nanoscope Technologies, LLC (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 5: Optogenetics IV  
Date and Time: 2/1/20 5:00 PM

## **Holographic display for optical retinal prosthesis: design and validation**

Paper 11227-21  
Author(s): Shani Rosen, Technion-Israel Institute of Technology (Israel), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 5: Optogenetics IV  
Date and Time: 2/1/20 5:20 PM

## **Optical coherence angiography reveals changes in murine fetal brain vasculature due to maternal exposure to nicotine**

Paper 11239-11  
Author(s): Raksha Raghunathan, Univ. of Houston (USA), et al.  
Conference 11239: Dynamics and Fluctuations in Biomedical Photonics XVII  
Session 2: Optical Coherence Tomography  
Date and Time: 2/1/20 5:20 PM

## **Sunday 2 February 2020**

## **Assessment of variable block lengths during infrared neural inhibition**

Paper 11227-22  
Author(s): Jeremy B. Ford, Vanderbilt Univ. (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 6: INS I  
Date and Time: 2/2/20 8:20 AM

## **Astrocyte sensitivity to pulsed infrared light: molecular, physiological, and mechanistic insights**

Paper 11227-23  
Author(s): Wilson R. Adams, Vanderbilt Univ. (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 6: INS I  
Date and Time: 2/2/20 8:40 AM

## **Pulsed infrared light modulates microglial function**

Paper 11227-24  
Author(s): John Logan Jenkins, Vanderbilt Univ. (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 6: INS I  
Date and Time: 2/2/20 9:00 AM

## **Computational and experimental evaluation of the mechanism of infrared neural inhibition in aplysia**

Paper 11227-25  
Author(s): E. Duco Jansen, Vanderbilt Univ. (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 6: INS I  
Date and Time: 2/2/20 9:20 AM

## **Non-invasive intracranial pressure monitoring and neurovascular coupling assessment in the context of brain injury**

Paper 11216-15  
Author(s): Jana M. Kainerstorfer, Carnegie Mellon Univ. (USA), et al.  
Conference 11216: Multiscale Imaging and Spectroscopy  
Session 4: Imaging and Spectroscopy through Time and Space: Longitudinal Studies  
Date and Time: 2/2/20 10:10 AM

## **Diffuse correlation spectroscopy in the Fourier domain with holographic camera-based detection**

Paper 11239-15  
Author(s): Edward James, Univ. College London (United Kingdom), et al.  
Conference 11239: Dynamics and Fluctuations in Biomedical Photonics XVII  
Session 4: Spectroscopy and Applications II  
Date and Time: 2/2/20 10:20 AM

## **Comparing the efficacy of infrared diode and Ho:YAG lasers for infrared neural stimulation**

Paper 11227-27  
Author(s): Graham A. Throckmorton, Vanderbilt Univ. (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 7: INS II  
Date and Time: 2/2/20 10:30 AM

## **Optoacoustic neuronal stimulation by nanotransducers operating at NIR II window**

Paper 11227-28  
Author(s): Chen Yang, Boston Univ. (USA), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 7: INS II  
Date and Time: 2/2/20 10:50 AM

## **Separating scalp and brain layer hemodynamics on a single channel diffuse optical spectroscopy**

Paper 11216-19  
Author(s): Sungchul Kim, Gwangju Institute of Science and Technology (Korea, Republic of), et al.  
Conference 11216: Multiscale Imaging and Spectroscopy  
Session 4: Imaging and Spectroscopy through Time and Space: Longitudinal Studies  
Date and Time: 2/2/20 11:40 AM

## **Light sources for coherent Raman and infrared microscopy**

Paper 11252-35  
Author(s): Ingo Rimke, APE Angewandte Physik & Elektronik GmbH (Germany), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 6: Infrared Chemical Imaging I  
Date and Time: 2/2/20 11:45 AM

## **Mapping brain connections with infrared neural stimulation and fMRI**

Paper 11227-31  
Author(s): Augix Guohua Xu, Zhejiang Univ. (China), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 7: INS II  
Date and Time: 2/2/20 11:50 AM

## **Brain metabolism changes in cases of impaired breathing or blood circulation in rodents evaluated by real time optical spectroscopy methods**

Paper 11234-6  
Author(s): Gennadii A. Piavchenko, Orel State Univ. named after I.S. Turgenev (Russian Federation), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 4: Cutting Edge Supercontinuum and Biomedical Science  
Date and Time: 2/2/20 1:30 PM

## **Developments in transcranial optoacoustic imaging in humans**

Paper 11240-16  
Author(s): Simon R. Powell, The Univ. of Texas Medical Branch (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 3: Clinical Imaging III: Ex Vivo  
Date and Time: 2/2/20 2:15 PM

## **Fast adaptive optics compensation via deep neural network**

Paper 11248-14  
Author(s): Yuanlong Zhang, Tsinghua Univ. (China), et al.  
Conference 11248: Adaptive Optics and Wavefront Control for Biological Systems VI  
Session 3: Computational AO  
Date and Time: 2/2/20 3:10 PM

## **New paradigms in femtosecond lasers for non-linear imaging of the brain and other tissues**

Paper 11244-15  
Author(s): Marco Arrigoni, Coherent, Inc. (USA), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 4: Multiphoton Microscopy and Applications III  
Date and Time: 2/2/20 3:30 PM

**Characterization of retinal changes in a mouse model of Alzheimer's disease using multi-contrast optical coherence tomography**

Paper 11218-47  
 Author(s): Bernhard Baumann, Medizinische Univ. Wien (Austria), et al.  
 Conference 11218: Ophthalmic Technologies XXX  
 Session 8: Small Animal Models  
 Date and Time: 2/2/20 4:15 PM

**Estimating receptor availability in altered tumor vasculature using MRI-coupled paired-agent fluorescence tomography**

Paper 11216-28  
 Author(s): Boyu Meng, Dartmouth College (USA), et al.  
 Conference 11216: Multiscale Imaging and Spectroscopy  
 Session 6: Emerging Sources of Multiscale Imaging Contrast  
 Date and Time: 2/2/20 5:00 PM

**Quantitative phase digital holographic microscopy combined with stem cell technology for identifying cell biomarkers of neurodevelopmental brain disorders including schizophrenia**

Paper 11249-30  
 Author(s): Pierre P. Marquet, CERVO Brain Research Ctr. (Canada), et al.  
 Conference 11249: Quantitative Phase Imaging VI  
 Session 8: QPI of Cells and Tissues II  
 Date and Time: 2/2/20 5:00 PM

**A novel multiscale imaging system for brain studies**

Paper 11230-34  
 Author(s): Amarendra Nath Yatavakilla, Vignan's Univ. (India), et al.  
 Conference 11230: Optics and Biophotonics in Low-Resource Settings VI  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

**Classification of brain lesions from MRI images using a novel neural network**

Paper 11232-17  
 Author(s): Vasudevan Lakshminarayanan, Univ. of Waterloo (Canada), et al.  
 Conference 11232: Multimodal Biomedical Imaging XV  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

**Automated spherical aberration correction applied to multiphoton microscopy**

Paper 11244-69  
 Author(s): Carlo-Amadeo C. Alonzo, Olympus Corp. of the Americas (USA), et al.  
 Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

**Two photon excitation in neurosciences using fiber lasers operating at 920nm and 1064nm**

Paper 11244-79  
 Author(s): Pascal Dupriez, Spark Lasers (France), et al.  
 Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

**Monitoring the role of palmitic acid in glioma cells using stimulated Raman scattering microscopy**

Paper 11244-84  
 Author(s): Yuhao Yuan, Binghamton Univ. (USA), et al.  
 Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

**High-speed, large field-of-view and deep multiphoton imaging with an adaptive excitation source**

Paper 11244-93  
 Author(s): Bo Li, Cornell Univ. (USA), et al.  
 Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

**Design of a portable multiwavelength and multidistance diffuse correlation spectroscopy system**

Paper 11253-30  
 Author(s): Adriano Peruch, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA), et al.  
 Conference 11253: Biomedical Applications of Light Scattering X  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

## Monday 3 February 2020

**25 plane multifocus microscopy for fast and live 3D imaging**

Paper 11226-1  
 Author(s): Sara Abrahamsson, Univ. of California, Santa Cruz (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 1: Microscopy I  
 Date and Time: 2/3/20 8:20 AM

**Two-photon Bessel beam scanning microscope for neural activities**

Paper 11226-2  
 Author(s): Dongli Xu, Stanford Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 1: Microscopy I  
 Date and Time: 2/3/20 8:50 AM

**Pilot study of transcranial photobiomodulation of lymphatic clearance of beta-amyloid from the mouse brain: breakthrough strategies for non-pharmacologic therapy of Alzheimer's disease**

Paper 11241-2  
 Author(s): Oxana V. Semyachkina-Glushkovskaya, Saratov State Univ. (Russian Federation), et al.  
 Conference 11241: Biophotonics and Immune Responses XV  
 Session 1: Phototherapy and Immunotherapy  
 Date and Time: 2/3/20 8:55 AM

**Computational defocus correction methods for extended focus optical coherence tomography angiography**

Paper 11228-3  
 Author(s): ByungKun Lee, KAIST (Korea, Republic of), et al.  
 Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
 Session 1: OCT Angiography  
 Date and Time: 2/3/20 9:00 AM

**Two-photon high-speed light-sheet volumetric imaging of brain activity during sleep in zebrafish larvae**

Paper 11226-3  
 Author(s): Giuseppe de Vito, Univ. degli Studi di Firenze (Italy), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 1: Microscopy I  
 Date and Time: 2/3/20 9:10 AM

**Scalable analysis of architecture of brain tissue with label-free imaging and deep learning**

Paper 11251-40  
 Author(s): Shalin B. Mehta, Chan Zuckerberg Biohub (USA), et al.  
 Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
 Session 7: Polarization and Dark-Field  
 Date and Time: 2/3/20 9:15 AM

**Scalable analysis of architecture of brain tissue with label-free imaging and deep learning**

Paper 11251-40  
 Author(s): Shalin B. Mehta, Chan Zuckerberg Biohub (USA), et al.  
 Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
 Session 7: Polarization and Dark-Field  
 Date and Time: 2/3/20 9:15 AM

**Phase dual-slopes for enhanced depth sensitivity in diffuse optical imaging**

Paper 11226-6  
 Author(s): Sergio Fantini, Tufts Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 2: Diffused Optical Imaging  
 Date and Time: 2/3/20 10:40 AM

# BRAIN APPLICATIONS

## **Developing diffuse correlation spectroscopic tools for continuous, real-time, spatially-resolved monitoring of spinal cord blood flow**

Paper 11229-28  
Author(s): David R. Busch, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA), et al.  
Conference 11229: Advanced Biomedical and Clinical Diagnostic and Surgical Guidance Systems XVIII  
Session 6: Spectroscopy and Other Techniques  
Date and Time: 2/3/20 11:20 AM

## **Diffuse optical tomography with a source-detector grid with 6.5 mm spacing for high-performance imaging of human brain hemodynamics**

Paper 11226-8  
Author(s): Zachary E. Markow, Washington Univ. in St. Louis (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 2: Diffused Optical Imaging  
Date and Time: 2/3/20 11:30 AM

## **Quantification of blood-brain barrier permeability with multiphoton fluorescence imaging**

Paper 11244-28  
Author(s): Lingyan Shi, Univ. of California, San Diego (USA), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 6: Technology and In Vivo Imaging I  
Date and Time: 2/3/20 11:35 AM

## **Mapping deep brain stimulation's impact on cortical networks using high-density diffuse optical tomography**

Paper 11226-9  
Author(s): Arefeh Sherafati, Washington Univ. School of Medicine in St. Louis (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 2: Diffused Optical Imaging  
Date and Time: 2/3/20 11:50 AM

## **Large area functional and structural nonlinear brain imaging**

Paper 11244-31  
Author(s): Francesco Saverio Pavone, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 7: Technology and In Vivo Imaging II  
Date and Time: 2/3/20 1:30 PM

## **Applications of liquid crystals in brain study**

Paper 11303-1  
Author(s): Tigran Galstian, Ctr. d'optique, photonique et laser (Canada), et al.  
Conference 11303: Emerging Liquid Crystal Technologies XV  
Session 1: Liquid Crystal Lenses and Microlens Arrays  
Date and Time: 2/3/20 1:30 PM

## **Using fNIRS to study the brain activation and networks associated with Chinese character recognition**

Paper 11226-11  
Author(s): Zhen Yuan, Univ. of Macau (Macao, China), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 3: Human Brain  
Date and Time: 2/3/20 2:20 PM

## **Applications of single-cell Raman microspectroscopy in cancer cell**

Paper 11252-64  
Author(s): Tong Yu, Univ. of Oxford (United Kingdom), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 11: CARS, SRS, Raman Innovation and Applications IV  
Date and Time: 2/3/20 2:35 PM

## **fNIRS examination of mental workload changes during N-back tasks**

Paper 11226-12  
Author(s): Kosar Khaksari, National Institutes of Health (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 3: Human Brain  
Date and Time: 2/3/20 2:40 PM

## **Functional brain mapping in preschool-age children with high density diffuse optical tomography**

Paper 11226-13  
Author(s): Kalyan Tripathy, Washington Univ. School of Medicine in St. Louis (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 3: Human Brain  
Date and Time: 2/3/20 3:00 PM

## **Projection-specific neuronal recordings at deep layers of visual cortex via three-photon microscopy in awake mice**

Paper 11226-14  
Author(s): Murat Yildirim, Massachusetts Institute of Technology (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 4: Awake Animals  
Date and Time: 2/3/20 3:50 PM

## **AMCoherence gated, time-of-flight resolved measurements of human brain blood flow dynamics**

Paper 11228-21  
Author(s): Oybek Kholiqov, Univ. of California, Davis (USA), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 4: Brain and Neural Imaging  
Date and Time: 2/3/20 4:00 PM

## **Miniaturized device for whole cortex mesoscale imaging in freely behaving mice**

Paper 11226-15  
Author(s): Suhasa Kodandaramaiah, Univ. of Minnesota, Twin Cities (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 4: Awake Animals  
Date and Time: 2/3/20 4:10 PM

## **Label-free characterization of attenuation lengths of cortical regions via three-photon microscopy in awake mice**

Paper 11244-38  
Author(s): Murat Yildirim, Massachusetts Institute of Technology (USA), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 8: SHG/THG Microscopy  
Date and Time: 2/3/20 4:30 PM

## **Label-free neurophotonics: electro-plasmonic biosensors for ultrasensitive detection of electrogenic activity of cells**

Paper 11257-26  
Author(s): Ahsan Habib, Univ. of California, Santa Cruz (USA), et al.  
Conference 11257: Plasmonics in Biology and Medicine XVII  
Session 5: Plasmonic Detection and Sensing  
Date and Time: 2/3/20 4:30 PM

## **Mesoscale imaging of neuronal activity coupled with light-evoked motor mapping reveal movement-specific spatiotemporal patterns of cortical activation in awake mice**

Paper 11226-17  
Author(s): Francesco A. Resta, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 4: Awake Animals  
Date and Time: 2/3/20 4:50 PM

## **Quantifying changes in murine fetal brain vasculature due to prenatal exposure to teratogens with in utero optical coherence tomography**

Paper 11228-25  
Author(s): Raksha Raghunathan, Univ. of Houston (USA), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 4: Brain and Neural Imaging  
Date and Time: 2/3/20 5:00 PM

## **Effect of contrast agents and enhancement of cerebrovascular on mouse brain microvasculature studies using 800nm Gaussian and Polarization sensitive (PS) OCT system**

Paper 11228-26  
Author(s): Mounika Rapolu, Institute of Physical Chemistry (Poland), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 4: Brain and Neural Imaging  
Date and Time: 2/3/20 5:15 PM

Tuesday 4 February 2020

**A pipeline to indirectly integrate mouse brain single neuron morphology and single cell transcriptome**

Paper 11226-55  
 Author(s): Wenyan Guo, Huazhong Univ. of Science and Technology (China), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Wireless high definition neuroimaging system for fNIRS using single photosensor**

Paper 11226-59  
 Author(s): Keum-Shik Hong, Pusan National Univ. (Korea, Republic of), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Characterization of temporal and spatial frequency preference of cortical layers in six visual areas via three-photon microscopy in awake mice**

Paper 11226-63  
 Author(s): Murat Yildirim, Massachusetts Institute of Technology (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Establishment of cortical photothrombosis based on skull optical clearing**

Paper 11226-64  
 Author(s): Dan Zhu, Huazhong Univ. of Science and Technology (China), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Optical methods for non-invasive assessment of arteriole flow impedance**

Paper 11226-65  
 Author(s): Jason Yang, Carnegie Mellon Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Multimodal imaging integrating structural and functional information**

Paper 11226-66  
 Author(s): Jean-Paul Badjo, Univ. of Maryland, Baltimore County (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Speckle fluctuations contribute excess noise to coherent near infrared spectroscopy measurements**

Paper 11226-54  
 Author(s): Antonio Ortega-Martinez, Boston Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**A novel majorize-minimize algorithm for jointly estimating scattering coefficient and denoising speckle in optical coherence tomography images**

Paper 11228-92  
 Author(s): Divya Varadarajan, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA), et al.  
 Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Long-term cortex-wide imaging of the awake mouse brain using multi-parametric photoacoustic microscopy**

Paper 11240-151  
 Author(s): Vincent M. Sciortino, Univ. of Virginia (USA), et al.  
 Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**MEMS scanning multi-scale photoacoustic microscopy for tumor anti-angiogenic therapy monitoring**

Paper 11240-157  
 Author(s): Chengbo Liu, Shenzhen Institutes of Advanced Technology (China), et al.  
 Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Snapshot polarization microscopy for imaging of brain tissue**

Paper 11251-83  
 Author(s): Marco Augustin, Medizinische Univ. Wien (Austria), et al.  
 Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Birefringence microscopy for imaging the structural integrity of myelin**

Paper 11251-85  
 Author(s): Nathan Blanke, Boston Univ. (USA), et al.  
 Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

**Clear optically matched panoramic access channel technique (COMPACT) for large volume deep brain imaging**

Paper 11226-19  
 Author(s): Meng Cui, Purdue Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 5: Microscopy II  
 Date and Time: 2/4/20 8:10 AM

**Whole-brain imaging using wide-field fluorescence microscope with deep ultraviolet surface excitation**

Paper 11226-21  
 Author(s): Deepa K. Kasaragod, Hiroshima Univ. (Japan), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 5: Microscopy II  
 Date and Time: 2/4/20 8:50 AM

**Spatial gradient based segmentation of vessels and quantitative measurement of the inner diameter and wall thickness from ICG fluorescence angiographies**

Paper 11229-37  
 Author(s): Ady Naber, Karlsruher Institut für Technologie (Germany), et al.  
 Conference 11229: Advanced Biomedical and Clinical Diagnostic and Surgical Guidance Systems XVIII  
 Session 9: Image Processing  
 Date and Time: 2/4/20 8:50 AM

**System optimization of head-mounted fiber-optic nonlinear endomicroscope for brain imaging of freely behaving mice**

Paper 11226-23  
 Author(s): Ang Li, Johns Hopkins Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 5: Microscopy II  
 Date and Time: 2/4/20 9:30 AM

**Exploring diagnosing brain disease with quantum entanglement**

Paper 11234-16  
 Author(s): Enrique J. Galvez, Colgate Univ. (USA), et al.  
 Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
 Session 9: Novel Techniques  
 Date and Time: 2/4/20 10:30 AM

**Time-resolved mesoscopic imaging of a whole animal by FastFLIM**

Paper 11244-47  
 Author(s): Yuansheng Sun, ISS, Inc. (USA), et al.  
 Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
 Session 10: Technology and In Vivo Imaging III  
 Date and Time: 2/4/20 10:30 AM

# BRAIN APPLICATIONS

**The optical property and morphometry of human cerebellum cortex with automatic serial sectioning polarization sensitive optical coherence tomography**  
Paper 11226-25

Author(s): Hui Wang, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 6: OCT  
Date and Time: 2/4/20 10:40 AM

**Three-dimensional partial coherent holography by a digital micro-mirror device**

Paper 11245-6  
Author(s): Yi Xue, Univ. of California, Berkeley (USA), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 2: Illumination and Optical Coherence  
Date and Time: 2/4/20 10:40 AM

**Multiplexed 3-photon microscopy for functional connectomics of mammalian cortex**

Paper 11244-50  
Author(s): Kevin Takasaki, Allen Institute for Brain Science (USA), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 10: Technology and In Vivo Imaging III  
Date and Time: 2/4/20 11:30 AM

**High speed resonant fiber-optic scanning nonlinear endomicroscopy for monitoring brain functional dynamics**

Paper 11244-51  
Author(s): Hyeon-Cheol Park, Johns Hopkins Univ. (USA), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 10: Technology and In Vivo Imaging III  
Date and Time: 2/4/20 11:45 AM

**Hue representation of the DKL color space at columnar resolution in the early visual cortex of macaques**

Paper 11226-30  
Author(s): Hisashi Tanigawa, Zhejiang Univ. (China), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 7: Brain Activities I  
Date and Time: 2/4/20 2:00 PM

**Ultra-high-speed wide-field photoacoustic microscopy using a polygon mirror scanner**

Paper 11240-73  
Author(s): Junjie Yao, Duke Univ. (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 12: Microscopy I  
Date and Time: 2/4/20 2:00 PM

**Model impact in resolving DCS CBF measurements from systemic variations in blood flow**

Paper 11226-31  
Author(s): Melissa M. Wu, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 7: Brain Activities I  
Date and Time: 2/4/20 2:20 PM

**High-speed wide-field multi-parametric photoacoustic microscopy**

Paper 11240-75  
Author(s): Fenghe Zhong, Univ. of Virginia (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 12: Microscopy I  
Date and Time: 2/4/20 2:30 PM

**Role of cerebrovascular autoregulation in neurovascular coupling**

Paper 11226-32  
Author(s): Deepshikha Acharya, Carnegie Mellon Univ. (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 7: Brain Activities I  
Date and Time: 2/4/20 2:40 PM

**In vivo cuticle intact Drosophila mushroom body imaging using laser scanning optical resolution photoacoustic microscopy**

Paper 11240-76  
Author(s): Kai-Yao Chang, National Tsing Hua Univ. (Taiwan), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 12: Microscopy I  
Date and Time: 2/4/20 2:45 PM

**Data reduction for terabytes-scale brain wide neuron images via deep learning**

Paper 11226-33  
Author(s): Qing Huang, Wuhan National Research Ctr. for Optoelectronics (China), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 8: Novel Techniques I  
Date and Time: 2/4/20 3:30 PM

**A generalizable deep-learning approach to anatomical modeling of brain vasculature**

Paper 11226-34  
Author(s): Waleed Tahir, Boston Univ. (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 8: Novel Techniques I  
Date and Time: 2/4/20 3:50 PM

**Skull optical clearing for longitudinal non invasive optical imaging**

Paper 11226-37  
Author(s): Frédéric Pain, Univ. Paris-Saclay (France), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 8: Novel Techniques I  
Date and Time: 2/4/20 4:50 PM

**Wireless data transfer through biological tissues using near-infrared light: testing skull and skin phantoms**

Paper 11226-38  
Author(s): Iqar Ahmed, Univ. of Oulu (Finland), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 8: Novel Techniques I  
Date and Time: 2/4/20 5:10 PM

**Abnormal tryptophan metabolism in Alzheimer's disease (ALZ): label-free spectroscopy suggests an alternative theory of ALZ causation**

Paper 11234-59  
Author(s): Laura A. Sordillo, The City College of New York (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session PTues: Posters-Tuesday  
Date and Time: 2/4/20 6:00 PM

## Wednesday 5 February 2020

**longitudinal multimodal mapping of neural activity and blood flow reveals neurovascular dissociations in an awake mouse model of microinfarcts**

Paper 11226-41  
Author(s): Lan Luan, Rice Univ. (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 9: Brain Activities II  
Date and Time: 2/5/20 9:00 AM

**Wide-field multi-scale areal parcellation of neural circuits in mice**

Paper 11226-42  
Author(s): Lindsey M. Brier, Washington Univ. in St. Louis (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 9: Brain Activities II  
Date and Time: 2/5/20 9:20 AM

**Minimally-invasive brain activity monitoring using voltage-sensitive dye fluorescence imaging**

Paper 11226-43  
Author(s): Rebecca W. Pak, Johns Hopkins Univ. (USA), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 9: Brain Activities II  
Date and Time: 2/5/20 9:40 AM

**Photoacoustic microscopy of metabolic dysfunction in neonatal hypoxic-ischemic encephalopathy**

Paper 11240-90  
Author(s): Naidi Sun, Univ. of Virginia (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 14: Functional, Molecular, and Quantitative I  
Date and Time: 2/5/20 9:45 AM

**Compact microLED optrode device for patterned inter-cortical optogenetics**

Paper 11226-46  
 Author(s): Niall McAlinden, Univ. of Strathclyde (United Kingdom), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 10: Novel Techniques II  
 Date and Time: 2/5/20 11:10 AM

**Optical gearbox for kHz frame rate imaging**

Paper 11226-47  
 Author(s): Meng Cui, Purdue Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 10: Novel Techniques II  
 Date and Time: 2/5/20 11:30 AM

**Deep tissue imaging and focusing for neuroscience**

Paper 11245-29  
 Author(s): Ke Si, Zhejiang Univ. (China), et al.  
 Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
 Session 7: Innovative Methods in Microscopy  
 Date and Time: 2/5/20 1:30 PM

**Optical imaging of endogenous lipid particles instructs on the dynamics and functions of the cerebrospinal fluid**

Paper 11226-51  
 Author(s): Olivier Thouvenin, Institut Langevin Ondes et Images (France), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 11: Diseases  
 Date and Time: 2/5/20 2:40 PM

**Intracranial pressure estimated non-invasively in non-human primates and pediatric critical care**

Paper 11226-52  
 Author(s): Alexander Ruesch, Carnegie Mellon Univ. (USA), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 11: Diseases  
 Date and Time: 2/5/20 3:00 PM

**Aberrant hippocampal neurogenesis prevention using nano-pulsed laser therapy**

Paper 11240-102  
 Author(s): Adelaide Micci, The Univ. of Texas Medical Branch (USA), et al.  
 Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
 Session 17: Novel Approaches and Applications  
 Date and Time: 2/5/20 4:45 PM

**Super-speed multiphoton microscopy for mesoscopic volume imaging with ultra-dense sampling beyond Nyquist Limit**

Paper 11245-38  
 Author(s): Bhaskar Jyoti Borah, National Taiwan Univ. (Taiwan), et al.  
 Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
 Session 8: Fluorescence and Nonlinear Microscopy  
 Date and Time: 2/5/20 5:20 PM



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# TRANSLATIONAL RESEARCH APPLICATIONS

See individual conferences for locations



## TRANSLATIONAL RESEARCH

SPIE Translational Research 2020 will highlight papers that showcase the latest photonics technologies, tools, and techniques with high potential to impact healthcare.

- Photonic Therapeutics and Diagnostics
- Neurophotonics, Neurosurgery, and Optogenetics
- Clinical Technologies and Systems
- Tissue Optics, Laser-Tissue Interaction, and Tissue Engineering
- Biomedical Spectroscopy, Microscopy, and Imaging
- Nano/Biophotonic

### TRACK CHAIRS



**Aaron Aguirre**  
Massachusetts General Hospital (USA)



**Gabriela Apiou**  
Wellman Center for Photomedicine, Massachusetts General Hospital Research Institute, Harvard Medical School (USA)

### Sunday Special Event:

Translational Research Lunchtime Forum, See page 20 for details.

### Saturday 1 February 2020

#### Progress in angle-resolved low-coherence interferometry for real-time detection of epithelial dysplasia

Paper 11253-1  
Author(s): Zachary A. Steelman, Duke Univ. (USA), et al.  
Conference 11253: Biomedical Applications of Light Scattering X  
Session 1: Cancer Detection and Characterization  
Date and Time: 2/1/20 8:00 AM

#### Wearable time-domain near-infrared spectroscopy system

Paper 11237-1  
Author(s): Michele Lacerenza, Politecnico di Milano (Italy), et al.  
Conference 11237: Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables  
Session 1: Wearable Optical Sensing Techniques I  
Date and Time: 2/1/20 8:30 AM

#### Success of tympanoplasty evaluated by endoscopic OCT: a case report

Paper 11213-2  
Author(s): Jonas Golde, TU Dresden (Germany), et al.  
Conference 11213: Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2020  
Session 1: Functional Diagnostic Technologies and Quality Assurance in Tympanic Membrane Reconstruction  
Date and Time: 2/1/20 9:00 AM

#### Combined OCT and angle-resolved low-coherence interferometry using endoscope-coupled paddle probe

Paper 11214-3  
Author(s): Kengye K. Chu, Duke Univ. (USA), et al.  
Conference 11214: Endoscopic Microscopy XV  
Session 1: Gastroenterology  
Date and Time: 2/1/20 9:00 AM

#### Wearable oxymetry system for real-time deep tissue monitoring

Paper 11237-3  
Author(s): Siddharth M. Khare, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA), et al.  
Conference 11237: Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables  
Session 1: Wearable Optical Sensing Techniques I  
Date and Time: 2/1/20 9:10 AM

#### Impediments of autoantibodies to human megakaryocyte differentiation are significantly mitigated with low-level laser therapy

Paper 11221-3  
Author(s): Mei X. Wu, Harvard Medical School (USA), et al.  
Conference 11221: Mechanisms of Photobiomodulation Therapy XV  
Session 1: Cellular Mechanisms of PBM  
Date and Time: 2/1/20 9:20 AM

#### Imaging Amphotericin B orientation in *Candida* spp. through polarization stimulated Raman scattering microscopy

Paper 11252-6  
Author(s): Pu-Ting Dong, Boston Univ. (USA), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 1: CARS, SRS, Raman Innovation and Applications I  
Date and Time: 2/1/20 9:35 AM

#### Minimally invasive intestinal permeability assessment using an optical coherence tomography guided intestinal potential difference probe

Paper 11214-5  
Author(s): Serena Z. Shi, Wellman Ctr. for Photomedicine (USA), et al.  
Conference 11214: Endoscopic Microscopy XV  
Session 1: Gastroenterology  
Date and Time: 2/1/20 9:40 AM

#### Clinical applicability of in vivo harmonic generation microscopy for the diagnosis and grading of actinic keratosis

Paper 11211-5  
Author(s): Chi-Kuang Sun, National Taiwan Univ. (Taiwan), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 2: Skin Cancer  
Date and Time: 2/1/20 10:30 AM

#### Speckle-free, spectrally-encoded confocal microscopy

Paper 11214-7  
Author(s): DongKyun Kang, Wyant College of Optical Sciences (USA), et al.  
Conference 11214: Endoscopic Microscopy XV  
Session 2: Spectral Encoding  
Date and Time: 2/1/20 10:50 AM

#### Femtosecond laser induced densification within cell-laden hydrogels results in cellular alignment

Paper 11270-7  
Author(s): Zheng Xiong, Syracuse Biomaterials Institute (USA), et al.  
Conference 11270: Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX  
Session 2: Ultrafast Lasers for the Manipulation of Cells  
Date and Time: 2/1/20 11:00 AM

#### Tapered fiber sensor for head and neck cancer precursor

Paper 11233-8  
Author(s): Cong Deng, Univ. of Dayton (USA), et al.  
Conference 11233: Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications XX  
Session 2: Fiber Optic Tools for Medical Applications I  
Date and Time: 2/1/20 11:10 AM

# TRANSLATIONAL RESEARCH APPLICATIONS

## First biopotential recordings from a liquid crystal optrode

Paper 11225-6

Author(s): Leonardo Silvestri, The Univ. of New South Wales (Australia), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 2: Optical Spectroscopy: Pre-Clinical II  
Date and Time: 2/1/20 11:20 AM

## Development of a biodegradable and non-toxic near infrared optically active quantum dot

Paper 11255-6

Author(s): Joshua Kays, Boston Univ. (USA), et al.  
Conference 11255: Colloidal Nanoparticles for Biomedical Applications XV  
Session 2: Synthesis and Characterization of Nanoparticles  
Date and Time: 2/1/20 11:20 AM

## Review on clinical trial results of red and near infrared LED photobiomodulation

Paper 11221-8

Author(s): Sungkyoo Lim, Dankook Univ. (Korea, Republic of), et al.  
Conference 11221: Mechanisms of Photobiomodulation Therapy XV  
Session 2: Modeling PBM Dosimetry  
Date and Time: 2/1/20 11:40 AM

## Phosphorescence-based oxygen-sensing optrode for improved assessment of compartment syndrome

Paper 11233-10

Author(s): Lilian Witthauer, Wellman Ctr. for Photomedicine, Massachusetts General Hospital (USA), et al.  
Conference 11233: Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications XX  
Session 2: Fiber Optic Tools for Medical Applications I  
Date and Time: 2/1/20 11:50 AM

## Fluorescence biomodulation in wound healing: when is a photon something more?

Paper 11221-9

Author(s): Shannon E. Campbell, Klox Technologies, Inc. (Canada), et al.  
Conference 11221: Mechanisms of Photobiomodulation Therapy XV  
Session 2: Modeling PBM Dosimetry  
Date and Time: 2/1/20 12:00 PM

## Quantification of anti-HER2 drug uptake into human breast cancer cells and tumor xenografts using fluorescence lifetime FRET imaging

Paper 11219-11

Author(s): Alena Rudkouskaya, Albany Medical College (USA), et al.  
Conference 11219: Visualizing and Quantifying Drug Distribution in Tissue IV  
Session 3: Novel Model and Imaging Screening Tools for Drug Development  
Date and Time: 2/1/20 1:10 PM

## Quantification of anti-HER2 drug uptake into human breast cancer cells and tumor xenografts using fluorescence lifetime FRET imaging

Paper 11219-11

Author(s): Alena Rudkouskaya, Albany Medical College (USA), et al.  
Conference 11219: Visualizing and Quantifying Drug Distribution in Tissue IV  
Session 3: Novel Model and Imaging Screening Tools for Drug Development  
Date and Time: 2/1/20 1:10 PM

## Optical mapping of effective brain networks during the tangram task

Paper 11225-7

Author(s): Zhen Yuan, Univ. of Macau (Macao, China), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 3: Optical Spectroscopy: Clinical  
Date and Time: 2/1/20 1:10 PM

## Confocal mimics hematoxylin and eosin: recent technical development in translation

Paper 11213-10

Author(s): Daniel S. Gareau, SurgiVance Inc. (USA), et al.  
Conference 11213: Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2020  
Session 4: Clinical Translation of Confocal Optics and Surgical use of Laser Technology  
Date and Time: 2/1/20 1:20 PM

## In vivo diagnosis of idiopathic pulmonary fibrosis (IPF) using endobronchial OCT

Paper 11214-10

Author(s): Sreyankar Nandy, Massachusetts General Hospital (USA), et al.  
Conference 11214: Endoscopic Microscopy XV  
Session 3: Respiratory  
Date and Time: 2/1/20 1:40 PM

## Validation of laser pulse shaping for increased sensitivity to brain blood flow using time-domain diffuse correlation spectroscopy during a hypercapnic challenge

Paper 11225-9

Author(s): Stefan A. Carp, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 3: Optical Spectroscopy: Clinical  
Date and Time: 2/1/20 1:50 PM

## Detecting nodular basal cell carcinoma in pathology imaging using deep learning image segmentation

Paper 11211-11

Author(s): Daniel S. Gareau, The Rockefeller Univ. (USA), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 3: Machine Learning  
Date and Time: 2/1/20 2:10 PM

## Quantitative melanin imaging using label-free third-harmonic-generation enhancement-ratio microscopy

Paper 11251-11

Author(s): Chi-Kuang Sun, National Taiwan Univ. (Taiwan), et al.  
Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
Session 3: Autofluorescence, Nonlinear, and Multiphoton Imaging  
Date and Time: 2/1/20 2:15 PM

## Nose cone with inflatable probe-clamping balloons improves stabilization of an intranasal $\mu$ OCT imaging probe

Paper 11214-11

Author(s): Hui Min Leung, Massachusetts General Hospital (USA), et al.  
Conference 11214: Endoscopic Microscopy XV  
Session 3: Respiratory  
Date and Time: 2/1/20 2:40 PM

## A backside-illuminated low-noise multispectral imager for near-infrared fluorescence image-guided surgery

Paper 11222-9

Author(s): Steven M. Blair, Univ. of Illinois (USA), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 2: Advanced Detection Methods II  
Date and Time: 2/1/20 2:40 PM

## Utilization of machine learning classifiers in a cervical cancer screening camp in rural China

Paper 11230-14

Author(s): David Levitz, MobileODT Ltd. (Israel), et al.  
Conference 11230: Optics and Biophotonics in Low-Resource Settings VI  
Session 3: Machine Learning-enabled Microscopy and Sensing I  
Date and Time: 2/1/20 2:40 PM

## High-speed, high-resolution mesoscopic multiphoton microscopy of human skin

Paper 11211-13

Author(s): Alexander Fast, Beckman Laser Institute and Medical Clinic (USA), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 4: Confocal and Multiphoton Microscopy I  
Date and Time: 2/1/20 2:50 PM

## Quantitative curvature maps of the ocular posterior segment utilizing OCT with demonstration of local shape change over time

Paper 11218-18

Author(s): Ryan P. McNabb, Duke Univ. School of Medicine (USA), et al.  
Conference 11218: Ophthalmic Technologies XXX  
Session 3: Ophthalmic Imaging and Diagnosis: Clinical  
Date and Time: 2/1/20 3:00 PM

# TRANSLATIONAL RESEARCH APPLICATIONS

## **Confocal video microscopy reveals altered leukocyte-endothelial interactions in skin preceding acute graft-versus-host disease**

Paper 11211-14  
Author(s): Inga Saknite, Vanderbilt Univ. Medical Ctr. (USA), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 4: Confocal and Multiphoton Microscopy I  
Date and Time: 2/1/20 3:10 PM

## **5-ALA induced PpIX fluorescence guided surgery of gliomas: comparison of expert and machine learning based models**

Paper 11225-13  
Author(s): Bruno Montcel, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante (France), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 4: Operative and Post Op Therapy  
Date and Time: 2/1/20 3:10 PM

## **Wide field vectorial polarization sensitive optical coherence tomography imaging of human vocal folds**

Paper 11213-15  
Author(s): Sarat Gundavarapu, Harvard Medical School (USA), et al.  
Conference 11213: Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2020  
Session 5: Combining Novel Imaging Technology for Functional Assessment and Therapy Guidance in Upper and Lower Airways  
Date and Time: 2/1/20 3:30 PM

## **Confined heat generation using gold nanoparticles for the activation and control of biological processes**

Paper 11255-12  
Author(s): David A. Hastman, U.S. Naval Research Lab. (USA), et al.  
Conference 11255: Colloidal Nanoparticles for Biomedical Applications XV  
Session 4: Biomedical Applications of Plasmonic Nanoparticles II  
Date and Time: 2/1/20 3:40 PM

## **Quantitative assessment of the three-dimensional microarchitecture of the human vocal fold using optical coherence tomography, two-photon excitation fluorescence microscopy, and second harmonic generation**

Paper 11213-16  
Author(s): Fouzi Benboujja, Harvard Medical School (USA), et al.  
Conference 11213: Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2020  
Session 5: Combining Novel Imaging Technology for Functional Assessment and Therapy Guidance in Upper and Lower Airways  
Date and Time: 2/1/20 3:50 PM

## **Fluorescence biomodulation**

Fluorescence headlights proposed for minimally-invasive surgical tools  
Paper 11222-11  
Author(s): Eric J. Seibel, Univ. of Washington (USA), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 3: Imaging Systems  
Date and Time: 2/1/20 4:00 PM

## **Time resolved fluorescence spectroscopy for intra-operative identification of glial tumors**

Paper 11225-14  
Author(s): Pramod V. Butte, Cedars-Sinai Medical Ctr. (USA), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 4: Operative and Post Op Therapy  
Date and Time: 2/1/20 4:00 PM

## **Development of a compact multimodal imaging system for rapid characterisation of intrinsic optical properties of freshly excised tissue**

Paper 11232-18  
Author(s): Jonghee Yoon, Univ. of Cambridge (United Kingdom), et al.  
Conference 11232: Multimodal Biomedical Imaging XV  
Session 4: Tissue Imaging and Spectroscopy  
Date and Time: 2/1/20 4:10 PM

## **Indocyanine-green matching phantom for fluorescence-guided imaging system characterization and performance monitoring**

Paper 11222-12  
Author(s): Alberto J. Ruiz, Thayer School of Engineering at Dartmouth (USA), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 3: Imaging Systems  
Date and Time: 2/1/20 4:20 PM

## **Laser-based liquid jet injection from minimally invasive device**

Paper 11235-7  
Author(s): Jan Krizek, Ecole Polytechnique Fédérale de Lausanne (Switzerland), et al.  
Conference 11235: Microfluidics, BioMEMS, and Medical Microsystems XVIII  
Session 2: Devices I  
Date and Time: 2/1/20 4:20 PM

## **Comparison of clinical effectiveness of laser acupuncture and amitriptyline in diabetic peripheral neuropathy(DPN): a sham controlled randomized trial**

Paper 11221-17  
Author(s): Shahzad Anwar, Anwar Shah Trust for Cerebral Palsy & Paralysis (Pakistan), et al.  
Conference 11221: Mechanisms of Photobiomodulation Therapy XV  
Session 4: PBM Clinical Applications  
Date and Time: 2/1/20 4:30 PM

## **Noninvasive in vivo mapping of intracellular signaling proteins using a pairing of targeted and untargeted fluorescently labeled small molecule kinase inhibitors**

Paper 11219-19  
Author(s): Kenneth M. Tichauer, Illinois Institute of Technology (USA), et al.  
Conference 11219: Visualizing and Quantifying Drug Distribution in Tissue IV  
Session 4: Advanced Methods in Drug Detection and Imaging  
Date and Time: 2/1/20 5:00 PM

## **Laser acupuncture for autism spectrum disorder: a randomized sham controlled trial**

Paper 11221-19  
Author(s): Shahzad Anwar, Anwar Shah Trust for Cerebral Palsy & Paralysis (Pakistan), et al.  
Conference 11221: Mechanisms of Photobiomodulation Therapy XV  
Session 4: PBM Clinical Applications  
Date and Time: 2/1/20 5:10 PM

## **40 Hz invisible spectral flicker and its potential use in Alzheimer's light therapy treatment**

Paper 11221-20  
Author(s): Marcus S. Carstensen, Technical Univ. of Denmark (Denmark), et al.  
Conference 11221: Mechanisms of Photobiomodulation Therapy XV  
Session 4: PBM Clinical Applications  
Date and Time: 2/1/20 5:30 PM

## **Sunday 2 February 2020**

## **Optimizing selective phototherapy of port wine stain by two-photon fluorescence and optical coherence tomography imaging**

Paper 11211-15  
Author(s): Fouzi Benboujja, Harvard Medical School (USA), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 6: Therapeutics  
Date and Time: 2/2/20 8:00 AM

## **Optical sensing of haemostasis**

Paper 11215-20  
Author(s): Seemantini K. Nadkarni, Wellman Ctr. for Photomedicine (USA), et al.  
Conference 11215: Diagnostic and Therapeutic Applications of Light in Cardiology 2020  
Session 5: Blood and Oximetry  
Date and Time: 2/2/20 8:00 AM

## **Performance measures for fluorescence guided surgery systems**

Paper 11231-26  
Author(s): Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA), et al.  
Conference 11231: Design and Quality for Biomedical Technologies XIII  
Session 5: Standardization in Biophotonics  
Date and Time: 2/2/20 8:00 AM

# TRANSLATIONAL RESEARCH APPLICATIONS

## **A preliminary study on the application value of photoacoustic/ultrasound functional imaging in the diagnosis of breast intraductal mass**

Paper 11240-194

Author(s): Ming Wang, Peking Union Medical College Hospital (China), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 1: Clinical Imaging I: In Vivo  
Date and Time: 2/2/20 8:15 AM

## **High resolution 3D photoacoustic scanner for the assessment of inflammatory disease\***

Paper 11240-1

Author(s): Nam Trung Huynh, Univ. College London (United Kingdom), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 1: Clinical Imaging I: In Vivo  
Date and Time: 2/2/20 8:30 AM

## **Stimulated Raman scattering imaging of altered lipid metabolism in human cancers for precision medicine**

Paper 11236-13

Author(s): Shuhua Yue, Beihang Univ. (China), et al.  
Conference 11236: Biomedical Vibrational Spectroscopy 2020: Advances in Research and Industry  
Session 3: Bioimaging and Biosensing I  
Date and Time: 2/2/20 8:35 AM

## **Light-assisted drying (LAD) for anhydrous preservation of biologics: using Raman spectroscopy to assess the uniformity of drying in processed samples**

Paper 11230-21

Author(s): Susan R. Trammell, The Univ. of North Carolina at Charlotte (USA), et al.  
Conference 11230: Optics and Biophotonics in Low-Resource Settings VI  
Session 5: Emerging Platforms for Imaging, Sensing and Diagnostics  
Date and Time: 2/2/20 8:40 AM

## **Wide-field intraoperative polarization sensitive and angiographic optical coherence tomography of in vivo non-human primate peripheral nerve**

Paper 11251-23

Author(s): Mohsen Erfanzadeh, Massachusetts General Hospital (USA), et al.  
Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
Session 4: OCT and Interferometry  
Date and Time: 2/2/20 8:45 AM

## **Monitoring of platelets function using the laser speckle aggregometry**

Paper 11215-22

Author(s): Diane M. Tshikudi, Massachusetts General Hospital (USA), et al.  
Conference 11215: Diagnostic and Therapeutic Applications of Light in Cardiology 2020  
Session 5: Blood and Oximetry  
Date and Time: 2/2/20 8:50 AM

## **All-optical correlative micro-spectroscopies in the investigation of stromal collagen morpho-mechanics**

Paper 11218-29

Author(s): Francesca Rossi, Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche (Italy), et al.  
Conference 11218: Ophthalmic Technologies XXX  
Session 5: Ocular Biomechanics: Joint Session with Conferences 11242 and 11218  
Date and Time: 2/2/20 8:55 AM

## **Endoscopic micro-optical coherence tomography of the inner ear for diagnosis of sensorineural hearing loss**

Paper 11214-20

Author(s): Janani S. Iyer, Harvard Univ. (USA), et al.  
Conference 11214: Endoscopic Microscopy XV  
Session 5: Optical Coherence Tomography  
Date and Time: 2/2/20 9:00 AM

## **Wide-field multispectral photoacoustic imaging of human melanomas in vivo**

Paper 11240-4

Author(s): Byullee Park, Pohang Univ. of Science and Technology (Korea, Republic of), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 1: Clinical Imaging I: In Vivo  
Date and Time: 2/2/20 9:15 AM

## **Optimization of near-infrared nerve-specific fluorophores for clinical translation to improve fluorescence-guided nerve sparing surgical procedures**

Paper 11222-18

Author(s): Connor W. Barth, Oregon Health & Science Univ. (USA), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 4: Contrast Agents  
Date and Time: 2/2/20 9:20 AM

## **Phase-decorrelation OCT for detection of corneal softening in an enzymatic ex vivo model of ectasia**

Paper 11218-31

Author(s): Brecken J. Blackburn, Case Western Reserve Univ. (USA), et al.  
Conference 11218: Ophthalmic Technologies XXX  
Session 5: Ocular Biomechanics: Joint Session with Conferences 11242 and 11218  
Date and Time: 2/2/20 9:25 AM

## **High signal fidelity time-resolved fluorescence spectroscopy for intraoperative brain tumor detection**

Paper 11229-4

Author(s): Bartosz J. Bortnik, Cedars-Sinai Medical Ctr. (USA), et al.  
Conference 11229: Advanced Biomedical and Clinical Diagnostic and Surgical Guidance Systems XVIII  
Session 1: Clinical Applications of Fluorescence I  
Date and Time: 2/2/20 9:30 AM

## **Nanoplasmonic imaging biosensor for digital detection of disease biomarkers**

Paper 11254-5

Author(s): Alexander Belushkin, Ecole Polytechnique Fédérale de Lausanne (Switzerland), et al.  
Conference 11254: Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XVII  
Session 1: Multifunctional Nanoparticles  
Date and Time: 2/2/20 9:50 AM

## **Non-contact and rapid plaque pH measurement using a multimodal scanning fiber endoscope**

Paper 11217-4

Author(s): Eric J. Seibel, Univ. of Washington (USA), et al.  
Conference 11217: Lasers in Dentistry XXVI  
Session 1: Laser in Erosion Reduction, Thermal Imaging of Dental Materials, Bleaching and Plaque pH Measurement  
Date and Time: 2/2/20 10:00 AM

## **Antibodies, favorite tools for fluorescence-guided surgery**

Paper 11222-20

Author(s): André Pèlerin, Institut de Recherche en Cancérologie de Montpellier (France), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 5: Clinical Translation and Clinical Applications I  
Date and Time: 2/2/20 10:30 AM

## **Optical resonators and lasers for monitoring of mechanical activity in cells and tissue**

Paper 11242-22

Author(s): Matte C. Gather, Univ. of St. Andrews (United Kingdom), et al.  
Conference 11242: Optical Elastography and Tissue Biomechanics VII  
Session 7: Novel Methods II  
Date and Time: 2/2/20 10:30 AM

## **Development and testing of portable NIRS for sleep studies**

Paper 11237-27

Author(s): Robert V. Warren, Univ. of California, Irvine (USA), et al.  
Conference 11237: Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables  
Session 6: Body Function and Health Monitoring  
Date and Time: 2/2/20 10:50 AM

## **Mid-infrared optical photothermal imaging for cancer diagnosis**

Paper 11252-32

Author(s): Rohith K. Reddy, Univ. of Houston (USA), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 6: Infrared Chemical Imaging I  
Date and Time: 2/2/20 11:00 AM

# TRANSLATIONAL RESEARCH APPLICATIONS

## **An all optical photoacoustic needle probe for assessing the aggressiveness of prostate cancer**

Paper 11240-9  
Author(s): Guan Xu, Univ. of Michigan Medical School (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 2: Clinical Imaging II: Ex Vivo  
Date and Time: 2/2/20 11:00 AM

## **Supercontinuum-enabled label-free optical biopsy of tumor margins, markers, and the microenvironment**

Paper 11234-4  
Author(s): Stephen A. Boppart, Beckman Institute for Advanced Science and Technology (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 3: Supercontinuum in Biomedical Science: Introduction  
Date and Time: 2/2/20 11:15 AM

## **Deep tissue contractility sensing with bio-integrated micro- and nanolaser**

Paper 11215-30  
Author(s): Marcel Schubert, Univ of St. Andrews (United Kingdom), et al.  
Conference 11215: Diagnostic and Therapeutic Applications of Light in Cardiology 2020  
Session 6: Microscopy  
Date and Time: 2/2/20 11:20 AM

## **A surrogate-sssay for low-resource settings: equipment free detection of viral biomarkers at femtomolar levels**

Paper 11230-27  
Author(s): Xiangchao Zhu, Univ. of California, Santa Cruz (USA), et al.  
Conference 11230: Optics and Biophotonics in Low-Resource Settings VI  
Session 6: Sensing Technologies for Low-Resource Settings  
Date and Time: 2/2/20 11:20 AM

## **Depolarization imaging for caries detection validated by co-registered PS-OCT and $\mu$ CT volumes**

Paper 11217-7  
Author(s): Jonas Golde, TU Dresden (Germany), et al.  
Conference 11217: Lasers in Dentistry XXVI  
Session 2: Laser in Acid Resistance, OCT and Adaption of Restorations, Caries Detection and its Validation and Imaging  
Date and Time: 2/2/20 11:30 AM

## **Low-cost, portable confocal scanning laser ophthalmoscope for remote screening and telemedicine applications**

Paper 11218-36  
Author(s): Al-Hafeez Z. Dhalla, Duke Univ. (USA), et al.  
Conference 11218: Ophthalmic Technologies XXX  
Session 6: Imaging, Surgery, and Therapy: New Technologies II  
Date and Time: 2/2/20 11:30 AM

## **Quantum imaging with SPAD arrays**

Paper 11246-24  
Author(s): Gur Lubin, Weizmann Institute of Science (Israel), et al.  
Conference 11246: Single Molecule Spectroscopy and Superresolution Imaging XIII  
Session 6: Nanoscopy and Superresolution Microscopy II  
Date and Time: 2/2/20 11:30 AM

## **Endoscopic strain-photoacoustic imaging for quantifying the stiffness of intestinal strictures**

Paper 11242-25  
Author(s): Guan Xu, Univ. of Michigan Medical School (USA), et al.  
Conference 11242: Optical Elastography and Tissue Biomechanics VII  
Session 7: Novel Methods II  
Date and Time: 2/2/20 11:40 AM

## **Light sources for coherent Raman and infrared microscopy**

Paper 11252-35  
Author(s): Ingo Rimke, APE Angewandte Physik & Elektronik GmbH (Germany), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 6: Infrared Chemical Imaging I  
Date and Time: 2/2/20 11:45 AM

## **The best kidney: Using photoacoustic imaging for assessing pre-transplantation kidney quality**

Paper 11240-12  
Author(s): Eno Hysi, Ryerson Univ. (Canada), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 2: Clinical Imaging II: Ex Vivo  
Date and Time: 2/2/20 11:45 AM

## **Label-free classification of T cell activation**

Paper 11244-9  
Author(s): Melissa C. Skala, Morgridge Institute for Research (USA), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 2: Multiphoton Microscopy and Applications I  
Date and Time: 2/2/20 11:50 AM

## **Quantifying pharmacokinetics and pharmacodynamics with coherent Raman imaging and deep learning**

Paper 11252-36  
Author(s): Conor L. Evans, Wellman Ctr. for Photomedicine (USA), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 7: Data Science in Chemical Microscopy  
Date and Time: 2/2/20 1:30 PM

## **Tapered fiber sensor for head and neck cancer screening**

Paper 11233-34  
Author(s): Cong Deng, Univ. of Dayton (USA), et al.  
Conference 11233: Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications XX  
Session 7: Fiber Optic Tools for Medical Applications IV  
Date and Time: 2/2/20 1:40 PM

## **Photoacoustic imaging of fresh human surgical and endoscopic gastrointestinal specimens: a pilot study**

Paper 11240-14  
Author(s): Miya Ishihara, National Defense Medical College (Japan), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 3: Clinical Imaging III: Ex Vivo  
Date and Time: 2/2/20 1:45 PM

## **AI-driven imaging biomarkers for sensory cue integration during melanoma screening**

Paper 11230-31  
Author(s): Daniel S. Gareau, The Rockefeller Univ. (USA), et al.  
Conference 11230: Optics and Biophotonics in Low-Resource Settings VI  
Session 7: Machine Learning-enabled Microscopy and Sensing II  
Date and Time: 2/2/20 2:10 PM

## **Early metastatic colonization of the liver by breast cancer cells: the role of extracellular matrix mechanics and implications for treatment and diagnostics**

Paper 11242-29  
Author(s): Anna Guller, The Univ. of New South Wales (Australia), et al.  
Conference 11242: Optical Elastography and Tissue Biomechanics VII  
Session 8: Computational Methods for Biomechanics  
Date and Time: 2/2/20 2:10 PM

## **Developments in transcranial optoacoustic imaging in humans**

Paper 11240-16  
Author(s): Simon R. Powell, The Univ. of Texas Medical Branch (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 3: Clinical Imaging III: Ex Vivo  
Date and Time: 2/2/20 2:15 PM

## **Capillary refill: a technique for obtaining histology-grade OCT angiography maps of human dermal vasculature in vivo**

Paper 11211-27  
Author(s): Michael Evers, Massachusetts General Hospital (USA), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 8: Optical Coherence Tomography  
Date and Time: 2/2/20 2:20 PM

# TRANSLATIONAL RESEARCH APPLICATIONS

## **InP quantum dot based optoelectronic biointerfaces for high level control of photostimulation of neurons**

Paper 11255-22  
Author(s): Onuralp Karatum, Koç Univ. (Turkey), et al.  
Conference 11255: Colloidal Nanoparticles for Biomedical Applications XV  
Session 7: Biofouling and Applications in Neuroscience  
Date and Time: 2/2/20 2:20 PM

## **Update on AAPM task group 311: guidance for technical performance evaluation for fluorescence guided surgery systems**

Paper 11222-27  
Author(s): Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 6: Clinical Translation and Clinical Applications II  
Date and Time: 2/2/20 2:30 PM

## **Colorectal cancer resection using ultrashort laser pulses**

Paper 11238-30  
Author(s): Rainer J. Beck, Heriot-Watt Univ. (United Kingdom), et al.  
Conference 11238: Optical Interactions with Tissue and Cells XXXI  
Session 8: Ultrafast pulsed laser interactions  
Date and Time: 2/2/20 2:30 PM

## **Demonstration of an optical coherence tomography imaging system developed for real-time burn injury quantification in clinical settings**

Paper 11211-28  
Author(s): Dan Paul Popescu, National Research Council Canada (Canada), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 8: Optical Coherence Tomography  
Date and Time: 2/2/20 2:40 PM

## **A-scan spectral intensity profile in OCT as a potential imaging biomarker of oral precancerous and cancerous tissues**

Paper 11217-11  
Author(s): Prashanth Panta, Indian Institute of Technology Hyderabad (India), et al.  
Conference 11217: Lasers in Dentistry XXVI  
Session 3: LLT and Periodontal Ligament, PS-OCT in Oral Tissues with Precancerous and Cancerous Lesions  
Date and Time: 2/2/20 2:40 PM

## **Genetic algorithm-driven design of SERS-active surfaces for early detection of diseases**

Paper 11236-25  
Author(s): Buse Ebre, Koç Univ. (Turkey), et al.  
Conference 11236: Biomedical Vibrational Spectroscopy 2020: Advances in Research and Industry  
Session 5: Technical Advances I  
Date and Time: 2/2/20 2:40 PM

## **The control of light-activated capacitive and faradaic charge-transfer mechanisms in optoelectronic biointerfaces**

Paper 11255-23  
Author(s): Rustamzhon Melikov, Koç Univ. (Turkey), et al.  
Conference 11255: Colloidal Nanoparticles for Biomedical Applications XV  
Session 7: Biofouling and Applications in Neuroscience  
Date and Time: 2/2/20 2:40 PM

## **First short-wave infrared (SWIR) fluorescence imaging in humans: imaging of ABY-029 in head and neck cancers**

Paper 11222-28  
Author(s): Brook K. Byrd, Dartmouth College (USA), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 6: Clinical Translation and Clinical Applications II  
Date and Time: 2/2/20 2:50 PM

## **Incorporating machine learning with Raman spectroscopy to differentiate bone types**

Paper 11252-40  
Author(s): Pratima Labroo, PolarityTE, Inc. (USA), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 7: Data Science in Chemical Microscopy  
Date and Time: 2/2/20 2:50 PM

## **Aluminum plasmonics for self cleaning surfaces: Complete inactivation of multidrug-resistant bacteria with low-intensity visible light**

Paper 11257-5  
Author(s): Xiangchao Zhu, Univ. of California, Santa Cruz (USA), et al.  
Conference 11257: Plasmonics in Biology and Medicine XVII  
Session 1: Plasmonics and SERS Systems  
Date and Time: 2/2/20 2:50 PM

## **Heart rate app at 10: How to write a biophotonics app that reaches more than 500 million people**

Paper 11239-25  
Author(s): Martin J. Leahy, National Univ. of Ireland, Galway (Ireland), et al.  
Conference 11239: Dynamics and Fluctuations in Biomedical Photonics XVII  
Session 5: Functional Imaging and Evaluations  
Date and Time: 2/2/20 3:00 PM

## **Simple, rapid and cost-effective drug-susceptibility testing of leukemia by intelligent whole-blood imaging flow cytometry**

Paper 11250-32  
Author(s): Hirofumi Kobayashi, The Univ. of Tokyo (Japan), et al.  
Conference 11250: High-Speed Biomedical Imaging and Spectroscopy V  
Session 7: Machine Learning  
Date and Time: 2/2/20 3:00 PM

## **LED-based photoacoustic imaging for early detection of joint inflammation in rodents – Towards achieving 3Rs in rheumatoid arthritis research**

Paper 11240-20  
Author(s): Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 5: Small-Animal Imaging  
Date and Time: 2/2/20 3:45 PM

## **Cherenkov imaging to quantify radiation dose in human tissue**

Paper 11216-25  
Author(s): Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA), et al.  
Conference 11216: Multiscale Imaging and Spectroscopy  
Session 6: Emerging Sources of Multiscale Imaging Contrast  
Date and Time: 2/2/20 3:50 PM

## **Fiber-integrated fabric for non-tight contact bio-sensing of vital signs**

Paper 11258-12  
Author(s): Zeev Zalevsky, Bar-Ilan Univ. (Israel), et al.  
Conference 11258: Frontiers in Biological Detection: From Nanosensors to Systems XII  
Session 4: Resonators and Integrated Photonics II  
Date and Time: 2/2/20 3:50 PM

## **Near infrared fluorescence-guided surgery in pancreatic cancers**

Paper 11222-31  
Author(s): Guolan Lu, Stanford Univ. (USA), et al.  
Conference 11222: Molecular-Guided Surgery: Molecules, Devices, and Applications VI  
Session 7: Clinical Translation and Clinical Applications III  
Date and Time: 2/2/20 4:40 PM

## **Skimager for the objective erythema estimation in atopic dogs**

Paper 11211-35  
Author(s): Blaž Cugmas, Univ. of Latvia (Latvia), et al.  
Conference 11211: Photonics in Dermatology and Plastic Surgery 2020  
Session 9: Skin Characterization/Biological Response  
Date and Time: 2/2/20 5:30 PM

# TRANSLATIONAL RESEARCH APPLICATIONS

## **The transposition of caffeine in skin layers, visualization at a molecular scale by molecular dynamics simulations**

Paper 11211-37

Author(s): Neila Machado, Univ.

Federal do ABC (Brazil), et al.

Conference 11211: Photonics in

Dermatology and Plastic Surgery 2020

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Optical simulations for determining efficacy of new light source designs for excitation-scanning high-speed hyperspectral imaging systems**

Paper 11216-30

Author(s): Craig M. Browning, Univ.

of South Alabama (USA), et al.

Conference 11216: Multiscale

Imaging and Spectroscopy

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Quantitative analysis of vascular complexity in OCTA of diabetic retinopathy**

Paper 11218-75

Author(s): Minhaj Nur Alam, Univ. of

Illinois at Chicago (USA), et al.

Conference 11218: Ophthalmic

Technologies XXX

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Photodynamic priming to attenuate ovarian cancer cell migration**

Paper 11220-23

Author(s): Aaron Sorrin, Univ. of

Maryland, College Park (USA), et al.

Conference 11220: Optical Methods

for Tumor Treatment and Detection:

Mechanisms and Techniques in

Photodynamic Therapy XXIX

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Pupillary sensor for ocular cranial nerve monitoring**

Paper 11225-18

Author(s): Bridget Slomka, The

Univ. of Arizona (USA), et al.

Conference 11225: Clinical and

Translational Neurophotonics 2020

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Laser biospeckle metrology in investigating plant-sound interactions**

Paper 11238-38

Author(s): Minoru Hirai, Shibaura

Institute of Technology (Japan), et al.

Conference 11238: Optical Interactions

with Tissue and Cells XXXI

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Ultrahigh accurate Statistical Interferometric Technique utilizing uniformity of speckle phase in the study of plant physiology**

Paper 11238-40

Author(s): Uma M. Rajagopalan, Shibaura

Institute of Technology (Japan), et al.

Conference 11238: Optical Interactions

with Tissue and Cells XXXI

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Fast fourier transform versus wavelet transform analyses on photoacoustic spectral data of breast tumor progression**

Paper 11238-45

Author(s): Jackson Rodrigues, Manipal

Academy of Higher Education (India), et al.

Conference 11238: Optical Interactions

with Tissue and Cells XXXI

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Polyvinyl chloride-plastisol: a soft tissue-mimicking phantom dedicated to multi-modality elastography**

Paper 11242-40

Author(s): Amir Nahas, Lab. des

sciences de l'Ingénieur, de l'Informatique

et de l'Imagerie (France), et al.

Conference 11242: Optical Elastography

and Tissue Biomechanics VII

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **A high-fat diet impacts collagen organization in breast tumor tissues but not in healthy ones**

Paper 11244-67

Author(s): Yang Zhang, Tufts Univ. (USA), et al.

Conference 11244: Multiphoton Microscopy

in the Biomedical Sciences XX

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Optical parameter scans of scattering media using multispectral spatial frequency domain imaging under a curvilinear coordinates system**

Paper 11253-20

Author(s): Jose E. Calderon, Univ. de

Puerto Rico Mayagüez (USA), et al.

Conference 11253: Biomedical

Applications of Light Scattering X

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

## **Application of laser speckle contrast imaging in laparoscopic surgery**

Paper 11253-22

Author(s): Wido Heeman, Univ. of

Groningen (Netherlands), et al.

Conference 11253: Biomedical

Applications of Light Scattering X

Session PSun: Posters-Sunday

Date and Time: 2/2/20 5:30 PM

**Monday 3 February 2020**

## **OCT oximetry in retinal capillaries**

Paper 11228-1

Author(s): Shaohua Pi, Oregon Health

& Science Univ. (USA), et al.

Conference 11228: Optical Coherence

Tomography and Coherence Domain

Optical Methods in Biomedicine XXIV

Session 1: OCT Angiography

Date and Time: 2/3/20 8:30 AM

## **Cholesteryl ester-rich lipid droplet is a prognostic marker and therapeutic target for human metastatic melanoma**

Paper 11252-53

Author(s): Hyeon Jeong Lee, The Boston

Univ. Photonics Ctr. (USA), et al.

Conference 11252: Advanced

Chemical Microscopy for Life Science

and Translational Medicine

Session 9: Translation into Clinic

Date and Time: 2/3/20 9:20 AM

## **A label-free study of murine gut dysbiosis with fluorescence lifetime spectroscopy and imaging**

Paper 11223-4

Author(s): Alba Alfonso García, Univ.

of California, Davis (USA), et al.

Conference 11223: Photonic Diagnosis,

Monitoring, Prevention, and Treatment of

Infections and Inflammatory Diseases 2020

Session 1: Photonic Diagnosis I

Date and Time: 2/3/20 9:40 AM

## **Copper systemine: a new sensitizer for x-ray induced photodynamic therapy**

Paper 11224-5

Author(s): Wei Chen, The Univ. of

Texas at Arlington (USA), et al.

Conference 11224: Optics

and Ionizing Radiation

Session 1: X-ray Dynamic Therapy

Date and Time: 2/3/20 9:45 AM

## **CARSA: Fast & accurate antibiotic susceptibility testing tool by coherent anti-stokes Raman scattering imaging of D2O metabolism**

Paper 11252-55

Author(s): Pu Wang, Vibronix, Inc. (USA), et al.

Conference 11252: Advanced

Chemical Microscopy for Life Science

and Translational Medicine

Session 9: Translation into Clinic

Date and Time: 2/3/20 9:50 AM

## **Multiphoton and FLIM imaging in quantifying ex vivo and in vivo body organ kinetics of solutes**

Paper 11244-27

Author(s): Michael S. Roberts, Univ.

of South Australia (Australia), et al.

Conference 11244: Multiphoton Microscopy

in the Biomedical Sciences XX

Session 6: Technology and In Vivo Imaging I

Date and Time: 2/3/20 11:15 AM

# TRANSLATIONAL RESEARCH APPLICATIONS

## **Developing diffuse correlation spectroscopic tools for continuous, real-time, spatially-resolved monitoring of spinal cord blood flow**

Paper 11229-28  
Author(s): David R. Busch, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA), et al.  
Conference 11229: Advanced Biomedical and Clinical Diagnostic and Surgical Guidance Systems XVIII  
Session 6: Spectroscopy and Other Techniques  
Date and Time: 2/3/20 11:20 AM

## **Highly sensitive and reliable plasmonic nanoparticle-based digital cytometry for quantification of MUC16 binding on the surface of leukocytes**

Paper 11254-26  
Author(s): Sinyoung Jeong, Massachusetts General Hospital (USA), et al.  
Conference 11254: Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XVII  
Session 3: Nanoscale Imaging II  
Date and Time: 2/3/20 11:30 AM

## **Cerium dioxide (CeO<sub>2</sub>) quantum dots as hole blocking layer for avalanche amorphous selenium photodetector**

Paper 11288-20  
Author(s): Haripriya Kannan, NYU Tandon School of Engineering (USA), et al.  
Conference 11288: Quantum Sensing and Nano Electronics and Photonics XVII  
Session 5: Quantum Sensing I  
Date and Time: 2/3/20 11:45 AM

## **Cherenkov imaging for total skin electron therapy: an update**

Paper 11224-11  
Author(s): Timothy C. Zhu, Perelman Ctr. for Advanced Medicine (USA), et al.  
Conference 11224: Optics and Ionizing Radiation  
Session 3: Novel detectors and Imaging Systems  
Date and Time: 2/3/20 1:45 PM

## **Label-free hematology analysis using deep-ultraviolet microscopy**

Paper 11247-10  
Author(s): Ashkan Ojaghi, Georgia Institute of Technology (USA), et al.  
Conference 11247: Optical Diagnostics and Sensing XX: Toward Point-of-Care Diagnostics  
Session 3: Optical Analysis of Blood for Multiple Applications  
Date and Time: 2/3/20 2:00 PM

## **Enhanced non-contact and continuous sensing of periodic bio-signs: Laser encoded illumination for extending sensor's temporal bandwidth**

Paper 11254-27  
Author(s): Zeev Zalevsky, Bar-Ilan Univ. (Israel), et al.  
Conference 11254: Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XVII  
Session 4: Nanostructures for Biomedical Sensors I  
Date and Time: 2/3/20 2:00 PM

## **Advanced broadband MEMS infrared emitter based on high-temperature-resistant nanostructured surfaces and packaging solutions for harsh environments**

Paper 11279-7  
Author(s): Steffen Biermann, Micro-Hybrid Electronic GmbH (Germany), et al.  
Conference 11279: Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XIII  
Session 2: Infrared Devices, Technology, and Applications  
Date and Time: 2/3/20 2:10 PM

## **Using fNIRS to study the brain activation and networks associated with Chinese character recognition**

Paper 11226-11  
Author(s): Zhen Yuan, Univ. of Macau (Macao, China), et al.  
Conference 11226: Neural Imaging and Sensing 2020  
Session 3: Human Brain  
Date and Time: 2/3/20 2:20 PM

## **Cherenkov emission from tissue is inversely related to tissue optical attenuation and proportional to the radiation dose buildup gradient**

Paper 11224-13  
Author(s): Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA), et al.  
Conference 11224: Optics and Ionizing Radiation  
Session 3: Novel detectors and Imaging Systems  
Date and Time: 2/3/20 2:30 PM

## **Anticoagulation and hemostasis monitoring at the bedside during cardiac surgical procedures**

Paper 11247-12  
Author(s): Diane M. Tshikudi, Massachusetts General Hospital (USA), et al.  
Conference 11247: Optical Diagnostics and Sensing XX: Toward Point-of-Care Diagnostics  
Session 3: Optical Analysis of Blood for Multiple Applications  
Date and Time: 2/3/20 2:40 PM

## **Integrated optofluidics: label-free isolation of nanoscale bioparticles from heterogeneous samples**

Paper 11235-30  
Author(s): Xiangchao Zhu, Univ. of California, Santa Cruz (USA), et al.  
Conference 11235: Microfluidics, BioMEMS, and Medical Microsystems XVIII  
Session 8: Optofluidics  
Date and Time: 2/3/20 2:50 PM

## **Thermo-photonic detection and quantification of THC in oral fluid at unprecedented low concentrations**

Paper 11247-13  
Author(s): Damber Thapa, York Univ. (Canada), et al.  
Conference 11247: Optical Diagnostics and Sensing XX: Toward Point-of-Care Diagnostics  
Session 4: Use of Mobile Phone for POC Analysis  
Date and Time: 2/3/20 3:30 PM

## **Studying intrinsic skin aging by slide-free in vivo harmonic generation microscopy**

Paper 11244-36  
Author(s): Chi-Kuang Sun, National Taiwan Univ. (Taiwan), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 8: SHG/THG Microscopy  
Date and Time: 2/3/20 3:50 PM

## **Test-objects and phantoms for characterization and optimization of hybrid 3D PA-US systems**

Paper 11240-47  
Author(s): Maura Dantuma, Univ. of Twente (Netherlands), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 9: Phantoms and Standardization Activities  
Date and Time: 2/3/20 4:00 PM

## **Lipid metabolic imaging opens new avenue for human cancer diagnosis**

Paper 11252-67  
Author(s): Shuhua Yue, Beihang Univ. (China), et al.  
Conference 11252: Advanced Chemical Microscopy for Life Science and Translational Medicine  
Session 12: CARS, SRS, Raman Innovation and Applications V  
Date and Time: 2/3/20 4:00 PM

## **Label-free neurophotonics: electro-plasmonic biosensors for ultrasensitive detection of electrogenic activity of cells**

Paper 11257-26  
Author(s): Ahsan Habib, Univ. of California, Santa Cruz (USA), et al.  
Conference 11257: Plasmonics in Biology and Medicine XVII  
Session 5: Plasmonic Detection and Sensing  
Date and Time: 2/3/20 4:30 PM

# TRANSLATIONAL RESEARCH APPLICATIONS

## **Bringing third and second harmonic generation microscopy into the clinic for the assessment of fresh lung (tumor) tissue**

Paper 11244-40  
Author(s): Laura M. G. Van Huizen, Vrije Univ. Amsterdam (Netherlands), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 8: SHG/THG Microscopy  
Date and Time: 2/3/20 5:00 PM

## **Segmented OCT data set for depth resolved brain tumor detection validated by histological analysis**

Paper 11228-96  
Author(s): Paul Streng, Medizinisches Laserzentrum Lübeck GmbH (Germany), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Photoacoustic imaging using a transvaginal ultrasound probe: A comparison of image reconstruction methods**

Paper 11240-134  
Author(s): Guilherme Fernandes, Univ. de São Paulo (Brazil), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Quantitative analysis of photoacoustic clutter artifact reduction using short-lag spatial coherence metric**

Paper 11240-147  
Author(s): Guilherme Fernandes, Univ. de São Paulo (Brazil), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Optimizing irradiation geometry in LED-based photoacoustics: Towards point-of-care deep tissue functional imaging**

Paper 11240-156  
Author(s): Maju Kuriakose, Tufts Univ. (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Photoplethysmography for bovine heat detection: the preliminary results**

Paper 11247-18  
Author(s): Blaž Čugmas, Univ. of Latvia (Latvia), et al.  
Conference 11247: Optical Diagnostics and Sensing XX: Toward Point-of-Care Diagnostics  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Enhanced capacitive photostimulation of neurons by hot-electron injection in optoelectronic biointerfaces**

Paper 11257-35  
Author(s): Rustamzhan Melikov, Koç Univ. (Turkey), et al.  
Conference 11257: Plasmonics in Biology and Medicine XVII  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Tuesday 4 February 2020**

## **Hand-held multispectral imager to study Cushing syndrome: moving from portable to point of care**

Paper 11234-11  
Author(s): Siddharth Khare, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 8: Spectral Imaging  
Date and Time: 2/4/20 8:10 AM

## **Near infrared photoimmunotherapy for cancer; Immunoactivation regimens and applications of imaging technologies**

Paper 11256-1  
Author(s): Hisataka Kobayashi, National Cancer Institute (USA), et al.  
Conference 11256: Reporters, Markers, Dyes, Nanoparticles, and Molecular Probes for Biomedical Applications XII  
Session 1: Phototherapeutic Applications using NIR and other Probes  
Date and Time: 2/4/20 8:10 AM

## **Dual modality probe for photoacoustic tomography and widefield endoscopy\***

Paper 11240-55  
Author(s): Reham Ansari, Univ. College London (United Kingdom), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 10: Endoscopy and Minimally-Invasive  
Date and Time: 2/4/20 9:00 AM

## **Photodynamic therapy: alternative in decontamination of surfaces**

Paper 11223-20  
Author(s): Augusto Alberto Foggiano, Univ. Estadual do Norte do Paraná (Brazil), et al.  
Conference 11223: Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2020  
Session 4: Antimicrobial Photodynamic Therapy  
Date and Time: 2/4/20 9:45 AM

## **Development of a miniature balloon probe for light-enhanced transesophageal echocardiography: towards transnasal deployment**

Paper 11240-172  
Author(s): Li Li, Massachusetts General Hospital (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 10: Endoscopy and Minimally-Invasive  
Date and Time: 2/4/20 9:45 AM

## **Mechanism study for bactericidal synergy between antimicrobial blue light (aBL) and carvacrol**

Paper 11223-21  
Author(s): Mei X. Wu, Harvard Medical School (USA), et al.  
Conference 11223: Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2020  
Session 5: Antimicrobial Blue Light  
Date and Time: 2/4/20 10:30 AM

## **Endobronchial optical coherence tomography for in vivo microscopic diagnosis of pulmonary fibrosis**

Paper 11228-35  
Author(s): Lida P. Hariri, Massachusetts General Hospital (USA), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 6: Clinical Applications  
Date and Time: 2/4/20 10:30 AM

## **Development of a clinically translatable hyperspectral endoscopy (HySE) system and analysis methods for the improved diagnosis of gastrointestinal disease**

Paper 11229-41  
Author(s): Jonghee Yoon, Univ. of Cambridge (United Kingdom), et al.  
Conference 11229: Advanced Biomedical and Clinical Diagnostic and Surgical Guidance Systems XVIII  
Session 10: Imaging  
Date and Time: 2/4/20 10:40 AM

## **Integration of light-induced autofluorescence and optical coherence tomography for dental applications**

Paper 11228-37  
Author(s): Nhan Le, Univ. of Washington (USA), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 6: Clinical Applications  
Date and Time: 2/4/20 11:00 AM

## **A hyperspectral microscope based on a birefringent ultrastable common-path interferometer**

Paper 11245-8  
Author(s): Cristian Manzoni, Politecnico di Milano (Italy), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 2: Illumination and Optical Coherence  
Date and Time: 2/4/20 11:20 AM

## **Thermal-energy memory based photoacoustic thermometry (TEMPT) in deep tissue**

Paper 11240-67  
Author(s): Junjie Yao, Duke Univ. (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 15: Functional, Molecular, and Quantitative II  
Date and Time: 2/4/20 11:30 AM

# TRANSLATIONAL RESEARCH APPLICATIONS

## Tomographic imaging with an LED-based photoacoustic-ultrasound system

Paper 11240-71  
Author(s): Francis Kalloor Joseph, Univ. of Twente (Netherlands), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 11: Multi-modality Imaging  
Date and Time: 2/4/20 12:00 PM

## Coherent Raman scattering imaging for pharmacokinetics and pharmacodynamics

Paper 11244-54  
Author(s): Conor L. Evans, Wellman Ctr. for Photomedicine (USA), et al.  
Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
Session 11: Technology and Raman Microscopy  
Date and Time: 2/4/20 1:50 PM

## Visualizing clean tumor margins using time resolved fluorescence spectroscopy

Paper 11234-22  
Author(s): Pramod V. Butte, Cedars-Sinai Medical Ctr. (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 10: Spectroscopic Methods I  
Date and Time: 2/4/20 2:00 PM

## Inhibiting Staphylococcus aureus antibiotic resistance via photo-disassembly of membrane microdomains

Paper 11223-29  
Author(s): Jie Hui, Boston Univ. (USA), et al.  
Conference 11223: Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2020  
Session 7: New Mechanisms and Miscellaneous  
Date and Time: 2/4/20 2:35 PM

## The toxicity and clearance of copper indium sulfide quantum dots in vivo

Paper 11256-9  
Author(s): Joshua Kays, Boston Univ. (USA), et al.  
Conference 11256: Reporters, Markers, Dyes, Nanoparticles, and Molecular Probes for Biomedical Applications XII  
Session 2: Nanomaterials as Probes and in Imaging Applications I  
Date and Time: 2/4/20 2:40 PM

## Flow cytometry visualisation and real-time processing with a CMOS SPAD array and high-speed hardware implementation algorithm

Paper 11243-29  
Author(s): Hanning Mai, The Univ. of Edinburgh (United Kingdom), et al.  
Conference 11243: Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues XVIII  
Session 7: Cytomics II  
Date and Time: 2/4/20 2:50 PM

## Eradication of broad-spectrum multi-drug fungal pathogens through photoinactivation of a detoxifying enzyme

Paper 11223-30  
Author(s): Pu-Ting Dong, Boston Univ. (USA), et al.  
Conference 11223: Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2020  
Session 7: New Mechanisms and Miscellaneous  
Date and Time: 2/4/20 3:00 PM

## Virtual multi-directional optical coherence tomography

Paper 11228-51  
Author(s): Daisuke Oida, Univ. of Tsukuba (Japan), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 8: Signal/Image Processing  
Date and Time: 2/4/20 4:30 PM

## Ultraviolet hyperspectral microscopy using chromatic aberration based iterative phase-recovery

Paper 11251-73  
Author(s): Nischita Kaza, Georgia Institute of Technology (USA), et al.  
Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
Session 14: Holography and Phase Microscopy IV  
Date and Time: 2/4/20 4:30 PM

## A luminescent oxygen-sensing hydrogel for mapping tissue oxygenation

Paper 11256-14  
Author(s): Haley L. Marks, Massachusetts General Hospital (USA), et al.  
Conference 11256: Reporters, Markers, Dyes, Nanoparticles, and Molecular Probes for Biomedical Applications XII  
Session 4: Fluorescent and Luminescent Probes  
Date and Time: 2/4/20 5:10 PM

## Color mapping of collagen spectra from near-infrared transparency window III to the visible spectrum

Paper 11234-56  
Author(s): Vivian Wang, Institute for Ultrafast Spectroscopy and Lasers (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session PTues: Posters-Tuesday  
Date and Time: 2/4/20 6:00 PM

## Minimally invasive photoacoustic imaging for device guidance and monitoring of radiofrequency ablation

Paper 11240-58  
Author(s): Francis Kalloor Joseph, Univ. of Twente (Netherlands), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session PTue: Posters-Tuesday  
Date and Time: 2/4/20 6:00 PM

## Wednesday 5 February 2020

## Quantitative detection of breast cancer using confocal fluorescence polarization imaging

Paper 11234-33  
Author(s): Anna N. Yaroslavsky, Univ. of Massachusetts Lowell (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 12: Optical Histology I  
Date and Time: 2/5/20 8:40 AM

## Computational super-resolution microscopy: leveraging noise models, regularization and sparsity to achieve highest resolution

Paper 11245-21  
Author(s): Jian Xing, Univ. of Colorado Boulder (USA), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 5: Computational Imaging  
Date and Time: 2/5/20 8:50 AM

## Quantitative photoacoustic oximetry using convolutional neural networks

Paper 11240-87  
Author(s): Kevin Hoffer-Hawlik, Thayer School of Engineering at Dartmouth (USA), et al.  
Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
Session 14: Functional, Molecular, and Quantitative I  
Date and Time: 2/5/20 9:00 AM

## Rapid label-free computational staining for cancer histopathology

Paper 11234-41  
Author(s): Min Xu, Hunter College (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 14: Optical Histology III  
Date and Time: 2/5/20 1:40 PM

## Hybrid laser platform for printing 3D multiscale multi-material hydrogel structures

Paper 11271-22  
Author(s): Pranav Soman, Syracuse Biomaterials Institute, Syracuse Univ. (USA), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 7: Multi-material Printing and Laser Cladding  
Date and Time: 2/5/20 1:40 PM

## Excitation-scan hyperspectral mirror array system advancements to hyperspectral imaging applications

Paper 11245-31  
Author(s): Marina Parker, Univ. of South Alabama (USA), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 7: Innovative Methods in Microscopy  
Date and Time: 2/5/20 2:20 PM

## TRANSLATIONAL RESEARCH APPLICATIONS

### **Quantitative assessment of acute mesenteric ischemia in preclinical models using laser speckle contrast imaging (LSCI)**

Paper 11234-45

Author(s): So Hyun Nam, Children's National Health System (USA), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 15: Optical Bioassay Platforms  
Date and Time: 2/5/20 3:40 PM

### **Imaging biomarkers quantify therapeutic effect in 3D-printed skin cancer constructs**

Paper 11243-54

Author(s): Daniel S. Gareau, The Rockefeller Univ. (USA), et al.  
Conference 11243: Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues XVIII  
Session 12: Monitoring and Regenerative Medicine II  
Date and Time: 2/5/20 4:10 PM

### **Lipid metabolic imaging opens new avenue for human cancer diagnosis**

Paper 11234-49

Author(s): Shuhua Yue, Beihang Univ. (China), et al.  
Conference 11234: Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis  
Session 15: Optical Bioassay Platforms  
Date and Time: 2/5/20 5:00 PM

### **Super-speed multiphoton microscopy for mesoscopic volume imaging with ultra-dense sampling beyond Nyquist Limit**

Paper 11245-38

Author(s): Bhaskar Jyoti Borah, National Taiwan Univ. (Taiwan), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 8: Fluorescence and Nonlinear Microscopy  
Date and Time: 2/5/20 5:20 PM

### **Quantification of ex vivo tissue activity by short and long time-course analysis of multifunctional OCT signals**

Paper 11228-83

Author(s): Ibrahim Abd El-Sadek, Univ. of Tsukuba (Japan), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 12: Novel Contrast Mechanisms  
Date and Time: 2/5/20 5:30 PM

### **Convolutional neural network (CNN) based needle-tracking for OCT-guided cornea "Big Bubble" procedure**

Paper 11243-58

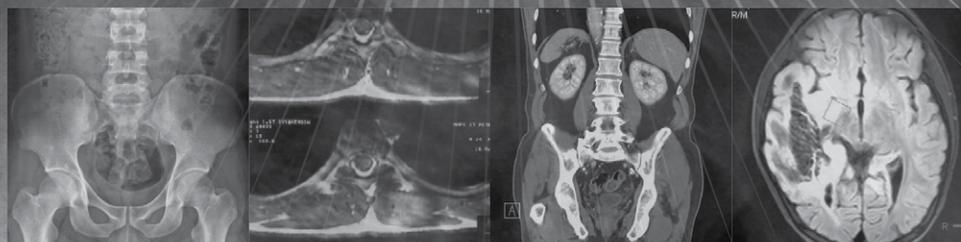
Author(s): Ruizhi Zuo, Johns Hopkins Univ. (USA), et al.  
Conference 11243: Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues XVIII  
Session 13: Bioinformatics  
Date and Time: 2/5/20 5:30 PM

### **Saliency-driven airport detection via global contrast analysis and geometric feature extraction for remote-sensing images**

Paper 11299-31

Author(s): Yang Sun, Beijing Normal Univ. (China), et al.  
Conference 11299: AI and Optical Data Sciences  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

# Journal of Medical Imaging



**Maryellen L. Giger**, The University of Chicago  
Editor-in-Chief

[spie.org/jmi](http://spie.org/jmi)

**SPIE.**

See individual conferences  
for locations

## 3D PRINTING APPLICATIONS

# 3D PRINTING

SPIE Applications of 3D Printing 2020 highlights papers that showcase innovative ways to apply this multidimensional/multidisciplinary technology.

- Additive Manufacturing
- Selective Laser Melting, Laser Sintering, Laser Photopolymerization
- Novel Materials, Protean Materials, and Laser Interactions
- Software that Increases Efficiencies and Speed
- In-situ Sensors or Probes to Verify and Quantify Additive Manufacturing Processes in Real Time
- Conformal Photonics/Electronics

### TRACK CHAIR



**Henry Helvajian**  
The Aerospace Corp. (USA)

### Saturday 1 February 2020

#### **Progress in angle-resolved low-coherence interferometry for real-time detection of epithelial dysplasia**

Paper 11253-1  
Author(s): Zachary A. Steelman, Duke Univ. (United States), et al.  
Conference 11253: Biomedical Applications of Light Scattering X  
Session 1: Cancer Detection and Characterization  
Date and Time: 2/1/20 8:00 AM

#### **Laser induced forward transfer as a tool for precise bioprinting**

Paper 11270-1  
Author(s): Ioanna Zergioti, National Technical Univ. of Athens (Greece), et al.  
Conference 11270: Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX  
Session 1: Biomedical Applications for Ultrafast Lasers  
Date and Time: 2/1/20 8:10 AM

#### **Combined OCT and angle-resolved low-coherence interferometry using endoscope-coupled paddle probe**

Paper 11214-3  
Author(s): Kengyeh K. Chu, Duke Univ. (United States), et al.  
Conference 11214: Endoscopic Microscopy XV  
Session 1: Gastroenterology  
Date and Time: 2/1/20 9:00 AM

#### **Development on Utah optrode array for efficient neural stimulation and recording device**

Paper 11227-5  
Author(s): Steve Blair, The Univ. of Utah (United States), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 2: Optogenetics I  
Date and Time: 2/1/20 10:30 AM

#### **Nanofluidics fabricated by femtosecond laser 3D processing for mechanism study of cancer cell metastasis**

Paper 11270-6  
Author(s): Koji Sugioka, RIKEN Ctr. for Advanced Photonics (Japan), et al.  
Conference 11270: Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX  
Session 2: Ultrafast Lasers for the Manipulation of Cells  
Date and Time: 2/1/20 10:30 AM

#### **Femtosecond laser induced densification within cell-laden hydrogels results in cellular alignment**

Paper 11270-7  
Author(s): Zheng Xiong, Syracuse Biomaterials Institute (United States), et al.  
Conference 11270: Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX  
Session 2: Ultrafast Lasers for the Manipulation of Cells  
Date and Time: 2/1/20 11:00 AM

#### **Prototype of three-dimensional-printing-based vaginal endoscope**

Paper 11231-9  
Author(s): Myoungjae Jun, Osaka Univ. (Japan), et al.  
Conference 11231: Design and Quality for Biomedical Technologies XIII  
Session 2: Device Design  
Date and Time: 2/1/20 11:50 AM

#### **A laser scanning based 3D object sensing method using multiple frequencies modulation**

Paper 11293-9  
Author(s): InGyu Jang, KAIST (Korea, Republic of), et al.  
Conference 11293: MOEMS and Miniaturized Systems XIX  
Session 2: LIDAR  
Date and Time: 2/1/20 11:50 AM

#### **Optical mapping of effective brain networks during the tangram task**

Paper 11225-7  
Author(s): Zhen Yuan, Univ. of Macau (Macao, China), et al.  
Conference 11225: Clinical and Translational Neurophotonics 2020  
Session 3: Optical Spectroscopy: Clinical  
Date and Time: 2/1/20 1:10 PM

#### **Simultaneous multiplane imaging with reverberation multiphoton microscopy**

Paper 11250-9  
Author(s): Jerome Mertz, Boston Univ. (United States), et al.  
Conference 11250: High-Speed Biomedical Imaging and Spectroscopy V  
Session 3: High-Throughput Microscopy  
Date and Time: 2/1/20 1:30 PM

#### **Dynamic pattern generation by singlemode fibers for endoscopic 3D measurement systems**

Paper 11293-13  
Author(s): Silvio Pulwer, Technische Hochschule Wildau (Germany), et al.  
Conference 11293: MOEMS and Miniaturized Systems XIX  
Session 3: Novel Optical Devices  
Date and Time: 2/1/20 3:10 PM

#### **Quantitative assessment of the three-dimensional microarchitecture of the human vocal fold using optical coherence tomography, two-photon excitation fluorescence microscopy, and second harmonic generation**

Paper 11213-16  
Author(s): Fouzi Benboujja, Harvard Medical School (United States), et al.  
Conference 11213: Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2020  
Session 5: Combining Novel Imaging Technology for Functional Assessment and Therapy Guidance in Upper and Lower Airways  
Date and Time: 2/1/20 3:50 PM

# 3D PRINTING APPLICATIONS

## **Fluorescence molecular tomography based on machine-learning strategy for tracer visualization**

Paper 11219-16  
Author(s): Hui Meng, Institute of Automation (China), et al.  
Conference 11219: Visualizing and Quantifying Drug Distribution in Tissue IV  
Session 4: Advanced Methods in Drug Detection and Imaging  
Date and Time: 2/1/20 4:00 PM

## **Evaluation of FFF 3D printed features using OCT**

Paper 11270-16  
Author(s): Marcus Paulo Raele, Instituto de Pesquisas Energéticas e Nucleares (Brazil), et al.  
Conference 11270: Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX  
Session 4: Ultrafast Laser Imaging and Diagnostic  
Date and Time: 2/1/20 4:00 PM

## **Identifying optical analogs to MRI Gd-contrast using whole-body hyperspectral cryo-fluorescence imaging**

Paper 11219-17  
Author(s): Brook K. Byrd, Dartmouth College (United States), et al.  
Conference 11219: Visualizing and Quantifying Drug Distribution in Tissue IV  
Session 4: Advanced Methods in Drug Detection and Imaging  
Date and Time: 2/1/20 4:20 PM

## **Sunday 2 February 2020**

## **Harnessing femtosecond laser filaments for nano-structuring of "Lab-in-Fibre" sensors and "Spectrometer-in-Fibre" microsystems**

Paper 11292-1  
Author(s): Peter R. Herman, Univ. of Toronto (Canada), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 1: Microoptics: Sensors and Concentrators  
Date and Time: 2/2/20 8:10 AM

## **Laser fabrication inside birefringent crystals with aberration correction**

Paper 11270-23  
Author(s): Patrick S. Salter, Univ. of Oxford (United Kingdom), et al.  
Conference 11270: Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX  
Session 5: Ultrafast Laser Micro/Nano-machining  
Date and Time: 2/2/20 8:30 AM

## **Light-sheet microscopy using MEMS and active optics for 3D image acquisition control**

Paper 11293-21  
Author(s): Spyridon Bakas, Univ. of Strathclyde (United Kingdom), et al.  
Conference 11293: MOEMS and Miniaturized Systems XIX  
Session 5: Imaging  
Date and Time: 2/2/20 8:30 AM

## **Fabrication and replication of high efficiency blazed gratings with grayscale electron beam lithography and UV nanoimprint lithography**

Paper 11292-3  
Author(s): Marie-Aline Mattelin, Ctr. for Microsystems Technology (Belgium), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 1: Microoptics: Sensors and Concentrators  
Date and Time: 2/2/20 9:00 AM

## **Combining infrared neuromodulation (IRN) with isotonic glucose solution to lower the IR dose requirement**

Paper 11227-26  
Author(s): Junqi Zhuo, Case Western Reserve Univ. (United States), et al.  
Conference 11227: Optogenetics and Optical Manipulation 2020  
Session 6: INS I  
Date and Time: 2/2/20 9:40 AM

## **Testing trichomes designs of 3D microstructures using multiphoton polymerization: Toward hydrophobic surfaces**

Paper 11269-11  
Author(s): Areti Mourka, Foundation for Research and Technology-Hellas (Greece), et al.  
Conference 11269: Synthesis and Photonics of Nanoscale Materials XVII  
Session 3: Synthesis and Diagnostics of Nanoscale Materials I  
Date and Time: 2/2/20 9:50 AM

## **Comparison of 3D-printed phantoms for testing cerebral oximeter performance**

Paper 11231-23  
Author(s): Ali Afshari, U.S. Food and Drug Administration (United States), et al.  
Conference 11231: Design and Quality for Biomedical Technologies XIII  
Session 6: Standardization: Phantoms and Metrology  
Date and Time: 2/2/20 11:20 AM

## **Optical tweezers for micro- and nano-assembly**

Paper 11292-8  
Author(s): Jeffrey E. Melzer, Wyant College of Optical Sciences (United States), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 2: Plasmonics  
Date and Time: 2/2/20 11:30 AM

## **Fabricating millifluidic devices for SAXS/WAXS beamlines using 3D printing**

Paper 11235-18  
Author(s): Cate O'Brien, The Univ. of Sheffield (United Kingdom), et al.  
Conference 11235: Microfluidics, BioMEMS, and Medical Microsystems XVIII  
Session 5: Manufacturing II  
Date and Time: 2/2/20 2:10 PM

## **Nanoscale light management with 3D scanning near-field optical microscopy for optoelectronics material design**

Paper 11269-17  
Author(s): Giovanni Fanchini, Western Univ. (Canada), et al.  
Conference 11269: Synthesis and Photonics of Nanoscale Materials XVII  
Session 5: Synthesis and Diagnostics of Nanoscale Materials III  
Date and Time: 2/2/20 2:10 PM

## **A novel gravity valve and its application in a 3D printed centrifugal fluidic-system for solid phase extraction (SPE)**

Paper 11235-19  
Author(s): Wanjun Wang, Louisiana State Univ. (United States), et al.  
Conference 11235: Microfluidics, BioMEMS, and Medical Microsystems XVIII  
Session 5: Manufacturing II  
Date and Time: 2/2/20 2:30 PM

## **Dual-arm robotic system for 3D biofabrication**

Paper 11235-20  
Author(s): Charlotte Hauser, King Abdullah Univ. of Science and Technology (Saudi Arabia), et al.  
Conference 11235: Microfluidics, BioMEMS, and Medical Microsystems XVIII  
Session 5: Manufacturing II  
Date and Time: 2/2/20 2:50 PM

## **Multiphoton 3D laser printing of nanoporous architectures**

Paper 11292-16  
Author(s): Frederik Mayer, Karlsruhe Institut für Technologie (Germany), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 4: Novel Materials  
Date and Time: 2/2/20 4:30 PM

## **A 3D actuator for laser scanning endoscopy**

Paper 11293-26  
Author(s): Oguz Gurcuoglu, Istanbul Technical Univ. (Turkey), et al.  
Conference 11293: MOEMS and Miniaturized Systems XIX  
Session 6: Endoscopic Microscopy: Joint Session with 11214 and 11293  
Date and Time: 2/2/20 4:30 PM

## AgNP-decorated 3D nano-bowl structures for SERS detection of urea and exosomes

Paper 11254-18  
 Author(s): Juanjuan Liu, McGill Univ. (Canada), et al.  
 Conference 11254: Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XVII  
 Session 2: Nanoscale Imaging I  
 Date and Time: 2/2/20 5:20 PM

## Safe puncture optimized tool (SPOT) to safely inject clot-dissolving drug into the retinal vein

Paper 11218-87  
 Author(s): Andrea Lovera, FEMTOprint SA (Switzerland), et al.  
 Conference 11218: Ophthalmic Technologies XXX  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

## Optical parameter scans of scattering media using multispectral spatial frequency domain imaging under a curvilinear coordinates system

Paper 11253-20  
 Author(s): Jose E. Calderon, Univ. de Puerto Rico Mayagüez (United States), et al.  
 Conference 11253: Biomedical Applications of Light Scattering X  
 Session PSun: Posters-Sunday  
 Date and Time: 2/2/20 5:30 PM

## Monday 3 February 2020

### 25 plane multifocus microscopy for fast and live 3D imaging

Paper 11226-1  
 Author(s): Sara Abrahamsson, Univ. of California, Santa Cruz (United States), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 1: Microscopy I  
 Date and Time: 2/3/20 8:20 AM

### Recent advances in 3D printing of pure proteinaceous microstructures by femtosecond laser direct write

Paper 11268-1  
 Author(s): Daniela Serien, RIKEN (Japan), et al.  
 Conference 11268: Laser-based Micro- and Nanoprocessing XIV  
 Session 1: Microfluidics and Medical Micro Systems: Joint Session with 11235 and 11268  
 Date and Time: 2/3/20 9:00 AM

### Laser welding of silica glass fibre: Enabling robust Bragg grating sensing for high temperature environment

Paper 11270-49  
 Author(s): Oleg Vorobyev, Univ. of Toronto (Canada), et al.  
 Conference 11270: Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX  
 Session 9: 3D Ultrafast Laser Microfabrication  
 Date and Time: 2/3/20 9:50 AM

### 3D-printed, low-cost, lightweight optomechanics for a compact, low-power solid state amplifier system

Paper 11261-4  
 Author(s): Fabian Kranert, Laser Zentrum Hannover e.V. (Germany), et al.  
 Conference 11261: Components and Packaging for Laser Systems VI  
 Session 1: Advanced Laser Packaging Solutions  
 Date and Time: 2/3/20 11:40 AM

### Approaching two-photon excitation microscopy from PCM2000 confocal to PRISM image scanning system.

Paper 11244-30  
 Author(s): Alberto Diaspro, Istituto Italiano di Tecnologia (Italy), et al.  
 Conference 11244: Multiphoton Microscopy in the Biomedical Sciences XX  
 Session 7: Technology and In Vivo Imaging II  
 Date and Time: 2/3/20 1:15 PM

### Applications of liquid crystals in brain study

Paper 11303-1  
 Author(s): Tigran Galstian, Ctr. d'optique, photonique et laser (Canada), et al.  
 Conference 11303: Emerging Liquid Crystal Technologies XV  
 Session 1: Liquid Crystal Lenses and Microlens Arrays  
 Date and Time: 2/3/20 1:30 PM

### Robust 4D wavefront control through coherent fiber bundles for lensless endoscopy and optical tweezing

Paper 11248-28  
 Author(s): Jürgen Czarske, TU Dresden (Germany), et al.  
 Conference 11248: Adaptive Optics and Wavefront Control for Biological Systems VI  
 Session 7: Endoscopy and Multimode Fiber Imaging II  
 Date and Time: 2/3/20 1:50 PM

### Using fNIRS to study the brain activation and networks associated with Chinese character recognition

Paper 11226-11  
 Author(s): Zhen Yuan, Univ. of Macau (Macao, China), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 3: Human Brain  
 Date and Time: 2/3/20 2:20 PM

### Structural remodeling of fibrillar collagens in posterior tibial tendinopathy in three dimensional space identified using multiphoton and second harmonic generation imaging

Paper 11243-14  
 Author(s): Thomas Abraham, Penn State College of Medicine (United States), et al.  
 Conference 11243: Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues XVIII  
 Session 3: Functional Imaging II  
 Date and Time: 2/3/20 3:00 PM

### 172 nm patterning of optical components on polymers

Paper 11292-28  
 Author(s): Andrey E. Mironov, Univ. of Illinois (United States), et al.  
 Conference 11292: Advanced Fabrication Technologies for Micro/ Nano Optics and Photonics XIII  
 Session 6: Large Area Optics  
 Date and Time: 2/3/20 3:10 PM

### Test-objects and phantoms for characterization and optimization of hybrid 3D PA-US systems

Paper 11240-47  
 Author(s): Maura Dantuma, Univ. of Twente (Netherlands), et al.  
 Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
 Session 9: Phantoms and Standardization Activities  
 Date and Time: 2/3/20 4:00 PM

### Two-photon polymerisation with anisotropic materials

Paper 11292-30  
 Author(s): Patrick S. Salter, Univ. of Oxford (United Kingdom), et al.  
 Conference 11292: Advanced Fabrication Technologies for Micro/ Nano Optics and Photonics XIII  
 Session 7: DLW: Sensing and Waveguides  
 Date and Time: 2/3/20 4:30 PM

### Directed assembly of 3D nanophotonic systems from building blocks

Paper 11289-10  
 Author(s): Euan McLeod, James C. Wyant College of Optical Sciences (United States), et al.  
 Conference 11289: Photonic and Phononic Properties of Engineered Nanostructures X  
 Session 3: Photonic Crystals  
 Date and Time: 2/3/20 4:40 PM

### Direct laser writing of waveguides using the exposure dependent polymerization of IP-Dip

Paper 11292-31  
 Author(s): Christina Jörg, Technische Univ. Kaiserslautern (Germany), et al.  
 Conference 11292: Advanced Fabrication Technologies for Micro/ Nano Optics and Photonics XIII  
 Session 7: DLW: Sensing and Waveguides  
 Date and Time: 2/3/20 5:00 PM

### Ultrapure plasmonic chain-like gold nanoparticle-enhanced multimodal photoacoustic microscopy and optical coherence tomography for the identification of choroidal neovascularization in living rabbits

Paper 11240-138  
 Author(s): Van Phuc Nguyen, Univ. of Michigan-Kellogg Eye Ctr. (United States), et al.  
 Conference 11240: Photons Plus Ultrasound: Imaging and Sensing 2020  
 Session PMon: Posters-Monday  
 Date and Time: 2/3/20 5:30 PM

# 3D PRINTING APPLICATIONS

## **3D printed diffraction phase microscope with low-coherent radiation for quantitative phase imaging**

Paper 11249-75  
Author(s): Nikolay V. Petrov, ITMO Univ. (Russian Federation), et al.  
Conference 11249: Quantitative Phase Imaging VI  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **3D printed portable holographic microscope for biomedical particle ensemble investigations**

Paper 11251-97  
Author(s): Nikolay V. Petrov, ITMO Univ. (Russian Federation), et al.  
Conference 11251: Label-free Biomedical Imaging and Sensing (LBIS) 2020  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Low-cost glucose biosensor fabricated by a photosensitive resin that features nanoparticles**

Paper 11254-48  
Author(s): José V. Guzmán-Gonzalez, Univ. Autónoma de Nuevo León (Mexico), et al.  
Conference 11254: Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XVII  
Session PMon: Posters-Monday  
Date and Time: 2/3/20 5:30 PM

## **Tuesday 4 February 2020**

## **3D printed micro-optics: Millimeter size, multiple materials, and combining refractive and diffractive imaging leads to novel functionalities**

Paper 11292-34  
Author(s): Harald Giessen, Univ. Stuttgart (Germany), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 9: DLW: Microoptics and Metals: Joint Session with Conferences 11271 and 11292  
Date and Time: 2/4/20 8:20 AM

## **Fabrication and characterization of 3D silver micro-structures**

Paper 11292-35  
Author(s): Erik Hagen Waller, Technische Univ. Kaiserslautern (Germany), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 9: DLW: Microoptics and Metals: Joint Session with Conferences 11271 and 11292  
Date and Time: 2/4/20 9:10 AM

## **High-throughput fabrication of right-angle prism mirrors with selective metalization by two-step 3D printing and computer vision alignment**

Paper 11292-36  
Author(s): Andrea Bertocchini, King Abdullah Univ. of Science and Technology (Saudi Arabia), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 9: DLW: Microoptics and Metals: Joint Session with Conferences 11271 and 11292  
Date and Time: 2/4/20 9:30 AM

## **Scalable fabrication of nano-architected materials using 3D interference lithography with metasurfaces at visible wavelengths**

Paper 11289-18  
Author(s): Phillippe Pearson, Caltech (United States), et al.  
Conference 11289: Photonic and Phononic Properties of Engineered Nanostructures X  
Session 4: Photonic Metasurfaces I  
Date and Time: 2/4/20 9:50 AM

## **Challenges and opportunities for occlusion-capable optical see-through head-mounted displays for augmented reality**

Paper 11299-4  
Author(s): Hong Hua, James C. Wyant College of Optical Sciences (United States), et al.  
Conference 11299: AI and Optical Data Sciences  
Session 2: AR/VR Sciences II  
Date and Time: 2/4/20 10:30 AM

## **Three-dimensional partial coherent holography by a digital micro-mirror device**

Paper 11245-6  
Author(s): Yi Xue, Univ. of California, Berkeley (United States), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 2: Illumination and Optical Coherence  
Date and Time: 2/4/20 10:40 AM

## **Rapid multi-focus multi-photon three-dimensional laser micro-printing**

Paper 11271-2  
Author(s): Vincent Hahn, Karlsruher Institut für Technologie (Germany), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 2: DLW: High Speed Printing: Joint Session with Conferences 11271 and 11292  
Date and Time: 2/4/20 10:40 AM

## **Two-photon grayscale lithography**

Paper 11292-38  
Author(s): Yann Tanguy, Nanoscribe GmbH (Germany), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session 10: DLW: High Speed Printing: Joint Session with Conferences 11271 and 11292  
Date and Time: 2/4/20 11:10 AM

## **Stable fiber-based polarization sensitive optical coherence tomography/optical microangiography system for simultaneous birefringent and microvascular imaging**

Paper 11228-39  
Author(s): Peijun Tang, Univ. of Washington (United States), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 6: Clinical Applications  
Date and Time: 2/4/20 11:30 AM

## **Digitally designed holographic optical elements for large-size light field display**

Paper 11305-21  
Author(s): Boaz Jessie Jackin, National Institute of Information and Communications Technology (Japan), et al.  
Conference 11305: Ultra-High-Definition Imaging Systems III  
Session 5: Display II  
Date and Time: 2/4/20 11:30 AM

## **Impact of massive parallelization on two-photon absorption micro- and nanofabrication**

Paper 11271-4  
Author(s): Fabian Hilbert, Multiphoton Optics GmbH (Germany), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 2: DLW: High Speed Printing: Joint Session with Conferences 11271 and 11292  
Date and Time: 2/4/20 11:50 AM

## **High-resolution holographic display system by holographic printer with UHD spatial light modulator**

Paper 11305-22  
Author(s): Jinsoo Jeong, Seoul National Univ. (Korea, Republic of), et al.  
Conference 11305: Ultra-High-Definition Imaging Systems III  
Session 5: Display II  
Date and Time: 2/4/20 11:55 AM

## **High-speed single-photon 3D nanolithography by controlling polymerization inhibition**

Paper 11271-5  
Author(s): Liang Pan, Purdue Univ. (United States), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 2: DLW: High Speed Printing: Joint Session with Conferences 11271 and 11292  
Date and Time: 2/4/20 12:10 PM

## **Industrial use of high precision 3D printing**

Paper 11271-6  
Author(s): Benedikt Stender, Multiphoton Optics GmbH (Germany), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 3: 3D Micro-nano Printing I: Multi-photon Polymerization  
Date and Time: 2/4/20 2:00 PM

## Single-shot surface 3-D imaging by optical coherence visibility

Paper 11245-12  
 Author(s): Jian Xu, Caltech (United States), et al.  
 Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
 Session 3: Multidimensional Image Reconstruction and Analysis  
 Date and Time: 2/4/20 2:10 PM

## Towards the improvement of axial resolution: 4Pi multiphoton polymerization

Paper 11271-7  
 Author(s): Titas Tičkūnas, Vilnius Univ. (Lithuania), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 3: 3D Micro-nano Printing I: Multi-photon Polymerization  
 Date and Time: 2/4/20 2:30 PM

## Curing subpixel structures for high-resolution printing of translucent materials using standard DLP-projectors

Paper 11294-7  
 Author(s): Yannick Bauckhage, Hochschule Aalen - Technik und Wirtschaft (Germany), et al.  
 Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
 Session 3: Advanced Manufacturing using a DMD or other SLM: Joint Session with 11292 and 11294  
 Date and Time: 2/4/20 2:30 PM

## Optical and structural properties of 3D-printed plasmonic nanowires with dynamically tunable nano-gap size

Paper 11276-12  
 Author(s): Jong-Min Lee, Pusan National Univ. (Korea, Republic of), et al.  
 Conference 11276: Optical Components and Materials XVII  
 Session 3: Plasmonic Devices and Technologies  
 Date and Time: 2/4/20 2:40 PM

## Using optical tweezers and two-photon polymerization to assemble microspheres

Paper 11271-8  
 Author(s): Samira Chizari, Univ. of California, Los Angeles (United States), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 3: 3D Micro-nano Printing I: Multi-photon Polymerization  
 Date and Time: 2/4/20 2:50 PM

## Effects of post curing on 3D printed DOEs

Paper 11294-8  
 Author(s): Manuel Rank, Hochschule Aalen - Technik und Wirtschaft (Germany), et al.  
 Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
 Session 3: Advanced Manufacturing using a DMD or other SLM: Joint Session with 11292 and 11294  
 Date and Time: 2/4/20 2:50 PM

## Machine Learning predicts printing parameters for multi-photon polymerization three-dimensional direct laser writing (3D-DLW)

Paper 11271-9  
 Author(s): Areti Mourka, Foundation for Research and Technology-Hellas (Greece), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 3: 3D Micro-nano Printing I: Multi-photon Polymerization  
 Date and Time: 2/4/20 3:10 PM

## Data reduction for terabytes-scale brain wide neuron images via deep learning

Paper 11226-33  
 Author(s): Qing Huang, Wuhan National Research Ctr. for Optoelectronics (China), et al.  
 Conference 11226: Neural Imaging and Sensing 2020  
 Session 8: Novel Techniques I  
 Date and Time: 2/4/20 3:30 PM

## Projection two-photon lithography for rapid 3D nanoprinting

Paper 11271-10  
 Author(s): Paul Somers, Purdue Univ. (United States), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 3: 3D Micro-nano Printing I: Multi-photon Polymerization  
 Date and Time: 2/4/20 3:30 PM

## High throughput LIFT printing of electric circuitry

Paper 11271-11  
 Author(s): Sharona Cohen, Orbotech Ltd. (Israel), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 4: 3D Micro-nano Printing II: Forward Transfer  
 Date and Time: 2/4/20 4:20 PM

## Single low-NA objective counterpropagating optical traps enabled by 3D-printed mirrors

Paper 11297-16  
 Author(s): Carlo Liberale, King Abdullah Univ. of Science and Technology (Saudi Arabia), et al.  
 Conference 11297: Complex Light and Optical Forces XIV  
 Session 4: Optical Fields and Forces  
 Date and Time: 2/4/20 4:20 PM

## Amplitude-modulated continuous-wave laser scanner employing adaptive gain control for avoidance of receiver saturation

Paper 11287-8  
 Author(s): Chao Zhang, The Univ. of Tokyo (Japan), et al.  
 Conference 11287: Photonic Instrumentation Engineering VII  
 Session 2: Light Sources in Photonic Instrumentation  
 Date and Time: 2/4/20 4:40 PM

## Ultrafast multi-focus 3D printing based on a digital micro-mirror device

Paper 11292-41  
 Author(s): Wenqi Ouyang, The Chinese Univ. of Hong Kong (Hong Kong, China), et al.  
 Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
 Session 12: 3D Lithography with DMD and SLM Devices: Joint Session with 11292 and 11294  
 Date and Time: 2/4/20 4:40 PM

## Micro-continuous liquid interface production 3D printing of customized optical components in minutes

Paper 11292-43  
 Author(s): Rihan Hai, Northwestern Univ. (United States), et al.  
 Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
 Session 12: 3D Lithography with DMD and SLM Devices: Joint Session with 11292 and 11294  
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## Laser-induced forward transfer and reduction of graphene oxide in silk fibroin

Paper 11268-61  
 Author(s): Cleber R. Mendonça, Instituto de Física de São Carlos (Brazil), et al.  
 Conference 11268: Laser-based Micro- and Nanoprocessing XIV  
 Session PTue: Posters-Tuesday  
 Date and Time: 2/4/20 6:00 PM

## Dynamic voxel size tuning for direct laser writing

Paper 11268-76  
 Author(s): Titas Tičkūnas, Vilnius Univ. (Lithuania), et al.  
 Conference 11268: Laser-based Micro- and Nanoprocessing XIV  
 Session PTue: Posters-Tuesday  
 Date and Time: 2/4/20 6:00 PM

## Pseudo random micro lens array manufacturing with using two-photon polymerization technology

Paper 11268-78  
 Author(s): Eunsong Oh, YNG Optics, Inc. (Korea, Republic of), et al.  
 Conference 11268: Laser-based Micro- and Nanoprocessing XIV  
 Session PTue: Posters-Tuesday  
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## 3D PRINTING APPLICATIONS

### Cooper absorption coefficient

Paper 11271-40  
Author(s): Susumu Kato, National Institute of Advanced Industrial Science and Technology (Japan), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session PTue: Posters-Tuesday  
Date and Time: 2/4/20 6:00 PM

### Fabrication of tunable and wearable strain sensor for adjusting photo-polymerization

Paper 11271-43  
Author(s): Tae Seung Hwang, Kyungpook National Univ. (Korea, Republic of), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session PTue: Posters-Tuesday  
Date and Time: 2/4/20 6:00 PM

### Meso-optical elements printed via 3D laser lithography

Paper 11271-45  
Author(s): Linas Jonušauskas, Femtika UAB (Lithuania), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session PTue: Posters-Tuesday  
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## Wednesday 5 February 2020

### 3D-printed multi-layered soft actuators with embedded photo-responsive molecules

Paper 11277-1  
Author(s): Andrea Camposeo, Istituto Nanoscienze (Italy), et al.  
Conference 11277: Organic Photonic Materials and Devices XXII  
Session 1: 3D Printing  
Date and Time: 2/5/20 8:00 AM

### Additive manufacturing of a ceramic micro-tool by two-photon polymerization of a low-shrinkage pre-ceramic polymer

Paper 11277-2  
Author(s): Georgia Konstantinou, Ecole Polytechnique Fédérale de Lausanne (Switzerland), et al.  
Conference 11277: Organic Photonic Materials and Devices XXII  
Session 1: 3D Printing  
Date and Time: 2/5/20 8:25 AM

### Sampling requirements and visual artifacts of head-mounted light-field displays

Paper 11304-2  
Author(s): Hong Hua, Wyant College of Optical Sciences (United States), et al.  
Conference 11304: Advances in Display Technologies X  
Session 1: AR and VR Displays  
Date and Time: 2/5/20 8:40 AM

### Can one 3D print a laser?

Paper 11277-3  
Author(s): Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany), et al.  
Conference 11277: Organic Photonic Materials and Devices XXII  
Session 1: 3D Printing  
Date and Time: 2/5/20 8:45 AM

### Freeform optics design for Raman spectroscopy

Paper 11287-10  
Author(s): Tobias Grabe, Leibniz Univ. Hannover (Germany), et al.  
Conference 11287: Photonic Instrumentation Engineering VII  
Session 3: Design, Development, and Fabrication of Photonic Instruments  
Date and Time: 2/5/20 8:50 AM

### Metal 3D printing: Process validation for high-requirement applications

Paper 11271-15  
Author(s): Eric Utley, Protolabs (United States), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 5: Powder-bed SLM Metal Printing I  
Date and Time: 2/5/20 9:00 AM

### Additive manufactured organic light-emitting diodes

Paper 11277-4  
Author(s): Christian Eder, Zentrum für Optische Technologien, Hochschule Aalen - Technik und Wirtschaft (Germany), et al.  
Conference 11277: Organic Photonic Materials and Devices XXII  
Session 1: 3D Printing  
Date and Time: 2/5/20 9:05 AM

### 940nm 400mW transverse single-mode laser diode with RISA structure

Paper 11301-33  
Author(s): Jeong-Geun Kwak, Quantum Semiconductor International Inc. (Korea, Republic of), et al.  
Conference 11301: Novel In-Plane Semiconductor Lasers XIX  
Session 7: Photonic Bandgap and Microcavity  
Date and Time: 2/5/20 9:10 AM

### Laser powder bed fusion process sensitivity analysis through meso-scale modelling

Paper 11271-16  
Author(s): Sankhya Mohanty, Technical Univ. of Denmark (Denmark), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 5: Powder-bed SLM Metal Printing I  
Date and Time: 2/5/20 9:20 AM

### Optical analysis of a 3D-printed photoluminescent chip

Paper 11277-5  
Author(s): Sangeetha Suresh Nair, Hochschule Aalen - Technik und Wirtschaft (Germany), et al.  
Conference 11277: Organic Photonic Materials and Devices XXII  
Session 2: Photo Excitations  
Date and Time: 2/5/20 9:25 AM

### Multifrequency-swept optical coherence microscopy for full-field in-vivo intracochlear vibration measurement

Paper 11228-61  
Author(s): Samuel Choi, Niigata Univ. (Japan), et al.  
Conference 11228: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV  
Session 9: Full Field OCT  
Date and Time: 2/5/20 9:30 AM

### Multi-laser fusion process with pre-heating for additive manufacturing

Paper 11271-17  
Author(s): Philipp Wagenblast, TRUMPF Laser- und Systemtechnik GmbH (Germany), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 5: Powder-bed SLM Metal Printing I  
Date and Time: 2/5/20 9:40 AM

### 3D analysis of the spatial relationships of collagen and nerves in adipose tissue using the Metric Space Technique.

Paper 11245-24  
Author(s): Karissa Tilbury, The Univ. of Maine (United States), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 5: Computational Imaging  
Date and Time: 2/5/20 9:50 AM

### Additive manufacturing with green disk lasers

Paper 11271-18  
Author(s): Philipp Wagenblast, TRUMPF Laser- und Systemtechnik GmbH (Germany), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 6: Powder-bed SLM Metal Printing II  
Date and Time: 2/5/20 10:30 AM

### Laser power controlling in SLM: Key point for non-conventional alloy fabrication

Paper 11271-19  
Author(s): Mehdi Dadras, CSEM SA (Switzerland), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 6: Powder-bed SLM Metal Printing II  
Date and Time: 2/5/20 11:00 AM

### A study for accelerating the speed of all-in-focus image processing

Paper 11245-27  
Author(s): Lihui Wang, Guangdong Institute of Semiconductor Industrial Technology (China), et al.  
Conference 11245: Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII  
Session 6: Extended Depth of Focus Microscopy  
Date and Time: 2/5/20 11:20 AM

**Measurement of energy transfer and balance in a scanned laser-induced melt pool**

Paper 11271-20  
 Author(s): David Deisenroth, National Institute of Standards and Technology (United States), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 6: Powder-bed SLM Metal Printing II  
 Date and Time: 2/5/20 11:20 AM

**Universal picometer interferometry unveils ultra-precise devices from scrap**

Paper 11267-37  
 Author(s): Pooja Munjal, Indian Institute of Science Education and Research Mohali (India), et al.  
 Conference 11267: Laser Applications in Microelectronic and Optoelectronic Manufacturing (LAMOM) XXV  
 Session 9: Modelling and Process Control  
 Date and Time: 2/5/20 11:20 AM

**Material characterization of production additively manufactured SiC for multifunction application**

Paper 11273-10  
 Author(s): Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (United States), et al.  
 Conference 11273: High-Power Laser Materials Processing: Applications, Diagnostics, and Systems IX  
 Session 2: Sensing and Control  
 Date and Time: 2/5/20 11:30 AM

**Origins and mitigations of automotive pulsed lidar artifacts**

Paper 11299-22  
 Author(s): Mark Shand, Waymo, LLC (United States), et al.  
 Conference 11299: AI and Optical Data Sciences  
 Session 6: Computational Imaging  
 Date and Time: 2/5/20 11:30 AM

**Laser assisted powder bed fusion of hypereutectic Al-Si using ultra-short laser pulses at different pulse durations**

Paper 11271-21  
 Author(s): Tobias Ullsperger, Friedrich-Schiller-Univ. Jena (Germany), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 6: Powder-bed SLM Metal Printing II  
 Date and Time: 2/5/20 11:50 AM

**Hybrid laser platform for printing 3D multiscale multi-material hydrogel structures**

Paper 11271-22  
 Author(s): Pranav Soman, Syracuse Biomaterials Institute, Syracuse Univ. (United States), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 7: Multi-material Printing and Laser Cladding  
 Date and Time: 2/5/20 1:40 PM

**Public engagement in science and technology using holography**

Paper 11306-12  
 Author(s): Pedro M. Pombo, Univ. de Aveiro (Portugal), et al.  
 Conference 11306: Practical Holography XXXIV: Displays, Materials, and Applications  
 Session 3: Exhibitions  
 Date and Time: 2/5/20 2:00 PM

**Projector-based augmented reality with simultaneous 3D inspection using a single DMD**

Paper 11294-19  
 Author(s): Marc-Antoine Drouin, National Research Council Canada (Canada), et al.  
 Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
 Session 7: AR/VR Displays using DMDs or other SLM Devices: Joint Session with 11294 and 11304  
 Date and Time: 2/5/20 2:05 PM

**Augmented reality, 3D measurement, and thermal imagery for computer-assisted manufacturing**

Paper 11294-20  
 Author(s): Marc-Antoine Drouin, National Research Council Canada (Canada), et al.  
 Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
 Session 7: AR/VR Displays using DMDs or other SLM Devices: Joint Session with 11294 and 11304  
 Date and Time: 2/5/20 2:25 PM

**Integrated photonic solutions for 3D imaging and sensing using the multi-micron silicon-photonics platform**

Paper 11285-42  
 Author(s): Aaron J. Zilkie, Rockley Photonics (United States), et al.  
 Conference 11285: Silicon Photonics XV  
 Session 9: Emerging Applications I  
 Date and Time: 2/5/20 2:30 PM

**Numerical simulation and experimental validation of deposition geometry and TiC dissolution in functionally graded Ti-Al composite coatings fabricated with laser metal deposition**

Paper 11271-25  
 Author(s): Eytayo Olatunde Olakanmi, Botswana International Univ. of Science & Technology (BIUST) (Botswana), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 7: Multi-material Printing and Laser Cladding  
 Date and Time: 2/5/20 3:00 PM

**Laser-induced breakdown spectroscopy: A versatile tool for quality-controlled development of Li-based battery systems**

Paper 11268-40  
 Author(s): Peter Smyrek, Karlsruhe Nano Micro Facility, Karlsruher Institut für Technologie (Germany), et al.  
 Conference 11268: Laser-based Micro- and Nanoprocessing XIV  
 Session 8: Direct Write Processing Ablation and Surface Modification I  
 Date and Time: 2/5/20 3:20 PM

**Oxidation resistance of tungsten carbide reinforced stellite 6 matrix composite coating fabricated with laser cladding at elevated temperature**

Paper 11271-26  
 Author(s): Eytayo Olatunde Olakanmi, Botswana International Univ. of Science & Technology (BIUST) (Botswana), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 7: Multi-material Printing and Laser Cladding  
 Date and Time: 2/5/20 3:20 PM

**Impact of the shape of digital micro-mirrors on super high-resolution 3D shape measurement**

Paper 11294-22  
 Author(s): Jae-Sang Hyun, Purdue Univ. (United States), et al.  
 Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
 Session 8: 3D Metrology  
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**Application of 3D printing of fused silica glass using direct laser melting for fabrication of photonic sensors**

Paper 11271-27  
 Author(s): Qi Zhang, Clemson Univ. (United States), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 8: Glass 3D Printing  
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**Structured-light systems using programmable quasi-analogue projection subsystem**

Paper 11294-23  
 Author(s): Marc-Antoine Drouin, National Research Council Canada (Canada), et al.  
 Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
 Session 8: 3D Metrology  
 Date and Time: 2/5/20 4:15 PM

**Laser powder bed fusion of glass: a comparative study between CO2 lasers and ultrashort laser pulses**

Paper 11271-28  
 Author(s): Brian Seyfarth, Friedrich-Schiller-Univ. Jena (Germany), et al.  
 Conference 11271: Laser 3D Manufacturing VII  
 Session 8: Glass 3D Printing  
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## 3D PRINTING APPLICATIONS

### **An introduction to high-speed structured light 3D imaging using a digital micromirror device**

Paper 11294-25  
Author(s): Thomas Tong, Polyga (Canada), et al.  
Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
Session 8: 3D Metrology  
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### **Optical fibers fabricated from 3D printed silica preforms**

Paper 11271-29  
Author(s): Angeles L. Camacho Rosales, Optoelectronics Research Ctr. (United Kingdom), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 8: Glass 3D Printing  
Date and Time: 2/5/20 5:00 PM

### **One shot high resolution refractive index profile measurement for 3D printed optics**

Paper 11294-26  
Author(s): Manuel Rank, Hochschule Aalen - Technik und Wirtschaft (Germany), et al.  
Conference 11294: Emerging Digital Micromirror Device Based Systems and Applications XII  
Session 8: 3D Metrology  
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### **Development of IOT mechanical device for fabrication of tapers and gratings using CO2 IR laser**

Paper 11277-41  
Author(s): Carlota Bujanos Buenrostro, Univ. Autónoma de Nuevo León (Mexico), et al.  
Conference 11277: Organic Photonic Materials and Devices XXII  
Session PWed: Posters-Wednesday  
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### **Development of a new polymer (OSTE+) optical waveguide for evanescent wave absorption-based photonic sensors**

Paper 11277-44  
Author(s): Sonatan Das, Ctr. for Research in Nanotechnology and Sciences, Indian Institute of Technology Bombay (India), et al.  
Conference 11277: Organic Photonic Materials and Devices XXII  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Waviness of additive manufactured polymer optical waveguides**

Paper 11283-63  
Author(s): Carsten Backhaus, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany), et al.  
Conference 11283: Integrated Optics: Devices, Materials, and Technologies XXIV  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Photo-polymerization-based endoscopic multi-layers printing system**

Paper 11292-44  
Author(s): Marcel Nassif, Univ. de Technologie Compiègne (France), et al.  
Conference 11292: Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Retinal image generation method for retinal projection type super multi-view 3D head-mounted display**

Paper 11304-40  
Author(s): Junya Kohno, Osaka City Univ. (Japan), et al.  
Conference 11304: Advances in Display Technologies X  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Control method of active parallax barrier and binocular image for glasses-free stereoscopic display according to viewing position**

Paper 11304-41  
Author(s): Hiiro Nakamura, Osaka City Univ. (Japan), et al.  
Conference 11304: Advances in Display Technologies X  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Foveated high-resolution light-field system based on integral imaging for near-eye displays**

Paper 11304-44  
Author(s): Gyohyun Koo, KAIST (Korea, Republic of), et al.  
Conference 11304: Advances in Display Technologies X  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Time-multiplexing auto-stereoscopic three-dimensional display to enhance angular-resolution**

Paper 11304-45  
Author(s): Tae-Hyun Lee, Kyungpook National Univ. (Korea, Republic of), et al.  
Conference 11304: Advances in Display Technologies X  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Optimizing focal plane configuration for multifocal head-mounted displays via the learning-based algorithm**

Paper 11305-31  
Author(s): Dongheon Yoo, Seoul National Univ. (Korea, Republic of), et al.  
Conference 11305: Ultra-High-Definition Imaging Systems III  
Session PWed: Posters-Wednesday  
Date and Time: 2/5/20 6:00 PM

### **Generation speed enhancement for full-color computer-generated holography using multiple wavefront recording planes**

Paper 11306-32  
Author(s): Yan-Ling Piao, Chungbuk National Univ. (Korea, Republic of), et al.  
Conference 11306: Practical Holography XXXIV: Displays, Materials, and Applications  
Session PWed: Posters-Wednesday  
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## Thursday 6 February 2020

### **Hybrid additive-subtractive femtosecond laser 3D fabrication of medical microdevices**

Paper 11271-31  
Author(s): Linas Jonušauskas, Femtika UAB (Lithuania), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 9: Novel Devices and Biosensor Printing  
Date and Time: 2/6/20 8:30 AM

### **Composite bionanomaterial layers as a strain sensor**

Paper 11271-32  
Author(s): Levan Ichkitidze, National Research Univ. of Electronic Technology (Russian Federation), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 9: Novel Devices and Biosensor Printing  
Date and Time: 2/6/20 9:00 AM

### **Upscaling laser polishing of large 3D surfaces**

Paper 11273-4  
Author(s): Florent Husson, ALPhANOV (France), et al.  
Conference 11273: High-Power Laser Materials Processing: Applications, Diagnostics, and Systems IX  
Session 1: Surface Treatment  
Date and Time: 2/5/20 9:00 AM

### **Laser formation of electrically conductive nanocomposites for bioelectronic applications**

Paper 11271-33  
Author(s): Natalia Demidenko, National Research Univ. of Electronic Technology (Russian Federation), et al.  
Conference 11271: Laser 3D Manufacturing VII  
Session 9: Novel Devices and Biosensor Printing  
Date and Time: 2/6/20 9:20 AM

**3D printing of chalcogenide glasses: an original way for the elaboration of microstructured preforms and optical fibers**

Paper 11276-41

Author(s): Johann Troles, Univ. de Rennes 1 (France), et al.  
Conference 11276: Optical Components and Materials XVII  
Session 10: Nanostructures  
Date and Time: 2/6/20 10:30 AM

**3D auxetic metamaterials as scaffolds for cell growth**

Paper 11271-36

Author(s): Maria Farsari, Foundation for Research and Technology-Hellas (Greece), et al.  
Conference 11271: Laser  
3D Manufacturing VII  
Session 10: Biostructure 3D Printing  
Date and Time: 2/6/20 10:50 AM

**Stimuli-responsive 3D micro-scaffolds for single cell actuation**

Paper 11271-37

Author(s): Marc Hippler, Karlsruher Institut für Technologie (Germany), et al.  
Conference 11271: Laser  
3D Manufacturing VII  
Session 10: Biostructure 3D Printing  
Date and Time: 2/6/20 11:20 AM

**Pulse propagation through an EIT medium in presence of permanent dipole moment**

Paper 11266-48

Author(s): Nilamoni Daloi, Indian Institute of Technology Guwahati (India), et al.  
Conference 11266: Laser Resonators, Microresonators, and Beam Control XXII  
Session 11: Adaptive Optics, Laser Diagnostics, Nonlinear Propagation  
Date and Time: 2/6/20 11:30 AM

**Bacterial cellulose growth in 3D hybrid scaffolds sculpted via multiphoton polymerization**

Paper 11271-39

Author(s): Adriano J. G. Otuka, Instituto de Física de São Carlos, Univ. de São Paulo (Brazil), et al.  
Conference 11271: Laser  
3D Manufacturing VII  
Session 10: Biostructure 3D Printing  
Date and Time: 2/6/20 12:00 PM

**Design and fabrication of multilayer GRIN lenses by multi-material additive manufacturing for light coupling applications in planar optoelectronic systems**

Paper 11283-54

Author(s): Hossein Salmani Rezaei, Laser Zentrum Hannover e.V. (Germany), et al.  
Conference 11283: Integrated Optics: Devices, Materials, and Technologies XXIV  
Session 14: Photonic Devices  
Date and Time: 2/6/20 2:00 PM



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**Kin Foong Chan**, Consultant (USA)

**Wei R. Chen**, Univ. of Central Oklahoma (USA)

**Ji-Xin Cheng**, Boston Univ. (USA)

**Bernard Choi**, Beckman Laser Institute and Medical Clinic (USA)

**Gerard L. Coté**, Texas A&M Univ. (USA)

**Tianhong Dai**, Wellman Ctr. for Photomedicine (USA), Massachusetts General Hospital (USA), and Harvard Medical School (USA)

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**Antonio G. Kanaras**, Univ. of Southampton (United Kingdom)

**Hyun Wook Kang**, Pukyong National Univ. (Korea, Republic of)

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**Karsten König**, Univ. des Saarlandes (Germany) and JenLab GmbH (Germany)

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**Kristen C. Maitland**, Texas A&M Univ. (USA)

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**Alexander A. Oraevsky**, TomoWave Labs, Inc. (USA)

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**Aydogan Ozcan**, Univ. of California, Los Angeles (USA)

**YongKeun Park**, KAIST (Korea, Republic of)

**Ammasi Periasamy**, Univ. of Virginia (USA)

**Wolfgang Petrich**, Roche Diagnostics GmbH (Germany)

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**Gabriel Popescu**, Univ. of Illinois (USA)

**Jürgen Popp**, Leibniz-Institut für Photonische Technologien e.V. (Germany)

**Paras Prasad**, Univ. at Buffalo (USA)

**Ramesh Raghavachari**, U.S. Food and Drug Administration (USA)

**Jessica C. Ramella-Roman**, Florida International Univ. (USA)

**Krishanu Ray**, Univ. of Maryland School of Medicine (USA)

**Peter Rechmann**, Univ. of California, San Francisco (USA)

**Darren M. Roblyer**, Boston Univ. (USA)

**Anna W. Roe**, Zhejiang Univ. (China)

**Giuliano Scarcelli**, Univ. of Maryland, College Park (USA)

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**Eva M. Sevick**, The Univ. of Texas Health Science Ctr. at Houston (USA)

**Babak Shadgan**, International Collaboration On Repair Discoveries (Canada)

**Natan T. Shaked**, Tel Aviv Univ. (Israel)

**Garth J. Simpson**, Purdue Univ. (USA)

**Peter T. C. So**, Massachusetts Institute of Technology (USA)

**Per G. Söderberg**, Uppsala Univ. (Sweden)

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**Kevin K. Tsia**, The Univ. of Hong Kong (Hong Kong, China)

**Valery V. Tuchin**, Saratov State Univ. (Russian Federation), Tomsk State Univ. (Russian Federation), and Institute of Precision Mechanics and Control of the RAS (Russian Federation)

**Gracie Vargas**, The Univ. of Texas Medical Branch (USA)

**Tuan Vo-Dinh**, Duke Univ. (USA)

**Laura Waller**, Univ. of California, Berkeley (USA)

**Lihong V. Wang**, Caltech (USA)

**Ruikang K. Wang**, Univ. of Washington (USA)

**Thomas D. Wang**, Univ. of Michigan (USA)

**Adam Wax**, Duke Univ. (USA)

**Sharon M. Weiss**, Vanderbilt Univ. (USA)

**Tony Wilson**, Univ. of Oxford (United Kingdom)

**Brian Jet-Fei Wong**, Beckman Laser Institute and Medical Clinic, Univ. of California, Irvine (USA)

**Mei X. Wu**, Harvard Medical School (USA)

**Victor X. D. Yang**, Ryerson Univ. (Canada)

**Haishan Zeng**, BC Cancer Research Ctr. (Canada)

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# BiOS 2020 BEST PAPER AWARDS

## Best Paper Award

### THERAPEUTICS AND DIAGNOSTICS IN UROLOGY (CONF. 11212)

Presentations and manuscripts will be judged based on scientific merit and potential clinical impact. Candidates for the award need to be the presenting author, a full-time student or resident in urology, must submit an extended technical summary (1-3 pages) of their best results at the time of Abstract submission, must present their papers at the conference (oral or poster), and must publish a full manuscript in the SPIE Proceedings. Cash awards will be delivered after the publication of the conference proceedings volume.

AWARD SPONSOR:



## BEST STUDENT PAPER AWARDS

### MULTISCALE IMAGING AND SPECTROSCOPY

Judging and Requirements Presentations and manuscripts will be judged based on scientific merit, impact, and clarity. Candidates for the award need to be the presenting author, a full-time student, must have conducted the majority of the research presented in the paper, and must submit their manuscript by the deadline (January 2020).

Nominations To be considered, submit your abstract online, select "Yes" when asked if you are a full-time student, and select yourself as the speaker.

AWARD SPONSOR:



## Pascal Rol Award 2019

### OPHTHALMIC TECHNOLOGIES (CONF. 11218)

Sunday 2 February 2020  
6:00 PM - 6:15 PM

Outstanding extended abstracts submitted to the Ophthalmic Technologies conference will be nominated for the Pascal Rol Award for Best Paper in Ophthalmic Technologies. The award and prize will be presented after the last scientific session of the conference to recognize the best paper and presentation. The 2018 recipient of the Pascal Rol Award was Kazuhiro Kurokawa and his colleagues from Indiana Univ. (USA) (see [www.pascalrolfoundation.org](http://www.pascalrolfoundation.org)).



## Best Student Paper Award

### MICROFLUIDICS, BIOMEMS, AND MEDICAL MICROSYSTEMS (CONF. 11235)

Monday 3 February 2020  
6:20 PM - 6:25 PM

We are pleased to announce that a cash prize will be awarded to the best student paper in this conference. Qualifying papers and presentations will be evaluated by the awards committee and the winner will be notified at the end of or after the meeting.

AWARD SPONSORS:



## Seno Medical Best Paper Awards

### PHOTONS PLUS ULTRASOUND: IMAGING AND SENSING 2019 (CONF. 11240)

Sunday 2 February 2020  
5:00 PM - 5:15 PM

Seno Medical Instruments of San Antonio, Texas, will sponsor the "Best Paper Award" at this conference (Certificate of recognition to all coauthors and \$3,000). To qualify for the Award, authors must submit an extended technical Summary (1-3 pages) of their best results at the time of Abstract submission, present their papers at the conference (oral or poster) and publish a full manuscript in the SPIE Proceedings. A special session will be organized at the conference dedicated to The Best Paper Award. A Certificate of The Best Paper will be presented at the Award Ceremony to be held as the last session of the Conference. Cash award will be delivered after the publication of the conference proceedings volume.

AWARD SPONSOR:



## JenLab Young Investigator Award

### MULTIPHOTON MICROSCOPY IN THE BIOMEDICAL SCIENCES XIX (CONF. 11244)

Monday 3 February 2020  
2:40 PM - 3:30 PM

We encourage graduate students, postdocs, and scientists or junior faculty who are not more than 32 years old to apply for the JenLab Young Investigator Award. To be eligible for this \$2000 cash award, participants must:

- be both the primary author and presenter of an accepted abstract for poster presentation
- submit the proceedings paper by the due date, prior to the meeting, for review by the selection committee
- self-nominate by entering "Jen Lab Young Investigator Award" as a keyword in the abstract.
- qualified abstracts will be chosen for a 5-minute oral presentation

Selection of final two (winner and runner-up) is based on abstract, proceedings manuscript, and 5-minute oral presentation.

The winner will receive \$1500 and the runner-up \$500.

Submitted proceedings manuscripts may be resubmitted to the *Journal of Biomedical Optics* (please visit <http://spie.org/jbo> for details). Prize donated by JenLab GmbH, Germany.

AWARD SPONSOR:



## Student Poster Session Competition

### MULTIPHOTON MICROSCOPY IN THE BIOMEDICAL SCIENCES XIX (CONF. 11244)

Monday 3 February 2020  
2:50 PM - 3:10 PM

Graduate students and postdoctoral fellows are welcome to participate in the poster session competition of the conference on Multiphoton Microscopy in the Biomedical Sciences. There is a cash award (\$500/award) for the winner(s). The winner(s) will be informed in person or by email and must receive the award in person in the conference hall. Participants should follow the rules and regulations of SPIE for submission of their abstract and manuscript. Participants should also register their names for the competition with the Conference Chairs or Session Chairs during the first day of the conference. Submitted proceeding manuscripts are allowed for resubmission to the *Journal of Biomedical Optics* (please visit <http://spie.org/jbo> for details).

PRIZE DONATED BY THE CONFERENCE SPONSORS.

## PicoQuant Young Investigator Award

### SINGLE MOLECULE SPECTROSCOPY AND SUPERRESOLUTION IMAGING XII (CONF. 11246)

Sunday 2 February 2020  
3:00 PM - 3:15 PM

Young scientists (age 30 or below and not yet full faculty members) are encouraged to participate in this best paper competition, which offers a \$1000 USD cash award. Participants must be both the primary author and presenter of an accepted abstract to be eligible. Please select "PicoQuant Young Investigator Award" as the last Topic in the abstract submission wizard in order to be considered. This award is sponsored by PicoQuant GmbH Berlin and presented Sunday afternoon.

AWARD SPONSOR:



## Best Paper Awards

### HIGH-SPEED BIOMEDICAL IMAGING AND SPECTROSCOPY IV (CONF. 11250)

We are pleased to announce that Hamamatsu, PiPhotonics, and Hitachi High-Tech will sponsor six Best Paper Awards for this Conference, with a total cash prize of \$3000: two Hamamatsu Best Paper Awards (\$500 each), two PiPhotonics Best Paper Awards (\$500 each), and two Hitachi High-Tech Best Paper Awards (\$500 each). Participants must be both the primary author and presenter of an accepted abstract to be eligible. Qualifying presentations will be evaluated by the awards committee. The winners will be notified at the end of, or after, the meeting.

AWARD SPONSOR:

**HAMAMATSU**  
PHOTON IS OUR BUSINESS

**OPTICS**  
from image to knowledge

**Hitachi High-Tech**

## Prizmatix Young Investigator Awards

### NANOSCALE IMAGING, SENSING, AND ACTUATION FOR BIOMEDICAL APPLICATIONS XVI (CONF. 11254)

Two \$500USD "Young Investigator Awards" sponsored by Prizmatix Ltd. will be awarded for notable contributions by young scientists presenting their work in this conference.

AWARD SPONSOR:

**Prizmatix**

## Ocean Optics Young Investigator Award

### COLLOIDAL NANOCRYSTALS FOR BIOMEDICAL APPLICATIONS XIV (CONF. 11255)

Monday 3 February 2020  
4:20 PM - 4:35 PM

The Ocean Optics Young Investigator Awards will be given for the best contributed papers presented by a leading author who is either a graduate student or has graduated within less than five years of the paper submission date. Two prizes will be awarded. The First Prize will consist of a \$1,000 cash prize for the Young Investigator and \$2,000 Ocean Optics equipment credit for the laboratory where the work was performed. The Second Prize will consist of a \$500 cash prize for the Young Investigator and \$1,000 Ocean Optics equipment credit for the laboratory where the work was performed. To be eligible, manuscripts of self-nominating authors must be received by the due date. Nominations should be sent to [osinski@chtm.unm.edu](mailto:osinski@chtm.unm.edu) and should include a brief CV of the leading author.

AWARD SPONSOR:



# CONFERENCE DAILY SCHEDULE

SATURDAY 1 February	SUNDAY 2 February	MONDAY 3 February	TUESDAY 4 February	WEDNESDAY 5 February	THURSDAY 6 February
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	BiOS Poster Session, 5:30 PM - 7:00 PM	BiOS Poster Session, 5:30 PM - 7:00 PM	BiOS & LASE Poster Session, 6:00 PM - 8:00 PM		
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Saturday - Sunday • Hall DE

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11250 <b>High-Speed Biomedical Imaging and Spectroscopy V</b> ( <i>Tsia, Goda</i> ) p. 255					
11251 <b>Label-free Biomedical Imaging and Sensing (LBIS) 2020</b> ( <i>Shaked, Hayden</i> ) p. 258					
11252 <b>Advanced Chemical Microscopy for Life Science and Translational Medicine</b> ( <i>Cheng, Min, Simpson</i> ) p. 263					
11253 <b>Biomedical Applications of Light Scattering X</b> ( <i>Wax, Backman</i> ) p. 267					
11240 <b>Photons Plus Ultrasound: Imaging and Sensing 2020</b> ( <i>Oraevsky, Wang</i> ) p. 217					

SATURDAY 1 February	SUNDAY 2 February	MONDAY 3 February	TUESDAY 4 February	WEDNESDAY 5 February	THURSDAY 6 February
	Neurotechnologies Plenary Session, 3:30 PM - 5:30 PM		Nano/Biophotonics Plenary Session, 10:30 AM - 11:30 AM		
	BiOS Poster Session, 5:30 PM - 7:00 PM	BiOS Poster Session, 5:30 PM - 7:00 PM	BiOS & LASE Poster Session, 6:00 PM - 8:00 PM		
BiOS Hot Topics, 7:00 PM - 9:30 PM	BiOS Sunday Plenary, 7:15 PM - 8:00 PM				
<b>NANO/BIOPHOTONICS</b> Program Track Chairs: <b>Paras Prasad</b> , Univ. at Buffalo (USA); <b>Ewa M. Goldys</b> , The Univ. of New South Wales (Australia)					
	11254 <b>Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XVII</b> (Fixler, Goldys, Wachsmann-Hogiu) p. 269				
11255 <b>Colloidal Nanoparticles for Biomedical Applications XV</b> (Osirński, Kanaras) p. 272					
		11256 <b>Reporters, Markers, Dyes, Nanoparticles, and Molecular Probes for Biomedical Applications XII</b> (Achilefu, Raghavachari) p. 275			
	11257 <b>Plasmonics in Biology and Medicine XVII</b> (Vo-Dinh, Ho, Ray) p. 277				
	11258 <b>Frontiers in Biological Detection: From Nanosensors to Systems XII</b> (Danielli, Miller, Weiss) p. 279				

### BiOS Expo Industry Stage

Saturday - Sunday • Hall DE

Keynotes and panels on the latest developments, open to all attendees.

Pages 56-59

# CONFERENCE 11211

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11211

# Photonics in Dermatology and Plastic Surgery 2020

Conference Chairs: **Bernard Choi**, Beckman Laser Institute and Medical Clinic (USA); **Haishan Zeng**, BC Cancer Research Ctr. (Canada)

Program Committee: **Anthony J. Durkin**, Beckman Laser Institute and Medical Clinic (USA); **Conor L. Evans**, Wellman Ctr. for Photomedicine (USA); **Manu Jain**, Memorial Sloan-Kettering Cancer Ctr. (USA); **Kristen M. Kelly**, Univ. of California, Irvine School of Medicine (USA); **Boris Majaron**, Jožef Stefan Institute (Slovenia); **Milind Rajadhyaksha**, Memorial Sloan-Kettering Cancer Ctr. (USA); **Jessica C. Ramella-Roman**, Florida International Univ. (USA); **Lise Lyngnes Randeberg**, Norwegian Univ. of Science and Technology (Norway); **Rolf B. Saager**, Beckman Laser Institute and Medical Clinic (USA); **InSeok Seo**, Johnson & Johnson Consumer Products (USA); **Eric R Tkaczyk**, Vanderbilt Univ. Medical Ctr. (USA); **Hequn Wang**, Johnson & Johnson Consumer Products (USA); **Ruikang K. Wang**, Univ. of Washington (USA)

Conference Co-Sponsor:   
CONSUMER INC.

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . SAT 8:20 AM TO 10:00 AM

#### Spatial Frequency Domain Imaging

Session Chair: **Jessica C. Ramella-Roman**, Florida International Univ. (USA)

8:20 am: **Comparing reduced scattering variation by skin type and tissue location using Spatial Frequency Domain Imaging (SFDI) for clinical burn wound imaging**, Rebecca A. Rowland, Binh Le, Thinh Phan, Adrien Ponticorvo, Beckman Laser Institute and Medical Clinic (USA); Nicole P. Bernal, UCI Health Regional Burn Ctr. (USA); Anthony J. Durkin, Beckman Laser Institute and Medical Clinic (USA) and Univ. of California, Irvine (USA) . . . . . [11211-1]

8:40 am: **Spatial frequency domain imaging of millimeter wave induced skin burns**, Gordon T. Kennedy, Beckman Laser Institute and Medical Clinic, Univ. of California, Irvine (USA); William B. Voorhees, 711th Human Performance Wing, U.S. Air Force (USA); James E. Parker III, General Dynamics Information Technology (USA); Christine J. Kowalczewski, U.S. Army Institute of Surgical Research (USA); Andrew C. Kowalczewski, Combat Trauma and Burn Injury Research (USA); Rebecca A. Rowland, Adrien Ponticorvo, Beckman Laser Institute and Medical Clinic, Univ. of California, Irvine (USA); Robert J. Christy, U.S. Army Institute of Surgical Research (USA); Nicole P. Bernal, UCI Health Regional Burn Ctr. (USA); Anthony J. Durkin, Beckman Laser Institute and Medical Clinic, Univ. of California, Irvine (USA) . . . . . [11211-41]

9:00 am: **Quantification of skin reactivity after microneedle provocation using spatial frequency domain spectroscopy**, Hanna Jonasson, Linköping Univ. (Sweden); David Muller, Univ. of Queensland (Australia); Joakim Henricson, Chris Anderson, Rolf Saager, Linköping Univ. (Sweden) . . . [11211-2]

9:20 am: **Experimental integration of a spatial frequency domain spectroscopy (SFDS) and pulse cam system for quantifying changes in skin optical properties and vasculature among individuals with obesity**, Andres J. Rodriguez, Tananant Boonya-ananta, Florida International Univ. (USA); Ashok Veerarahavan, Rice Univ. (USA); Jessica C. Ramella-Roman, Florida International Univ. (USA) . . . . . [11211-3]

9:40 am: **Using Spatial Frequency Domain Imaging (SFDI) to quantify physiological changes of patients undergoing radiotherapy for breast cancer treatment**, Adrien Ponticorvo, Rebecca A. Rowland, Oluwaseun Adelusi, Anaïs Leproux, Beckman Laser Institute and Medical Clinic (USA); Randy Wei, Memorial Radiation Oncology Medical Group (USA); Jeffrey Kuo, Parima Daroui, Nilam Ramsinghani, Muthana Al-Ghazi, Univ. of California, Irvine (USA); Anthony J. Durkin, Beckman Laser Institute and Medical Clinic (USA) . . . . . [11211-4]

Coffee Break . . . . . Sat 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . SAT 10:30 AM TO 11:50 AM

#### Skin Cancer

Session Chairs: **Manu Jain**, Memorial Sloan-Kettering Cancer Ctr. (USA); **Eric R. Tkaczyk**, Vanderbilt Health One Hundred Oaks (USA)

10:30 am: **Clinical applicability of in vivo harmonic generation microscopy for the diagnosis and grading of actinic keratosis**, Chi-Kuang Sun, Yi Pan, Pei-Che Wu, Sheng-Tse Chen, National Taiwan Univ. (Taiwan); Yi-Hua Liao, National Taiwan Univ. Hospital (Taiwan) . . . . . [11211-5]

10:50 am: **Multimodal optical imaging for in vivo discrimination of equivocal melanocytic skin lesions**, Vadim V. Elagin, Ekaterina V. Gubarkova, Oksana Garanina, Natalia Orlinkaya, Diana Davydova, Irina Klemenova, Irena Shlivko, Elena V. Zagaynova, Privolzhsky Research Medical Univ. (Russian Federation) . . . . . [11211-6]

11:10 am: **Visible light optical coherence microscopy for quantitative imaging of human skin in vivo**, Shau Poh Chong, Zhen Yu Gordon Ko, Nanguang Chen, National Univ. of Singapore (Singapore) . . . . . [11211-7]

11:30 am: **Polarization sensitive optical coherence tomography for assessing skin roughness and lesions**, Xin Zhou, Daniel C. Louie, Sina Maloufi, Qihao Liu, Lioudmila Tchvialeva, Tim Lee, Shuo Tang, The Univ. of British Columbia (Canada) . . . . . [11211-8]

Lunch/Exhibition Break . . . . . Sat 11:50 am to 1:20 pm

### SESSION 3

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . SAT 1:20 PM TO 2:30 PM

#### Machine Learning

Session Chair: **Boris Majaron**, Jožef Stefan Institute (Slovenia)

1:20 pm: **Automatic classification of melanocytic skin tumors based on hyperparameters optimized by cross-validation using support vector machines**, Ozan Gökkan Sr., Izmir Biomedicine and Genome Ctr. (Turkey); Serhat Tozburun Sr., Izmir Biomedicine and Genome Ctr. (Turkey) and Izmir International Biomedicine and Genome Institute, Dokuz Eylul Univ. (Turkey) . . . . . [11211-9]

1:40 pm: **Generative adversarial networks in biophotonics: a tutorial with examples (Invited Paper)**, Nicholas J. Durr, Johns Hopkins Univ. (USA) . . . . . [11211-10]

2:10 pm: **Detecting nodular basal cell carcinoma in pathology imaging using deep learning image segmentation**, Daniel S. Gareau, Jeannie Ren, Rivka Lax, James G. Krueger, James Browning, The Rockefeller Univ. (USA); John Carucci, New York University (USA) . . . . . [11211-11]

**SESSION 4**

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . SAT 2:30 PM TO 3:30 PM

**Confocal and Multiphoton Microscopy I**

Session Chair: **Milind Rajadhyaksha**,  
Memorial Sloan-Kettering Cancer Ctr. (USA)

2:30 pm: **Clinical multimodal multiphoton tomography of pigmented skin lesions with an ultracompact femtosecond fiber laser**, Karsten König, JenLab GmbH (Germany) . . . . . [11211-12]

2:50 pm: **High-speed, high-resolution mesoscopic multiphoton microscopy of human skin**, Alexander Fast, Beckman Laser Institute and Medical Clinic (USA); Anand Ganesan, Kristen Kelly, Christopher Zachary, Univ. of California, Irvine (USA); Mihaela Balu, Beckman Laser Institute and Medical Clinic (USA) . . . . . [11211-13]

3:10 pm: **Confocal video microscopy reveals altered leukocyte-endothelial interactions in skin preceding acute graft-versus-host disease**, Inga Saknite, Michael Byrne, Madan Jagasia, Vanderbilt Univ. Medical Ctr. (USA); Eric R. Tkaczyk, Tennessee Valley Healthcare System, U.S. Dept. of Veterans Affairs (USA) and Vanderbilt Univ. Medical Ctr. (USA) and Vanderbilt Univ. (USA) . . . . . [11211-14]

Coffee Break. . . . . Sat 3:30 pm to 4:00 pm

**SESSION 5**

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . SAT 4:00 PM TO 5:30 PM

**Kollias Memorial Lecture:  
Current Problems in Dermatology**

Session Chairs: **Haishan Zeng**, BC Cancer Research Ctr. (Canada);  
**Bernard Choi**, Beckman Laser Institute and Medical Clinic (USA)

**BIOS HOT TOPICS**

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**SESSION 6**

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . SUN 8:20 AM TO 10:00 AM

**Therapeutics**

Session Chair: **Bernard Choi**,  
Beckman Laser Institute and Medical Clinic (USA)

8:20 am: **Optimizing selective phototherapy of port wine stain by two-photon fluorescence and optical coherence tomography imaging**, Iván Coto Hernández, Fouzi Benboujja, Nate Jowett, Tan Oon, Harvard Medical School (USA) . . . . . [11211-15]

8:40 am: **Precise closure of single blood vessels via multiphoton photothermolysis**, Yimei Huang, BC Cancer Research Ctr. (Canada) and Fujian Normal Univ. (China); Zhenguo Wu, Harvey Lui, Jianhua Zhao, The Univ. of British Columbia (Canada) and BC Cancer Research Ctr. (Canada); Shusen Xie, Fujian Normal Univ. (China); Haishan Zeng, BC Cancer Research Ctr. (Canada) and The Univ. of British Columbia (Canada) . . . . . [11211-16]

9:00 am: **Optimizing parameters for inducing repigmentation in subjects with generalized vitiligo: comparing the efficacy of visible light with ultraviolet A1 versus narrowband ultraviolet B**, Indermeet Kohli, Alexis B. Lyons, Raheel Zubair, Bhavnit Bhatia, Henry Ford Health System (USA); Amanda F. Nahhas, Henry Ford Health System (USA) and Beaumont Hospital (USA); Taylor L. Braunberger, Henry W. Lim, Iltefat H. Hamzavi, Henry Ford Health System (USA) . . . . . [11211-17]

9:20 am: **Transient vascular temperature variation during laser irradiation recorded by high speed thermal camera**, Dong Li, Hao Zhang, Bin Chen, Wenjuan Wu, Xi'an Jiaotong Univ. (China) . . . . . [11211-18]

9:40 am: **A novel method for direct measurement of optical fluence of focused laser energy in ex-vivo skin**, Rajender Katkam, Tania To, Matthew Hibert, Jayant Bhawalkar, AVAVA Inc. (USA) . . . . . [11211-20]

Coffee Break. . . . . Sat 10:00 am to 10:30 am

**SESSION 7**

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . SUN 10:30 AM TO 11:30 AM

**Confocal and Multiphoton Microscopy II**

Session Chair: **Conor L. Evans**, Wellman Ctr. for Photomedicine (USA)

10:30 am: **Two-photon autofluorescence imaging and analysis for automated assessment of skin changes associated with psoriasis in humans**, Mantas Žurauskas, Ronit Barkalifa, Univ. of Illinois (USA); Aneesh Alex, GlaxoSmithKline (USA); Marina Marjanovic, Univ. of Illinois (USA); Zane Arp, GlaxoSmithKline (USA) and U.S. Food and Drug Administration (USA); Darold R. Spillman, Prabhuddha Mukherjee, Univ. of Illinois (USA); Craig D. Neitzel, Warren Lee, Jeremy Medler, Carle Foundation Hospital (USA); Steve R. Hood, Matthew Cleveland, GlaxoSmithKline (United Kingdom); Stephen A. Boppart, Univ. of Illinois (USA) . . . . . [11211-21]

10:50 am: **In vivo optical imaging of vitiligo skin grafting treatment using multiphoton microscopy and reflectance confocal microscopy**, Griffin R. Lentsch, Pezhman Mobasher, Univ. of California, Irvine (USA); Craig Mizzone, Tufts Univ. (USA); Karsten Koenig, Univ. des Saarlandes (Germany); Bruce Tromberg, National Institutes of Health (USA); Irene Georgakoudi, Tufts Univ. (USA); Anand Ganesan, Mihaela Balu, Univ. of California, Irvine (USA) . . . . . [11211-22]

11:10 am: **Combined reflectance confocal microscopy and optical coherence tomography (RCM-OCT) for improving the diagnosis of small, equivocal, non-pigmented papules: a prospective study**, Jilliana Monnier, Cristian Navarrete-Dechent, Saud Aleissa, Konstantinos Liopyris, Ofer Reiter, Memorial Sloan-Kettering Cancer Ctr. (USA); Nicusor V. Iftimia, Physical Sciences Inc. (USA); Kishwer S. Nehal, Alina Markova, Liang Deng, Memorial Sloan-Kettering Cancer Ctr. (USA); Josep Malvehy, Univ. de Barcelona (Spain); Anthony Rossi, Milind Rajadhyaksha, Allan C. Halpern, Ashfaq A. Marghoob, Veronica Rotemberg, Manu Jain, Memorial Sloan-Kettering Cancer Ctr. (USA) . . . . . [11211-23]

Lunch/Exhibition Break . . . . . Sun 11:30 am to 1:00 pm

# CONFERENCE 11211

## SESSION 8

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . SUN 1:20 PM TO 3:00 PM

### Optical Coherence Tomography

Session Chair: **Ruikang K. Wang**, Univ. of Washington (USA)

1:20 pm: **Multi-parameter polarization-sensitive optical coherence tomography for improved burn depth determination**, Taylor M. Cannon, Harvard-MIT Health Sciences and Technology (USA); Pelham Keahey, Néstor Uribe-Patarroyo, Martin Villiger, Brett E. Bouma, Wellman Ctr. for Photomedicine, Massachusetts General Hospital (USA) and Harvard Medical School (USA). . . . . [11211-24]

1:40 pm: **Depth-resolved investigation of multiple optical properties and wrinkle morphology in eye-corner area by multi-functional Jones matrix optical coherence tomography**, Kohei Yamazaki, KAO Corp. (Japan); En Li, Arata Miyazawa, Univ. of Tsukuba (Japan); Masaki Kobayashi, Tetsuya Sayo, KAO Corp. (Japan); Shuichi Makita, Univ. of Tsukuba (Japan); Yoshito Takahashi, KAO Corp. (Japan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan); Shingo Sakai, KAO Corp. (Japan) . . . . . [11211-25]

2:00 pm: **Handheld line-field confocal optical coherence tomography for dermatology**, Jonas Ogien, Olivier Levecq, Maxime Cazalas, DAMAE Medical (France); Mariano Suppa, Véronique del Marmol, Hôpital Erasme (Belgium); Josep Malvehy, Hospital Clínic de Barcelona (Spain); Elisa Cinotti, Pietro Rubegni, Univ. degli Studi di Siena (Italy); Jean Luc Perrot, Ctr. Hospitalier Univ. de Saint-Étienne (France); Arnaud Dubois, Lab. Charles Fabry, Institut d'Optique Graduate School (France) . . . . . [11211-26]

2:20 pm: **Capillary refill: a technique for obtaining histology-grade OCT angiography maps of human dermal vasculature in vivo**, Michael Evers, Massachusetts General Hospital (USA); Malte Casper, Columbia Univ. (USA); Garuna Kosiratna, Josh Glahn, Weeranut Phothong, Tuanlian Luo, Dieter Manstein, Massachusetts General Hospital (USA). . . . . [11211-27]

2:40 pm: **Demonstration of an optical coherence tomography imaging system developed for real-time burn injury quantification in clinical settings**, Dan Paul Popescu, Michael S. D. Smith, National Research Council Canada (Canada); Michael G. Sowa, Kent Imaging Inc. (Canada) . . . . . [11211-28]

Coffee Break. . . . . Sun 3:00 pm to 3:30 pm

## SESSION 9

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . SUN 3:30 PM TO 5:50 PM

### Skin Characterization/Biological Response

Session Chairs: **Rolf B. Saager**, Linköping Univ. (Sweden); **InSeok Seo**, Johnson & Johnson Consumer Products (USA); **Haishan Zeng**, BC Cancer Research Ctr. (Canada)

3:30 pm: **Rapid handheld screening device to detect skin and soft tissue infections**, Geethanjali Radhakrishnan, Aduvo Diagnostics, Ltd. (India); Aayush G. Gupta, Dr. D. Y. Patil Medical College, Hospital & Research Ctr. (India); John King, Devina Ganvir, Aduvo Diagnostics, Ltd. (India) . . . [11211-29]

3:50 pm: **A full spectral modified 'UV camera' for improving the assessment and quantification of vitiligo lesions compared to conventional photography**, Rudolf M. Verdaasdonk, Univ. of Twente (Netherlands); Sanne Uitentuis, M. Heilman, J.M. Bae, Rosalie Luiten, Albert Wolkerstorfer, Marcel Bekkenk, Amsterdam UMC (Netherlands). . . . . [11211-30]

4:10 pm: **Characterization of tattoos in human skin using pulsed photothermal radiometry and diffuse reflectance spectroscopy**, Nina Verdel, Boris Majaron, Jožef Stefan Institute (Slovenia); Matjaž Lukač, Fotona d.d. (Slovenia), Jožef Stefan Institute (Slovenia), Univ. of Ljubljana (Slovenia). . . . . [11211-31]

4:30 pm: **Video-rate multi-exposure laser speckle contrast imaging for real-time microcirculation blood flow assessment in skin**, Martin Hultman, Linköping Univ. (Sweden); Ingemar Fredriksson, Linköping Univ. (Sweden) and Perimed AB (Sweden); Marcus Larsson, Tomas Strömberg, Linköping Univ. (Sweden) . . . . . [11211-32]

4:50 pm: **Hemodynamics in traumatic bruises assessed by diffuse reflectance spectroscopy and photothermal radiometry**, Boris Majaron, Jožef Stefan Institute (Slovenia), Univ. of Ljubljana (Slovenia); Ana Marin, Univ. of Ljubljana (Slovenia); Nina Verdel, Jožef Stefan Institute (Slovenia); Matija Milanič, Univ. of Ljubljana (Slovenia), Jožef Stefan Institute (Slovenia). . . . . [11211-33]

5:10 pm: **Skimager for the objective erythema estimation in atopic dogs**, Blaž Cugmas, Janis Spigulis, Univ. of Latvia (Latvia). . . . . [11211-35]

5:30 pm: **Visualization of burn severity and progression using a topical fluorescein based liquid bandage and digital camera**, John Quan M. Nguyen, Haley Marks, Wellman Ctr. for Photomedicine, Massachusetts General Hospital (USA); Tyler Everett, Timothy Haire, Anders Carlsson, Rodney Chan, U.S. Army Institute of Surgical Research (USA); Conor L. Evans, Wellman Ctr. for Photomedicine, Massachusetts General Hospital (USA) . . . . . [11211-36]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**The transposition of caffeine in skin layers, visualization at a molecular scale by molecular dynamics simulations**, Neila Machado, Erika Sato, Univ. Federal do ABC (Brazil); Clarissa Callegaro, AXCEM Dermatologia, Cosmiatria e Laser (Brazil); Daniele Araújo, Herculano Martinho, Univ. Federal do ABC (Brazil) . . . . . [11211-37]

**Visual assessment of facial pigmented lesions post picosecond laser therapy using optical coherence tomography**, Masato Ninomiya, Yusuke Hara, Toyonobu Yamashita, Chika Katagiri, Shiseido Co., Ltd. (Japan); Kei Negishi, Institute of Geriatrics, Tokyo Women's Medical Univ. (Japan) . . . . . [11211-38]

**Video-mosaicking of human skin in vivo using handheld line-field confocal optical coherence tomography**, Jonas Ogien, Anthony Daures, Maxime Cazalas, Olivier Levecq, DAMAE Medical (France); Arnaud Dubois, Lab. Charles Fabry, Institut d'Optique Graduate School (France) . . . . . [11211-39]

**Using high-power, continuous-wave laser diodes for tumor ablation guided by optical coherence tomography/angiography**, Wen-Ju Chen, Chun-Chieh Wang, Chang Gung Univ. (Taiwan); Ya-Ju Lee, Institute of Electro-Optical Science and Technology, National Taiwan Normal Univ. (Taiwan); Meng-Tsan Tsai, Chang Gung Univ. (Taiwan) . . . . . [11211-40]

**Non-contact fast Mueller matrix measurement system for investigation of bio-tissues**, Dierk Fricke, Alexander Becker, Leibniz Univ. Hannover (Germany); Merve Wollweber, Laser Zentrum Hannover e.V. (Germany); Birgit Glasmacher, Bernhard Roth, Leibniz Univ. Hannover (Germany) . . . . . [11211-42]

# CONFERENCE 11212

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH)

Saturday 1 February 2020 • Proceedings of SPIE Vol. 11212

## Therapeutics and Diagnostics in Urology 2020

Conference Chair: **Hyun Wook Kang**, Pukyong National Univ. (Korea, Republic of)

Program Committee: **Geoffrey N. Box**, The Ohio State Univ. (USA); **Kin F Chan**, Simpson Interventions (USA); **Nathaniel M. Fried**, The Univ. of North Carolina at Charlotte (USA); **Thomas Hasenberg**, Boston Scientific Corp. (USA); **Joseph C. Liao**, Stanford Univ. (USA); **William W. Roberts**, Univ. of Michigan Health System (USA); **Babak Shadgan**, The Univ. of British Columbia (Canada); **Ronald Sroka**, Laser-Forschungslabor (Germany); **Joel M. Teichman**, St. Paul's Hospital (Canada); **Matthias Trottmann**, Univ. München (Germany); **Rudolf M. Verdaasdonk**, Vrije Univ. Medical Ctr. (Netherlands); **Jian J. Zhang**, Boston Scientific Corp. (USA)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . SAT 8:40 AM TO 10:00 AM

#### Laser Treatment I

Session Chair: **Hyun Wook Kang**,  
Pukyong National Univ. (Korea, Republic of)

- 8:40 am: **In vivo noncontact photothermal hemostasis using dual-wavelengths for laser prostatectomy**, Myeongjin Kim, Pukyong National Univ. (Korea, Republic of); Sung Won Kim, Kosin Univ. (Korea, Republic of); Jason R. Xuan, Thomas C. Hasenberg, Boston Scientific Corp. (USA); Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of) . . . . . [11212-1]
- 9:00 am: **Transperineal laser ablation treatment of benign prostatic obstruction: preliminary results of a pilot study**, Rob van Kollenburg, Luigi van Riel, Jorg Oddens, Theo de Reijke, Harrie Beerlage, Martijn de Bruin, Amsterdam UMC (Netherlands) . . . . . [11212-2]
- 9:20 am: **In search of optimal settings for Ho:YAG laser- lithotripsy to maximize the ablation rate, while minimizing the retropulsion**, Jian J. Zhang, Dongyul Chai, Jason R. Xuan, Aditi Ray, Thomas C. Hasenberg, Tim Harrah, Boston Scientific Corp. (USA) . . . . . [11212-3]
- 9:40 am: **Effect of mechanical expansion on tissue coagulation for treatment of ureteral stricture**, Van Gia Truong, Hyun Wook Kang, Van Nam Tran, Myeongjin Kim, Pukyong National Univ. (Korea, Republic of) . . . [11212-4]
- Coffee Break . . . . . Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . SAT 10:30 AM TO 11:50 AM

#### Optical Imaging

Session Chair: **Kin F. Chan**, Simpson Interventions (USA)

- 10:30 am: **Application of a NIRS-derived measure to quantify reoxygenation of the pelvic floor muscles in women following sustained maximal voluntary contraction**, Andrew J. Macnab, Emily Deegan, Lynn Stothers, The Univ. of British Columbia (Canada) . . . . . [11212-5]
- 10:50 am: **Diagnosing urothelial carcinoma through multiple spectroscopic techniques**, Enrico Baria, Istituto Nazionale di Ottica (Italy); Simone Morselli, Andrea Liaci, Mauro Gacci, Sergio Serni, Marco Carini, Univ. degli Studi di Firenze (Italy); Riccardo Cicchi, Istituto Nazionale di Ottica (Italy); Francesco Saverio Pavone, Univ. degli Studi di Firenze (Italy) . . . . . [11212-6]
- 11:10 am: **Imaging the urothelium with optical coherence tomography**, Hui Wang, Xu Zhou, Miami Univ. (USA) . . . . . [11212-7]
- 11:30 am: **Monitoring changes in kidney optical properties during cold storage preservation with spatial frequency domain imaging**, Rebecca A. Rowland, Adrien Ponticorvo, Beckman Laser Institute and Medical Clinic (USA); Alberto Jarrin Lopez, Shiri Li, Hirohito Ichii, UC Irvine Medical Ctr. (USA); Anthony J. Durkin, Beckman Laser Institute and Medical Clinic (USA) and Univ. of California, Irvine (USA) . . . . . [11212-8]
- Lunch/Exhibition Break . . . . . Sat 11:50 am to 1:20 pm

#### SESSION 3

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . SAT 1:20 PM TO 3:00 PM

#### Laser Treatment II

Session Chairs: **Jian J. Zhang**, Boston Scientific Corp. (USA);  
**William W. Roberts**, Univ. of Michigan Health System (USA)

- 1:20 pm: **PEGylated nanographene oxide-Chlorin e6 with p53 conjugate for enhanced and selective ablation therapy of bladder cancer**, Hyejin Kim, Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of) . . . . . [11212-9]
- 1:40 pm: **Introducing outpatient PDD and IMAGE1-S guided diode laser treatment of intermediate-risk non-invasive bladder tumors to the outpatient department: optic diagnosis is needed for immediate treatment**, Gregers G. Hermann, Marie S. Erikson, Karin Mogensen, Herlev Hospital (Denmark) . . . . . [11212-10]
- 2:00 pm: **Strike rate: analysis of stone to fiber contact during popcorn laser lithotripsy**, timothy Hall, Ali H. Aldoukhi, Khurshid Ghani, William Roberts, Univ. of Michigan (USA) . . . . . [11212-11]
- 2:20 pm: **In vivo feasibility study of chemo-combined low-level laser therapy (LLLT) for treating recurrent urethral stricture**, Yeachan Lee, Myeongjin Kim, Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of) . . . . . [11212-12]
- 2:40 pm: **The effect of passability speed on fiber ball-tip breakage**, Clara Lin, Ashkan Aryaei, Boston Scientific Corp. (USA) . . . . . [11212-13]
- Coffee Break . . . . . Sat 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . SAT 3:30 PM TO 5:10 PM

#### Laser Treatment IV

Session Chairs: **Thomas Hasenberg**, Boston Scientific Corp. (USA);  
**Hyun Wook Kang**, Pukyong National Univ. (Korea, Republic of)

- 3:30 pm: **Numerical simulations of bubble dynamics in laser lithotripsy**, Steven Peng, Boston Scientific Corp. (USA) . . . . . [11212-14]
- 3:50 pm: **Parameter boundaries for thermally safe laser lithotripsy power and irrigation: in vitro model**, William W. Roberts, Ali H. Aldoukhi, Kristian Black, Univ. of Michigan Health System (USA); Timothy L. Hall, Univ. of Michigan (USA); Khurshid R. Ghani, Univ. of Michigan Health System (USA); Adam D. Maxwell, Brian MacConaghy, Univ. of Washington (USA) . . . [11212-15]
- 4:10 pm: **Thermo-chemical analysis on kidney stones after laser lithotripsy**, Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of); James Zhang, Dongyul Chai, Jason R. Xuan, Thomas C. Hasenberg, Timothy Harrah, Boston Scientific Corp. (USA) . . . . . [11212-16]
- 4:30 pm: **Dynamic combination of chemical and laser lights for bacterial biofilm disinfection in flexible ureteroscopy**, Van Nam Tran, Fazlurrahman Khan, Van Gia Truong, Young Mog Kim, Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of) . . . . . [11212-17]
- 4:50 pm: **Studying burnback mechanisms for large and small core size fibers**, Ashkan Aryaei, Sneha Srinivasan, Boston Scientific Corp. (USA) . . . . . [11212-18]

# CONFERENCE 11212

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**US-assisted Nd:YAG laser treatment with modulated energy for prostate tumors: computational and experimental evaluations.** Van Nam Tran, Van Gia Truong, Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of). . . . . [11212-19]

**Photobiomodulation (PBM) on diabetic human bladder fibroblasts for treating urinary tract infection (UTI).** Yeachan Lee, Hyejin Kim, Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of) . . . . . [11212-21]

**EGF-inspired cryogels for induction of apoptosis in human bladder cancer cells through photobiostimulation.** Shanmugapriya Karuppusamy, Hyejin Kim, Hyun Wook Kang, Pukyong National Univ. (Korea, Republic of). . . . . [11212-23]

### BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

#### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

#### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

#### Talk by 2014 Nobel Prize Winner in Physics:

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

## BIOS Expo Industry Stage

Saturday – Sunday • Hall DE

Keynotes and panels on the latest developments, open to all attendees.

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# CONFERENCE 11213

LOCATION: ROOM 302 (LEVEL 3 SOUTH)

Saturday 1 February 2020 • Proceedings of SPIE Vol. 11213

# Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2020

Conference Chairs: **Brian J. F. Wong**, Beckman Laser Institute and Medical Clinic (USA); **Justus F. Ilgner**, Uniklinik RWTH Aachen (Germany)

Program Committee: **Milind Rajadhyaksha**, Memorial Sloan-Kettering Cancer Ctr. (USA); **Henricus J. C. M. Sterenborg**, Netherlands Cancer Institute, Univ. Medical Center Amsterdam AMC (Netherlands); **Javier A. Jo**, Texas A&M Univ. (USA); **Amy L. Oldenburg**, The Univ. of North Carolina at Chapel Hill (USA); **Maie A. St. John**, The Henry Samueli School of Engineering (USA)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SAT 9:00 AM TO 9:20 AM

#### Functional Diagnostic Technologies and Quality Assurance in Tympanic Membrane Reconstruction

Session Chair: **Brian J. F. Wong**,  
Beckman Laser Institute and Medical Clinic (USA)

9:00 am: **Success of tympanoplasty evaluated by endoscopic OCT: a case report**, Jonas Golde, TU Dresden (Germany); Joseph Morgenstern, Universitätsklinikum Carl Gustav Carus Dresden (Germany); Martin Schindler, TU Dresden (Germany); Max Kemper, Matthias Bornitz, Marcus Neudert, Thomas Zahnert, Universitätsklinikum Carl Gustav Carus Dresden (Germany); Edmund Koch, Lars Kirsten, TU Dresden (Germany) ..... [11213-2]

### SESSION 2

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SAT 9:20 AM TO 10:00 AM

#### OCT and Related Imaging Techniques for Diagnostics and Therapy Guidance for the Inner Ear

Session Chair: **Justus F. Ilgner**,  
Uniklinik RWTH Aachen (Germany)

9:20 am: **Dual-mode endoscopic probe combining OCT and autofluorescence imaging for inner ear hearing loss diagnosis and therapy guidance**, Jesung Park, Physical Sciences Inc. (USA); Jeffrey T. Cheng, Daniel Lee, Massachusetts Eye and Ear (USA); Jeffrey Holt, Hannah Goldberg, Boston Children's Hospital (USA); Gopi N. Maguluri, John Grimble, Nicusor V. Iftimia, Physical Sciences Inc. (USA) ..... [11213-3]

9:40 am: **Quantitative spectroscopic comparison of the optical properties of the mouse cochlear microstructures using optical coherence tomography at 1.3  $\mu\text{m}$  and 1  $\mu\text{m}$  wavelength regimes**, Ting-Yen Tsai, Ting Hao Chen, National Taiwan Univ. (Taiwan); Hsin-Chien Chen, Hao Wang, Tri-Service General Hospital (Taiwan) and National Defense Medical Ctr. (Taiwan); Yin-Peng Huang, Teng-Chieh Chang, Yu-Wei Chang, Yi-Ping Hung, National Taiwan Univ. (Taiwan); Meng-Tsan Tsai, Chang Gung Univ. (Taiwan); Chih-Hung Wang, Taichung Armed Forces General Hospital (Taiwan) and National Defense Medical Ctr. (Taiwan); Hsiang-Chieh Lee, National Taiwan Univ. (Taiwan) ..... [11213-5]

Coffee Break ..... Sat 10:00 am to 10:30 am

### SESSION 3

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SAT 10:30 AM TO 12:50 PM

#### From Bench to Bedside: Optical Diagnostic Techniques for Malignant and Pre-malignant Lesions of the Oral Cavity

Session Chair: **Brian J. F. Wong**,  
Beckman Laser Institute and Medical Clinic (USA)

10:30 am: **Serum Raman spectroscopy: evaluation in hamster buccal pouch models**, Sourav Raj Singh, Heero Vaswani, Kshama Pansare, Arvind Ingle, C. Murali Krishna, Advanced Ctr. for Treatment, Research & Education in Cancer (India) ..... [11213-6]

10:50 am: **Non-invasive structural and functional imaging of the human oral mucosa by optical coherence tomography**, Julia Walther, Jonas Golde, Florian Tetschke, Christian Schnabel, Lars Kirsten, Christian Hannig, Edmund Koch, TU Dresden (Germany) ..... [11213-7]

11:10 am: **Raman microspectroscopy of oral mucosa: exploring Raman maps in experimental carcinogenesis**, Piyush Kumar, Arti R. Hole, Arvind Ingle, C. Murali Krishna, Advanced Ctr. for Treatment, Research & Education in Cancer (India) ..... [11213-8]

11:30 am: **Development of a new polarized hyperspectral imaging microscope**, Ximing Zhou, Ling Ma, Martin Halicek, James D. Dormer, The Univ. of Texas at Dallas (USA); Baowei Fei, The Univ. of Texas at Dallas (USA) and The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA) . . . [11213-9]

11:50 am: **Design and validation of an intraoperative autofluorescence lifetime imaging device**, Yong Hu, Univ. of California, Los Angeles (USA); Peter Pellionisz, The Henry Samueli School of Engineering (USA); Seong Moon, Shan Huang, Maie A. St. John, Univ. of California, Los Angeles (USA) ..... [11213-18]

12:10 pm: **Assessment of gate width and delay time in dynamic optical contrast imaging for application in head and neck surgery**, Peter Pellionisz, The Henry Samueli School of Engineering (USA); Yong Hu, Shan Huang, Andy Moon, Univ. of California, Los Angeles (USA); Khuzaima Rangwalla, The Henry Samueli School of Engineering (USA); Maie A. St. John, Univ. of California, Los Angeles (USA) ..... [11213-19]

12:30 pm: **Fluorescence guided surgery in Head and Neck cancer for in vivo tumor detection using Cetuximab-800CW**, Max Witjes, University Medical Center Groningen (Netherlands) ..... [11213-22]

Lunch/Exhibition Break ..... Sat 12:50 pm to 2:00 pm

# CONFERENCE 11213

## SESSION 4

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SAT 2:00 PM TO 2:40 PM

### Clinical Translation of Confocal Optics and Surgical Use of Laser Technology

Session Chair: **Justus F. Ilgner**,  
Uniklinik RWTH Aachen (Germany)

2:00 pm: **Confocal mimics hematoxylin and eosin: recent technical development in translation**, Daniel S. Gareau, SurgiVance Inc. (USA); John A. Carucci, New York Univ. (USA); Alba G. Mülberger, The Rockefeller Univ. (USA) ..... [11213-10]

2:20 pm: **Comparative in-vitro investigations on the cutting quality of the CO2 laser and the diode pumped Er:YAG laser**, Karl Stock, Holger Wurm, Institut für Lasertechnologien in der Medizin und Messtechnik (Germany) ..... [11213-11]

## SESSION 5

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SAT 2:40 PM TO 5:50 PM

### Combining Novel Imaging Technology for Functional Assessment and Therapy Guidance in Upper and Lower Airways

Session Chair: **Brian J. F. Wong**,  
Beckman Laser Institute and Medical Clinic (USA)

2:40 pm: **Assessment of nasal valve surgery outcomes using anatomical optical coherence tomography**, Santosh Balakrishnan, Ruofei Bu, Candace M. Waters, Julia S. Kimbell, Wesley H. Stepp, William W. Shockley, Madison J. Clark, Amy L. Oldenburg, The Univ. of North Carolina at Chapel Hill (USA) ..... [11213-12]

3:00 pm: **Validation of CFD predicted airway pressures built from aOCT reconstruction of 3D printed stenosis phantoms**, Hillel B. Price, Ruofei Bu, Santosh Balakrishnan, Julia S. Kimbell, Amy L. Oldenburg, The Univ. of North Carolina at Chapel Hill (USA) ..... [11213-13]

Coffee Break ..... Sat 3:20 pm to 3:50 pm

3:50 pm: **Assessment of toxin-induced airway injury and therapeutic effects in a rat model by optical coherence tomography**, Yusi Miao, Andy Choi, Univ. of California, Irvine (USA); Heidi Nick, Jacqueline Rioux, Rhonda Garlick, Joseph C. Jing, Livia A. Veress, Univ. of Colorado Denver (USA); Sari B. Mahon, Beckman Laser Institute and Medical Clinic (USA); Matthew Brenner, Beckman Laser Institute (USA); Carl W. White, Univ. of Colorado Denver (USA); Zhongping Chen, Univ. of California, Irvine (USA) ..... [11213-14]

4:10 pm: **Wide field vectorial polarization sensitive optical coherence tomography imaging of human vocal folds**, Sarat Gundavarapu, Harvard Medical School (USA) and Wellman Ctr. of Photomedicine (USA); James B. Kobler, Harvard Medical School (USA) and Wellman Ctr. of Photomedicine (USA) and Massachusetts General Hospital (USA); James A. Burns, Harvard Medical School (USA) and Massachusetts General Hospital (USA); Benjamin J. Vakoc, Harvard Medical School (USA) and Wellman Ctr. of Photomedicine (USA) and Harvard-MIT Health Sciences and Technology (USA) ..... [11213-15]

4:30 pm: **Quantitative assessment of the three-dimensional microarchitecture of the human vocal fold using optical coherence tomography, two-photon excitation fluorescence microscopy, and second harmonic generation**, Fouzi Benboujja, Christopher J. Hartnick, Harvard Medical School (USA) ..... [11213-16]

4:50 pm: **Design of a novel MEMS based Laser scanning laryngoscope to combine high precision laser cuts with simultaneous MHz OCT and stereo camera feedback**, James Napier, Hochschule Emden-Leer (Germany); Miroslav Zabic, Sontje Ihler, Max-Heinrich Laves, Leibniz Univ. Hannover (Germany); Walter Neu, Hochschule Emden-Leer (Germany) ..... [11213-17]

5:10 pm: **Differentiation of tumors of the upper respiratory tract using optical metabolic imaging**, Dennis Eggert, Volkan Dogan, David Gaertner, Christian Betz, Universitätsklinikum Hamburg-Eppendorf (Germany) [11213-20]

5:30 pm: **In vivo detection of laryngeal cancer by hyperspectral imaging combined with deep learning methods**, Dennis Eggert, Universitätsklinikum Hamburg-Eppendorf (Germany); Marcel Bengs, Technische Univ. Hamburg-Harburg (Germany); Stephan Westermann, Rheinische Friedrich-Wilhelms-Univ. Bonn (Germany); Nils Gessert, Technische Univ. Hamburg-Harburg (Germany); Andreas O.H. Gerstner, Städtisches Klinikum Braunschweig (Germany); Nina A Müller, Rheinische Friedrich-Wilhelms-Univ. Bonn (Germany); Alexander Schlaefer, Technische Univ. Hamburg-Harburg (Germany); Christian Betz, Wiebke Laffers, Universitätsklinikum Hamburg-Eppendorf (Germany) [11213-21]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
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**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
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**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

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**Micro vibration measurement of membrane in an eardrum model sample using micro vi-bro tomography**, Yoonseok Kim, Jae-Hwan Kwon, Pilun Kim, Mansik Jeon, Jeehyun Kim, Kyungpook National Univ. (Korea, Republic of) ..... [11213-1]

# CONFERENCE 11214

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11214

## Endoscopic Microscopy XV

Conference Chairs: **Guillermo J. Tearney**, Wellman Ctr. for Photomedicine (USA); **Thomas D. Wang**, Univ. of Michigan (USA); **Melissa J. Suter**, Massachusetts General Hospital (USA)

Program Committee: **Kathy Beaudette**, Castor Optics, Inc. (Canada); **Matthew Brenner**, Univ. of California, Irvine (USA); **Johannes F. de Boer**, Vrije Univ. Amsterdam (Netherlands); **Arthur F. Gmitro**, The Univ. of Arizona (USA); **Michalina J. Gora**, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France); **Lida P. Hariri**, Massachusetts General Hospital (USA); **Stephen Lam**, The BC Cancer Agency Research Ctr. (Canada); **Amy L. Oldenburg**, The Univ. of North Carolina at Chapel Hill (USA); **Wibool Piyawattanametha**, King Mongkut's Institute of Technology Ladkrabang (Thailand); **DongKyun Kang**, College of Optical Sciences, The Univ. of Arizona (USA); **David D. Sampson**, Univ. of Surrey (United Kingdom); **Eric J. Seibel**, Univ. of Washington (USA)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . SAT 8:20 AM TO 10:00 AM

#### Gastroenterology

Session Chair: **Michalina J. Gora**, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France)

8:20 am: **Extended scanning workspace using steerable OCT endomicroscopy**, Oscar Caravaca Mora, Florent P. Nageotte Sr., Philippe Zanne, Lucile Zorn, Natalia Zulina, Sara Gravelyn, Paul C. Montgomery, Michel de Mathelin, Bernard Dallemagne, Michalina J. Gora, Univ. de Strasbourg (France) . . . . . [11214-1]

8:40 am: **Polarization-sensitive micro optical coherence tomography tethered capsule endomicroscopy for investigation of eosinophilic esophagitis**, Andreas Wartak, Biwei Yin, Chia-Pin Liang, Harvard Medical School (USA); Brandon Apoo, Wellman Ctr. for Photomedicine (USA); Hui Min Leung, Barry Vuong, Jose Carlos Gallego Fernandez, Osman O. Ahlsen, Chukwuemeka Okoro, Guillermo J. Tearney, Harvard Medical School (USA) . . . . . [11214-2]

9:00 am: **Combined OCT and angle-resolved low-coherence interferometry using endoscope-coupled paddle probe**, Kengyeh K. Chu, Zachary A. Steelman, Michael Crose, Evan Jelly, Brian Cox, Duke Univ. (USA); Yaa Ofori-Marfoh, Lama Moussa, Holly Cirri, Ariel E. Watts, Nicholas J. Shaheen, Univ. of North Carolina (USA); Adam P. Wax, Duke Univ. (USA) . . . . . [11214-3]

9:20 am: **Transnasal imaging tube for unседated OCT imaging the upper gastrointestinal tract in infants**, Hamid Farrokhi, Jing Dong, David O. Otuya, Yogesh Verma, Sarah K. Zemlok, Aditya Kumar, Peter Choy, Rachel E. Shore, Sarah L. Giddings, Nitasha G. M. Bhat, Ara L. Bablouzian, Mason W. Schellenberg, Matthew Beatty, Zhonglie Piao, Catriona N. Grant, Wellman Ctr. for Photomedicine (USA); Norman S. Nishioka, Massachusetts General Hospital (USA); Mireille Rosenberg, Wellman Ctr. for Photomedicine (USA); Christopher J. Damman, Bill & Melinda Gates Foundation (USA); Guillermo J. Tearney, Wellman Ctr. for Photomedicine (USA) . . . . . [11214-4]

9:40 am: **Minimally invasive intestinal permeability assessment using an optical coherence tomography guided intestinal potential difference probe**, Serena Z. Shi, Wellman Ctr. for Photomedicine (USA) and Univ. of California, San Diego (USA); David O. Otuya, Hamid Farrokhi, Wellman Ctr. for Photomedicine (USA); Ariel J. Lee, Wellman Ctr. for Photomedicine (USA) and KAIST (Korea, Democratic Peoples Republic of); Jing Dong, Sarah L. Giddings, Wellman Ctr. for Photomedicine (USA); Christopher J. Damman, Bill & Melinda Gates Foundation (USA); Guillermo J. Tearney, Wellman Ctr. for Photomedicine (USA) . . . . . [11214-5]

Coffee Break. . . . . Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . SAT 10:30 AM TO 11:50 AM

#### Spectral Encoding

Session Chair: **DongKyun Kang**, Wyant College of Optical Sciences (USA)

10:30 am: **Imaging tympanic membrane vibrations in a human ear**, Matan Hamra, Technion-Israel Institute of Technology (Israel); Shadi Shinnawi, Rambam Medical Ctr. (Israel); Limor Minai, Technion-Israel Institute of Technology (Israel); Mauricio Cohen Vaizer, Rambam Medical Ctr. (Israel); Dvir Yelin, Technion-Israel Institute of Technology (Israel) . . . . . [11214-6]

10:50 am: **Speckle-free, spectrally-encoded confocal microscopy**, Cheng Gong, Wyant College of Optical Sciences (USA); Delaney Stratton, Clara Curiel-Lewandrowski, The Univ. of Arizona Cancer Ctr. (USA); DongKyun Kang, Wyant College of Optical Sciences (USA) . . . . . [11214-7]

11:10 am: **400-kHz and 1060-nm SECM tethered capsule endomicroscopy for human esophageal imaging in vivo**, Jiheun Ryu, Aaron R. Baillargeon, Edward C. Farewell, Ara L. Bablouzian, Mason W. Schellenberg, Alfred A. F. K. Kelada, Catriona N. Grant, Guillermo J. Tearney, Wellman Ctr. for Photomedicine (USA) . . . . . [11214-8]

11:30 am: **Imaging artifact correction for forward-viewing spectrally encoded endoscopy**, Jiheun Ryu, Adel Zeidan, Wellman Ctr. for Photomedicine (USA); Mitsuhiro Ikuta, Canon U.S.A., Inc. (USA); Guillermo J. Tearney, Wellman Ctr. for Photomedicine (USA) . . . . . [11214-9]

Lunch/Exhibition Break . . . . . Sat 11:50 am to 1:40 pm

#### SESSION 3

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . SAT 1:40 PM TO 3:00 PM

#### Respiratory

Session Chair: **Lida P. Hariri**, Massachusetts General Hospital (USA)

1:40 pm: **In vivo diagnosis of idiopathic pulmonary fibrosis (IPF) using endobronchial OCT**, Sreyankar Nandy, Benjamin W. Roop, David C. Adams, Ashok Muniappan, Colleen M. Keyes, John C. Wain, Christopher R. Morse, Michael Lanuti, Massachusetts General Hospital (USA); Thomas V. Colby, Mayo Clinic (USA); Angela Shih, Mari Mino-Kenudson, Eugene J. Mark, Richard L. Kradin, Amita Sharma, Lloyd Liang, Diane L. Davies, Margit V. Szabari, Andrew M. Tager, Melissa J. Suter, Lida P. Hariri, Massachusetts General Hospital (USA) . . . . . [11214-10]

2:00 pm: **Full resolution PS-OCT assessment of airway smooth muscle in a longitudinal bronchial thermoplasty study**, David C. Adams, Jasmin A. Holz, Andrew F. McCrossan, Lida P. Hariri, Margit V. Szabari, Melissa J. Suter, Massachusetts General Hospital (USA) . . . . . [11214-12]

2:20 pm: **Multifunctional optical coherence tomography for endoscopic in-vivo imaging of lungs periphery in asthma patients**, Margherita Vaselli, Fabio Feroldi, Joy Willemse, Valentina Davidoiu, Maximilian G. O. Graefe, Dirck van Iperen, Johannes F. de Boer, Vrije Univ. Amsterdam (Netherlands) . . . . . [11214-13]

2:40 pm: **Nose cone with inflatable probe-clamping balloons improves stabilization of an intranasal  $\mu$ OCT imaging probe**, Hui Min Leung, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Chulho Hyun, Rachel E. Shore, Jose Antonio Vasquez, Wellman Ctr. for Photomedicine (USA) and Massachusetts General Hospital (USA); Susan E. Birket, Ren-Jay Shei, George M. Solomon, Steven M. Rowe, The Univ. of Alabama at Birmingham School of Medicine (USA); Guillermo J. Tearney, Massachusetts General Hospital (USA) . . . . . [11214-11]

Coffee Break. . . . . Sat 3:00 pm to 3:30 pm



# CONFERENCE 11214

## SESSION 4

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . SAT 3:30 PM TO 4:50 PM

### Fluorescence and Photoacoustic

Session Chair: **Guillermo J. Tearney**,  
Massachusetts General Hospital (USA)

3:30 pm: **Structured illumination super-resolution module for 1- photon endomicroscopy**, Tabourin Loïc, Tigran Galstian, Ctr. d'Optique, photonique et laser, Univ. Laval (Canada) . . . . . [11214-14]

3:50 pm: **Forward-imaging photoacoustic laproscope with all-optical ultrasound detection and flexible fiber bundles**, Qian Li, Medizinische Univ. Wien (Austria); Wolfgang Rohringer, XARION Laser Acoustics GmbH (Austria); Mikael Timo Erkkilä, Stefan Preißer, Richard Haindl, Mengyang Liu, Medizinische Univ. Wien (Austria); Balthasar Fischer, XARION Laser Acoustics GmbH (Austria); Wolfgang Drexler, Medizinische Univ. Wien (Austria) [11214-15]

4:10 pm: **Photoacoustic endomicroscopy through a multimode fiber via spatial light modulator based optical wavefront shaping**, Sylvain Mezil, Irène Wang, Philippe Moreau, Théodore Remark, Antonio M. Caravaca-Aguirre, Emmanuel Bossy, Lab. Interdisciplinaire de Physique (France) and Univ. Grenoble Alpes (France) and CNRS (France) . . . . . [11214-16]

4:30 pm: **Effective imaging frame rate enhancement of two-photon endomicroscopy for neuroimaging in vivo**, Honghua Guan, Dawei Li, Hyeon-Cheol Park, Ang Li, Johns Hopkins Univ. (USA); Yuanlei Yue, The George Washington Univ. (USA); Ming-Jun Li, Corning Incorporated (USA); Hui Lu, The George Washington Univ. (USA); Xingde Li, Johns Hopkins Univ. (USA) . . . . . [11214-17]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)

*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 5

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . SUN 8:20 AM TO 10:00 AM

### Optical Coherence Tomography

Session Chair: **Amy L. Oldenburg**,  
The Univ. of North Carolina at Chapel Hill (USA)

8:20 am: **Endoscopic optical coherence tomography for sublayer measurement of the human oral mucosa in vivo**, Julia Walther, Marius Albrecht, Juliane Müller, Jonas Golde, Florian Tetschke, Christian Schnabel, Edmund Koch, TU Dresden (Germany) . . . . . [11214-18]

8:40 am: **Handheld intravaginal OCT endoscope for in-situ monitoring of laser vaginal ablation**, Yusi Miao, Univ. of California, Irvine (USA); Neha T. Sudol, Univ. of California, Irvine Medical Ctr. (USA); Xiaoming Hu, Beckman Laser Institute and Medical Clinic (USA); Yan Li, Univ. of California, Irvine (USA); Joseph C. Jing, Yona Tadir, Beckman Laser Institute and Medical Clinic (USA); Felicia Lane, Univ. of California, Irvine Medical Ctr. (USA); Zhongping Chen, Univ. of California, Irvine (USA) . . . . . [11214-19]

9:00 am: **Endoscopic micro-optical coherence tomography of the inner ear for diagnosis of sensorineural hearing loss**, Janani S. Iyer, Harvard Univ. (USA); Biwei Yin, Massachusetts General Hospital (USA); Konstantina Stankovic, Massachusetts Eye and Ear (USA); Guillermo Tearney, Massachusetts General Hospital (USA) . . . . . [11214-20]

9:20 am: **Correlation between optical reflectance contrast and ultrastructures**, Linbo Liu, Si Chen, Xi Ge, Xinyu Liu, Nanyang Technological Univ. (Singapore) . . . . . [11214-21]

9:40 am: **Modeling and optimization of depth of field extension based on mirror-tunneling**, Chukwuemeka Okoro, Biwei Yin, Guillermo J. Tearney, Harvard Medical School (USA) . . . . . [11214-22]

Coffee Break. . . . . Sun 10:00 am to 10:30 am

### SESSION 6

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . SUN 10:30 AM TO 11:50 AM

### Novel Probes

Session Chair: **Eric J. Seibel**, Univ. of Washington (USA)

10:30 am: **Shadow-free motorized capsule enables accurate beam positioning and sectorized OCT imaging of the esophagus**, Antonio López-Marín, Geert Springeling, Robert Beurskens, Heleen M. M. van Beusekom, Antonius F. W. van der Steen, Arjun D. Koch, Erasmus MC (Netherlands); Brett E. Bouma, Wellman Ctr. for Photomedicine (USA) and Harvard Medical School (USA) and Massachusetts General Hospital (USA); Robert A. Huber, Univ. zu Lübeck (Germany); Gijs van Soest, Tianshi Wang, Erasmus MC (Netherlands) . . . . . [11214-23]

10:50 am: **Shadow-free tethered capsule endomicroscopy using a hollow-shaft brushless DC motor**, Tim Eixmann, Medizinisches Laserzentrum Lübeck GmbH (Germany); Martin Ahrens, Univ. zu Lübeck (Germany); Gereon M. Hüttmann, Hinnerk Schulz-Hildebrandt, Univ. zu Lübeck (Germany) and Medizinisches Laserzentrum Lübeck GmbH (Germany) and Deutsche Zentrum für Lungenforschung (Germany) . . . . . [11214-24]

11:10 am: **Asymmetric piezoelectric tube-based fiber scanning OCT endoscope**, Jintaek Im, Yeon Hee Chang, Cheol Song, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) . . . . . [11214-25]

11:30 am: **Sub-millimeter diameter rotary pullback endoscope for co-registered high resolution narrow-band sequential RGB reflectance and autofluorescence imaging**, Max Manning, Andrea Louise Buenconsejo, Geoffrey Hohert, Anthony M. D. Lee, Pierre M. Lane, Calum E. MacAulay, BC Cancer Research Ctr. (Canada) . . . . . [11214-26]

Lunch/Exhibition Break . . . . . Sun 11:50 am to 1:40 pm

**SESSION 7**

**LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . SUN 1:40 PM TO 3:00 PM**

**Multimodality and Polarization**

Session Chair: **Johannes F. de Boer**,  
Vrije Univ. Amsterdam (Netherlands)

1:40 pm: **Endoscopic polarization-sensitive OCT using spun fiber**, Saijun Qiu, Yan Li, Zhongping Chen, Beckman Laser Institute and Medical Clinic (USA) and Univ. of California, Irvine (USA) . . . . . [11214-27]

2:00 pm: **In-vivo co-registered optical coherence tomography and autofluorescence imaging in the endocervical canal and ectocervix: a pilot study**, Andrea Louise Buenconsejo, Jeanie Malone, Sylvia Lam, BC Cancer Research Ctr. (Canada); Jessica N. McAlpine, Dianne M. Miller, Vancouver General Hospital (Canada); Anthony M. D. Lee, Pierre M. Lane, Calum E. MacAulay, BC Cancer Research Ctr. (Canada). . . . . [11214-28]

2:20 pm: **Polarization-sensitive nano-optic endoscope**, Hamid Pahlevaninezhad, Harvard Medical School (USA); Yao-Wei Huang, Harvard Univ. (USA); David C. Adams, Harvard Medical School (USA) and Massachusetts General Hospital (USA); Mohammadreza Khorasaninejad, Zhujun Shi, Federico Capasso, Harvard Univ. (USA); Melissa J. Suter, Harvard Medical School (USA) and Massachusetts General Hospital (USA) . . [11214-29]

2:40 pm: **High-resolution endoscopic OCT using a miniature nano-optic endoscope**, Masoud Pahlevaninezhad, Harvard Medical School (USA) and Massachusetts General Hospital (USA) and Univ. of Calgary (Canada); Yao-Wei Huang, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); Majid Pahlevani, Amir Sanati Nezhad, Univ. of Calgary (Canada); Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); Melissa J. Suter, Hamid Pahlevaninezhad, Harvard Medical School (USA) and Massachusetts General Hospital (USA) . . . . . [11214-30]

Coffee Break . . . . . Sun 3:00 pm to 3:30 pm

**SESSION 8**

**LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . SUN 3:30 PM TO 4:50 PM**

**Endoscopic Microscopy**

**Joint Session with 11214 and 11293**

Session Chair: **Wibool Piyawattanametha**, King Mongkut's Institute of Technology Ladkrabang (Thailand), Michigan State Univ. (USA)

3:30 pm: **Low-voltage magnetic actuated fiber scanning endoscope for 3D optical coherence tomography**, Hinnerk Schulz-Hildebrandt, Univ. zu Lübeck (Germany); Tim Eixmann, Malte vom Endt, Medizinisches Laserzentrum Lübeck GmbH (Germany); Gereon M. Hüttmann, Univ. zu Lübeck (Germany). [11214-31]

3:50 pm: **Dual modality multiphoton-OCT flexible endomicroscope with an integrated electromagnetic z-actuator for optical field-of-view switching and a piezo-fiber-scanner for image acquisition**, Bernhard Messerschmidt, Gregor Matz, Sven Flämig, Karl Reichwald, Ekaterina Pshenay-Severin, Grintech GmbH (Germany); Andreas Kamm, Claudia Reinlein, Beatrice Korn, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Karsten Kühnert, David Vasquez, Marianne Heilmann, piezosystem jena GmbH (Germany); Thomas Frank, Thomas Sattel, Tom Ströhma, Technische Univ. Ilmenau (Germany); Xiang Lu, Herbert Gross, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11214-32]

4:10 pm: **Multimodal two-photon and three-photon endomicroscopy for 3D tissue imaging**, Qihao Liu, Mukhlasur Rahman Tanvir, Lin Huang, Shuo Tang, The Univ. of British Columbia (Canada). . . . . [11214-33]

4:30 pm: **A 3D actuator for laser scanning endoscopy**, Oguz Gurcuoglu, Irem D. Derman, Istanbul Technical Univ. (Turkey); Melisa Altinsoy, Politecnico di Milano (Italy); Ramin Khayatzaadeh, Ahmet C. Erten, Istanbul Technical Univ. (Turkey); Fehmi Civitci, Oregon Health and Science Univ. (USA); Onur Ferhanoglu, Istanbul Technical Univ. (Turkey). . . . . [11293-26]

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Identification of early cancerous lesion of esophagus with endoscopic images by convolutional neural network**, Tsung-Yu Yang, Hao-Yi Syu, Hsiang-Chen Wang, National Chung Cheng Univ. (Taiwan); I-Chen Wu, Kaohsiung Medical Univ. (Taiwan). . . . . [11214-34]

**Micron precision fiber bundle coupler for confocal endomicroscope**, Qian Liu, Xiaoxiao Ma, Huazhong Univ. of Science and Technology (China). . . . . [11214-35]

**Design of a stabilizing device for an intranasal probe**, Rachel E. Shore, Jose A. Vasquez Porto-Viso, Hui Min Leung, Daryl Hyun, Guillermo J. Tearney, Wellman Ctr. for Photomedicine (USA) . . . . . [11214-36]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

# CONFERENCE 11215

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11215

# Diagnostic and Therapeutic Applications of Light in Cardiology 2020

Conference Chairs: **Kenton W. Gregory**, Oregon Medical Laser Ctr. (USA); **Laura Marcu**, Univ. of California, Davis (USA)

Program Committee: **Christine P. Hendon**, Columbia Univ. (USA); **Gijs van Soest**, Erasmus MC (Netherlands); **Stanislav Y. Emelianov**, The Univ. of Texas at Austin (USA); **Guillermo J. Tearney**, Massachusetts General Hospital (USA)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . SAT 8:00 AM TO 10:10 AM

#### Optical Coherence Tomography

Session Chair: **Guillermo J. Tearney**,  
Massachusetts General Hospital (USA)

8:00 am: **Hybrid intravascular imaging of coronary atherosclerosis: what is expected to be the role of hybrid imaging catheters in the clinical practice and research?** (*Invited Paper*), Christos V. Bourantas, Barts Heart Ctr., Univ. College London (United Kingdom) . . . . . [11215-1]

8:30 am: **Intravascular optical coherence elastography: simultaneous mechanical and morphological imaging of atherosclerotic plaques**, Tianshi Wang, Erasmus MC (Netherlands); Tom Pfeiffer, Institut für Biomedizinische Optik, Univ. zu Lübeck (Germany); Ali Akyildiz, Heleen van Beusekom, Erasmus MC (Netherlands); Wolfgang Wieser, Optores GmbH (Germany); A.F.W. van der Steen, Erasmus MC (Netherlands) and Chinese Academy of Sciences (China) and Delft Univ. of Technology (Netherlands); Robert Huber, Institut für Biomedizinische Optik, Univ. zu Lübeck (Germany); Gijs van Soest, Erasmus MC (Netherlands) . . . . . [11215-2]

8:50 am: **Lipid sensitive OCT**, Laurin Ginner, Johanna Gesperger, Barbara Messner, Matthias Salas, Michael Niederleithner, Bettina Kapsch, Rainer Leitgeb, Medizinische Univ. Wien (Austria) . . . . . [11215-3]

9:10 am: **A dual modality imaging system integrating optical frequency domain imaging (OFDI) and intravascular ultrasound imaging (IVUS) for intravascular diagnosis**, Jian Ren, Milen Shishkov, Martin Villiger, Kenichiro Otsuka, Brett Bouma, Wellman Ctr. for Photomedicine (USA) [11215-4]

9:30 am: **Deep learning segmentation used in IVOCCT images to guide optical attenuation imaging for plaque characterization**, Shengnan Liu, Erasmus MC (Netherlands); Denis Shamonin, Leiden Univ. Medical Ctr. (Netherlands); Guillaume Zahnd, Computer Aided Medical Procedures, Technische Univ. München (Germany); Joost Daemen, A.F.W. van der Steen, Theo van Walsum, Gijs van Soest, Erasmus MC (Netherlands) . . . . . [11215-5]

9:50 am: **Reproducibility and efficacy of attenuation-compensated optical coherence tomography for assessing external elastic membrane border and plaque composition in native and stented segments**, Anantharaman Ramasamy, Barts Health NHS Trust (United Kingdom); Jaryl Ng, National Univ. of Singapore (Singapore); Stephen White, Manchester Metropolitan Univ. (United Kingdom); Thomas W. Johnson, Bristol Royal Infirmary (United Kingdom); Nicolas Foin, Dept of Biomedical Engineering (Singapore); Michael J. A. Girard, National Univ. of Singapore (Singapore); Jouke Dijkstra, Leiden Univ. Medical Ctr. (Netherlands); Rajiv Amersey, Dept. of Cardiology (United Kingdom); Simon Scoltock, Univ. of Bristol (United Kingdom); Sudheer Koganti, Citizens Specialty Hospital, Hyderabad (India); Daniel A. Jones, Chongying Jin, Dept. of Cardiology (United Kingdom); Lorenz Räber, Univ. Bern (Switzerland); Patrick W. Serruys, National Heart and Lung Institute (United Kingdom); Ryo Torii, Univ. College London (United Kingdom); Tom Crane, Dept. of Cardiology (United Kingdom); Roby D. Rakhit, The Royal Free Hospital (United Kingdom); Andreas Baumbach, Anthony Mathur, Christos V. Bourantas, Dept. of Cardiology (United Kingdom) . . . . . [11215-6]

Coffee Break . . . . . Sat 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . SAT 10:40 AM TO 12:00 PM

#### Optical Imaging Guided Therapy

Session Chair: **Kenton W. Gregory**,  
Oregon Medical Laser Ctr. (USA)

10:40 am: **Quantifying differences in cardiac tissue structure related to patient characteristics using an optical coherence tomography cardiac tissue atlas**, Theresa H. Lye, Darnel Theagene, Columbia Univ. (USA); Charles C. Marboe, Columbia Univ. Medical Ctr. (USA); Christine P. Hendon, Columbia Univ. (USA) . . . . . [11215-7]

11:00 am: **Polarization sensitive optical coherence tomography-guided percutaneous radiofrequency ablation in left atrium of living swine**, Xiaowei Zhao, Case Western Reserve Univ. (USA); Ohad Ziv, MetroHealth Medical Ctr. (USA); Reza Mohammadpour, Benjamin Crosby, Case Western Reserve Univ. (USA); Walter J. Hoyt, Kaushal Dosani, Univ. Hospitals Rainbow Babies & Children's Hospital (USA); Michael W. Jenkins, Case Western Reserve Univ. (USA); Christopher Snyder, Univ. Hospitals Rainbow Babies & Children's Hospital (USA); Kenneth R. Laurita, Andrew M. Rollins, Case Western Reserve Univ. (USA) . . . . . [11215-8]

11:20 am: **Segmentation of cardiac tissues on optical coherence tomography via convolutional neural networks**, Ziyi Huang, Columbia Univ. (USA); Yu Gan, The Univ. of Alabama (USA); Theresa H. Lye, Darnel Theagene, Simeran Virdi, Spandana Chintapalli, Andrew Laine, Columbia Univ. (USA); Elsa Angelini, Imperial College London (United Kingdom) and Columbia Univ. (USA); Christine P. Hendon, Columbia Univ. (USA) . . . . . [11215-9]

11:40 am: **Real-time fiber-bundle based multispectral imaging of cardiac tissue structure and monitoring of radiofrequency ablation therapy**, Soo Young Park, Rajinder P. Singh-Moon, Christine P. Hendon, Columbia Univ. (USA) . . . . . [11215-10]

Lunch/Exhibition Break . . . . . Sat 12:00 pm to 1:30 pm

### SESSION 3

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . SAT 1:30 PM TO 3:10 PM

#### Optical Spectroscopy

Session Chair: **Laura Marcu**, Univ. of California, Davis (USA)

1:30 pm: **Spatial frequency domain imaging of hemodynamic parameters in a murine model of hindlimb ischemia**, Katherine Leyba, Purdue Univ. (USA); Sandhya Vasudevan, Thomas O'Sullivan, Univ. of Notre Dame (USA); Craig Goergen, Purdue Univ. (USA) . . . . . [11215-11]

1:50 pm: **Analysis diffusion and glycation rate of artery in high concentration sugar condition via autofluorescence of advanced glycation end products**, Chih-Ju Lin, National Taiwan Univ. (Taiwan); Jeon Woong Kang, Laser Biomedical Research Ctr., Massachusetts Institute of Technology (USA); Peter T. C. So, Laser Biomedical Research Ctr., Massachusetts Institute of Technology (USA); Chen-Yuan Dong, National Taiwan Univ. (Taiwan) and Molecular Imaging Ctr., National Taiwan Univ. (Taiwan) . . . . . [11215-12]

2:10 pm: **Visualization and quantification of biochemical markers of atherosclerotic plaque progression using intravascular fluorescence lifetime**, Julien Bec, Univ. of California, Davis (USA); Deborah Vela, The Texas Heart Institute (USA); Jennifer E. Phipps, Michael Agung, Jakob Unger, Univ. of California, Davis (USA); Kenneth B. Margulies, Cardiovascular Institute, Perelman School of Medicine, Univ. of Pennsylvania (USA); Maximilian Buja, The Texas Heart Institute (USA); Laura Marcu, Univ. of California, Davis (USA) . . . . . [11215-13]

SUNDAY 2 FEBRUARY

SESSION 5

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . SUN 8:00 AM TO 10:10 AM

Blood and Oximetry

Session Chair: **Christine P. Hendon**, Columbia Univ. (USA)

8:00 am: **Optical sensing of haemostasis** (*Invited Paper*), Seemantini K. Nadkarni, Wellman Ctr. for Photomedicine (USA) . . . . . [11215-20]

8:30 am: **Surface-enhanced Raman spectroscopy of human platelets as a perspective tool for antiplatelet therapy effectiveness prediction**, Andrey Y. Zyubin, Vladimir Rafalskiy, Ekaterina Moiseeva, Anna Tcibulnikova, Karina Matveeva, Alina Tsapkova, Iliia Samusev, Valery Bryukhanov, Immanuel Kant Baltic Federal Univ. (Russian Federation) . . . . . [11215-21]

8:50 am: **Monitoring of platelets function using the laser speckle aggregometry**, Diane M. Tshikudi, Asael Papour, John Barranco, Matthew Applegate, Seemantini K. Nadkarni, Massachusetts General Hospital (USA) . . . . . [11215-22]

9:10 am: **Non-invasive estimation of arterial and venous oxygen saturation using ultra-fast frequency-domain oximetry (UFO)**, Raef Istfan, Matthew Applegate, Carlos Gomez, Ashvin Pande, Darren Roblyer, Boston Univ. (USA) . . . . . [11215-23]

9:30 am: **Probing renal ischemia reperfusion-induced cardiac hypertrophy by a Raman spectroscopy**, Gabrielle L. J. T. Nepomuceno, Marcela Carneiro-Ramos, Herculano S. da Silva Martinho, Univ. Federal do ABC (Brazil) . . . . . [11215-24]

9:50 am: **Optical spectroscopy to assess muscle oxygenation in infants undergoing extracorporeal life support**, Kenneth A. Schenkman, Univ. of Washington (USA); Andrew D. Mesher, Univ. of Colorado Denver (USA); D. Michael McMullan, Wayne A. Ciesielski, Faith J. Ross, Lorilee S. L. Arakaki, Univ. of Washington (USA) . . . . . [11215-25]

Coffee Break. . . . . Sun 10:10 am to 10:40 am

SESSION 6

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . SUN 10:40 AM TO 12:00 PM

Microscopy

Session Chair: **Stanislav Y. Emelianov**, Georgia Tech Research Institute (USA)

10:40 am: **Live imaging and manipulation of cardiodynamics in mouse embryos** (*Invited Paper*), Irina V. Larina, Baylor College of Medicine (USA) . . . . . [11215-28]

11:00 am: **Analysis of coronary microvasculature and myocardial nuclei orientation in embryonic hearts**, Maryse Lapiere-Landry, Case Western Reserve Univ. (USA); Hana Kolesova, Charles Univ. (Czech Republic); Yehe Liu, Michiko Watanabe, Michael W. Jenkins, Case Western Reserve Univ. (USA) . . . . . [11215-29]

11:20 am: **Deep tissue contractility sensing with bio-integrated micro- and nanolaser**, Marcel Schubert, Univ. of St. Andrews (United Kingdom); Lewis Woolfson, Isla R. M. Barnard, Amy Dorward, Becky Casement, Andrew Morton, Gavin B. Robertson, Gareth B. Miles, Samantha J. Pitt, Univ. of St. Andrews (United Kingdom); Carl S. Tucker, The Univ. of Edinburgh (United Kingdom); Malte C. Gather, Univ. of St. Andrews (United Kingdom) . . [11215-30]

11:40 am: **Development of a polarized hyperspectral microscope for cardiac fiber orientation imaging**, Ximing Zhou, James D. Dormer, The Univ. of Texas at Dallas (USA); Baowei Fei, The Univ. of Texas at Dallas (USA) and The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA) . . . . . [11215-31]

BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**  
THE 2020 RECIPIENT

**Nirmala Ramanujam**,  
Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**  
**Spying on the Secret Lives of Cells**  
**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

2:30 pm: **NIRF-IVUS molecular-structural intravascular imaging of coronary arteries using a miniaturized catheter**, Stephan Kellnberger, Mazen Albaghdadi, Wenzhuo Li, Adam Mauskapf, Vasilis Ntziachristos, Farouc A. Jaffer, Massachusetts General Hospital (USA) . . . . . [11215-14]

2:50 pm: **Rapid optical spectroscopic quantification and mapping of human epicardial adipose tissue and lesion deposition**, Rajinder P. Singh-Moon, Diego Song Cho, Columbia Univ. (USA); Agastya Vaidya, Emory Univ. (USA); Charles C. Marboe, Elaine Y. Wan, Columbia Univ. Medical Ctr. (USA); Christine P. Hendon, Columbia Univ. (USA) . . . . . [11215-15]

Coffee Break. . . . . Sat 3:10 pm to 3:40 pm

SESSION 4

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . SAT 3:40 PM TO 5:00 PM

New Techniques and Methods

Session Chair: **Gijs van Soest**, Erasmus Univ. Rotterdam (Netherlands)

3:40 pm: **Novel broadband freeform micro-optics for multimodal FLIm-OCT intravascular catheter**, Julien Bec, Cai Li, Laura Marcu, Univ. of California, Davis (USA) . . . . . [11215-16]

4:00 pm: **FLIm guided Raman imaging for detecting bovine pericardium cross-links and calcification**, Tanveer Ahmed Shaik, Leibniz-Institut für Photonische Technologien e.V. (Germany); Alba Alfonso García, Xiangnan Zhou, Anne K. Haudenschild, Univ. of California, Davis (USA); Christoph Krafft, Leibniz-Institut für Photonische Technologien e.V. (Germany); Laura Marcu, Univ. of California, Davis (USA); Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany) . . . . . [11215-17]

4:20 pm: **Biomechanical analysis of the embryonic mouse heart by optogenetic control**, Andrew L. Lopez III, Shang Wang, Irina V. Larina, Baylor College of Medicine (USA) . . . . . [11215-18]

4:40 pm: **Design and assembly of InGaN LED matrix illumination scheme for ex-vivo optogenetics cardiac tissue pacing**, Ida Izadi, Abdulaziz Takrouni, Noreen Nudds, Kamil Gradkowski, Peter O'Brien, Brian Corbett, Tyndall National Institute (Ireland) . . . . . [11215-19]

BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

# CONFERENCE 11216

LOCATION: ROOM 202 (LEVEL 2 SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11216

## Multiscale Imaging and Spectroscopy

Conference Chairs: **Paul J. Campagnola**, Univ. of Wisconsin-Madison (USA); **Kristen C. Maitland**, Texas A&M Univ. (USA); **Darren M. Roblyer**, Boston Univ. (USA)

Program Committee: **Ji-Xin Cheng**, Boston Univ. (USA); **Kevin W. Eliceiri**, Univ. of Wisconsin-Madison (USA); **Irene Georgakoudi**, Tufts Univ. (USA); **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA); **Andrew M. Rollins**, Case Western Reserve Univ. (USA); **Melissa C. Skala**, Univ. of Wisconsin-Madison (USA); **Alex J. Walsh**, Texas A&M Univ. (USA)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... SAT 10:30 AM TO 12:00 PM

##### Nano-Based Imaging

Session Chair: **Darren M. Roblyer**, Boston Univ. (USA)

10:30 am: **Macro and microscopic imaging of multispectral rare-earth nanocomposites in small animal models of cancer** (*Invited Paper*), Mark C. Pierce, Vidya Ganapathy, Carolina Bobadilla-Mendez, Jay V. Shah, Amber Gonda, Rutgers, The State Univ. of New Jersey (USA); Mei Chee Tan, Singapore Univ. of Technology and Design (Singapore); Richard E. Riman, Prabhas V. Moghe, Rutgers, The State Univ. of New Jersey (USA) . . . . [11216-1]

11:00 am: **Multispectral nanoparticle tracking analysis for the real-time characterization of amyloid- $\beta$  self assembly in vitro**, Colman Moore, Ryan Wing, Jesse V. Jokerst, Univ. of California, San Diego (USA) . . . . [11216-2]

11:20 am: **Single-cell to whole-organ imaging of PSMA over-expressing prostate tumor with functionalized NIR-II semiconducting polymer nanoparticles**, Jiayingzi Wu, Boston Univ. (USA) and Purdue Univ. (USA); Ji-Xin Cheng, Boston Univ. (USA); Jianguo Mei, Purdue Univ. (USA); Hyeon Jeong Lee, Boston Univ. (USA); Liyan You, Xuyi Luo, Purdue Univ. (USA); Kai-Chih Huang, Peng Lin, Boston Univ. (USA) . . . . [11216-3]

11:40 am: **Optical spectroscopic and imaging biomarkers of ulcerative colitis disease progression and remission**, Ariel I. Mundo, Elizabeth Bullard, Kyle P. Quinn, Timothy J. Muldoon, Univ. of Arkansas (USA) . . . . [11216-4]

Lunch/Exhibition Break . . . . . Sat 12:00 pm to 1:30 pm

#### SESSION 2

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... SAT 1:30 PM TO 3:20 PM

##### Bridging Spatial Scales: From Nano to Micro to Meso Scale Imaging

Session Chair: **Paul J. Campagnola**, Univ. of Wisconsin-Madison (USA)

1:30 pm: **An OCT-based toolkit for measuring intracellular dynamics and tissue structure from the nano- to meso-scale in 3D mammary spheroid models** (*Invited Paper*), Amy L. Oldenburg, Lin Yang, The Univ. of North Carolina at Chapel Hill (USA); Joseph B. Tracy, North Carolina State Univ. (USA); Melissa A. Troester, The Univ. of North Carolina at Chapel Hill (USA); Richard L. Blackmon, Elon Univ. (USA) . . . . [11216-5]

2:00 pm: **Imaging cellular dynamics by micro-optical coherence tomography**, Hui Min Leung, Michelle Wang, Hany Osman, Massachusetts General Hospital (USA); Devon Michael Thompson, Oliver H. Jonas, Brigham and Women's Hospital (USA); Guillermo J. Tearney, Massachusetts General Hospital (USA) . . . . [11216-6]

2:20 pm: **A compact time-resolved emission spectroscopy system based on a high-throughput common-path interferometer with high temporal and spectral resolution**, Antonio Perri, Fabrizio Preda, Giulio N. Cerullo, Dario Polli, Politecnico di Milano (Italy) . . . . [11216-7]

2:40 pm: **Combined optical coherence tomography and single-fiber reflectance spectroscopy in a rotating catheter probe**, Xavier Attundu, Polytechnique Montréal (Canada); Abel Swaan, Daniel M. de Bruin, Dirk J. Faber, Amsterdam UMC (Netherlands); Caroline Boudoux, Polytechnique Montréal (Canada); Ton G. van Leeuwen, Amsterdam UMC (Netherlands) . . . . [11216-8]

3:00 pm: **Assessing changes of collagen fiber organization and cellular metabolism during the onset of osteoarthritis by non-invasive, label-free imaging**, Zhiyi Liu, Carrie Hui Mingalona, Yang Zhang, Li Zeng, Irene Georgakoudi, Tufts Univ. (USA) . . . . [11216-9]

Coffee Break . . . . . Sat 3:20 pm to 3:50 pm

#### SESSION 3

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... SAT 3:50 PM TO 5:50 PM

##### Omniscale Imaging

Session Chair: **Kristen C. Maitland**, Texas A&M Univ. (USA)

3:50 pm: **Omniscale photoacoustic tomography from organelles to patients** (*Invited Paper*), Lihong V. Wang, Caltech (USA) . . . . [11216-10]

4:20 pm: **Next generation clinical applications of open-top light-sheet microscopy** (*Invited Paper*), Adam K. Glaser, Univ. of Washington (USA); Nicholas P. Reeder, LightSpeed Microscopy, Inc. (USA); Lawrence D. True, Jonathan T. C. Liu, Univ. of Washington (USA) . . . . [11216-11]

4:50 pm: **Nonlinear optical microscopy of lipogenesis and metabolism in HER2+ breast cancer**, Sean Fitzgerald, Giju Thomas, Anita Mahadevan-Jansen, Vanderbilt Univ. (USA) . . . . [11216-12]

5:10 pm: **In vivo confocal high-resolution imaging of bladder lesions in conjunction with cystoscopy**, Yubo Tang, Alex Kortum, Imran S. Vohra, Jennifer L. Carns, Richard A. Schwarz, Rice Univ. (USA); Nadeem Dhanani, The Univ. of Texas Health Science Ctr. at Houston (USA); Rebecca R. Richards-Kortum, Rice Univ. (USA) . . . . [11216-13]

5:30 pm: **Silicon photomultipliers as a replacement for GaAsP and GaAs PMTs in high speed fluorescence imaging**, Michael G. Giacomelli, Univ. of Rochester (USA) . . . . [11216-14]

#### BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**

*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**

**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**

**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**

**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**

**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**

**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**

**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**

**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**

**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**

**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**

**Keisuke Goda**, Univ. of Tokyo (Japan)

SUNDAY 2 FEBRUARY

SESSION 4

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... SUN 10:10 AM TO 12:00 PM

**Imaging and Spectroscopy through Time and Space: Longitudinal Studies**

Session Chair: **Darren M. Roblyer**, Boston Univ. (USA)

10:10 am: **Non-invasive intracranial pressure monitoring and neurovascular coupling assessment in the context of brain injury** (*Invited Paper*), Jana M. Kainerstorfer, Carnegie Mellon Univ. (USA) ..... [11216-15]

10:40 am: **Key features in the optical properties of tissue during and after radiofrequency ablation**, Francis Kalloor Joseph, Univ. of Twente (Netherlands); Pranav Lanka, Politecnico di Milano (Italy); Hindrik Kruit, Univ. of Twente (Netherlands); Sanathana Konugolu Venkata Sekar, Andrea Farina, Rinaldo Cubeddu, Politecnico di Milano (Italy); Srirang Manohar, Univ. of Twente (Netherlands); Antonio Pifferi, Politecnico di Milano (Italy) ... [11216-16]

11:00 am: **Development of DRS-DCS system for measurement of oxygenation change in a rat model under anesthesia state**, Yoonho Oh, Gwangju Institute of Science and Technology (Korea, Republic of); Myeongsu Seong, Shanghai Jiao Tong Univ. (China); Sungchul Kim, Seonghyun Kim, Jae Gwan Kim, Gwangju Institute of Science and Technology (Korea, Republic of) ..... [11216-17]

11:20 am: **High optode-density wearable probe for monitoring breast tumor hemodynamics: normal volunteer and initial clinical results**, Samuel Spink, Fei Teng, Vivian E. Pera, Hannah M. Peterson, Boston Univ. (USA); Adam T. Eggebrecht, Washington Univ. School of Medicine in St. Louis (USA); Naomi Yu Ko, Boston Medical Ctr. (USA); Darren M. Roblyer, Boston Univ. (USA) ..... [11216-18]

11:40 am: **Separating scalp and brain layer hemodynamics on a single channel diffuse optical spectroscopy**, Sungchul Kim, Jae Gwan Kim, Gwangju Institute of Science and Technology (Korea, Republic of) .. [11216-19]

Lunch/Exhibition Break ..... Sun 12:00 pm to 1:30 pm

SESSION 5

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... SUN 1:30 PM TO 3:20 PM

**Multiscale Imaging in Oncology**

Session Chair: **Paul J. Campagnola**, Univ. of Wisconsin-Madison (USA)

1:30 pm: **Fluorescence lifetime techniques in oncology** (*Invited Paper*), Laura Marcu, Univ. of California, Davis (USA) ..... [11216-20]

2:00 pm: **Electron transport chain protein knockouts induce changes in the autofluorescence of NAD(P)H and FAD**, Amani A. Gillette, Univ. of Wisconsin-Madison (USA); Jarred Rensvold, Morgridge Institute for Research (USA); Peter F. Favreau, Ava VanDommelen, Univ. of Wisconsin-Madison (USA); David Pagliarini, Melissa C. Skala, Morgridge Institute for Research (USA) and Univ. of Wisconsin-Madison (USA) ..... [11216-21]

2:20 pm: **Spatial frequency domain imaging (SFDI) can identify treatment response earlier and with higher accuracy than tumor volume changes in a preclinical subcutaneous tumor model**, Syeda M. Tabassum, Fay Wang, David J. Waxman, Darren M. Roblyer, Boston Univ. (USA) ..... [11216-22]

2:40 pm: **Label-free Raman spectroscopy to study radiation-induced biomolecular changes in animal model of head and neck cancer**, Sina Dadgar, Joel Rodríguez Troncoso, April F. Jules, Austin R. Dotson, Narasimhan Rajaram, Univ. of Arkansas (USA) ..... [11216-23]

3:00 pm: **Heterogeneity of organelle morphology in 2D cell culture and 3D bioprinted breast tumor systems**, Ling Wang, Jamie Ward, Megan Boueya, Kate Tubbesing, Albany Medical College (USA); Cassie Roberge, David T. Corr, Rensselaer Polytechnic Institute (USA); Margarida Barroso, Albany Medical College (USA) ..... [11216-24]

Coffee Break ..... Sun 3:20 pm to 3:50 pm

SESSION 6

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... SUN 3:50 PM TO 5:40 PM

**Emerging Sources of Multiscale Imaging Contrast**

Session Chair: **Kristen C. Maitland**, Texas A&M Univ. (USA)

3:50 pm: **Cherenkov imaging to quantify radiation dose in human tissue** (*Invited Paper*), Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) ..... [11216-25]

4:20 pm: **Hyperspectral shortwave infrared spatial frequency domain imaging for the extraction of water, lipids, and collagen concentrations in tissue and blood**, Anahita Pilvar, Boston Univ. (USA); Yanyu Zhao, Caltech (USA); Matthew B. Applegate, Samuel Spink, Boston Univ. (USA); Mark C. Pierce, Rutgers, The State Univ. of New Jersey (USA); Darren M. Roblyer, Boston Univ. (USA) ..... [11216-26]

4:40 pm: **Investigation of a high-resolution optical inspection system for fabricated metallic nanostructures using structured illuminations**, Taerim Yoon, Heesang Ahn, Taeyeon Kim, Pusan National Univ. (Korea, Republic of); Jong-ryul Choi, Daegu-Gyeongbuk Medical Innovation Foundation (Korea, Republic of); Kyujung Kim, Pusan National Univ. (Korea, Republic of) ..... [11216-27]

5:00 pm: **Estimating receptor availability in altered tumor vasculature using MRI-coupled paired-agent fluorescence tomography**, Boyu Meng, Rendall R. Strawbridge, Kimberley S. Samko, Dartmouth College (USA); Negar Sadeghipour, Kenneth M. Tichauer, Illinois Institute of Technology (USA); Scott C. Davis, Dartmouth College (USA) ..... [11216-28]

5:20 pm: **Advances in two-dimensional spatial frequency modulation imaging (SPIFI)**, Alyssa Allende Motz, Colorado School of Mines (USA); Randy A. Bartels, Colorado State Univ. (USA); John Czerski, Colorado School of Mines (USA); Jeffrey J. Field, Colorado State Univ. (USA); Daniel Scarbrough, Colorado School of Mines (USA); Patrick A. Stockton, Colorado State Univ. (USA); Jeffrey A. Squier, Colorado School of Mines (USA); Keith A. Wernsing, Colorado State Univ. (USA) ..... [11216-29]

POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

Poster Setup: Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Optical simulations for determining efficacy of new light source designs for excitation-scanning high-speed hyperspectral imaging systems**, Craig M. Browning, Joshua Deal, Samantha Gunn Mayes, Marina Parker, Thomas C. Rich, Silas J. Leavesley, Univ. of South Alabama (USA) .. [11216-30]

**Optical coherence microscopy using topography mapping**, Kibeom Park, Yujin Ahn, Jung Kweon Bae, Gahyang Lee, Myung-Ju Kim, Woonggyu Jung, Ulsan National Institute of Science and Technology (Korea, Republic of) ..... [11216-31]

**Automatic time gating for time-domain diffuse correlation spectroscopy**, Akhil Goel, MIT Lincoln Lab. (USA) and Georgia Institute of Technology (USA); Lorenzo C. Vigano, Massachusetts Institute of Technology (USA); Mitchell B. Robinson, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) and Harvard-MIT Health Sciences and Technology (USA); Stefan A. Carp, Maria A. Franceschini, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Megan H. Blackwell, MIT Lincoln Lab. (USA) ..... [11216-32]

**Multimodal and multiscale visualization of cancerous tissue using coherence gating optical imaging and computed tomography**, Myung-Ju Kim, Kibeom Park, Yujin Ahn, Ga Hyang Lee, Soo-Ah Park, Ulsan National Institute of Science and Technology (Korea, Republic of); Jin Seok Kang, Namseoul Univ. (Korea, Republic of); Woonggyu Jung, Ulsan National Institute of Science and Technology (Korea, Republic of) ..... [11216-33]

**Femtosecond third-order sum frequency and four-wave mixing imaging**, Evan P. Perillo, NanoString Technologies, Inc (USA); Mary E. Phipps, Los Alamos National Lab. (USA); Jennifer Martinez, Northern Arizona Univ. (USA); Anatoly Efimov, Los Alamos National Lab. (USA) ..... [11216-34]

**Dynamic range enhancement for diffuse optical spectroscopy in breast scanning applications**, Mi Zhou, Zhi Yih Lim, Farid Golnaraghi, Majid Shokoufi, Simon Fraser Univ. (Canada) ..... [11216-35]

BIOS

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# CONFERENCE 11216

**Evaluating multimodal imaging to perform chemical risk assessment in rodent models**, Björn-Ole Meyer, Dominik Marti, Technical Univ. of Denmark (Denmark); Hanna K. L. Johansson, Julie Boberg, National Food Institute, Technical Univ. of Denmark (Denmark); Peter E. Andersen, Technical Univ. of Denmark (Denmark) ..... [11216-36]

**Differentiating prostate cancer cell lines with different metastatic abilities using native fluorescence spectroscopy and machine learning methods**, Jianpeng Xue, China Pharmaceutical Univ. (China); Yang Pu, MicroPhotoAcoustics, Inc. (USA); Jason T. Smith, Southern Connecticut State Univ. (USA) and Rensselaer Polytechnic Institute (USA); Xin Gao, LaGuardia Community College (USA); Binlin Wu, Southern Connecticut State Univ. (USA) ..... [11216-37]

**Characteristic of five subpopulation leukocytes in single-cell levels based on Raman spectroscopy**, Wenxue Li, Yixin Dai, Sichuan Univ. (China); Liu Wang, Chuan Luo, Qing Huang, Army Medical Univ. (China); Lin Pang, Sichuan Univ. (China) ..... [11216-38]

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## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells

**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

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## BiOS Expo Industry Stage

Saturday – Sunday • Hall DE

Keynotes and panels on the latest developments, open to all attendees.

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# CONFERENCE 11217

LOCATION: ROOM 205 (LEVEL 2 SOUTH)

Sunday 2 February 2020 • Proceedings of SPIE Vol. 11217

## Lasers in Dentistry XXVI

Conference Chairs: **Peter Rechmann**, Univ. of California, San Francisco (USA); **Daniel Fried**, Univ. of California, San Francisco (USA)

Program Committee: **Gregory B. Altshuler**, IPG Medical Corp. (USA); **Tatjana Dostálová**, Charles Univ. in Prague (Czech Republic); **Thomas Ertl**, Univ. Stuttgart (Germany); **David M. Harris**, Bio-Medical Consultants, Inc. (USA); **Jörg Meister**, Universitätsklinikum Bonn (Germany); **Eric J. Seibel**, Univ. of Washington (USA)

### SUNDAY 2 FEBRUARY

#### SESSION 1

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... SUN 9:00 AM TO 10:20 AM

#### Laser in Erosion Reduction, Thermal Imaging of Dental Materials, Bleaching and Plaque pH Measurement

Session Chair: **Peter Rechmann**, Univ. of California, San Francisco (USA)

9:00 am: **CO<sub>2</sub>-9.3 μm short-pulsed laser irradiation for reduction of enamel erosion**, Peter Rechmann, Univ. of California, San Francisco (USA); Camila V. Silva, Tais F. Mantilla, Yael Engel, Juliane P. Tavares, Patricia M. Freitas, Univ. de São Paulo (Brazil) ..... [11217-1]

9:20 am: **Assessment of thermal changes in different restorative materials using a thermal camera**, Turki A. Bakhsh, King Abdulaziz Univ. (Saudi Arabia) ..... [11217-2]

9:40 am: **Diode activated home bleaching techniques with stereolithographic models and trays**, Tatjana Dostálová, Charles Univ. (Czech Republic); Helena Jelínková, Jan Šulc, Michal Němec, Martin Fibrich, Adam Riha, Miroslav Čech, Czech Technical Univ. in Prague (Czech Republic) ..... [11217-3]

10:00 am: **Non-contact and rapid plaque pH measurement using a multimodal scanning fiber endoscope**, Lauren K. Lee, Manuja Sharma, Matthew D. Carson, Mark E. Fauver, Eric J. Seibel, Univ. of Washington (USA) ..... [11217-4]

Coffee Break ..... Sun 10:20 am to 10:50 am

#### SESSION 2

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... SUN 10:50 AM TO 11:50 AM

#### Laser in Acid Resistance, OCT and Adaption of Restorations, Caries Detection and its Validation and Imaging

Session Chair: **Daniel Fried**, Univ. of California, San Francisco (USA)

10:50 am: **Optical coherence omography (OCT) and field emission scanning electron microscope (Fe-SEM) for the evaluation of marginal and internal adaptation of resin restorations on healthy and caries-simulated dentin**, Marwa Abdelaziz, Univ. de Genève (Switzerland); Andrés F. Zuluaga, AXSUN Technologies Inc. (USA); Francisco Betancourt, Univ. de Genève (Switzerland); Daniel Fried, Univ. of California, San Francisco (USA); Ivo Krejci, Tissiana Bortolotto, Univ. de Genève (Switzerland) ..... [11217-6]

11:10 am: **Depolarization imaging for caries detection validated by co-registered PS-OCT and μCT volumes**, Jonas Golde, Florian Tetschke, TU Dresden (Germany); Robin Vosahlo, Universitätsklinikum Carl Gustav Carus Dresden (Germany); Julia Walther, TU Dresden (Germany); Christian Hannig, Universitätsklinikum Carl Gustav Carus Dresden (Germany); Edmund Koch, Lars Kirsten, TU Dresden (Germany) ..... [11217-7]

11:30 am: **Near-IR, thermal and CP-OCT imaging probes for the in vivo assessment of the activity of root caries lesions**, Nai-Yuan N. Chang, Yihua Zhu, Donald A. Curtis, Jacob C. Simon, Oanh Le, Vincent Yang, William A. Fried, Prajna Banan, Cynthia L. Darling, Daniel Fried, Univ. of California, San Francisco (USA) ..... [11217-8]

Lunch Break ..... Sun 11:50 am to 2:00 pm

#### SESSION 3

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... SUN 2:00 PM TO 3:20 PM

#### LLT and Periodontal Ligament, PS-OCT in Oral Tissues with Precancerous and Cancerous Lesions

Session Chair: **Peter Rechmann**, Univ. of California, San Francisco (USA)

2:00 pm: **Evaluation of low level laser therapy, platelet rich plasma and their combination on the proliferation rate of human periodontal ligament fibroblast: an in vitro study**, Shelly Ahuja, Geetanjali Univ. (India); Pankaj Madhukar, Manav Rachna Dental College (India); Kishore Bhatt, Maratha Mandal Dental College (India) ..... [11217-9]

2:20 pm: **Effects of oral tissue preservation on polarization contrast measured with PS-OCT**, Karol Karnowski, Institute of Physical Chemistry PAS (Poland); Qingyun Li, Anima Poudyal, Camile S. Farah, The Univ. of Western Australia (Australia); David D. Sampson, Univ. of Surrey (United Kingdom) ..... [11217-10]

2:40 pm: **A-scan spectral intensity profile in OCT as a potential imaging biomarker of oral precancerous and cancerous tissues**, Prashanth Panta, Pawan Kumar, Renu John, Indian Institute of Technology Hyderabad (India) ..... [11217-11]

3:00 pm: **Multiscale imaging of the ex vivo oral precancerous lesions with a custom developed swept-source optical coherence tomography/microscopy platform and a 1.7 μm wavelength-swept laser**, Chuan-Bor Chueh, Ching-Yu Wang, Ting-Yen Tsai, Yin-Peng Huang, Teng-Chieh Chang, Ting-Hao Chen, You-Nan Tsai, Yi-Ping Hung, Hsiang-Chieh Lee, National Taiwan Univ. (Taiwan) ..... [11217-12]

#### POSTERS-SUNDAY

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Poster Setup: Sunday 10:00 AM – 4:30 PM

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**Depolarization imaging of suspect pits and fissures based on polarization-sensitive optical coherence tomography**, Florian Tetschke, Jonas Golde, Robin Vosahlo, Julia Walther, Lars Kirsten, Edmund Koch, Christian Hannig, TU Dresden (Germany) ..... [11217-13]

**Classification of pit and fissure for caries risk based on 3D surface morphology analysis of tooth**, Qingguang Chen, Xing Jin, Hangzhou Dianzi Univ. (China); Haihua Zhu, Zhejiang Univ. (China); Hassan S. Salehi, California State Univ., Chico (USA) ..... [11217-14]

**Quantitative assessment technique of dentine using FLIM**, Roaa Abuljadayel, King Abdulaziz Univ. (Saudi Arabia) ..... [11217-15]

**Deep neural networks improve classification and diagnosis of dental caries using optical coherence tomography**, Hassan S. Salehi, California State Univ., Chico (USA); Mohammad M. Murshid, Top Flight Technologies (USA); Mina Mahdian, Stony Brook Medicine (USA) ..... [11217-16]

**A thermal imaging handpiece for the clinical assessment of lesion activity on root surfaces via dehydration: preclinical Assessment**, Vicent Yang, Nai-Yuan Chang, Daniel Fried, Univ. of California, San Francisco (USA) ..... [11217-17]

**A near-IR imaging handpiece for the clinical assessment of lesion activity on coronal and root surfaces via dehydration: preclinical assessment**, William Fried, Vincent Yang, Nai-Yuan Chang, Daniel Fried, Univ. of California, San Francisco (USA) ..... [11217-18]

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# CONFERENCE 11217

**A comparison of dual SWIR transillumination/reflectance and microCT images of occlusal and approximal lesions on extracted teeth**, Yihua Zhu, Nai-Yuan Chang, Vincent Yang, William Fried, Daniel Fried, Univ. of California, San Francisco (USA) ..... [11217-19]

**In vivo spectral guided removal of composite from tooth surfaces with a CO2 laser**, Jacob Simon, Jye Hye Choi, Andrew Jang, Daniel Fried, Univ. of California, San Francisco (USA). ..... [11217-20]

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## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

#### **Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

#### **Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

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# CONFERENCE 11218

LOCATION: ROOM 303 (LEVEL 3 SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11218

## Ophthalmic Technologies XXX

Conference Chairs: **Fabrice Manns**, Univ. of Miami (USA); **Arthur Ho**, Brien Holden Vision Institute (Australia); **Per G. Söderberg**, Uppsala Univ. (Sweden)

Program Committee: **Rafat R. Ansari**, NASA Glenn Research Ctr. (USA); **Michael Belkin**, Tel Aviv Univ. (Israel); **Kostadinka Bizheva**, Univ. of Waterloo (Canada); **David Borja**, Alcon Labs., Inc. (USA); **Ralf Brinkmann**, Univ. zu Lübeck (Germany); **Wolfgang Drexler**, Medizinische Univ. Wien (Austria); **Sina Farsiu**, Duke Univ. (USA); **Daniel X. Hammer**, U.S. Food and Drug Administration (USA); **Karen M. Joos**, Vanderbilt Univ. (USA); **Kirill V. Larin**, Univ. of Houston (USA); **Ezra Maguen**, American Eye Institute (USA); **Donald T. Miller**, Indiana Univ. (USA); **Derek Nankivil**, Johnson & Johnson Vision Care, Inc. (USA); **Daniel V. Palanker**, Stanford Univ. (USA); **Jean-Marie Parel**, Bascom Palmer Eye Institute (USA); **Roberto Pini**, Istituto di Fisica Applicata Nello Carrara (Italy); **Ygal Rotenstreich**, The Chaim Sheba Medical Ctr., Tel Hashomer (Israel); **Luigi Rovati**, Univ. degli Studi di Modena e Reggio Emilia (Italy); **Marco Ruggeri**, Bascom Palmer Eye Institute (USA); **Georg Schuele**, OptiMedica Corp. (USA); **Jerry Sebag**, VMRI Institute (USA); **Peter Soliz**, VisionQuest Biomedical, LLC (USA); **Yuankai K. Tao**, Vanderbilt Univ. (USA); **Valery V. Tuchin**, Saratov State Univ. (Russian Federation), Tomsk State Univ. (Russian Federation), Institute of Precision Mechanics and Control of the RAS (Russian Federation); **Robert J. Zawadzki**, Univ. of California, Davis (USA)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SAT 8:15 AM TO 10:00 AM

#### Imaging, Surgery, and Therapy: New Technologies I

Session Chairs: **Robert J. Zawadzki**, Univ. of California, Davis (USA); **Georg Schuele**, Johnson & Johnson Vision (USA)

8:15 am: **Ultrafast, precise and robust human eye motion detection with a novel MEMS-based retinal tracker**, Maciej M. Bartuzel, Nicolaus Copernicus Univ. (Poland); Michal Meina, Maciej Nowakowski, AM2M Sp. z.o.o. sp. k. (Poland); Krystian Wrobel, Szymon Tamborski, Nicolaus Copernicus Univ. (Poland); Krzysztof Dalasi?ski, Anna Szkulmowska, AM2M Sp. z.o.o. sp. k. (Poland); Maciej Szkulmowski, Nicolaus Copernicus Univ. (Poland) . . . [11218-1]

8:30 am: **Feasibility of oblique scanning laser ophthalmoscope (oSLO) on a human eye model**, Wenjun Shao, Boston Univ. (USA) . . . . . [11218-2]

8:45 am: **Motion-free optical coherence tomography imaging of retinal disease using Lissajous scanning pattern**, Shuichi Makita, Univ. of Tsukuba (Japan); Masahiro Miura, Ibaraki Medical Ctr., Tokyo Medical Univ. (Japan); Toshihiro Mino, Topcon Corp. (Japan); Shinnosuke Azuma, Univ. of Tsukuba (Japan) and Topcon Corp. (Japan); Tatsuo Yamaguchi, Topcon Corp. (Japan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan) . . . . . [11218-3]

9:00 am: **In-vivo quantification of the nerve fiber layer with transscleral optical phase imaging**, Timothé Laforest, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Mathieu Künzi, EarlySight SA (Switzerland); Florentino Caetano Dos Santos, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Laura Kowalczyk, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and Hôpital ophtalmique Jules-Gonin, Univ. de Lausanne (Switzerland); Irmela Mantel, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Francine Behar-Cohen, INSERM (France); Christophe Moser, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11218-4]

9:15 am: **Holographic display for optical retinal prosthesis: design and validation**, Shani Rosen, Moshe Gur, Technion-Israel Institute of Technology (Israel); Shy Shoham, NYU Langone Health (USA) . . . . . [11218-5]

9:30 am: **Photoablation of human vitreous opacities by light-induced vapor nanobubbles**, Félix Sauvage, Juan C. Fraire, Katrien Remaut, Univ. Gent (Belgium); Jerry Sebag, VMRI Institute (USA); Karen Peynshaert, Univ. Gent (Belgium); Frans J. Van de Velde, Schepens Eye Institute (USA); Ranhua Xiong, Univ. Gent (Belgium); Marie-José Tassignon, Univ. Ziekenhuis Antwerpen (Belgium); Toon Brans, Kevin Braeckmans, Stefaan C. De Smedt, Univ. Gent (Belgium) . . . . . [11218-6]

9:45 am: **Real-time temperature controlled retinal laser therapies**, Ralf Brinkmann, Medizinisches Laserzentrum Lübeck GmbH (Germany) . . . . . [11218-7]

Coffee Break . . . . . Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SAT 10:30 AM TO 11:30 AM

#### Angiography and Blood Flow

Session Chair: **Yuankai Kenny K. Tao**, Vanderbilt Univ. (USA)

10:30 am: **Automated choroidal neovascularization diagnosis and quantification using convolutional neural networks in OCT angiography**, Jie Wang, Tristan Hormel, Liqin Gao, Pengxiao Zang, Yukun Guo, Steven T. Bailey, Yali Jia, Oregon Health & Science Univ. (USA) . . . . [11218-51]

10:45 am: **Visible light optical coherence tomography angiography (vis-OCTA) in human retina for small vessel blood oxygenation**, Weiye Song, Boston Univ. (USA); Steven Ness, Manishi Desai, Boston Medical Ctr. (USA); Ji Yi, Boston Univ. (USA) . . . . . [11218-9]

11:00 am: **Non-invasive optical measurement of hemoglobin concentration in human retinal vessels**, Johannes Kübler, Vrije Univ. Amsterdam (Netherlands) and Heidelberg Engineering GmbH (Germany); Mathi Damodaran, Vrije Univ. Amsterdam (Netherlands) and Philips Research (Netherlands); Arjen Amelink, TNO (Netherlands); Johannes F. de Boer, Vrije Univ. Amsterdam (Netherlands) . . . . . [11218-10]

11:15 am: **Clinical trial of retinal and choroidal angiography by laser Doppler holography**, Michael Atlan, Leo Puyo, Institut Langevin Ondes et Images (France); Michel Paques, José-Alain Sahel, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France); Mathias Fink, Institut Langevin Ondes et Images (France) . . . . . [11218-11]

#### PASCAL ROL LECTURE

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... 11:30 AM TO 12:15 PM

Session Chair: **Per G. Söderberg**, Uppsala Univ. (Sweden)

11:30 am: **Achievements and need for technologies to advance retinal disease management in children and image-guided retinal surgery (Invited Paper)**, Cynthia A. Toth, Duke Univ. Medical Ctr. (USA) . . . . [11218-12]

Lunch/Exhibition Break . . . . . Sat 12:15 pm to 1:45 pm

# CONFERENCE 11218

## SESSION 3

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SAT 1:45 PM TO 3:30 PM

### Ophthalmic Imaging and Diagnosis: Clinical

Session Chair: **Marco Ruggeri**, Bascom Palmer Eye Institute (USA)

1:45 pm: **Clinical Megahertz-OCT for ophthalmic applications**, Michael Niederleithner, Anja Britten, Laurin Ginner, Matthias Salas, Medizinische Univ. Wien (Austria); Hugang Ren, Muzammil A. Arain, Rick A. Williams, Carl Zeiss Meditec, Inc. (USA); Wolfgang Drexler, Rainer A. Leitgeb, Medizinische Univ. Wien (Austria); Tilman Schroll, Carl Zeiss Meditec, Inc. (USA) ..... [11218-13]

2:00 pm: **360 degree reconstruction of Schlemm's Canal using swept-source OCT at 1060 nm**, Xinwen Yao, Kavya Devarajan, Singapore Eye Research Institute (Singapore); Damon Wong, Nanyang Technological Univ. (Singapore); Jacqueline Chua, Bingyao Tan, Leopold Schmetterer, Singapore Eye Research Institute (Singapore) ..... [11218-14]

2:15 pm: **In vivo vitreous imaging using optical coherence tomography**, Daniel Ruminski, Ashish Gupta, Nicolaus Copernicus Univ. (Poland); Jerry Sebag, VMR Institute (USA); Silvestre Manzanera, Pablo Artal, Univ. de Murcia (Spain); Ireneusz Grulkowski, Nicolaus Copernicus Univ. (Poland) ..... [11218-15]

2:30 pm: **In vivo quantification of Bruch's membrane in humans with visible light OCT**, Tingwei Zhang, Aaron Kho, Univ. of California, Davis (USA); Vyas Akondi, Alfredo Dubra, Stanford Univ. (USA); Vivek Srinivasan, Univ. of California, Davis (USA) ..... [11218-16]

2:45 pm: **Fully automatic estimation of the angular distribution of the waist of the nerve fiber layer in the optic nerve head**, Gabriel Carrizo, Uppsala Univ. (Finland); Zhaohua Yu, Uppsala Univ. (Sweden); Chunliang Wang, KTH Royal Institute of Technology (Sweden); Camilla Sandström Melin, Per G. Söderberg, Uppsala Univ. (Sweden) ..... [11218-17]

3:00 pm: **Quantitative curvature maps of the ocular posterior segment utilizing OCT with demonstration of local shape change over time**, Ryan P. McNabb, Alice S. Liu, Sidney M. Gospe III, Mays El Dairi, Charlene James, Robin R. Vann, Duke Univ. School of Medicine (USA); Joseph A. Izatt, Duke Univ. (USA) and Duke Univ. School of Medicine (USA); Anthony N. Kuo, Duke Univ. School of Medicine (USA) and Duke Univ. (USA) ..... [11218-18]

3:15 pm: **Real time volumetric intrasurgical optical coherence tomography with 4D visualization of surgical maneuvers**, Christian Viehland, Al-Hafeez Z. Dhalla, Jianwei D. Li, Moseph Jackson-Atogi, Duke Univ. (USA); Lejla Vajzovic, Duke Univ. School of Medicine (USA); Anthony N. Kuo, Cynthia A. Toth, Joseph A. Izatt, Duke Univ. (USA) ..... [11218-19]

Coffee Break. .... Sat 3:30 pm to 4:00 pm

## SESSION 4

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SAT 4:00 PM TO 6:00 PM

### Ophthalmic Imaging: Cellular

Session Chairs: **Donald T. Miller**, Indiana Univ. (USA); **Kostadinka Bizheva**, Univ. of Waterloo (Canada)

4:00 pm: **In vivo corneal endothelium imaging using ultrahigh resolution OCT**, Xinwen Yao, Kavya Devarajan, Singapore Eye Research Institute (Singapore); René Werkmeister, Valentin Aranha dos Santos, Medizinische Univ. Wien (Austria); Amutha Barathi Veluchamy, Marcus Ang, Singapore Eye Research Institute (Singapore); Anthony N. Kuo, Duke Univ. (USA); Damon Wong, Nanyang Technological Univ. (Singapore); Jacqueline Chua, Bingyao Tan, Singapore Eye Research Institute (Singapore); Leopold Schmetterer, Singapore Eye Research Institute (Singapore) and Medizinische Univ. Wien (Austria) and Nanyang Technological Univ. (Singapore) ..... [11218-20]

4:15 pm: **Investigating corneal nerve structures using micro optical coherence tomography**, Andreas Wartak, Harvard Medical School (USA); Carolin Elhardt, Christian M. Wertheimer, Jie Zhao, Wellman Ctr. for Photomedicine (USA); Hui Min Leung, Biwei Yin, Harvard Medical School (USA); Stefan A. Kassumeh, Merle S. Schenk, Wellman Ctr. for Photomedicine (USA); Guillermo J. Tearney, Harvard Medical School (USA); Reginald Birngruber, Wellman Ctr. for Photomedicine (USA) ..... [11218-21]

4:30 pm: **Curved-field optical coherence tomography: a tool for large field imaging of corneal cells and nerves**, Viacheslav Mazlin, Institut Langevin Ondes et Images (France); Kristina Irsch, Institut de la Vision, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France); Mathias Fink, Claude Boccard, Institut Langevin Ondes et Images (France) ..... [11218-22]

4:45 pm: **In-vivo, non-contact, cellular resolution imaging of the human limbus with line-field SD-OCT at 2.5 kHz frame rate**, Le Han, Zohreh Hosseinaee, Lin Kun Chen, Kostadinka Bizheva, Univ. of Waterloo (Canada) ..... [11218-23]

5:00 pm: **Characterizing retinal ganglion cell morphology in glaucomatous eyes with adaptive optics: optical coherence tomography**, Zhuolin Liu, U.S. Food and Drug Administration (USA); Ricardo Villanueva, Univ. of Maryland School of Medicine (USA); Anant Agrawal, U.S. Food and Drug Administration (USA); Osamah Saeedi, Univ. of Maryland School of Medicine (USA); Daniel X. Hammer, U.S. Food and Drug Administration (USA) ..... [11218-24]

5:15 pm: **Fully automatic quantification of individual ganglion cells from AO-OCT volumes via weakly supervised learning**, Somayeh Soltanian-Zadeh, Duke Univ. (USA); Kazuhiro Kurokawa, Indiana Univ. (USA); Zhuolin Liu, Daniel X. Hammer, U.S. Food and Drug Administration (USA); Donald T. Miller, Indiana Univ. (USA); Sina Farsiu, Duke Univ. (USA) ..... [11218-25]

5:30 pm: **In-vivo demonstration of AO-OCT with a 3-sided pyramid wavefront sensor**, Elisabeth F. Brunner, Medizinische Univ. Wien (Austria); Lulia Shatokhina, Johannes Kepler Univ. Linz (Austria); Muhammad Faizan Shirazi, Wolfgang Drexler, Christoph K. F. Hitzenberger, Rainer A. Leitgeb, Medizinische Univ. Wien (Austria); Ronny Ramlau, Johannes Kepler Univ. Linz (Austria); Michael Pircher, Medizinische Univ. Wien (Austria) ..... [11218-26]

5:45 pm: **Increased field-of-view full-field OCT for 3D high-resolution retinal imaging**, Pedro Mecê, Kassandra Groux, Jules Scholler, Mathias Fink, Institut Langevin Ondes et Images (France); Kate Grieve, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France); Claude Boccard, Institut Langevin Ondes et Images (France) ..... [11218-27]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . SUN 8:20 AM TO 10:00 AM**

**Ocular Biomechanics**

Joint Session with Conferences 11242 and 11218

Session Chairs: **Kirill V. Larin**, Univ. of Houston (USA);  
**Giuliano Scarcelli**, Univ. of Maryland, College Park (USA)

8:20 am: **Clinical assessment of ocular biomechanics** (*Invited Paper*),  
Cynthia J. Roberts, The Ohio State Univ. (USA) . . . . . [11242-20]

8:40 am: **Characterization of biomechanical properties of crystalline lens using Brillouin microscopy and optical coherence elastography**,  
Yogeshwari Ambekar, Univ. of Houston (USA); Jitao Zhang, Univ. of Maryland, College Park (USA); Achuth Nair, Manmohan Singh, Salavat R. Aglyamov, Univ. of Houston (USA); Giuliano Scarcelli, Univ. of Maryland, College Park (USA); Kirill V. Larin, Univ. of Houston (USA) . . . . . [11218-28]

8:55 am: **All-optical correlative micro-spectroscopies in the investigation of stromal collagen morpho-mechanics**, Raffaella Mercatelli, Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Sara Mattana, Istituto Nazionale di Ottica (Italy); Laura Capozzoli, Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche (Italy) and Istituto di Chimica dei Composti Organometallici (Italy); Fulvio Ratto, Istituto di Fisica Applicata "Nello Carrara" (Italy); Francesca Rossi, Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche (Italy); Roberto Pini, Istituto di Fisica Applicata "Nello Carrara" (Italy); Daniele Fioretto, Univ. degli Studi di Perugia (Italy); Francesco Saverio Pavone, Istituto Nazionale di Ottica (Italy) and Univ. degli Studi di Firenze (Italy); Silvia Caponi, Istituto Officina dei Materiali, Consiglio Nazionale delle Ricerche (Italy); Riccardo Cicchi, Istituto Nazionale di Ottica (Italy) . . . . . [11218-29]

9:10 am: **Customized swept-source optical coherence tomography system for air-puff induced corneal deformation imaging on multiple meridians**,  
Andrea Curatolo, Judith Birkenfeld, Eduardo Martínez, James A. Germann, Consejo Superior de Investigaciones Científicas (Spain); Jesús Palaci, 2Eyes Vision SL (Spain); Daniel Pascual, Geethika Muralidharan, Consejo Superior de Investigaciones Científicas (Spain); Jędrzej Solarski, Karol Karnowski, Maciej Wojtkowski, Institute of Physical Chemistry (Poland); Susana Marcos, Consejo Superior de Investigaciones Científicas (Spain) . . . . . [11218-30]

9:25 am: **Phase-decorrelation OCT for detection of corneal softening in an enzymatic ex vivo model of ectasia**, Brecken J. Blackburn, John P. Murray, Case Western Reserve Univ. (USA); Matthew R. Ford, Cleveland Clinic (USA); Michael W. Jenkins, Case Western Reserve Univ. (USA); William J. Dupps Jr., Cleveland Clinic (USA); Andrew M. Rollins, Case Western Reserve Univ. (USA) . . . . . [11218-31]

9:40 am: **Corneal dynamic imaging and second harmonic generation to evaluate in vivo corneal cross-linking** (*Invited Paper*), Susana Marcos, Instituto de Óptica "Daza de Valdés" (Spain) . . . . . [11242-21]

Coffee Break. . . . . Sun 10:00 am to 10:30 am

**SESSION 6**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . SUN 10:30 AM TO 11:45 AM**

**Imaging, Surgery, and Therapy: New Technologies II**

Session Chairs: **Ezra Maguen**, American Eye Institute (USA);  
**Daniel V. Palanker**, Stanford Univ. (USA)

10:30 am: **Wavefront sensorless multimodal handheld adaptive optics scanning laser ophthalmoscope for in vivo imaging of human retinal cones**, Kristen Hagan, Theodore DuBose, David Cunefare, Gar Waterman, Jongwan Park, Ryan P. McNabb, Anthony N. Kuo, Joseph A. Izatt, Sina Farsiu, Duke Univ. (USA) . . . . . [11218-32]

10:45 am: **OCT on a chip: in-vivo retinal imaging using Photonic Integrated Circuit based spectral domain and swept source OCT at 840nm**,  
Elisabet A. Rank, Ryan Sentosa, Anna Gaugutz, Matthias Salas, Danielle J. Harper, Medizinische Univ. Wien (Austria); Stefan Nevlacsil, Alejandro Maese-Novo, Paul Mueller, Rainer Hainberger, AIT Austrian Institute of Technology GmbH (Austria); Dana Seyringer, FH Vorarlberg (Austria); Moritz Eggeling, AIT Austrian Institute of Technology GmbH (Austria); Stefan Partel, FH Vorarlberg (Austria); Marcus Duell, Stefan Gloor, EXALOS AG (Switzerland); Nanko Verwaal, Fraunhofer-Institut für Integrierte Schaltungen IIS (Germany); Gerhard Meinhardt, Martin Sagmeister, Jochen Kraft, ams AG (Austria); Moises A. Jezzini de Anda, Zhiheng Quan, Tyndall National Institute (Ireland); Stefan Richter, Michael Kempe, Carl Zeiss AG (Germany); Rainer A. Leitgeb, Wolfgang Drexler, Medizinische Univ. Wien (Austria) . . . . . [11218-33]

11:00 am: **The EVOKON study: detecting AMD biomarkers with OA-FF-TD OCT**, Peter Koch, Helge Sudkamp, Michael Müntz, Moritz Moltmann, Medizinisches Laserzentrum Lübeck GmbH (Germany); Claus von der Burchard, Universitätsklinikum Schleswig-Holstein (Germany); Reginald Birngruber, Medizinisches Laserzentrum Lübeck GmbH (Germany); Johann Roeder, Universitätsklinikum Schleswig-Holstein (Germany); Gereon Huettmann, Malte vom Endt, Medizinisches Laserzentrum Lübeck GmbH (Germany) . . . . . [11218-34]

11:15 am: **Combined OCT and wavefront aberrometer using a single beam delivery system**, Marco Ruggeri, Bascom Palmer Eye Institute (USA) and Univ. of Miami (USA); Giulia Belloni, Bascom Palmer Eye Institute (USA) and Univ. degli Studi di Modena e Reggio Emilia (Italy); Brandon Chou, Larissa L. Meza, Yu-Cheng Channing, Heather A. Durkee, Jean-Marie Parel, Fabrice Manns, Bascom Palmer Eye Institute (USA) and Univ. of Miami (USA) . . . . . [11218-35]

11:30 am: **Low-cost, portable confocal scanning laser ophthalmoscope for remote screening and telemedicine applications**, Al-Hafeez Z. Dhalla, Jongwan Park, Christian Viehland, Sina Farsiu, Anthony N. Kuo, Joseph A. Izatt, Duke Univ. (USA) . . . . . [11218-36]

Lunch/Exhibition Break . . . . . Sun 11:45 am to 1:15 pm

**SESSION 7**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . SUN 1:15 PM TO 3:15 PM**

**Ophthalmic Imaging: Functional**

Session Chairs: **Yuankai Kenny K. Tao**, Vanderbilt Univ. (USA);  
**Luigi Rovati**, Univ. degli Studi di Modena e Reggio Emilia (Italy)

1:15 pm: **Adaptive optics line-scan OCT for high-speed imaging of retinal structure and function**, Vimal Prabhu Pandiyan, Aiden M. Bertelli, James Kuchenbecker, Univ. of Washington (USA); Kevin C. Boyle, Tong Ling, Stanford Univ. (USA); B. Hyle Park, Univ. of California, Riverside (USA); Daniel Palanker, Stanford Univ. (USA); Austin Roorda, Univ. of California, Berkeley (USA); Ramkumar Sabesan, Univ. of Washington (USA) . . . [11218-37]

1:30 pm: **Investigating the functional response of human photoreceptors with combined adaptive optics SLO-OCT system**, Mehdi Azimipour, Denise Valente, Kari V. Vienola, John S. Werner, Robert J. Zawadzki, Ravi S. Jonnal, UC Davis Medical Ctr. (USA) . . . . . [11218-38]

1:45 pm: **Label-free imaging of neural function in the living human retina using phase sensitive adaptive optics optical coherence tomography**, Kazuhiro Kurokawa, Furu Zhang, James A. Crowell, Marcel T. Bernucci, Donald T. Miller, Indiana Univ. (USA) . . . . . [11218-39]

2:00 pm: **Measuring dysfunction of cone photoreceptors in retinitis pigmentosa with phase-sensitive AO-OCT**, Ayoub Lassoued, Furu Zhang, Kazuhiro Kurokawa, James A. Crowell, Donald T. Miller, Indiana Univ. (USA) . . . . . [11218-40]

2:15 pm: **Investigating the influence of cone function and relative proportions of cone types on color perception using phase-sensitive adaptive optics optical coherence tomography**, Furu Zhang, Kazuhiro Kurokawa, Marcel T. Bernucci, Hae Won Jung, James A. Crowell, Donald T. Miller, Indiana Univ. (USA) . . . . . [11218-41]

2:30 pm: **Measuring the spectral sensitivity of cone photoreceptors in human subjects with phase-sensitive AO-OCT**, Marcel T. Bernucci, Furu Zhang, Kazuhiro Kurokawa, James A. Crowell, Donald T. Miller, Indiana Univ. (USA) . . . . . [11218-42]

2:45 pm: **Microglia distribution and motility in human eyes measured with adaptive optics - optical coherence tomography (AO-OCT)**, Daniel X. Hammer, U.S. Food and Drug Administration (USA); Ricardo Villanueva, Univ. of Maryland School of Medicine (USA); Anant Agrawal, U.S. Food and Drug Administration (USA); Osamah Saeedi, Univ. of Maryland School of Medicine (USA); Zhuolin Liu, U.S. Food and Drug Administration (USA) . . . . . [11218-43]

3:00 pm: **Method to evaluate spatial dynamics of inner retinal neurons near arcuate scotomas in glaucomatous patients**, Hae Won Jung, Kazuhiro Kurokawa, John C. Hinely, James A. Crowell, Furu Zhang, Brett J. King, William H. Swanson, Donald T. Miller, Indiana Univ. (USA) . . . . . [11218-44]

Coffee Break. . . . . Sun 3:15 pm to 3:45 pm

# CONFERENCE 11218

## SESSION 8

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SUN 3:45 PM TO 5:00 PM

### Small Animal Models

Session Chairs: **Marco Ruggeri**, Bascom Palmer Eye Institute (USA);  
**Roberto Pini**, Istituto di Fisica Applicata "Nello Carrara" (Italy)

3:45 pm: **Effect of a mild, diffuse central retinal edema on light evoked outer retina optophysiology signals measured in vivo in mice with optical coherence tomography**, Robert J. Zawadzki, Pengfei Zhang, Ratheesh K. Meleppat, Edward N. Pugh Jr., Univ. of California, Davis (USA) ..... [11218-45]

4:00 pm: **Longitudinal structural and microvascular observation in RCS rat eyes using Optical Coherence Tomography Angiography**, Bingyao Tan, Xinwen Yao, Amutha Barathi Veluchamy, Anita Chan, Gavin Tan, Leopold Schmetterer, Singapore Eye Research Institute (Singapore) ..... [11218-46]

4:15 pm: **Characterization of retinal changes in a mouse model of Alzheimer's disease using multi-contrast optical coherence tomography**, Bernhard Baumann, Danielle J. Harper, Antonia Lichtenegger, Johanna Gesperger, Medizinische Univ. Wien (Austria); Tanja Himmel, Veterinaermedizinische Univ. Wien (Austria); Martina Muck, Conrad W. Merkle, Pablo Eugui, Medizinische Univ. Wien (Austria); Stefan Kummer, Veterinaermedizinische Univ. Wien (Austria); Adelheid Woehrer, Medizinische Univ. Wien (Austria); Martin Glösmann, Veterinaermedizinische Univ. Wien (Austria); Marco Augustin, Medizinische Univ. Wien (Austria) ..... [11218-47]

4:30 pm: **Combined scattering and fluorescent measurement of the retina in vivo reveals disease-dependent changes in intrinsic fluorophores of retinal pigment epithelium**, Ratheesh K. Meleppat, Gabriel Peinado, Kaitryn E. Ronning, Sarah J. Karlen, Pengfei Zhang, Edward N. Pugh Jr., Robert J. Zawadzki, Univ. of California, Davis (USA) ..... [11218-48]

4:45 pm: **OCT and fluorescence SLO for guided laser delivery and longitudinal imaging in a murine model of targeted retinal laser injury**, Joseph D. Malone, Edward M. Levine, Yuankai K. Tao, Vanderbilt Univ. (USA) ..... [11218-49]

## SESSION 9

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SUN 5:00 PM TO 6:00 PM

### Ophthalmic Diagnosis: Contrast and Biomarkers

Session Chairs: **Arthur Ho**, Brien Holden Vision Institute (Australia);  
**Ralf Brinkmann**, Medizinisches Laserzentrum Lübeck GmbH (Germany)

5:00 pm: **Ocular surface squamous neoplasia characterization using non-invasive multispectral autofluorescence imaging**, Abbas Habibalahi Sr., The Univ. of New South Wales (Australia); Alexandra Allende, Macquarie Univ. (Australia); Ayad Anwer, The Univ. of New South Wales (Australia); Chandra Bala, Macquarie Univ. (Australia); Eva Goldys, The Univ. of New South Wales (Australia) ..... [11218-50]

5:15 pm: **Analysing birefringence in the retinal nerve fiber layer of diabetic patients using polarization sensitive OCT**, Sylvia Desissaire, Andreas Pollreis, Felix Datlinger, Dorotyia Hajdu, Stefan Steiner, Clemens Vass, Michael Pircher, Ursula Schmidt-Erfurth, Christoph K. F. Hitzinger, Medizinische Univ. Wien (Austria) ..... [11218-8]

5:30 pm: **Retinal pigment epithelium-melanin specific contrast imaging by multi-contrast OCT**, Masahiro Miura, Ibaraki Medical Ctr., Tokyo Medical Univ. (Japan); Shuichi Makita, Univ. of Tsukuba (Japan); Shinnosuke Azuma, Univ. of Tsukuba (Japan) and Topcon Corp. (Japan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan); Toshihiro Mino, Tatsuo Yamaguchi, Topcon Corp. (Japan); Satoshi Sugiyama, Tomey Corp. (Japan); Takuya Iwasaki, Tokyo Medical Univ. (Japan) ..... [11218-52]

5:45 pm: **Visualizing orientation of retinal nerves and depolarization in the choroid using polarization-sensitive optical coherence tomography**, Joy Willems, Johannes F. de Boer, Maximilian Gräfe, Vrije Univ. Amsterdam (Netherlands); Aleid van de Kreeke, Frank Verbraak, Amsterdam UMC (Netherlands) ..... [11218-53]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Employing toric eye model and wavefront measurement technology to study soft contact lens on-eye wrapping properties**, Minghan Chen, Xin Wei, Philippe Jubin, Johnson & Johnson Vision Care, Inc. (USA) . [11218-54]

**Application of an enhanced deep super-resolution network in retinal image analysis**, Tanmay Gulati, Manipal Institute of Technology (India); Sourya Sengupta, Vasudevan Lakshminarayanan, School of Optometry and Vision Science, Univ. of Waterloo (Canada) ..... [11218-55]

**Analysis of tear film break-up time based on the tear film surface quality obtained using Placido rings images**, Lucas Orlandi de Oliveira, André Orlandi de Oliveira, Jarbas Caiado de Castro Neto, Univ. de São Paulo (Brazil) ..... [11218-56]

**Expanded visualization of the human crystalline lens and suspensory ligament using the large-angle oblique illumination OCT**, Byeong-Joo Song, Hyung-Jin Kim, Youngwoon Choi, Beop-Min Kim, Korea Univ. (Korea, Republic of) ..... [11218-57]

**Prototype for blue light blocking tests in sunglasses**, Artur D. Loureiro, Liliane Ventura, Univ. de São Paulo (Brazil) ..... [11218-58]

**Comparison of foveal avascular zone in diabetic retinopathy, high myopia and normal fundus images**, Jothi J. Balaji, Medical Research Foundation, Sankara Nethralaya (India); Arpit Agarwal, Indian Institute of Technology Kanpur (India); Vasudevan Lakshminarayanan, Univ. of Waterloo (Canada) . [11218-59]

**Deep learning for detection of diabetic retinopathy in OCTA**, David Le, Minhaj Nur Alam, Jennifer I. Lim, R.V. Paul Chan, Xincheng Yao, Univ. of Illinois at Chicago (USA) ..... [11218-60]

**UV and BLUE light protection on sunglasses after aging process**, Liliane Ventura, Mauro Masili, Univ. de São Paulo (Brazil) ..... [11218-61]

**A new technique for estimating the foveal avascular zone dimensions**, Arpit Agarwal, Indian Institute of Technology Kanpur (India); Jothi J. Balaji, Elite School of Optometry (India); Vasudevan Lakshminarayanan, Univ. of Waterloo (Canada) ..... [11218-62]

**Tracking longitudinal retinal changes in an ocular hypertension mouse model by visible and near-infrared optical coherence tomography (vnOCT)**, Weiye Song, Sipei Fu, Shangshang Song, Boston Univ. (USA); Sui Zhang, Dana-Farber Cancer Institute (USA); Lei Zhang, Boston Univ. (USA); Steven Ness, Manishi Desai, Boston Medical Ctr. (USA); Ji Yi, Boston Univ. (USA) ..... [11218-63]

**Morphological diversity of lacrimal canaliculus observed by dynamic OCT with extrinsic contrast agent**, Reiko Yoshimura, Dong-hak Choi, Kitasato Univ. (Japan); Masahiro Fujimoto, Akihito Uji, Kyoto Univ. Graduate School of Medicine (Japan); Kohji Ohbayashi, Advanced Imaging Co., Ltd. (Japan) and Systems Engineering Inc. (Japan); Fumiko Hiwatashi, Systems Engineering Inc. (Japan) ..... [11218-64]

**An optical design for choriocapillaris visualization with OCTA using tracking scanning laser ophthalmoscope**, Kari V. Vienola, Ravi S. Jonnal, John S. Werner, Robert J. Zawadzki, Univ. of California, Davis (USA) [11218-65]

**SS-OCT reveals crystalline lens sutures**, Ashish Gupta, Nicolaus Copernicus Univ. (Poland) ..... [11218-66]

**New high-resolution wave front sensing ophthalmic technique for the characterization of ocular optics**, Sergio Bonaque-González, Jan O. Gaudestad, Juan Manuel Trujillo-Sevilla, Oscar Casanova-Gonzalez, David Carmona-Ballester, Miguel Sicilia-Cabrera, Sabato Ceruso, Jose-Manuel Rodriguez-Ramos, Wootpix, S.L. (Spain) ..... [11218-67]

**In vitro optical quality measurement of three different intraocular lenses in various spherical aberration conditions**, Soohyun Park, Seunghun Lee, Bumju Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Myoung Joon Kim, Lib Lab. (Korea, Republic of); Ki Hean Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11218-68]

**High power microsecond laser induced effects on the retina**, Eric Seifert, Medizinisches Laserzentrum Lübeck GmbH (Germany); Svenja Sonntag, Universitätsklinikum Schleswig-Holstein (Germany); Philipp Kleingarn, Dirk Theisen-Kunde, Medizinisches Laserzentrum Lübeck GmbH (Germany); Yoko Miura, Universitätsklinikum Schleswig-Holstein (Germany) and Univ. zu Lübeck (Germany); Ralf Brinkmann, Medizinisches Laserzentrum Lübeck GmbH (Germany) and Univ. zu Lübeck (Germany) ..... [11218-69]

**Ultrahigh speed areal and tomographic imaging with a full-field adaptive optics retina camera.** Denise Valente, Mehdi Azimipour, Robert J. Zawadzki, Ravi S. Jonnal, UC Davis Medical Ctr. (USA) ..... [11218-70]

**Differential phase contrast corneal microscopy,** Timothy D. Weber, Jerome Mertz, Boston Univ. (USA) ..... [11218-71]

**Corneal filler for correction of astigmatism,** Stefan A. Kassumeh, Wellman Ctr. for Photomedicine (USA) and Klinikum der Univ. München, Ludwig-Maximilians-Univ. München (Germany); Katharina Brandt, Wellman Ctr. for Photomedicine (USA) and Institut für Biomedizinische Optik (Germany); Christian M. Wertheimer, Wellman Ctr. for Photomedicine (USA) and Klinikum der Univ. München, Ludwig-Maximilians-Univ. München (Germany); Merle S. Schenk, Richard R. Anderson, Wellman Ctr. for Photomedicine (USA); Reginald Birngruber, Wellman Ctr. for Photomedicine (USA) and Institut für Biomedizinische Optik (Germany) ..... [11218-72]

**Estimating visual acuity from a single wavefront measurement,** Derek Nankivil, Johnson & Johnson Vision Care, Inc. (USA); Thomas D. Raymond, Johnson & Johnson Vision (USA); Greg J. Hofmann, Johnson & Johnson Vision Care, Inc. (USA); Daniel R. Neal, Johnson & Johnson Vision (USA) ..... [11218-73]

**Estimating retinal vascular permeability from fluorescein videoangiography data despite signal saturation in large vessels in low-dynamic range systems,** Elif Kayaalp-Nalbant, Wenqiang Liu, Hande Pehlivan, Shailee Shah, Anessa Puskar, Meghna Sampath, Illinois Institute of Technology (USA); William F. Mieler, Univ. of Illinois at Chicago (USA); Jennifer J. Kang-Mieler, Kenneth M. Tichauer, Illinois Institute of Technology (USA) ... [11218-74]

**Quantitative analysis of vascular complexity in OCTA of diabetic retinopathy,** Minhaj Nur Alam, David Le, Jennifer I. Lim, Xincheng Yao, Univ. of Illinois at Chicago (USA) ..... [11218-75]

**Multimodal photoacoustic microscopy and optical coherence tomography imaging of laser-induced choroidal neovascularization in the rabbit retina,** Van Phuc Nguyen, Wen Fan, Yanxiu Li, Univ. of Michigan-Kellogg Eye Ctr. (USA); Sydney Jones, Thomas Qian, Univ. of Michigan Kellogg Eye Ctr. (USA); Wei Zhang, Univ. of Michigan-Kellogg Eye Ctr. (USA); Xueding Wang, Univ. of Michigan (USA); Yannis Paulus, Univ. of Michigan-Kellogg Eye Ctr. (USA) ..... [11218-76]

**Corneal collagen crosslinking and treatment outcome evaluation based on femtosecond lasers,** Ana Batista, Univ. des Saarlandes (Germany); Hans Georg Breunig, Univ. des Saarlandes (Germany) and JenLab GmbH (Germany); Elias Flockerzi, Berthold Seitz, Karsten König, Univ. des Saarlandes (Germany) ..... [11218-78]

**Imaging depth extension for optical coherence tomography for imaging the anterior and posterior segments of rabbit eyes,** Ruiming Kong, Wenjuan Wu, Rui Qiu, Lei Gao, Fengxian Du, Shanghai Institute of Technology (China); Ailin Liu, Fudan Univ. (China); Xiangning Wang, Xuan Cai, Shanghai Sixth People's Hospital (China); Cuixia Dai, Shanghai Institute of Technology (China) ..... [11218-79]

**Diagnosis of corneal pathologies using deep learning,** Amr Elsayw, Univ. of Miami (USA); Taher Eleiwa, Bascom Palmer Eye Institute (USA); Mohamed Abdel-Mottaleb, Univ. of Miami (USA); Mohamed Abou Shousha, Bascom Palmer Eye Institute (USA) ..... [11218-80]

**Precise movement registration for retinal-based eye tracker without reference frame,** Michal Meina, Nicolaus Copernicus Univ. (Poland); Maciej Nowakowski, AM2M Sp. z.o.o. sp. k. (Poland); Maciej M. Bartuzel, Krystian Wróbel, Szymon Tamborski, Nicolaus Copernicus Univ. (Poland); Krzysztof Dalasiński, Anna Szkulmowska, AM2M Sp. z.o.o. sp. k. (Poland); Maciej Szkulmowski, Nicolaus Copernicus Univ. (Poland) ..... [11218-81]

**GANgio: a conditional generative adversarial network for optical coherence tomography angiography,** Matthias Salas, Michael Niederleithner, Antonia Lichtenegger, Laurin Ginner, Bernhard Baumann, Wolfgang Drexler, Rainer A. Leitgeb, Medizinische Univ. Wien (Austria) ..... [11218-83]

**3D visualization of cataractous lesions in the murine crystalline lens by in vivo optical coherence tomography,** Pablo Eugui, Danielle J. Harper, Marco Augustin, Medizinische Univ. Wien (Austria); Johanna Gesperger, Medizinische Univ. Wien (Austria) and Institute of Neurology, General Hospital (Austria); Tanja Himmel, Veterinaermedizinische Univ. Wien (Austria); Antonia Lichtenegger, Conrad W. Merkle, Medizinische Univ. Wien (Austria); Adelheid Woehrer, Institute of Neurology, General Hospital (Austria); Martin Glösmann, Veterinaermedizinische Univ. Wien (Austria); Bernhard Baumann, Medizinische Univ. Wien (Austria) ..... [11218-84]

**Hyperspectral reflectivity of individual mouse retinal layers,** Danielle J. Harper, Medizinische Univ. Wien (Austria); Martin Glösmann, Veterinaermedizinische Univ. Wien (Austria); Pablo Eugui, Antonia Lichtenegger, Marion Gröger, Bernhard Baumann, Medizinische Univ. Wien (Austria) ..... [11218-85]

**Simultaneous optical coherence tomography measurements at two arbitrary meridians,** Karol Karnowski, Jędrzej SolarSKI, Alejandra Consejo, Maciej Wojtkowski, Institute of Physical Chemistry (Poland) ..... [11218-86]

**Safe puncture optimized tool (SPOT) to safely inject clot-dissolving drug into the retinal vein,** Andrea Lovera, FEMTOprint SA (Switzerland); Mohamed Zanaty, Thomas Fussinger, Arno Rogg, David Lambelet, Ilan Vardi, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Thomas Wolfensberger, Hôpital ophtalmique Jules-Gonin, Univ. de Lausanne (Switzerland); Charles Baur, Simon Henein, Yves Bellouard, Sacha Pollonghini, Lisa Bonnefoy, Hubert Pierre-Marie Benoît Schneegans, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11218-87]

**Large aperture deformable lenses for ophthalmic applications,** Giulio Bursi, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Francesco Mazzocco, Dynamic Optics S.r.l. (Italy); Tommaso Furiere, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Stefano Bonora, Dynamic Optics S.r.l. (Italy) ..... [11218-88]

**PASCAL ROL AWARD**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SUN 6:00 PM TO 6:15 PM**

Session Chair: **Arthur Ho**, Brien Holden Vision Institute (Australia)

**DISCUSSION**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SUN 6:15 PM TO 6:30 PM**

Session Chair: **Fabrice Manns**, Univ. of Miami (USA)

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam,**

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

# CONFERENCE 11219

LOCATION: ROOM 201 (LEVEL 2 SOUTH)

Saturday 1 February 2020 • Proceedings of SPIE Vol. 11219

# Visualizing and Quantifying Drug Distribution in Tissue IV

Conference Chairs: **Kin Foong Chan**, Simpson Interventions, Inc. (USA); **Conor L. Evans**, Wellman Ctr. for Photomedicine (USA)

Program Committee: **Zane A. Arp**, U.S. Food and Drug Administration (USA); **Huang-Chiao Huang**, Univ. of Maryland (USA); **Anand T. Kumar**, Massachusetts General Hospital (USA); **Melissa L. Mather**, Keele Univ. (United Kingdom); **Wei Min**, Columbia Univ. (USA); **Alex J. Walsh**, Morgridge Institute for Research (USA); **Cristina L. Zavaleta**, The Univ. of Southern California (USA); **Kurt R. Zinn**, The Univ. of Alabama at Birmingham (USA)

## SATURDAY 1 FEBRUARY

### INTRODUCTION

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SAT 8:00 AM TO 8:10 AM

Session Chairs: **Conor L. Evans**, Wellman Ctr. for Photomedicine (USA); **Kin F. Chan**, Simpson Interventions (USA)

8:00 am: **Pharmacokinetic and pharmacodynamic tomography**, Conor L. Evans, Wellman Ctr. for Photomedicine (USA) ..... [11219-1]

### SESSION 1

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SAT 8:10 AM TO 9:15 AM

#### Pharmacokinetic and Pharmacodynamic Tomography in Translational Research

Session Chair: **Alex J. Walsh**, Texas A&M Univ. (USA)

8:10 am: **Nonclinical applications of quantitative whole-body autoradiography, and imaging mass spectrometry in drug discovery and development** (*Invited Paper*), Eric G. Solon, Madrigal Pharmaceuticals, Inc. (USA) ..... [11219-2]

8:35 am: **Development of all-fiber light source based real-time clinical coherent Raman imaging system for in vivo drug monitoring in skin**, Isaac J. Pence, Avery Goss, Alexander Fast, Wellman Ctr. for Photomedicine (USA); Maximilian Brinkmann, Tim Hellwig, Westfälische Wilhelms-Universität Münster (Germany) and Refined Laser Systems UG (Germany); Carsten Fallnich, Westfälische Wilhelms-Universität Münster (Germany); Conor L. Evans, Wellman Ctr. for Photomedicine (USA) ..... [11219-3]

8:55 am: **In vivo quantitative molecular absorption of glycerol in human skin using coherent anti-Stokes Raman scattering (CARS) and two-photon auto-fluorescence**, Hervé Rigneault, Barbara Sarri, Institut Fresnel (France); Xueqin Chen, Sébastien Grégoire, Jean-Baptiste Galey, Anne Potter, Thomas Bornschlögl, L'Oréal Recherche et Innovation (France) ..... [11219-4]

### SESSION 2

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SAT 9:15 AM TO 11:50 AM

#### Pharmacokinetic and Pharmacodynamic Tomography in Preclinical Research

Session Chair: **Cristina L. Zavaleta**, The Univ. of Southern California (USA)

9:15 am: **Vaccine visualization using a zwitterionic near-infrared fluorophore** (*Invited Paper*), Wataru Katagiri, Gordon Ctr. for Medical Imaging (USA) and Keio Univ. (Japan); Marc-André Tétrault, Homan Kang, Gordon Ctr. for Medical Imaging (USA); Sinyoung Jeong, Conor L. Evans, Wellman Ctr. for Photomedicine (USA); Hak Soo Choi, Satoshi Kashiwagi, Gordon Ctr. for Medical Imaging (USA) ..... [11219-5]

9:35 am: **Raman spectroscopy for detection of drug distribution in rabbit cornea**, Sean P. O'Connor, Eddie M. Gil, Mark A. Keppler, Marlan O. Scully, Vladislav V. Yakovlev, Texas A&M Univ. (USA) ..... [11219-6]

9:55 am: **Quantitative assessment of cisplatin-associated organ toxicity using label-free multiphoton imaging microscopy**, Aneesh Alex, GlaxoSmithKline (USA); Eric J. Chaney, Prabuddha Mukherjee, Univ. of Illinois (USA); Endia Fletcher, North Carolina A&T State Univ. (USA); Jang Hyuk Lee, Jose J. Rico-Jimenez, Univ. of Illinois (USA); Sunish Mohanan, GlaxoSmithKline (USA); Steve R. Hood, GlaxoSmithKline (United Kingdom); Stephen A. Boppart, Univ. of Illinois (USA) ..... [11219-7]

Coffee Break ..... Sat 10:15 am to 10:45 am

10:45 am: **Estimating drug delivery using hybrid system for simultaneous dynamic MRI and fluorescence tomography**, Boyu Meng, Rendall R. Strawbridge, Kimberley S. Samkoe, Dartmouth College (USA); Negar Sadeghipour, Kenneth M. Tichauer, Illinois Institute of Technology (USA); Scott C. Davis, Dartmouth College (USA) ..... [11219-8]

11:05 am: **In vivo metabolic imaging of neoplasia in oral mucosa enabled by topical delivery of a fluorescent deoxyglucose** (*Invited Paper*), Gracie Vargas, The Univ. of Texas Medical Branch (USA); Rahul Pal, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Paula Villarreal, Suimin Qiu, The Univ. of Texas Medical Branch (USA) [11219-9]

11:30 am: **High resolution optical imaging of glucose metabolism in animals**, Lingyan Shi, Univ. of California, San Diego (USA); Luyuan Zhang, Columbia Univ. (USA); Yihui Shi, Princeton Univ. (USA); Wei Min, Columbia Univ. (USA) ..... [11219-10]

Lunch/Exhibition Break ..... Sat 11:50 am to 1:10 pm

### SESSION 3

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SAT 1:10 PM TO 2:50 PM

#### Novel Model and Imaging Screening Tools for Drug Development

Session Chair: **Cristina L. Zavaleta**, The Univ. of Southern California (USA)

1:10 pm: **Quantification of anti-HER2 drug uptake into human breast cancer cells and tumor xenografts using fluorescence lifetime FRET imaging**, Alena Rudkouskaya, Albany Medical College (USA); Jason T. Smith, Marien Ochoa, Xavier Intes, Rensselaer Polytechnic Institute (USA); Margarida Barroso, Albany Medical College (USA) ..... [11219-11]

1:30 pm: **Alkyne-tag SERS imaging for visualizing small molecule drugs in live cells**, Kota Koike, National Institute of Advanced Industrial Science and Technology (Japan) and Osaka Univ. (Japan); Kazuki Bando, Jun Ando, Nicholas I. Smith, Osaka Univ. (Japan); Kosuke Dodo, RIKEN (Japan); Satoshi Kawata, Serendip Research Ltd. (Japan); Mikiko Sodeoka, RIKEN (Japan); Katsumasa Fujita, Osaka Univ. (Japan) and National Institute of Advanced Industrial Science and Technology (Japan) ..... [11219-12]

1:50 pm: **Quantification of tissue distribution and therapeutic response using paired agent imaging in a chicken chorioallantoic membrane xenograft assay**, Kimberley S. Samkoe, Dartmouth-Hitchcock Medical Ctr. (USA); Lei G. Wang, Jesse R. Korber, Summer L. Gibbs, Oregon Health & Science Univ. (USA); Kenneth M. Tichauer, Illinois Institute of Technology (USA) ..... [11219-13]

2:10 pm: **Intracellular paired agent imaging enables improved evaluation of tyrosine kinase inhibitor target engagement**, Allison Solanki, Lei G. Wang, Jesse R. Korber, Oregon Health & Science Univ. (USA); Kenneth M. Tichauer, Illinois Institute of Technology (USA); Kimberley S. Samkoe, Dartmouth-Hitchcock Medical Ctr. (USA); Summer L. Gibbs, Oregon Health & Science Univ. (USA) ..... [11219-14]

2:30 pm: **A paired-agent fluorescent molecular imaging strategy for quantifying antibody drug target engagement in in vivo window chamber xenograft models**, Negar Sadeghipour, Elif Kayaalp-Nalbant, Illinois Institute of Technology (USA); Boyu Meng, Margaret R. Folaron, Dartmouth College (USA); Chandrika Haldar, Illinois Institute of Technology (USA); Rendall R. Strawbridge, Kimberley S. Samkoe, Scott C. Davis, Dartmouth College (USA); Kenneth M. Tichauer, Illinois Institute of Technology (USA) ..... [11219-15]



**PANEL DISCUSSION**

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SAT 2:50 PM TO 3:30 PM

**Visualizing and Quantifying Drug Distribution in Tissue**

Session Chairs: **Conor L. Evans**, Wellman Ctr. for Photomedicine (USA); **Kin F. Chan**, Simpson Interventions (USA)

Panelists:

**Zane Arp**, U.S. Food and Drug Administration, Division of BioMedical Physics (USA)

**Georg Duenstl**, LEO Science & Tech Hub (USA)

**Conor L. Evans**, Massachusetts General Hospital (USA)

**Sameersingh Raney**, U.S. Food and Drug Administration, CDER Office of Generic Drugs (USA)

**Eric Solon**, Madrigal Pharmaceuticals (USA)

Coffee Break. .... Sat 3:30 pm to 4:00 pm

**SESSION 4**

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SAT 4:00 PM TO 6:00 PM

**Advanced Methods in Drug Detection and Imaging**

Session Chairs: **Wei Min**, Columbia Univ. (USA); **Anand T. Kumar**, Massachusetts General Hospital (USA)

4:00 pm: **Fluorescence molecular tomography based on machine-learning strategy for tracer visualization**, Hui Meng, Yuan Gao, Institute of Automation (China) and Univ. of Chinese Academy of Sciences (China); Kun Wang, Jie Tian, Institute of Automation (China). .... [11219-16]

4:20 pm: **Identifying optical analogs to MRI Gd-contrast using whole-body hyperspectral cryo-fluorescence imaging**, Brook K. Byrd, Dartmouth College (USA); Boyu Meng, Thayer School of Engineering at Dartmouth (USA); Dennis J. Wirth, Dartmouth-Hitchcock Medical Ctr. (USA); Rendall R. Strawbridge, Scott C. Davis, Thayer School of Engineering at Dartmouth (USA) ..... [11219-17]

4:40 pm: **Using fluorescence laminar optical tomography to measure the distribution photodynamic drug in the brain to optimize dosage and treatment time**, Brandon Gaitan, Collin T. Inglut, Yu Chen, Huang-Chiao Huang, Univ. of Maryland, College Park (USA) ..... [11219-18]

5:00 pm: **Noninvasive in vivo mapping of intracellular signaling proteins using a pairing of targeted and untargeted fluorescently labeled small molecule kinase inhibitors**, Kenneth M. Tichauer, Illinois Institute of Technology (USA); Lei G. Wang, Allison Solanki, Jesse R. Korber, Summer L. Gibbs, Oregon Health & Science Univ. (USA); Kimberley S. Samkoe, Geisel School of Medicine (USA). .... [11219-19]

5:20 pm: **Dye diffusion proximal to in situ forming implants is increased by ultrasound stimulation**, Elizabeth Berndt, Ryerson Univ. (Canada); Selva Jeganathan, Emily Budziszewski, Agata A. Exner, Case Western Reserve Univ. (USA); Michael C. Kolios, Ryerson Univ. (Canada) ..... [11219-20]

5:40 pm: **Hyperspectral fluorescence imaging for improved specificity in whole body cryo-imaging**, Boyu Meng, Dennis J. Wirth, Brook K. Byrd, Rendall R. Strawbridge, Scott C. Davis, Dartmouth College (USA). . . [11219-21]

**BEST PAPER AWARD**

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SAT 6:00 PM TO 6:05 PM

**Bee K. Leong Best Paper Award**

**BIOS HOT TOPICS**

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**POSTERS-SUNDAY**

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Method for depth resolved quantification of fluorescent drugs in skin**, Ashwini Sen Palliparambil Jayakumar, Hanna Jonasson, Tomas Strömberg, Rolf B. Saager, Linköping Univ. (Sweden). .... [11219-22]

**Fluorescent imaging technologies for in situ measurement of drug target engagement and cell signaling pathway reprogramming**, Nathan McMahon, Jocelyn Jones, Jennifer Eng, Sunjong Kwon, Koei Chin, Oregon Health & Science Univ. (USA); Michel A. Nederlof, Quantitative Imaging Systems (USA); Summer L. Gibbs, Oregon Health & Science Univ. (USA). .... [11219-23]

**Effect of nonspecific binding of imaging agents to plasma protein in the paired-agent imaging for resection during surgery (PAIRS)**, Xiaochun Xu, Dartmouth-Hitchcock Medical Ctr. (USA); Kenneth M. Tichauer, Illinois Institute of Technology (USA); Kimberley S. Samkoe, Dartmouth-Hitchcock Medical Ctr. (USA). .... [11219-24]

**BIOS SUNDAY PLENARY**

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SUN 7:15 PM TO 8:00 PM

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam**,  
Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

# CONFERENCE 11220

LOCATION: ROOM 306 (LEVEL 3 SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11220

# Optical Methods for Tumor Treatment and Detection: Mechanisms and Techniques in Photodynamic Therapy XXIX

Conference Chairs: **David H. Kessel**, Wayne State Univ. (USA); **Tayyaba Hasan**, Wellman Ctr. for Photomedicine (USA)

Program Committee: **Bryan Q. Spring**, Northeastern Univ. (USA); **Srivalleesha Mallidi**, Tufts Univ. (USA); **Theresa M. Busch**, Univ. of Pennsylvania (USA)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... SAT 9:00 AM TO 10:10 AM

#### Photodynamic Therapy I

Session Chair: **David H. Kessel**, Wayne State Univ. (USA)

9:00 am: **Paraptosis: a death mechanism for cells with an impaired pathway to apoptosis**, David H. Kessel, Won-Jin Cho, Hyeong-Reh Kim, Wayne State Univ. (USA) ..... [11220-1]

9:25 am: **Is PDT-based metastatic reduction a consequence of local tumor control or a true abscopal effect in immunodeficient mice?** Tayyaba Hasan, Massachusetts General Hospital (USA) and Harvard Medical School (USA) ..... [11220-2]

9:50 am: **Molecular targeting of photochemical nanoconjugates for pancreatic cancer: modulating desmoplasia and alleviating dose-limiting toxicities**, Girgis Obaid, Wellman Ctr. for Photomedicine (USA) ..... [11220-3]

Coffee Break ..... Sat 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... SAT 10:40 AM TO 12:00 PM

#### Photodynamic Therapy II

Session Chair: **Srivalleesha Mallidi**, Tufts Univ. (USA)

10:40 am: **Evaluating temporal effects of photodynamic priming on stroma modification in pancreatic cancer**, Phuong Vincent, Jason R. Gunn, Kimberley S. Samkoe, Thayer School of Engineering at Dartmouth (USA); Tayyaba Hasan, Wellman Ctr. for Photomedicine (USA); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) ..... [11220-4]

11:00 am: **Clinical implementation of model-based dose planning for indoor daylight photodynamic therapy of skin**, Ethan Philip M. LaRochelle, Alberto J. Ruiz, Thayer School of Engineering at Dartmouth (USA); M. Shane Chapman, Geisel School of Medicine, Dartmouth College (USA); Edward V. Maytin, Lerner Research Institute - Cleveland Clinic (USA); Tayyaba Hasan, Wellman Ctr. for Photomedicine, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) ..... [11220-5]

11:20 am: **Fluorescence dosimetry for indoor-daylight photodynamic therapy: clinical results using wide-field imaging and point-probe measurements**, Alberto J. Ruiz, Ethan Philip M. LaRochelle, Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) ..... [11220-6]

11:40 am: **A high throughput spectroscopic dosimeter for simultaneous measurement of singlet oxygen and photosensitizer during PDT Treatment**, Youbo Zhao, Tobias Morritz, Physical Sciences Inc. (USA); Jason R. Gunn, Dartmouth College (USA); Michael Hinds, Physical Sciences Inc. (USA); Brian W. Pogue, Dartmouth College (USA); Steven J. Davis, Physical Sciences Inc. (USA) ..... [11220-7]

Lunch/Exhibition Break ..... Sat 12:00 pm to 1:35 pm

### SESSION 3

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... SAT 1:35 PM TO 3:00 PM

#### Photodynamic Therapy III

Session Chair: **Theresa M. Busch**, Univ. of Pennsylvania (USA)

1:35 pm: **What is its impact factor? Oxygen dependencies in photodynamic therapy**, Theresa M. Busch, Univ. of Pennsylvania (USA) ..... [11220-8]

2:00 pm: **Development of photodynamic diagnosis and therapy for peritoneal dissemination using NIR fiber laser system**, Yoshinori Shirasaka, Oita Univ. (Japan); Yusuke Oshima, Tohoku Univ. (Japan) and Oita Univ. (Japan); Takanori Inoue, Oita Univ. (Japan); Yasuhiro Maeda, RIKEN (Japan); Takahiro Hiratsuka, Tomonori Akagi, Kosuke Suzuki, Tomotaka Shibata, Yoshitake Ueda, Manabu Tojigamori, Hidefumi Shiroshita, Oita Univ. (Japan); Tsuyoshi Etoh, Tohoku Univ. (Japan); Norio Shiraiishi, Masafumi Inomata, Oita Univ. (Japan) ..... [11220-9]

2:20 pm: **Surgically induced immunosuppression limits photodynamic therapy efficacy: local to systemic mechanisms**, Gwendolyn M. Cramer, Richard W. Davis IV, Astero Klampatsa, Shirron Carter, Joann Miller, Keith A. Cengel, Theresa M. Busch, Univ. of Pennsylvania (USA) ..... [11220-10]

2:40 pm: **Perfluorocarbon nanodroplets enhance treatment of hypoxic tumors using photoacoustic guided photodynamic therapy**, Marvin Xavierselvan, Tufts Univ. (USA); Jason Cook, Kimberly Homan, Nanohybrids Inc. (USA); Srivalleesha Mallidi, Tufts Univ. (USA) and Wellman Ctr. for Photomedicine (USA) ..... [11220-11]

Coffee Break ..... Sat 3:00 pm to 3:30 pm

### SESSION 4

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... SAT 3:30 PM TO 4:50 PM

#### Photodynamic Therapy IV

Session Chair: **Girgis Obaid**, Wellman Ctr. for Photomedicine (USA)

3:30 pm: **Minimally invasive intraperitoneal photodynamic therapy using a new soft robot system**, Yang Liu, Vanderbilt Univ. Medical Ctr. (USA); Kashu Yamazaki, Univ. of Arkansas (USA); Dawei Zhang, Vanderbilt Univ. Medical Ctr. (USA); Yucheng Li, Univ. of Arkansas (USA); Meng Su, Qing Xie, Vanderbilt Univ. Medical Ctr. (USA); Yue Chen, Univ. of Arkansas (USA); Mingfeng Bai, Vanderbilt Univ. Medical Ctr. (USA) ..... [11220-12]

3:50 pm: **Light induced bacterial deactivation using graphene quantum dot**, Ermek Belekov, Ali O. Er, Lauren Cooper, Khomidkhozda Kholikov, Western Kentucky Univ. (USA) ..... [11220-13]

4:10 pm: **Photodynamic inhibition of ATP-binding cassette transporters in cancer cells**, Yan Baglo, Barry J. Liang, Univ. of Maryland, College Park (USA); Robert Robey, Suresh Ambudkar, Michael Gottesman, National Cancer Institute (USA); Huang-Chiao Huang, Univ. of Maryland, College Park (USA) ..... [11220-14]

4:30 pm: **Investigation of adsorption and release of photodynamic dyes by Clinoptilolite zeolite**, Anupama Nair, Vladimir Hovhannissyan, Shean-Jen Chen, National Chiao Tung Univ. (Taiwan) ..... [11220-15]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 5

LOCATION: ROOM 306 (LEVEL 3 SOUTH) . . . . . SUN 8:30 AM TO 10:00 AM

### Photodynamic Therapy V

Session Chair: **Edward V. Maytin**,  
 Lerner Research Institute - Cleveland Clinic (USA)

- 8:30 am: **Tribulations in medicine: designing and implementing a trial of PDT plus vitamin D3 for high-grade anal dysplasia and microinvasive anal cancer**, Keith A. Cengel, Timothy C. Zhu, Sally McNulty, Edgar Ben-Josef, Theresa M. Busch, Penn Medicine (USA) . . . . . [11220-16]
- 9:00 am: **Metronomic PDT induces innate and adaptive immune responses in murine models of skin cancer and pre-cancer**, Sanjay Anand, Mukul Govande, Anton Yasinchak, Lauren Heusinkveld, Sajina Shakya, Edward V. Maytin, Cleveland Clinic (USA) . . . . . [11220-17]
- 9:30 am: **EUS guided Verteporfin PDT for locally advanced pancreatic cancer**, Kenneth K. Wang, Mayo Clinic (USA) . . . . . [11220-18]
- Coffee Break. . . . . Sun 10:00 am to 10:30 am

### SESSION 6

LOCATION: ROOM 306 (LEVEL 3 SOUTH) . . . . . SUN 10:30 AM TO 11:40 AM

### Photodynamic Therapy VI

Session Chair: **Keith A. Cengel**, Penn Medicine (USA)

- 10:30 am: **Changes in T-cells and other components of the immune system after photodynamic therapy of basal cell carcinoma**, Edward V. Maytin, Lerner Research Institute - Cleveland Clinic (USA) . . . . . [11220-19]
- 11:00 am: **Use of 3-D photographic images to document changes in tumor volume following photodynamic therapy in patients with basal cell carcinoma of the skin**, Taylor Bullock, Dermatology and Plastic Surgery Institute, Cleveland Clinic (USA) and Lerner Research Institute - Cleveland Clinic (USA); Jeffrey Negrey, Cleveland Clinic (USA); Urvashi Kaw, Dermatology and Plastic Surgery Institute, Cleveland Clinic (USA); Christine Warren, Dermatology and Plastic Surgery Institute, Cleveland Clinic (USA) and Lerner Research Institute - Cleveland Clinic (USA); Edward V. Maytin, Dermatology and Plastic Surgery Institute (USA) and Cleveland Clinic (USA) and Cleveland Clinic Lerner College of Medicine (USA) . . . . . [11220-20]
- 11:20 am: **Acoustic microscopy guided laser ablation therapy**, Hakan Erkol, Bogaziçi Üniv. (Turkey) . . . . . [11220-22]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

- Photodynamic priming to attenuate ovarian cancer cell migration**, Aaron Sorrin, Univ. of Maryland, College Park (USA); Jocelyn Reader, Univ. of Maryland School of Medicine (USA); Daniel Najafali, Barry J. Liang, Yan Baglo, Univ. of Maryland, College Park (USA); Dana Roque, Univ. of Maryland School of Medicine (USA); Huang-Chiao Huang, Univ. of Maryland, College Park (USA) . . . . . [11220-23]
- Simulation of light delivery efficiency of diffusers using photodynamic therapy for cervical cancer**, Jae Hyuk Kim, Princess Margaret Cancer Ctr., Univ. Health Network (Canada) and Health and Medical Equipment Business, Samsung Electronics Co. Ltd. (Korea, Republic of) and Catholic Kwandong Univ. (Korea, Republic of); Seung Hee Han, Brian Wilson, Princess Margaret Cancer Ctr., Univ. Health Network (Canada) and Univ. of Toronto (Canada) . . . . . [11220-24]
- Photodynamic diagnosis with 5-aminolevulinic acid for intramucosal gastric cancer using green light**, Daisuke Ihara, Hisanao Hazama, Takahiro Nishimura, Kunio Awazu, Osaka Univ. (Japan) . . . . . [11220-25]
- Photodynamic therapy for skin cancer with minimized light doses and minimized doses of chlorin derivative photosensitizer Photodiatine**, Violeta Purtskhvanidze, MCHT LaserVita (Russian Federation) . . . . . [11220-26]
- Reactive oxygen species explicit dosimetry (ROSED) for single and fractionated illumination ALA-mediated photodynamic therapy**, Yi Hong Ong, Tianqi Sheng, Theresa M. Busch, Timothy C. Zhu, Perelman Ctr. for Advanced Medicine (USA) . . . . . [11220-27]
- Determination of in-vivo tissue optical properties for anal photodynamic therapy**, Yi Hong Ong, Andrew C. Li, Andreea Dimofte, Theresa M. Busch, Timothy C. Zhu, Perelman Ctr. for Advanced Medicine (USA) . . . . . [11220-28]
- Determination of the distribution of light, drug concentration, and tissue oxygenation in-vivo in anal canal during ALA-mediated photodynamic therapy**, Yi Hong Ong, Andreea Dimofte, Theresa M. Busch, Edgar Ben-Josef, Perelman Ctr. for Advanced Medicine (USA); Nicole Saur, Univ. of Pennsylvania (USA) and Pennsylvania Hospital (USA); Keith A. Cengel, Timothy C. Zhu, Perelman Ctr. for Advanced Medicine (USA) . . . . . [11220-29]
- Soft robotic laparoscope for photodynamic therapy**, Yucheng Li, Kashu Yamazaki, Univ. of Arkansas (USA); Yang Liu, Dawei Zhang, Qing Xie, Meng Su, Mingfeng Bai, Vanderbilt Univ. Medical Ctr. (USA); Yue Chen, Univ. of Arkansas (USA) . . . . . [11220-30]
- Combined fluorescence and optoacoustic imaging for monitoring the efficiency of photodynamic therapy with BPD based nanoconstructs**, Ilya V. Turchin, Institute of Applied Physics of the RAS (Russian Federation) . . . . . [11220-31]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

#### Spying on the Secret Lives of Cells

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

# CONFERENCE 11221

LOCATION: ROOM 301 (LEVEL 3 SOUTH)

Saturday 1 February 2020 • Proceedings of SPIE Vol. 11221

## Mechanisms of Photobiomodulation Therapy XV

**Conference Chairs:** **Michael R. Hamblin**, Wellman Ctr. for Photomedicine (USA); **James D. Carroll**, THOR Photomedicine Ltd. (United Kingdom); **Praveen Arany**, Univ. at Buffalo (USA)

**Program Committee:** **Heidi Abrahamse**, Univ. of Johannesburg (South Africa); **Michael L. Denton**, Air Force Research Lab. (USA); **Tomas Hode**, Immunophotonics, Inc. (USA); **Clark E. Tedford**, LumiThera (USA); **Mei X. Wu**, Harvard Medical School (USA), Wellman Ctr. for Photomedicine (USA)

### SATURDAY 1 FEBRUARY

#### WELCOME REMARKS

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SAT 8:30 AM TO 8:40 AM

Session Chairs: **Praveen Arany**, Univ. at Buffalo (USA);  
**James D. Carroll**, THOR Photomedicine Ltd. (United Kingdom)

#### SESSION 1

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SAT 8:40 AM TO 10:20 AM

#### Cellular Mechanisms of PBM

Session Chairs: **Michael L. Denton**, Air Force Research Lab. (USA);  
**Ann Liebert**, Australasian Research Institute (Australia)

8:40 am: **Mechanisms of photobiomodulation**, Ann Liebert, Australasian Research Institute (Australia) ..... [11221-26]

9:00 am: **Photobiomodulation promotes cell survival in diabetic wounded fibroblast cells**, Nicolette N. Houreld, Sandy Jere, Univ. of Johannesburg (South Africa) ..... [11221-2]

9:20 am: **Impediments of autoantibodies to human megakaryocyte differentiation are significantly mitigated with low-level laser therapy**, Mei X. Wu, Li Wang, Harvard Medical School (USA) ..... [11221-3]

9:40 am: **Photostimulation effects on the embryo development of chicken eggs and rats newborns**, Hilde H. Buzzá, Amanda C. Zangirolami, Cristina Kurachi, Vanderlei S. Bagnato, Univ. de São Paulo (Brazil) ... [11221-4]

10:00 am: **Photobiomodulation promotes cell survival in diabetic wounded fibroblast cells**, Sandy Jere, Univ. of Johannesburg (South Africa) ... [11221-5]

Coffee Break. .... Sat 10:20 am to 10:50 am

#### SESSION 2

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SAT 10:50 AM TO 12:40 PM

#### Modeling PBM Dosimetry

Session Chair: **James D. Carroll**,  
THOR Photomedicine Ltd. (United Kingdom)

10:50 am: **To be announced (Invited Paper)**, James D. Carroll, THOR Photomedicine Ltd. (United Kingdom) ..... [11221-6]

11:20 am: **Effects of 690nm light on the response of Staphylococcus aureus to oxidative stress**, Alec B. Walter, Vanderbilt Univ. (USA); Eric P. Skaar, Vanderbilt Univ. Medical Ctr. (USA); E. Duco Jansen, Vanderbilt Univ. (USA) ..... [11221-7]

11:40 am: **Review on clinical trial results of red and near infrared LED photobiomodulation**, Sungkyoo Lim, Dankook Univ. (Korea, Republic of) ..... [11221-8]

12:00 pm: **Fluorescence biomodulation in wound healing: when is a photon something more?**, Michela Zago, Klox Technologies, Inc. (Canada); Mehrnoush Dehghani, Montreal Clinical Research Institute (Canada); Joanna Jaworska, Shannon E. Campbell, Michael Nielsen, Lise Hebert, Klox Technologies, Inc. (Canada) ..... [11221-9]

12:20 pm: **Effects of wavelength on transcranial laser stimulation: a Monte Carlo simulation study based on standard brain model**,

Fenghua Tian, Jenson Varghese, The Univ. of Texas at Arlington (USA);

Anh Phong Tran, Qianqian Fang, Northeastern Univ. (USA);

Francisco Gonzalez-Lima, The Univ. of Texas at Austin (USA) ..... [11221-10]

Lunch/Exhibition Break ..... Sat 12:40 pm to 1:40 pm

#### SESSION 3

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SAT 1:40 PM TO 3:30 PM

#### Molecular mechanisms of PBM

Session Chair: **Mei X. Wu**, Harvard Medical School (USA)

1:40 pm: **To be announced (Invited Paper)**, Mei X. Wu, Harvard Medical School (USA) ..... [11221-11]

2:10 pm: **Low irradiance visible light effects on cytochrome c and purified cytochrome c reductase using femtosecond transient absorption**,

Sean P. O'Connor, Texas A&M Univ. (USA); Samantha M. Powell, Air Force Research Lab. (USA); John M. Rickman, Gary D. Noojin, SAIC (USA); Nathaniel J. Pope, Oak Ridge Institute for Science and Education (USA) and Joint Base San Antonio-Fort Sam Houston (USA); Marlan O. Scully, Texas A&M Univ. (USA); Michael L. Denton, Air Force Research Lab. (USA); Vladislav V. Yakovlev, Texas A&M Univ. (USA) ..... [11221-12]

2:30 pm: **Low irradiance light exposure alters the activity of key enzymes in the mitochondrial electron transport chain**, Nathaniel J. Pope, Oak Ridge Institute for Science and Education (USA) and Air Force Research Lab. (USA); Michael L. Denton, Air Force Research Lab. (USA) ..... [11221-13]

2:50 pm: **Effects of specific inhibitors and low irradiance visible light on the redox cycling of cytochrome c in isolated mitochondria using resonance Raman spectroscopy**, Josh W. Lalonde, Texas A&M Univ. (USA); Gary D. Noojin, SAIC, Joint Base San Antonio-Fort Sam Houston (USA); Nathaniel J. Pope, Air Force Research Lab., Joint Base San Antonio-Fort Sam Houston (USA); Samantha M. Powell, Air Force Research Lab. (USA); Vladislav V. Yakovlev, Texas A&M Univ. (USA); Michael L. Denton, Air Force Research Lab., Joint Base San Antonio-Fort Sam Houston (USA) ... [11221-14]

3:10 pm: **Using the tricarboxylic acid cycle to study photobiomodulation**, Michael L. Denton, Air Force Research Lab. (USA); Gary D. Noojin, SAIC (USA); Vladislav V. Yakovlev, Texas A&M Univ. (USA); Nathaniel J. Pope, Oak Ridge Institute for Science and Education (USA); Samantha M. Powell, National Research Council (USA) ..... [11221-15]

Coffee Break. .... Sat 3:30 pm to 4:00 pm

**SESSION 4**

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SAT 4:00 PM TO 6:50 PM

**PBM Clinical Applications**

Session Chair: **Praveen Arany**, Univ. at Buffalo (USA)

4:00 pm: **To be announced** (*Invited Paper*), Praveen Arany, Univ. at Buffalo (USA) ..... [11221-16]

4:30 pm: **Comparison of clinical effectiveness of laser acupuncture and amitriptyline in diabetic peripheral neuropathy(DPN): a sham controlled randomized trial**, Imran Hassan Khan, Lahore General Hospital (Pakistan); Shahzad Anwar, Anwar Shah Trust for Cerebral Palsy & Paralysis (Pakistan) and Iffat Anwar Medical Complex (Pakistan); Asif Hanif, The Univ. of Lahore (Pakistan); Muhammad Waseem Hassan, Iffat Anwar Medical Complex (Pakistan) ..... [11221-17]

4:50 pm: **Biphasic response of LED photobiomodulation measured in vivo on human forearms with near-infrared spectroscopy**, Ben Mattison, Paul Mathews, Peter Brawn, Biolux Research Ltd. (Canada) ..... [11221-18]

5:10 pm: **Laser acupuncture for autism spectrum disorder: a randomized sham controlled trial**, Shahzad Anwar, Muhammad Waseem Hassan, Faiza Munir Qazi, Anwar Shah Trust for Cerebral Palsy & Paralysis (Pakistan) ..... [11221-19]

5:30 pm: **40 Hz invisible spectral flicker and its potential use in Alzheimer's light therapy treatment**, Marcus S. Carstensen, Johannes Lindén, Technical Univ. of Denmark (Denmark); N. Mai Nguyen, Univ. of California, Berkeley (USA); Henrik E. Hansen, Technical Univ. of Denmark (Denmark); Gustavo M. Feijóo Carrillo, Luna S. Hansen, OptoCeutics ApS (Denmark); Dennis D. Corell, DTU Fotonik (Denmark); Jes Broeng, Technical Univ. of Denmark (Denmark); Lance J. Kriegsfeld, Univ. of California, Berkeley (USA); Paul Michael Petersen, Technical Univ. of Denmark (Denmark) ..... [11221-20]

**BIOS HOT TOPICS**

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**POSTERS-SUNDAY**

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Primary mechanism of action of optical radiation on living organisms**, Leonid Chervinsky, National Univ. of Life and Environmental Sciences of Ukraine (Ukraine) ..... [11221-21]

**Development of a miniature continuous-wave near-infrared spectroscopy probe for intraoral monitoring of photobiomodulation therapy**, Ben Mattison, Paul Mathews, Peter Brawn, Biolux Research Ltd. (Canada)[11221-22]

**Effect of LED phototherapy on pain control after insertion of elastomeric separators in Orthodontics patients: clinical trial**, Luiz Guilherme P. Soares, Maria Carolina S. M. Bezerra, Fernando Antonio L. Habib, Antônio Luiz B. Pinheiro, Univ. Federal da Bahia (Brazil) ..... [11221-23]

**Nanoconcentrations of of 1,9-dimethylmethylene blue (DMMB) associated to Laser, LED or Polarized light are highly effective on AmPDT carried out in aerobes and aerotolerant anaerobes Gram-positive bacteria**, Antônio Luiz B. Pinheiro, Fernando José P. Sampaio, Univ. Federal da Bahia (Brazil); Darcy Santos de Almeida, Univ. Federal do Recôncavo of Bahia (Brazil); Pedro Jorge L. Crugeira, Susana Carla P. S. de Oliveira, Univ. Federal da Bahia (Brazil); Juliana S. C. Monteiro, Univ. Estadual de Feira de Santana (Brazil); Sandra Regina C. A. Fagnani, Iago P. F. Nunes, Luiz Guilherme P. Soares, Paulo Fernando Almeida, Univ. Federal da Bahia (Brazil) ..... [11221-24]

**Evaluation of optical redox ratio in Candida albicans cells exposed to photobiomodulation**, Tamara Adjimann, Thaila Q. Corrêa, Fernanda Alves, Sebastião Pratavieira, Instituto de Física de São Carlos (Brazil) ..... [11221-25]

**LED-bed therapy of cardiovascular disorders: a volunteer study**, Zbignevs Marcinkevics, Dzintars Briljonoks, Hedviga Kronberga, Janis Spigulis, Univ. of Latvia (Latvia) ..... [11221-27]

**BIOS SUNDAY PLENARY**

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SUN 7:15 PM TO 8:00 PM

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**  
THE 2020 RECIPIENT

**Nirmala Ramanujam**,  
Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**  
**Spying on the Secret Lives of Cells**  
**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

# CONFERENCE 11222

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11222

# Molecular-Guided Surgery: Molecules, Devices, and Applications VI

Conference Chairs: **Sylvain Gioux**, Univ. de Strasbourg (France); **Summer L. Gibbs**, Oregon Health & Science Univ. (USA)

Conference Co-Chair: **Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA)

Program Committee: **Michael Bouvet**, Univ. of California, San Diego (USA); **David J. Cuccia**, Modulated Imaging, Inc. (USA); **Michele Diana**, The Institute of Image-Guided Surgery of Strasbourg (France); **Fernando Dip**, Consultant (USA); **Summer L. Gibbs**, Oregon Health & Science Univ. (USA); **Hisataka Kobayashi**, National Cancer Institute (USA); **Frédéric Leblond**, Ecole Polytechnique de Montréal (Canada); **Jonathan T.C. Liu**, Univ. of Washington (USA); **Vasilis Ntziachristos**, Helmholtz Zentrum München GmbH (Germany), Technical Univ. of Munich (Germany); **Keith D. Paulsen**, Thayer School of Engineering at Dartmouth (USA); **Eben L. Rosenthal**, Stanford Health Care (USA); **Jonathan M. Sorger**, Intuitive Surgical, Inc. (USA); **Kenneth M. Tichauer**, Illinois Institute of Technology (USA); **Alex Vahrmeijer**, Leiden Univ. Medical Ctr. (Netherlands); **Thomas D. Wang**, Univ. of Michigan (USA); **Brian C. Wilson**, Ontario Cancer Institute (Canada)

Conference Co-Sponsors:



## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . SAT 10:00 AM TO 11:40 AM

#### Advanced Detection Methods I

Session Chairs: **Frédéric Leblond**, Polytechnique Montréal (Canada); **Summer L. Gibbs**, Oregon Health & Science Univ. (USA)

10:00 am: **Quantitative assessment of lower limb circulation with non-invasive optical imaging** (*Invited Paper*), Amaan Mazhar, Modulim (USA) . . . . . [11222-1]

10:30 am: **Generative adversarial network prediction of optical properties from wide-field images** (*Invited Paper*), Nicholas J. Durr, Johns Hopkins Univ. (USA) . . . . . [11222-2]

11:00 am: **Combined structural and molecular imaging using optical coherence tomography and immunofluorescence imaging**, Fabio Feroldi, Margherita Vaselli, Vrije Univ. Amsterdam (Netherlands); Mariska Verlaan, Amsterdam UMC (Netherlands); Helene Knaus, Valentina Davidoiu, Vrije Univ. Amsterdam (Netherlands); Danielle Vugts, Carla Molthoff, Guus van Dongen, Amsterdam UMC (Netherlands); Johannes F. de Boer, Vrije Univ. Amsterdam (Netherlands) . . . . . [11222-3]

11:20 am: **Rapid assessment of skin surgical margins using superpixel Raman spectroscopic imaging**, Xu Feng, Matthew C. Fox, Jason S. Reichenberg, Fabiana C. P. S. Lopes, Katherine R. Sebastian, Andrew K. Dunn, Mia K. Markey, James W. Tunnell, The Univ. of Texas at Austin (USA) . [11222-5]

Lunch/Exhibition . . . . . Sat 11:40 am to 1:30 pm

### SESSION 2

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . SAT 1:30 PM TO 3:00 PM

#### Advanced Detection Methods II

Session Chairs: **Alexander L. Antaris**, Intuitive Surgical, Inc. (USA); **Amaan Mazhar**, Modulim (USA)

1:30 pm: **Augmenting the vision of the endoscopist: seeing cancer in a new light** (*Invited Paper*), Sarah E. Bohndiek, Univ. of Cambridge (United Kingdom) . . . . . [11222-6]

2:00 pm: **Affinity-based color enhancement methods for contrast enhancement in hyperspectral and multimodal imaging**, Arturo Pardo, José A. Gutiérrez-Gutiérrez, Univ. de Cantabria (Spain) and Instituto de Investigación Valdecilla (IDIVAL) (Spain); José M. López-Higuera, Univ. de Cantabria (Spain) and Instituto de Investigación Valdecilla (IDIVAL) (Spain) and CIBER-BBN (Spain); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA); Olga M. Conde, Univ. de Cantabria (Spain) and Instituto de Investigación Valdecilla (IDIVAL) (Spain) and CIBER-BBN (Spain) . . . . . [11222-7]

2:20 pm: **Real-time, quantitative and wide-field oxygenation imaging platform for surgery**, Enagnon Aguenounon, Silvère Ségaud, Henric Waxin, Lucile Zorn, Julien Lamy, Murielle Torregrossa, Joseph Angelo, Sylvain Gioux, ICube (France) . . . . . [11222-8]

2:40 pm: **A backside-illuminated low-noise multispectral imager for near-infrared fluorescence image-guided surgery**, Steven M. Blair, Amit Deliwala, Eric Chen, Sailesh Subashbabu, Anthony Li, Mebin George, Missael Garcia, Univ. of Illinois (USA); Nan Cui, Washington Univ. in St. Louis (USA); Viktor Gruev, Univ. of Illinois (USA) . . . . . [11222-9]

Coffee Break . . . . . Sat 3:00 pm to 3:30 pm

### SESSION 3

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . SAT 3:30 PM TO 5:40 PM

#### Imaging Systems

Session Chairs: **Sarah E. Elizabeth Bohndiek**, Univ. of Cambridge (United Kingdom); **Nicholas J. Durr**, Johns Hopkins Univ. (USA)

3:30 pm: **Imaging the cellular microenvironment in surgical wounds** (*Invited Paper*), Kevin W. Eliceiri, Univ. of Wisconsin-Madison (USA) . [11222-10]

4:00 pm: **Fluorescence headlights proposed for minimally-invasive surgical tools** (*Invited Paper*), Eric J. Seibel, Univ. of Washington (USA) . . . . . [11222-11]

4:20 pm: **Indocyanine-green matching phantom for fluorescence-guided imaging system characterization and performance monitoring**, Alberto J. Ruiz, Thayer School of Engineering at Dartmouth (USA); Mindy Wu, Duke Univ. (USA); Ethan P. M. LaRochelle, Thayer School of Engineering at Dartmouth (USA); Dimitris Gorpas, Technische Univ. München (Germany); Joshua Pfefer, U.S. Food and Drug Administration (USA); Vasilis Ntziachristos, Technische Univ. München (Germany); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11222-12]

4:40 pm: **Image-guided fluorescence tomography in tissue phantom models of oral cancer**, Michael J. Daly, Harley Chan, Univ. Health Network (Canada); Marco Ferrari, Univ. degli Studi di Brescia (Italy); Catriona Douglas, Jacqueline Fleisig, Brian C. Wilson, David A. Jaffray, Jonathan C. Irish, Univ. Health Network (Canada) . . . . . [11222-13]

5:00 pm: **Endosteal and periosteal blood flow quantified with dynamic contrast-enhanced fluorescence to guide open orthopaedic surgery**, Shudong Jiang, Thayer School of Engineering at Dartmouth (USA); Jonathan T. Elliott, Dartmouth-Hitchcock Medical Ctr. (USA); Jason R. Gunn, Alberto J. Ruiz, Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA); Eric R. Henderson, Ida Leah Gitajn, Dartmouth-Hitchcock Medical Ctr. (USA) . . . . . [11222-14]

5:20 pm: **Fluorescence lifetime-based tumor contrast enhancement using targeted near infrared probes**, Rahul Pal, Anand T. Kumar, Massachusetts General Hospital (USA) . . . . . [11222-15]



**BIOS HOT TOPICS**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**SESSION 4**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . SUN 8:30 AM TO 10:00 AM**

**Contrast Agents**

- Session Chairs: **Kimberley S. Samkoe**, Dartmouth-Hitchcock Medical Ctr. (USA); **Conor L. Evans**, Wellman Ctr. for Photomedicine (USA)
- 8:30 am: **Nanotechnology platforms for precision theranostics: deconvoluting the specificity puzzle with quantitative molecular imaging** (*Invited Paper*), Girgis Obaid, Wellman Ctr. for Photomedicine (USA). [11222-16]
- 9:00 am: **Development of near-infrared fluorophores for use as nerve-specific contrast in fluorescence-guided surgery**, Lei G. Wang, Connor W. Barth, Oregon Health & Science Univ. (USA); Alexander L. Antaris, Jonathan M. Sorger, Intuitive Surgical, Inc. (USA); Summer L. Gibbs, Oregon Health & Science Univ. (USA) . . . . . [11222-17]
- 9:20 am: **Optimization of near-infrared nerve-specific fluorophores for clinical translation to improve fluorescence-guided nerve sparing surgical procedures**, Connor W. Barth, Lei Wang, Oregon Health & Science Univ. (USA); Vidhiben Shah, Adam Alani, Oregon State Univ. (USA); Alexander Antaris, Jonathan Sorger, Intuitive Surgical, Inc. (USA); Summer Gibbs, Oregon Health & Science Univ. (USA). . . . . [11222-18]
- 9:40 am: **Fluorescence imaging contrast in guided surgery on nerves measured in rats in vivo**, Félix Fanjul-Vélez, Univ. de Cantabria (Spain); Álvaro M. Diaz-Martínez, Univ. de Cantabria (Spain) and Ctr. de Investigación Biomédica en Red de Salud Mental (Spain) and Instituto de Biomedicina y Biotecnología de Cantabria (Spain); Emilio Garro-Martínez, Univ. de Cantabria (Spain) and Ctr. de Investigación Biomédica en Red de Salud Mental (Spain); José L. Arce-Diego, Univ. de Cantabria (Spain) . . . . . [11222-19]
- Coffee Break. . . . . Sun 10:00 am to 10:30 am

**SESSION 5**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . SUN 10:30 AM TO 12:30 PM**

**Clinical Translation and Clinical Applications I**

- Session Chairs: **Kenneth M. Tichauer**, Illinois Institute of Technology (USA); **Summer L. Gibbs**, Oregon Health & Science Univ. (USA)
- 10:30 am: **Antibodies, favorite tools for fluorescence-guided surgery** (*Invited Paper*), André Pèlerin, Institut de Recherche en Cancérologie de Montpellier (France); Marian Gutowski, Institut Regional du Cancer de Montpellier (France); Françoise Cailler, SurgiMab (France) . . . . . [11222-20]
- 11:00 am: **MUC16 as a potential target for the surgical detection of pancreatic cancer** (*Invited Paper*), Madeline T. Olson, Nicholas E. Wojtynek, Thomas C. Caffrey, Prakash Radhakrishnan, Quan P. Ly, Geoffrey A. Talmon, Michael A. Hollingsworth, Aaron M. Mohs, Univ. of Nebraska Medical Ctr. (USA) . . . . . [11222-21]
- 11:30 am: **Tumor margin assessment using frozen sections can be improved by paired-agent imaging**, Kimberley S. Samkoe, Dartmouth-Hitchcock Medical Ctr. (USA); Cheng Wang, Thayer School of Engineering at Dartmouth (USA); Eunice Chen, Laura Tafe, Dartmouth-Hitchcock Medical Ctr. (USA); Kenneth Tichauer, Illinois Institute of Technology (USA). . . . . [11222-22]
- 11:50 am: **Task-based evaluation of fluorescent-guided cancer surgery as a means of identifying optimal imaging agent properties in the context of variability in tumor- and healthy-tissue physiology**, Kenneth M. Tichauer, Illinois Institute of Technology (USA); Cheng Wang, Thayer School of Engineering at Dartmouth (USA); Xiaochun Xu, Kimberley S. Samkoe, Dartmouth College (USA) . . . . . [11222-23]
- 12:10 pm: **A proof-of-concept methodology to validate the in situ visualization of residual disease using cancer-targeted molecular agents in fluorescence-guided surgery**, Servando Hernandez Vargas, Institute of Molecular Medicine, The Univ. of Texas Health Science Ctr. at Houston (USA); Christie Lin, OnLume, Inc. (USA); Solmaz Agha Amiri, Julie Voss, Institute of Molecular Medicine, The Univ. of Texas Health Science Ctr. at Houston (USA); Adam Uselmann, OnLume, Inc. (USA); Naru Ikoma, Hop S. Tran Cao, The Univ. of Texas M. D. Anderson Cancer Ctr. (USA); Sukhen C. Ghosh, The Univ. of Texas Health Science Ctr. at Houston (USA); Adam Uselmann, OnLume, Inc. (USA); Ali Azhdarinia, Institute of Molecular Medicine, The Univ. of Texas Health Science Ctr. at Houston (USA). . . . . [11222-24]
- Lunch/Exhibition Break . . . . . Sun 12:30 am to 1:30 am

**SESSION 6**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . SUN 1:30 PM TO 3:10 PM**

**Clinical Translation and Clinical Applications II**

- Session Chairs: **Sylvain Gioux**, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France); **Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA)
- 1:30 pm: **Clinical translation of novel contrast agent for image guided surgery** (*Invited Paper*), Alexander L. Vahrmeijer, Leiden Univ. Medical Ctr. (Netherlands) . . . . . [11222-30]
- 2:00 pm: **Optical imaging devices and optical imaging agents: a device maker's observations** (*Invited Paper*), John Fengler, Stryker Endoscopy (USA). . . . . [11222-26]
- 2:30 pm: **Update on AAPM task group 311: guidance for technical performance evaluation for fluorescence guided surgery systems**, Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA); Timothy Zhu, Univ. of Pennsylvania (USA); Vasilis Ntziachristos, Helmholtz Zentrum München GmbH (Germany); Brian C. Wilson, Univ. of Toronto (Canada); Keith D. Paulsen, Thayer School of Engineering at Dartmouth (USA); Sylvain Gioux, Univ. de Strasbourg (France); Robert Nordstrom, National Cancer Institute (USA); Joshua Pfefer, U.S. Food and Drug Administration (USA); Bruce J. Tromberg, National Institute of Biomedical Imaging and Bioengineering (USA); Heidrun Wabnitz, Physikalisch-Technische Bundesanstalt (Germany); Arjun Yodh, Univ. of Pennsylvania (USA); Yu Chen, Univ. of Maryland, Baltimore County (USA); Maritoni Litorja, National Institute of Standards and Technology (USA) . . . . . [11222-27]
- 2:50 pm: **First short-wave infrared (SWIR) fluorescence imaging in humans: imaging of ABY-029 in head and neck cancers**, Brook K. Byrd, Dartmouth College (USA); Joseph A. Paydarfar, Dennis J. Wirth, Laura J. Tafe, Kimberley S. Samkoe, Dartmouth-Hitchcock Medical Ctr. (USA); Keith D. Paulsen, Scott C. Davis, Thayer School of Engineering at Dartmouth (USA) . . . . . [11222-28]
- Coffee Break. . . . . Sun 3:10 pm to 3:40 pm

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# CONFERENCE 11222

## SESSION 7

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . SUN 3:40 PM TO 5:40 PM

### Clinical Translation and Clinical Applications III

Session Chairs: **Sylvain Gioux**, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France);

**Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA)

3:40 pm: **Optical imaging, surgery and drug development: a successful triangle** (*Invited Paper*), Gooitzen M. van Dam, Univ. Medical Ctr. Groningen (Netherlands) . . . . . [11222-29]

4:10 pm: **Clinical application of fluorescence in the operating room** (*Invited Paper*), Eben L. Rosenthal, Stanford Univ. School of Medicine (USA). [11222-25]

4:40 pm: **Near infrared fluorescence-guided surgery in pancreatic cancers**, Guolan Lu, Nynke van den Berg, Brock Martin, Zachary Hart, Naoki Nishio, Stan van Keulen, Shayan Fakurnejad, Quan Zhou, Stefania Chirita, George Fisher, George Poultsides, Eben Rosenthal, Stanford Univ. (USA) . . . . . [11222-31]

5:00 pm: **Perspectives on the phase 0 clinical trial of microdose administration of ABY-029 for fluorescence guided surgery**, Kimberley S. Samkoe, Jonathan Elliott, Dartmouth-Hitchcock Medical Ctr. (USA); Hira Shahzad Sardar, Jason Gunn, Thayer School of Engineering at Dartmouth (USA); Konstantinos Linos, Laura Tafe, Dartmouth-Hitchcock Medical Ctr. (USA); Brent Harris, Georgetown Univ. Medical Ctr. (USA); Joachim Feldwisch, Affibody AB (Sweden); Brian Pogue, Thayer School of Engineering at Dartmouth (USA); Eric Henderson, Joseph Paydarfar, David Roberts, Dartmouth-Hitchcock Medical Ctr. (USA); Keith Paulsen, Thayer School of Engineering at Dartmouth (USA) . . . . . [11222-32]

5:20 pm: **Effect of preoperative cancer treatment on epidermal growth factor receptor (EGFR) receptor expression level in ABY-029 guided sarcoma surgery**, Xiaochun Xu, Dartmouth-Hitchcock Medical Ctr. (USA); Kimberley Samkoe, Dartmouth College (USA) and Dartmouth-Hitchcock Medical Ctr. (USA); Eric Henderson, Dartmouth-Hitchcock Medical Ctr. (USA) . . . . . [11222-33]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Pharmacokinetic fluorescence imaging of for comparative uptake of therapeutics in an open skin murine model**, Jason R. Gunn, Ethan Philip M. LaRochelle, Thayer School of Engineering at Dartmouth (USA); Kimberley S. Samkoe, Dartmouth-Hitchcock Medical Ctr. (USA); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11222-34]

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## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

### Nirmala Ramanujam,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

### Spying on the Secret Lives of Cells

**Eric Betzig**, Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

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# CONFERENCE 11223

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY)

Monday–Tuesday 3–4 February 2020 • Proceedings of SPIE Vol. 11223

# Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2020

*Conference Chairs:* **Tianhong Dai**, Wellman Ctr. for Photomedicine (USA), Massachusetts General Hospital (USA), Harvard Medical School (USA); **Jürgen Popp**, Leibniz-Institut für Photonische Technologien e.V. (Germany); **Mei X. Wu**, Harvard Medical School (USA)

*Program Committee:* **Alessandro M. Deana**, UNINOVE (Brazil); **Pu-Ting Dong**, Boston Univ. (USA); **Walfre Franco**, Wellman Ctr. for Photomedicine (USA); **Michael R. Hamblin**, Wellman Ctr. for Photomedicine (USA); **Kristen C. Maitland**, Texas A&M Univ. (USA); **Akilan Palanisami**, Wellman Ctr. for Photomedicine (USA), Massachusetts General Hospital (USA), Harvard Medical School (USA); **Wei-Chuan Shih**, Univ. of Houston (USA); **Ying Wang**, Chinese PLA General Hospital (China)

## MONDAY 3 FEBRUARY

### SESSION 1

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . MON 8:25 AM TO 10:10 AM

#### Photonic Diagnosis I

Session Chair: **Mei X. Wu**, Harvard Medical School (USA)

8:25 am: **Deuterium uptake in combination with Raman spectroscopy as a tool to investigate antibiotic susceptibility of bacteria** (*Invited Paper*), Christoph Haisch, David Bauer, Li Qiu, Karin Wieland, Technische Univ. München (Germany); Anna-Catherine Neumann-Cip, Andreas Wieser, Max von Pettenkofer Institute, Ludwig-Maximilians-Univ. München (Germany) and Univ. Hospital, Ludwig-Maximilians-Univ. München (Germany); Giuseppe Magistro, Christian Stief, Ludwig-Maximilians-Univ. München (Germany) . . . . . [11223-1]

8:50 am: **Chip based sample preparation methods for the Raman spectroscopic identification of bacteria** (*Invited Paper*), Susanne Pahlow, Friedrich-Schiller-Univ. Jena (Germany) and Leibniz-Institut für Photonische Technologien e.V. (Germany); Thomas G. Mayerhöfer, Uwe Hübner, Karina Weber, Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany) . . . . . [11223-2]

9:15 am: **Quantitative fluorescence spectroscopy to detect and identify bacteria and to monitor their viability** (*Invited Paper*), Frédérique Vanholsbeeck, Julia Robertson, Fang Ou, Claire Honney, Rachel Guo, Simon Swift, Cushla M. McGoverin, The Univ. of Auckland (New Zealand) . . . . . [11223-3]

9:40 am: **A label-free study of murine gut dysbiosis with fluorescence lifetime spectroscopy and imaging**, Alba Alfonso Garcia, Stephanie A. Cevallos, Julien Bec, Xiangnan Zhou, Alisha E. Miller, Andreas Baumler, Laura Marcu, Univ. of California, Davis (USA) . . . . . [11223-4]

9:55 am: **A label-free localized surface plasmon resonance (LSPR) aptasensor for the detection of mycotoxins**, Min-Gon Kim, Jin-Ho Park, Bobin Lee, Su-Ji Ha, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [11223-5]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . MON 10:40 AM TO 11:45 AM

#### Photonic Diagnosis II

Session Chair: **Christoph Haisch**, Technische Univ. München (Germany)

10:40 am: **Simultaneous detection of different sepsis biomarkers: from the lab to the hospital** (*Invited Paper*), Francesco Baldini, Cosimo Trono, Sara Tombelli, Simone Berneschi, Ambra Giannetti, Barbara Adinolfi, Francesco Chiavaoli, Istituto di Fisica Applicata “Nello Carrara” (Italy); Romeo Bernini, Gianluca Persichetti, Genni Testa, Istituto per il Rilevamento Elettromagnetico dell’Ambiente (Italy); Giampiero Porro, Datamed S.r.l. (Italy); Jürgen Popp, Ute Neugebauer, Leibniz-Institut für Photonische Technologien e.V. (Germany); Daniel Thomas-Rüddel, Michael Kiehnopf, Anuradha Ramoji, Universitätsklinikum Jena (Germany) . . . . . [11223-6]

11:05 am: **Non-contact Raman spectroscopic pH measurement of cerebrospinal fluid: in vivo rat and perimortem swine models** (*Invited Paper*), Seth Fillioe, Kyle K. Bishop, Syracuse Univ. (USA); Josh Satalin, Sarah Blair, SUNY Upstate Medical Univ. (USA); Charles M. Peterson, Syracuse Univ. (USA); Gary Nieman, SUNY Upstate Medical Univ. (USA); Alexander V. Jannini, Jon J. Kim, Richard T. McDonough, Steve Ortiz, Jerry Goodisman, Julie M. Hasenwinkel, Joseph Chaiken, Syracuse Univ. (USA) . . . . . [11223-7]

11:30 am: **The PVOH device: our first stop on the path to small and very small physical embodiments of the PV[O]H algorithm**, David Rice, Jeffrey Bebernes, Sheryl Bebernes, John Fayos, Jonathan Cormier, Critical Link, LLC (USA); Michael Houk, Howard Ammenheuser, Bristol Instruments, Inc. (USA); Seth Fillioe, Charles M. Peterson, Joseph Chaiken, Syracuse Univ. (USA) . . . . . [11223-8]

Lunch Break . . . . . Mon 11:45 am to 1:30 pm

### SESSION 3

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . MON 1:30 PM TO 3:20 PM

#### Photonic Diagnosis III

Session Chair: **Francesco Baldini**, Istituto di Fisica Applicata “Nello Carrara” (Italy)

1:30 pm: **Rapid antibiotic susceptibility testing by single bacterium stimulated Raman metabolic imaging** (*Invited Paper*), Ji-Xin Cheng, Boston Univ. (USA) . . . . . [11223-10]

1:55 pm: **Rapid detection of antibiotic-resistant bacteria at the single-cell level using two-photon excitation fluorescence and coherent anti-Stokes Raman scattering microscopy**, Chi Zhang, Jungeun Won, Stephen A. Boppart, Univ. of Illinois (USA) . . . . . [11223-11]

2:10 pm: **Rapid antibiotic susceptibility testing of pathogenic bacteria using heavy-water-labeled single-cell Raman spectroscopy in clinical samples**, Li Cui, Kai Yang, Yong-Guan Zhu, Institute of Urban Environment (China) . . . . . [11223-12]

2:25 pm: **Phage susceptibility testing with lensless imaging technique**, Prisca Perlemoine, CEA-Grenoble (France); Emmanuel Picard, Emmanuel Hadji, Univ. Grenoble Alpes (France) and CEA - Institut de Recherche Interdisciplinaire de Grenoble (France); Marc Zelsmann, Alexis Maire, Univ. Grenoble Alpes (France) and Lab. des Technologies de La Microélectronique (France); Eric Lacot, Univ. Grenoble Alpes (France) and Lab. Interdisciplinaire de Physique (France); Pierre Marcoux, Univ. Grenoble Alpes (France) and Lab. d’Electronique de Technologie de l’Information (France) . . . . . [11223-13]

2:40 pm: **Shining a light on antibiotic selection: optimised live/dead fluorescence spectrometry for rapid antimicrobial susceptibility testing**, Julia Robertson, Fang Ou, Cushla M. McGoverin, Frédérique Vanholsbeeck, Simon Swift, The Univ. of Auckland (New Zealand) . . . . . [11223-14]

2:55 pm: **A paradigm shift in chronic wound assessment: incorporating bacterial fluorescence imaging into standard of care** (*Invited Paper*), Thomas Serena, SerenaGroup (USA) . . . . . [11223-15]

# CONFERENCE 11223

## POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**UV-C treatment for infection prevention**, Kavita Aswani, Excelitas Canada Inc. (Canada) . . . . . [11223-35]

**Decacationic chlorin-vancomycin conjugate mediated antimicrobial photodynamic inactivation of methicillin-resistant Staphylococcus aureus**, Xiaojing Liu, Wellman Ctr. for Photomedicine (USA) and Shanghai Skin Disease Hospital (China) and Massachusetts General Hospital (USA); He Yin, Min Wang, Univ. of Massachusetts Lowell (USA); Xueping S. Goh, Wellman Ctr. for Photomedicine (USA) and Massachusetts General Hospital (USA); Ying Wang, Chinese PLA General Hospital (China); Xiuli Wang, Shanghai Skin Disease Hospital (China); Long Y. Chiang, Univ. of Massachusetts Lowell (USA); Tianhong Dai, Wellman Ctr. for Photomedicine (USA) and Massachusetts General Hospital (USA) . . . . . [11223-36]

**Raman spectroscopy for identification M. tuberculosis strains with different antibiotic susceptibility**, Andrey Y. Zyubin, Immanuel Kant Baltic Federal Univ. (Russian Federation); Anastasiya I. Lavrova, Marine Z. Dogonadze, Saint Petersburg State Univ. (Russian Federation); Iliya G. Samusev, Immanuel Kant Baltic Federal Univ. (Russian Federation) . . . . . [11223-38]

**Exploring the using of curcumin in new formulations for treatment onychomycosis by photodynamic therapy**, Gabriela Adriano Sarilho, Ana Paula da Silva, Fabiana R. L. Ferreira, PDT Pharma Indústria e Comércio de Produtos Farmacêuticos (Brazil); Natália M. Inada, Vanderlei S. Bagnato, Instituto de Física de São Carlos (Brazil); Inara A. S. Luccas, PDT Pharma Indústria e Comércio de Produtos Farmacêuticos (Brazil) . . . . . [11223-39]

**The effect of ETNBS and BPD used for photodynamic inactivation over oral biofilms**, Alessandra Nara de Souza Rastelli, Univ. Estadual Paulista “Júlio de Mesquita Filho” (Brazil); Tayyaba Hasan, Wellman Ctr. for Photomedicine (USA) . . . . . [11223-40]

**Curcumin-mediated photodynamic inactivation and confocal microscopy analysis for food decontamination**, Thaila Q. Corrêa, Sebastião Pratavieira, Vanderlei S. Bagnato, Univ. de São Paulo (Brazil) . . . . . [11223-41]

**Implantable NIR muscle oxygenation sensor**, Chhavi Goenka, Walfre Franco, Massachusetts General Hospital (USA); Allyson Hindle, Univ. of Nevada, Las Vegas (USA); Manuel Ahumada, Univ. Mayor (Chile); Esmeralda Ibarra-Silva, Massachusetts General Hospital (USA) . . . . . [11223-42]

**Optical properties of human gums after photodynamic therapy with methylene blue (in vitro)**, Alex A. Selifonov, Saratov State Univ. (Russian Federation); Tatyana M. Zagorovskaya, Olga V. Syrova, Olga Y. Aleshkina, Saratov State Medical Univ. (Russian Federation); Valeriy V. Tuchin, Saratov State Univ. (Russian Federation) . . . . . [11223-43]

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 8:35 AM TO 10:00 AM

### Antimicrobial Photodynamic Therapy

Session Chair: **Kristen C. Maitland**, Texas A&M Univ. (USA)

8:35 am: **Photodynamic therapy for combating multidrug-resistant bacterial infections** (*Invited Paper*), Peng Li, Northwestern Polytechnical Univ. (China) and Nanjing Tech Univ. (China); Qingyan Jia, Wei Huang, Northwestern Polytechnical Univ. (China) . . . . . [11223-16]

9:00 am: **Improving photodynamic inactivation against staphylococcus aureus biofilms with ultrasound and potassium iodide**, Fernanda Alves, Natália Mayumi Inada, Sebastião Pratavieira, Vanderlei Salvador Bagnato, Cristina Kurachi, Instituto de Física de São Carlos (Brazil) . . . . . [11223-17]

9:15 am: **Photodynamic chitosan-based biomaterials as a potent alternative candidate for combating antibiotic-resistant bacteria**, Wenjun Miao, Nanjing Tech Univ. (China) . . . . . [11223-18]

9:30 am: **Photodynamic inactivation using curcumin-loaded Pluronic® F-127 over Streptococcus mutans biofilm**, Alessandra Nara de Souza Rastelli, Diego Dantas Lopes dos Santos, João Felipe Bessegato, Univ. Estadual Paulista “Júlio de Mesquita Filho” (Brazil); Joao Augusto Oshiro Jr., Univ. Estadual Paulista “Julio de Mesquita Filho” (Brazil); Vanderlei S. Bagnato, Univ. de São Paulo (Brazil); Marlus Chorilli, Univ. Estadual Paulista “Júlio de Mesquita Filho” (Brazil) . . . . . [11223-19]

9:45 am: **Photodynamic therapy: alternative in decontamination of surfaces**, Augusto Alberto Foggiano, Acacio Fuziy, UENP (Brazil) and Medical and Dental Institute of Phototherapy Foggiano (Brazil); Aguiinaldo Segundo Garcez, São Leopoldo Mandic (Brazil); Douglas Fernandes Silva, UENP (Brazil) and Medical and Dental Institute of Phototherapy Foggiano (Brazil) . . [11223-20]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

### SESSION 5

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 10:30 AM TO 12:05 PM

### Antimicrobial Blue Light

Session Chair: **Pu-Ting Dong**, Boston Univ. (USA)

10:30 am: **Mechanism study for bactericidal synergy between antimicrobial blue light (aBL) and carvacrol** (*Invited Paper*), Mei X. Wu, Shen Wang, Min Lu, Brijesh Bhayana, Mormoko Ishii, Tianhong Dai, Harvard Medical School (USA) . . . . . [11223-21]

10:55 am: **Sensitizing multidrug-resistant bacteria to antibiotics using the power of light** (*Invited Paper*), Leon G. Leanse, Jeffrey A. Gelfand, Tianhong Dai, Massachusetts General Hospital (USA) . . . . . [11223-22]

11:20 am: **Photoinactivation of otopathogens using 405 nm blue light: Implications for the treatment of otitis media**, Xiaojing Liu, Wellman Ctr. for Photomedicine (USA) and Shanghai Skin Disease Hospital (China) and Massachusetts General Hospital (USA); Qihang Chang, Wellman Ctr. for Photomedicine (USA) and Tongji Univ. (China); Raquel Ferrer-Espada, Leon G. Leanse, Xueping S. Goh, Wellman Ctr. for Photomedicine (USA) and Massachusetts General Hospital (USA); Xiuli Wang, Shanghai Skin Disease Hospital (China); Jeffrey A. Gelfand, Massachusetts General Hospital (USA); Tianhong Dai, Wellman Ctr. for Photomedicine (USA) and Massachusetts General Hospital (USA) . . . . . [11223-23]

11:35 am: **Distinct targets for blue light photoinactivation**, Carolina dos Anjos, Fabio C. Pogliani, Fábio P. Sellera, Mauricio Baptista, Martha S. Ribeiro, Nilton Lincopan, Milena Dropa, Caetano Sabino, Univ. de São Paulo (Brazil) . . . . . [11223-24]

11:50 am: **Effectiveness and potential mechanism of a novel photochemical strategy on Escherichia coli**, Shen Wang, Shanghai Ninth People's Hospital (China) and Wellman Ctr. for Photomedicine (USA) [11223-25]

Lunch Break . . . . . Tue 12:05 pm to 1:30 pm

**SESSION 6**

**LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 1:30 PM TO 2:35 PM**

**Light-Assisted Delivery of Antimicrobials**

Session Chair: **Walfre Franco**, Wellman Ctr. for Photomedicine (USA)

1:30 pm: **Improving antibiotics' penetration and efficiency for treating biofilm infections by laser-induced vapor nanobubbles** (*Invited Paper*), Eline Teirlinck, Ranhua Xiong, Toon Brans, Katrien Forier, Juan C. Fraire, Heleen Van Acker, Stefaan C. De Smedt, Tom Coenye, Kevin Braeckmans, Univ. Gent (Belgium) . . . . . [11223-26]

1:55 pm: **Photo-released drugs: a targeted treatment approach for arthritis** (*Invited Paper*), Victoria Wickenheisser, Duke Univ. (USA); Emilia Zywoot, The Univ. of North Carolina at Chapel Hill (USA); Emily Rabjohns, Duke Univ. (USA); Natalia Orlova, Christina Marvin, Song Ding, David Lawrence, The Univ. of North Carolina at Chapel Hill (USA); Teresa Tarrant, Duke Univ. (USA) . . . . . [11223-27]

2:20 pm: **New materials for laser welding of connective tissue and controlled release of antimicrobial principles**, Fulvio Ratto, Istituto di Fisica Applicata "Nello Carrara" (Italy); Annalisa Aluigi, Istituto per la Sintesi Organica e la Fotoreattività (Italy); Sonia Centi, Alessio Milanese, Istituto di Fisica Applicata "Nello Carrara" (Italy); Boris N. Khlbtsov, Nikolai G. Khlbtsov, Institute of Biochemistry and Physiology of Plants and Microorganisms (Russian Federation); Vania Delfino, Carmela Calonico, Antonella Lo Nostro, Univ. degli Studi di Firenze (Italy); Giada Magni, Claudia Borri, Lucia Cavigli, Paolo Matteini, Roberto Pini, Francesca Rossi, Istituto di Fisica Applicata "Nello Carrara" (Italy) . . . . . [11223-28]

**SESSION 7**

**LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 2:35 PM TO 4:50 PM**

**New Mechanisms and Miscellaneous**

Session Chair: **Tianhong Dai**, Harvard Medical School (USA)

2:35 pm: **Inhibiting Staphylococcus aureus antibiotic resistance via photo-disassembly of membrane microdomains** (*Invited Paper*), Jie Hui, Pu-Ting Dong, Boston Univ. (USA); Lijia Liang, Jilin Univ. (China); Taraknath Mandal, Junjie Li, Yuewei Zhan, Sebastian Jusuf, Cheng Zong, Qiang Cui, Ji-Xin Cheng, Boston Univ. (USA) . . . . . [11223-29]

3:00 pm: **Eradication of broad-spectrum multi-drug fungal pathogens through photoinactivation of a detoxifying enzyme** (*Invited Paper*), Pu-Ting Dong, Boston Univ. (USA); Zeina Dagher, Massachusetts General Hospital (USA); Yuewei Zhan, Jie Hui, Boston Univ. (USA); Michael K. Mansour, Massachusetts General Hospital (USA); Ji-Xin Cheng, Boston Univ. (USA) . . . . . [11223-30]

Coffee Break. . . . . Tue 3:25 pm to 3:55 pm

3:55 pm: **Investigation of active matrix- metalloproteinase-8 (aMMP-8) as a reference parameter for path control in antimicrobial photothermal therapy (aPTT) using a split-mouth design** (*Invited Paper*), Jeannette Deumer, Erstes Zahnärztliches Laserzentrum Berlin GmbH (Germany); Matthias Frentzen, Rheinische Friedrich-Wilhelms-Univ. Bonn (Germany); Martina C. Meinke, Charité Universitätsmedizin Berlin (Germany) . . . . . [11223-31]

4:20 pm: **Emerging applications of UVC LED emitters against common foodborne pathogens and spoilage organisms**, Tatiana Koutchma, Agriculture and Agri-Food Canada (Canada) . . . . . [11223-32]

4:35 pm: **Synergistic inactivation of methicillin resistant Staphylococcus aureus via photo-induced chemical bleaching of staphyloxanthin by antimicrobial blue light and pyocyanin**, Leon G. Leanse, Xiaojing Zeng, Tianhong Dai, Massachusetts General Hospital (USA) . . . . . [11223-33]

**Photonics West Industry Stage**

Tuesday - Thursday • Hall DE  
Keynotes and panels open to all attendees  
Pages 60-63

# CONFERENCE 11224

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH)

Monday 3 February 2020 • Proceedings of SPIE Vol. 11224

## Optics and Ionizing Radiation

Conference Chair: **Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA)

Program Committee: **Xiaoyuan Chen**, National Institutes of Health (USA); **Adam P. Gibson**, Univ. College London (United Kingdom); **Ewa M. Goldys**, The Univ. of New South Wales (Australia); **Guillem Pratx**, Stanford Univ. (USA); **Jie Tian**, Chinese Academy of Sciences (China); **Brian C. Wilson**, Princess Margaret Cancer Ctr. (Canada); **Raiyan T. Zaman**, Massachusetts General Hospital (USA); **Zhenxi Zhang**, Xi'an Jiaotong Univ. (China); **Timothy C. Zhu**, Perelman Ctr. for Advanced Medicine (USA)

### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . MON 8:45 AM TO 10:00 AM

#### X-ray Dynamic Therapy

Session Chairs: **Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA); **Guillem Pratx**, Stanford Univ. (USA)

8:45 am: **Radiodynamic therapy of cancer through nanotechnology** (*Invited Paper*), Xiaoyuan Chen, National Institutes of Health (USA). . . . . [11224-1]

9:15 am: **Nanoparticles aided synchronous cancer treatment triggered by x-ray**, Cuiping Yao, Xi'an Jiaotong Univ. (China) and Thayer School of Engineering at Dartmouth (USA); Zhenxi Zhang, Xi'an Jiaotong Univ. (China); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . [11224-3]

9:30 am: **Radiation activated photodynamic therapy-an insight to treat deep-seated tumours with biocompatible nanodrug**, Sandhya Clement, The Univ. of New South Wales (Australia); Layla Pires, Univ. of Toronto (Canada); Alina Kapitannikova, The Univ. of New South Wales (Australia) and Sechenov Univ. (Russian Federation); Tzong-Tyng Hung, Wei Deng, The Univ. of New South Wales (Australia); Anna Guller, The Univ. of New South Wales (Australia) and Sechenov Univ. (Russian Federation); Ayad Anwer, The Univ. of New South Wales (Australia); Brian Wilson, Univ. of Toronto (Canada); Christine Allen, Ewa Goldys, The Univ. of New South Wales (Australia) . . . . . [11224-4]

9:45 am: **Copper systemamine: a new sensitizer for x-ray induced photodynamic therapy** (*Invited Paper*), Wei Chen, The Univ. of Texas at Arlington (USA) . . . . . [11224-5]

Coffee Break. . . . . Mon 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) MON 10:30 AM TO 12:00 PM

#### Nuclear Medicine and Optics

Session Chairs: **Petr Brůža**, Dartmouth College (USA); **Zhenxi Zhang**, Xi'an Jiaotong Univ. (China)

10:30 am: **Positron emission tomography meets microscopy: microscale PET imaging of patient-derived tumor organoids for cancer research and personalized medicine** (*Invited Paper*), Syamantak Khan, June Ho Shin, John Sunwoo, Guillem Pratx, Stanford Univ. (USA) . . . . . [11224-6]

11:00 am: **Intraoperative tumor margin assessment in prostate cancer patients using Cerenkov luminescence imaging**, Judith olde Heuvel, The Netherlands Cancer Institute-Antoni van Leeuwenhoek Hospital (Netherlands) and Technical Medical Ctr., Univ. of Twente (Netherlands); Berlinda de Wit-van der Veen, Henk van der Poel, Marcel Stokkel, The Netherlands Cancer Institute-Antoni van Leeuwenhoek Hospital (Netherlands); Cornelis Slump, Technical Medical Ctr., Univ. of Twente (Netherlands) . . . . . [11224-7]

11:15 am: **In vivo radiopharmaceutical excited fluorescence molecular imaging** (*Invited Paper*), Zhenhua Hu, Xiaojing Shi, Zeyu Zhang, Kun Wang, Jie Tian, Institute of Automation (China) . . . . . [11224-8]

11:45 am: **A pre-clinical bioluminescence tomography-guided radiation research platform for pancreatic cancer**, Zijian Deng, Xiangkun Xu, The Johns Hopkins Univ. School of Medicine (USA); Hamid Dehghani, The Univ. of Birmingham (United Kingdom); Alexander Klose, InVivo Analytics, Inc. (USA); Phuoc Tran, Ken Wang, The Johns Hopkins Univ. School of Medicine (USA) . . . . . [11224-9]

Lunch/Exhibition Break . . . . . Mon 12:00 pm to 1:00 pm

#### SESSION 3

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . MON 1:15 PM TO 3:00 PM

#### Novel detectors and Imaging Systems

Session Chair: **Ethan Philip M. LaRochelle**, Thayer School of Engineering at Dartmouth (USA)

1:15 pm: **Perspectives and challenges in radiotherapy imaging camera design** (*Invited Paper*), Petr Bruza, Dartmouth College (USA). . . . . [11224-10]

1:45 pm: **Cherenkov imaging for total skin electron therapy: an update** (*Invited Paper*), Timothy C. Zhu, Perelman Ctr. for Advanced Medicine (USA); Tianshun Miao, Thayer School of Engineering at Dartmouth (USA); Yihong Ong, Perelman Ctr. for Advanced Medicine (USA); Petr Bruza, Thayer School of Engineering at Dartmouth (USA); Amit Maity, John Plastaras, Perelman Ctr. for Advanced Medicine (USA); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11224-11]

2:15 pm: **Nanosecond scanned x-ray sheet imaging for time-resolved luminescence tomography**, Arthur Pétusseau, Petr Bruza, Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA). . . . . [11224-12]

2:30 pm: **Cherenkov emission from tissue is inversely related to tissue optical attenuation and proportional to the radiation dose buildup gradient**, Brian W. Pogue, Petr Bruza, Thayer School of Engineering at Dartmouth (USA) . . . . . [11224-13]

2:45 pm: **Effect of external magnetic field on the collected Cherenkov radiation by fiber optic dosimeters**, Borna Maraghechi, Daniel Mulrow, Harold Li, Arash Darafsheh, Washington Univ. School of Medicine in St. Louis (USA) . . . . . [11224-14]

Coffee Break. . . . . Mon 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . MON 3:30 PM TO 5:00 PM

#### High Resolution X-Ray/Optical Imaging

Session Chairs: **Timothy C. Zhu**, Perelman Ctr. for Advanced Medicine (USA); **Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA)

3:30 pm: **X-ray luminescence imaging for small animals** (*Invited Paper*), Changqing Li, Michael C. Lun, Univ. of California, Merced (USA); Wenxiang Cong, Rensselaer Polytechnic Institute (USA); Md Arifuzzaman, Meenakshi Ranasinghe, Sriparna Bhattacharya, Jeffrey Anker, Clemson Univ. (USA); Ge Wang, Rensselaer Polytechnic Institute (USA) . . . . . [11224-15]

4:00 pm: **Improving temporal resolution of non-contact in vivo pO2 estimation during fractionated external beam radiotherapy** (*Invited Paper*), Ethan Philip M. LaRochelle, Jennifer R. Shell, Thayer School of Engineering at Dartmouth (USA); Michael Jermyn, DoseOptics, LLC (USA); Jason R. Gunn, Thayer School of Engineering at Dartmouth (USA); Sergei A. Vinogradov, Univ. of Pennsylvania (USA); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11224-16]

4:30 pm: **Cherenkov-excited detection of luminescent injections for a novel response assay in radiation therapy**, Jennifer Soter, Dartmouth College (USA) . . . . . [11224-17]

4:45 pm: **Improve depth reconstruction for Cherenkov-excited luminescence scanned tomography**, Jinchao Feng, Di Chang, Zhe Li, Zhonghua Sun, Kebin Jia, Beijing Univ. of Technology (China) . . . . . [11224-18]

**POSTERS-MONDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Growth kinetics of the response of EBT3 and EBT-XD radiochromic films irradiated with megavoltage beams,** Daniel Mulrow, Rao Khan, Arash Darafsheh, Washington Univ. School of Medicine in St. Louis (USA) . . . . . [11224-19]

**Quantification of osteosarcoma mineralization on plain radiographs: novel software applications to assess response to chemotherapy,** Xiaochun Xu, Dartmouth-Hitchcock Medical Ctr. (USA); Kimberley Samkoe, Dartmouth-Hitchcock Medical Ctr. (USA) and Dartmouth College (USA); Megan E. Anderson, Harvard Medical School (USA) and Boston Children’s Hospital (USA); Eric R. Henderson, Dartmouth-Hitchcock Medical Ctr. (USA) and Dartmouth College (USA) . . . . . [11224-20]

**Determination of the flood field of camera for Cherenkov imaging,** Shweta Majumder, Brown Univ. (USA); Tianshun Miao, Thayer School of Engineering at Dartmouth (USA); Timothy C. Zhu, Perelman Ctr. for Advanced Medicine (USA) . . . . . [11224-21]

# CONFERENCE 11225

LOCATION: ROOM 213 (LEVEL 2 SOUTH)

Saturday 1 February 2020 • Proceedings of SPIE Vol. 11225

# Clinical and Translational Neurophotonics 2020

*Conference Chairs:* **Steen J. Madsen**, Univ. of Nevada, Las Vegas (USA); **Victor X. D. Yang**, Ryerson Univ. (Canada); **Nitish V. Thakor**, National Univ. of Singapore (Singapore)

*Program Committee:* **David Abookasis**, Ariel Univ. of Samaria (Israel); **Frederic Leblond**, Ecole Polytechnique de Montréal (Canada); **Herbert Stepp**, Ludwig-Maximilians-Univ. München (Germany)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SAT 9:10 AM TO 10:10 AM

#### Optical Spectroscopy: Pre-Clinical I

Session Chair: **Steen J. Madsen III**, Univ. of Nevada, Las Vegas (USA)

9:10 am: **Collaborative medical robot for OCT imaging motion compensation**, Robnier Reyes, Ryerson Univ. (Canada); Mohammadmahdi Rastgar-Jazi, Univ. of Toronto (Canada); Andrew J. Marques, Chaoliang Chen, Victor D. Yang, Ryerson Univ. (Canada) ..... [11225-1]

9:30 am: **Feasibility study of using optical coherence tomography for ex-vivo pituitary adenoma biopsies screening**, Fabian Placzek, Alexander Micko, Ryan Sentosa, Jeremias Puels, Daniela Bovenkamp, Romana Hoeflberger, Arthur Hosmann, Marco Andreana, Angelika Unterhuber, Wolfgang Drexler, Stefan Wolfsberger, Rainer A. Leitgeb, Medizinische Univ. Wien (Austria) ..... [11225-2]

9:50 am: **In vivo imaging of shock wave-induced nitric oxide generation in the rat cortex**, Masaki Inaba, Tokyo Univ. of Agriculture and Technology (Japan); Satoko Kawauchi, National Defense Medical College Research Institute (Japan); Takeshi Adachi, National Defense Medical College (Japan); Shunichi Sato, National Defense Medical College Research Institute (Japan); Izumi Nishidate, Tokyo Univ. of Agriculture and Technology (Japan) . . . [11225-3]  
Coffee Break. . . . . Sat 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SAT 10:40 AM TO 11:20 AM

#### Optical Spectroscopy: Pre-Clinical II

Session Chair: **Steen J. Madsen III**, Univ. of Nevada, Las Vegas (USA)

10:40 am: **First biopotential recordings from a liquid crystal optrode**, Leonardo Silvestri, Amr Al Abed, Yuan Wei, Nathalie Gouailhardou, The Univ. of New South Wales (Australia); Emilie C. M. Revol, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Josiah Firth, Xinyue Lei, Han Wang, Torsten Lehmann, Nigel H. Lovell, Francois Ladouceur, The Univ. of New South Wales (Australia) ..... [11225-6]

11:00 am: **Functional connectivity predicts behavior deficit in a mouse model of brain tumor growth**, Inema E. Orukari, Nicole Warrington, Adam Q. Bauer, Joshua B. Rubin, Joseph Culver, Washington Univ. in St. Louis (USA) . . . . . [11225-20]  
Lunch/Exhibition Break . . . . . Sat 11:20 pm to 1:10 am

### SESSION 3

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SAT 1:10 PM TO 2:30 PM

#### Optical Spectroscopy: Clinical

Session Chair: **Steen J. Madsen III**, Univ. of Nevada, Las Vegas (USA)

1:10 pm: **Optical mapping of effective brain networks during the tangram task**, Zhen Yuan, Zhishan Hu, Univ. of Macau (Macao, China) ..... [11225-7]

1:30 pm: **Effects of transcranial infrared laser stimulation on short-term memory of veterans with post traumatic stress disorder: a functional near-infrared spectroscopy study**, Vidhya Vijayakrishnan Nair, Sunita Pandey, Chasley Brandon Jones, Danielle Marie Brecht, The Univ. of Texas at Arlington (USA); Fu Lye Woon, The Univ. of Texas at Arlington (USA) and Seton Brain & Spine Institute (USA); Francisco Gonzalez-Lima, The Univ. of Texas at Austin (USA); Robert J. Gatchel, Fenghua Tian, The Univ. of Texas at Arlington (USA) . . . . . [11225-8]

1:50 pm: **Validation of laser pulse shaping for increased sensitivity to brain blood flow using time-domain diffuse correlation spectroscopy during a hypercapnic challenge**, Stefan A. Carp, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Adriano Peruch, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA); Davide Tamborini, Dibbyan Mazumder, Melissa M. Wu, Suk-Tak Chan, Mitchell Robinson, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Jason Z. Qu, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Guillaume Delpont, Thomas Schoenau, PicoQuant GmbH (Germany); Alain Bourdon, PicoQuant Photonics North America, Inc. (USA); Maria A. Franceschini, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) and Harvard Medical School (USA) . . . . . [11225-9]

2:10 pm: **Monitoring cognitive effects of childhood ADHD using diffuse optical tomography**, Zephaniah Phillips V, Seung-ho Paik, Shin-Young Kang, Youngwoon Choi, Korea Univ. (Korea, Republic of); Bung-Nyun Kim, Seoul National Univ. (Korea, Republic of); Beop Min Kim, Korea Univ. (Korea, Republic of) . . . . . [11225-10]

### SESSION 4

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SAT 2:30 PM TO 5:00 PM

#### Operative and Post Op Therapy

Session Chair: **Victor X. D. Yang**, Ryerson Univ. (Canada)

2:30 pm: **Intraoperative functional and metabolic brain mapping using hyperspectral imaging**, Charly Caredda, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante, Univ. Claude Bernard Lyon 1 (France); Laurent Mahieu-William, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante (France); Raphaël Sablong, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante, Univ. Claude Bernard Lyon 1 (France); Michaël Sdika, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante, Univ. Claude Bernard Lyon 1 (France); Jacques Guyot, Ctr. Hospitalier Univ. de Lyon (France); Bruno Montcel, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante, Univ. Claude Bernard Lyon 1 (France) . . . . . [11225-11]

2:50 pm: **Creation of a non-contact, automated brain tumor detection device for use in brain tumor resection**, Matthew Tucker, Weston Ross, Guangshen Ma, Suzanna Joseph, Patrick Codd, Duke Univ. (USA) . . . [11225-12]

3:10 pm: **5-ALA induced PpIX fluorescence guided surgery of gliomas: comparison of expert and machine learning based models**, Pierre Leclerc, Laure Alston, Laurent Mahieu-Williams, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante (France); Cédric Ray, Institut Lumière Matière (France); Mathieu Hébert, Lab. Hubert Curien (France); Pascal Kantapareddy, Ctr. Hospitalier Univ. de Lyon (France); Carole Frindel, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante (France); Pierre-François Brevet, Institut Lumière Matière (France); David Meyronet, Jacques Guyotat, Ctr. Hospitalier Univ. de Lyon (France); David Rousseau, Lab. Angevin de Recherche en Ingénierie des Systèmes (France); Bruno Montcel, Ctr. de Recherche en Acquisition et Traitement d'images pour la Sante (France) ..... [11225-13]

Coffee Break. .... Sat 3:30 pm to 4:00 pm

4:00 pm: **Cross-polarization OCT for detection white matter tracts during brain tumor surgery**, Konstantin S. Yashin, Elena B. Kiseleva, Privozhsky Research Medical Univ. (Russian Federation); Alexander A. Moiseev, Institute of Applied Physics (Russian Federation); Diana A. Davydova, Ksenia A. Achkasova, Igor A. Medyanik, Leonid Y. Kravets, Privozhsky Research Medical Univ. (Russian Federation); Grigory V. Geikonov, Institute of Applied Physics (Russian Federation); Elena V. Zagaynova, Natalia D. Gladkova, Privozhsky Research Medical Univ. (Russian Federation) ..... [11225-15]

4:20 pm: **Improved charging rates by laser perforating polypyrrole electrodes: towards use as in vivo microelectronic and micromechanical devices**, Yuta Dobashi, Kenneth Lee, Univ. of Toronto (Canada); John Madden, The Univ. of British Columbia (Canada); Victor Yang, Univ. of Toronto (Canada) ..... [11225-16]

4:40 pm: **Preliminary ex vivo and in vivo evaluation of laser bonding in dura mater**, Roberto Colasanti, Maurizio Iacoangeli, Policlinico Umberto I, Univ. Politecnica delle Marche (Italy); Alessandra Marini, Denis Aiudi, Alessandro Di Rienzo, Erika Carrassi, Massimo Scerrati, Policlinico Umberto I (Italy); Fiorenza Orlando, Mauro Provinciali, Istituto Nazionale di Riposo e Cura per Anziani, Istituto di Ricovero e Cura a Carattere Scientifico (Italy); Luca Giannoni, Laura Pieri, El.En. S.p.A. (Italy); Filippo Fagnani, Quanta System S.p.A. (Italy); Stefano Dallari, Ospedale "A. Murri" di Fermo (Italy); Giada Magni, Paolo Matteini, Fulvio Ratto, Roberto Pini, Francesca Rossi, Consiglio Nazionale delle Ricerche (Italy) ..... [11225-17]

**BIOS HOT TOPICS**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**NEUROTECHNOLOGIES PLENARY SESSION**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 3:30 PM TO 5:30 PM**

This session will highlight the breadth of exciting advances occurring in the field of neurophotonics and provide a unique forum for communication and networking for leaders and innovators in the neurophotonics community.

**Welcome and Opening Remarks**

**David Boas**, Boston Univ. (USA) and **Elizabeth Hillman**, Columbia Univ. (USA)

**PRESENTATIONS:**

**New tools for optical recording of neuronal function**  
**Robert Prevedel**, European Molecular Biology Lab. (Germany)

**Volitional control of neuromodulators as a novel form of neural interface**

**David Kleinfeld**, Univ. of California, San Diego (USA)

**Wearable functional near infrared spectroscopy**

**Audrey Bowden**, Vanderbilt Univ. (USA)

**Noninvasive monitoring of intracerebral pressure**

**Jana Kainerstorfer**, Carnegie Mellon Univ. (USA)

**The role of NIBIB in neuro-technology development**

**Bruce Tromberg**, National Institutes of Health (USA)

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Pupillary sensor for ocular cranial nerve monitoring**, Rheagan Chambers, Nick Quon, Bridget Slomka, Nikolay Martirosyan, G. Michael Lemole Jr., Marek Romanowski, The Univ. of Arizona (USA) ..... [11225-18]

**Novel intra-operative peripheral nerve agent for fluorescence guided imaging**, Xiang Liu, Paul Lovell, Univ. of Nebraska Medical Ctr. (USA)[11225-19]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

# CONFERENCE 11226

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY)

Monday–Wednesday 3–5 February 2020 • Proceedings of SPIE Vol. 11226

## Neural Imaging and Sensing 2020

Conference Chairs: **Qingming Luo**, Hainan Univ. (China); **Jun Ding**, Stanford Univ. Medical Ctr. (USA); **Ling Fu**, Huazhong Univ. of Science and Technology (China)

Program Committee: **David A. Boas**, Boston Univ. (USA); **Shih-Chi Chen**, The Chinese Univ. of Hong Kong (Hong Kong, China); **Yu Chen**, Univ. of Maryland, College Park (USA); **Javier DeFelipe**, Univ. Politécnic de Madrid (Spain); **Hongwei Dong**, Univ. of California, Los Angeles (USA); **Congwu Du**, Stony Brook Univ. (USA); **Na Ji**, Univ. of California, Berkeley (USA); **Beop-Min Kim**, Korea Univ. (Korea, Republic of); **Pengcheng Li**, HUST-Suzhou Institute for Brainmatics (China); **Byungkook Lim**, Univ. of California, San Diego (USA); **Francesco Saverio Pavone**, European Lab. for Non-linear Spectroscopy (Italy); **Darcy S. Peterka**, Columbia Univ. (USA); **Kambiz Pourrezaei**, Drexel Univ. (USA); **Claus-Peter Richter**, Northwestern Univ. (USA); **Anna W. Roe**, Zhejiang Univ. (China); **Oxana V. Semyachkina-Glushkovskaya**, Saratov State Univ. (Russian Federation); **Shy Shoham**, Technion-Israel Institute of Technology (Israel); **Shaoqun Zeng**, Huazhong Univ. of Science and Technology (China)

### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . MON 8:20 AM TO 10:10 AM

#### Microscopy I

Session Chair: **Shaoqun Zeng**,  
Britton Chance Ctr. for Biomedical Photonics (China)

8:20 am: **25 plane multifocus microscopy for fast and live 3D imaging** (*Invited Paper*), Eduardo Hirata Miyasaki, Univ. of California, Santa Cruz (USA); Gustav M. Pettersson, KTH Royal Institute of Technology (Sweden); Khant Zaw, Univ. of California, Santa Cruz (USA); Demis D. John, Brian Thibeault, Univ. of California, Santa Barbara (USA); Brandon Lynch, Juliana Hernandez, Sara Abrahamsson, Univ. of California, Santa Cruz (USA) . . . . . [11226-1]

8:50 am: **Two-photon Bessel beam scanning microscope for neural activities**, Dongli Xu, Stanford Univ. (USA); Leilei Peng, The Univ. of Arizona (USA); Jun Ding, Stanford Univ. (USA) . . . . . [11226-2]

9:10 am: **Two-photon high-speed light-sheet volumetric imaging of brain activity during sleep in zebrafish larvae**, Giuseppe de Vito, Univ. degli Studi di Firenze (Italy) and LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy); Chiara Fornetto, Pietro Ricci, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy); Caroline Müllenbroich, Univ. of Glasgow (United Kingdom) and LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Giuseppe Sancataldo, Lapo Turrini, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Giacomo Mazzamuto, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Natascia Tiso, Univ. degli Studi di Padova (Italy); Leonardo Sacconi, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Duccio Fanelli, Univ. degli Studi di Firenze (Italy); Ludovico Silvestri, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Francesco Vanzani, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Francesco Saverio Pavone, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy) . . . . . [11226-3]

9:30 am: **Speed considerations for large field two-photon microscopy in brains**, Hunter B. Banks, Jonathan R. Bumstead, Lindsey M. Brier, Annie R. Bice, Joseph P. Culver, Washington Univ. in St. Louis (USA) . [11226-4]

9:50 am: **Adaptive optics two-photon microendoscopy for high-resolution and deep-brain imaging in vivo**, Congping Chen, Zhongya Qin, Sicong He, Wanjie Wu, Ye Wang, Kam Fai Tam, Nancy Y. Ip, Jianan Y. Qu, Hong Kong Univ. of Science and Technology (Hong Kong, China) . . . . . [11226-5]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

#### SESSION 2

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . MON 10:40 AM TO 12:10 PM

#### Diffused Optical Imaging

Session Chair: **Eduardo Hirata Miyasaki**,  
Univ. of California, Santa Cruz (USA)

10:40 am: **Phase dual-slopes for enhanced depth sensitivity in diffuse optical imaging** (*Invited Paper*), Sergio Fantini, Angelo Sassaroli, Giles Blaney, Thao Pham, Cristianne Fernandez, Tufts Univ. (USA) . . . . . [11226-6]

11:10 am: **Functional interferometric diffusing wave spectroscopy (fIDWS) of human brain activity**, Wenjun Zhou, Oybek Kholiqov, Vinh Nguyen Du Le, Vivek Srinivasan, Univ. of California, Davis (USA) . . . . . [11226-7]

11:30 am: **Diffuse optical tomography with a source-detector grid with 6.5 mm spacing for high-performance imaging of human brain hemodynamics**, Zachary E. Markow, Jason W. Trobaugh, Edward J. Richter, Kalyan Tripathy, Sean M. Rafferty, Alexa M. Svoboda, Mariel L. Schroeder, Washington Univ. in St. Louis (USA); Tracy M. Burns-Yocum, Indiana Univ. (USA); Karla M. Bergonzi, Broc A. Burke, Washington Univ. in St. Louis (USA); Mark A. Anastasio, Univ. of Illinois (USA); Adam T. Eggebrecht, Joseph P. Culver, Washington Univ. in St. Louis (USA) . . . . . [11226-8]

11:50 am: **Mapping deep brain stimulation's impact on cortical networks using high-density diffuse optical tomography**, Arefeh Sherafati, Adam T. Eggebrecht, Washington Univ. School of Medicine in St. Louis (USA); Tracy M. Burns-Yocum, Indiana Univ. (USA); Heather M. Lugar, Anagha Narayanan, Tasha Doty, Alexa M. Svoboda, Mariel L. Schroeder, Abraham Z. Snyder, Mwiza Ushe, Joseph P. Culver, Tamara Hershey, Washington Univ. School of Medicine in St. Louis (USA) . . . . . [11226-9]

Lunch/Exhibition Break . . . . . Mon 12:10 pm to 1:50 pm

#### SESSION 3

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . MON 1:50 PM TO 3:20 PM

#### Human Brain

Session Chair: **Shy Shoham**, NYU Langone Health (USA)

1:50 pm: **Fast volumetric mapping of human brain slices** (*Invited Paper*), Luca Pesce, Annunziata Laurino, Vladislav Gavryusev, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Giacomo Mazzamuto, Univ. degli Studi di Firenze (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Giuseppe Sancataldo, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Matteo Roffilli, Bioretics srl (Italy); Ludovico Silvestri, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Irene Costantini, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Francesco Saverio Pavone, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy) . . . . . [11226-10]

2:20 pm: **Using fNIRS to study the brain activation and networks associated with Chinese character recognition**, Zhen Yuan, Zhishan Hu, Univ. of Macau (Macao, China) . . . . . [11226-11]

2:40 pm: **fNIRS examination of mental workload changes during N-back tasks**, Kosar Khaksari, Emma Condy, John Millerhagen, Afrouz Anderson, Viswanath Gorti, Hadis Dashtestani, Amir Gandjibakhche, National Institutes of Health (USA) . . . . . [11226-12]

3:00 pm: **Functional brain mapping in preschool-age children with high density diffuse optical tomography**, Kalyan Tripathy, Alexa M. Svoboda, Mariel L. Schroeder, Andrew K. Fishell, Edward J. Richter, Sean M. Rafferty, Christopher Tracy, Zachary E. Markow, Muriah D. Wheelock, Adam T. Eggebrecht, Joseph P. Culver, Washington Univ. School of Medicine in St. Louis (USA) ..... [11226-13]  
 Coffee Break ..... Mon 3:20 pm to 3:50 pm

**SESSION 4**

**LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) ..... MON 3:50 PM TO 5:30 PM**

**Awake Animals**

Session Chair: **Beop-Min Kim**, Korea Univ. (Korea, Republic of)

3:50 pm: **Projection-specific neuronal recordings at deep layers of visual cortex via three-photon microscopy in awake mice**, Murat Yildirim, Hiroki Sugihara, Ning Leow, Keji Li, Mriganka Sur, Peter So, Massachusetts Institute of Technology (USA) ..... [11226-14]

4:10 pm: **Miniaturized device for whole cortex mesoscale imaging in freely behaving mice**, Mathew Rynes, Daniel Surinach, Micheal Laroque, Judith Dominguez, Zahra Navabi, Leila Ghanbari, Gregory Johnson, Suhasa Kodandaramaiah, Univ. of Minnesota, Twin Cities (USA) ..... [11226-15]

4:30 pm: **Optical fiber based methods for calcium recording in behaving mice**, Ling Fu, Lu He, Huazhong Univ. of Science and Technology (China) ..... [11226-16]

4:50 pm: **Mesoscale imaging of neuronal activity coupled with light-evoked motor mapping reveal movement-specific spatiotemporal patterns of cortical activation in awake mice**, Francesco A. Resta, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Anna Letizia Allegra Mascaro, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy) and Istituto di Neuroscienze, Consiglio Nazionale delle Ricerche (Italy); Elena Montagni, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy); Giuseppe de Vito, Univ. degli Studi di Firenze (Italy); Alessandro Scaglione, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy) and Univ. degli Studi di Firenze (Italy); Francesco Saverio Pavone, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy) and Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy) ..... [11226-17]

5:10 pm: **Lightweight miniaturized microscope system for imaging of calcium dynamics in freely behaving animals at variable focal depths using liquid crystal lenses**, Arutyun Bagramyan, Ctr. d'optique, photonique et laser (Canada) ..... [11226-18]

**POSTERS-MONDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... MON 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Monday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**In vivo rat brain imaging using a short multimode fiber probe**, Kai Eto, Masuta Junpei, Reiko Kurotani, Hiroyuki Abe, Yamagata Univ. (Japan); Izumi Nishidate, Tokyo Univ. of Agriculture and Technology (Japan); Manabu Sato, Yamagata Univ. (Japan) ..... [11226-53]

**Speckle fluctuations contribute excess noise to coherent near infrared spectroscopy measurements**, Antonio Ortega-Martinez, Bernhard Zimmermann, Xiaojun Cheng, Xinge Li, Meryem A. Yucel, David A. Boas, Boston Univ. (USA) ..... [11226-54]

**A pipeline to indirectly integrate mouse brain single neuron morphology and single cell transcriptome**, Wenyang Guo, Xiuli Liu, Yurong Liu, Ruixi Chen, Xiaofeng Cheng, Ying Wu, Shaoqun Zeng, Huazhong Univ. of Science and Technology (China) ..... [11226-55]

**BRIEF: a user-friendly whole-brain registration and analysis interface system based on semantic information guidance**, Yongsheng Zhang, Xiong Yang, Xiaofeng Cheng, Xiao-Jun Wang, Xin-Xin Wang, Jun-Jun Wang, Pei Sun, Yu-Hui Zhang, Hao-Hong Li, Xiao-Hua Lv, Shaoqun Zeng, Wuhan National Research Ctr. for Optoelectronics (China) ..... [11226-56]

**Optimization of preservation condition of cleared samples by modified FDISCO clearing**, Peng Wan, Tingting Yu, Dan Zhu, Huazhong Univ. of Science and Technology (China) ..... [11226-57]

**Is the kidneys innervated by parasympathetic nerves?**, Xiaofeng Cheng, Shaoqun Zeng, Yongshen Zhang, Xiong Yang, Yujuan Li, Xiuli Liu, Hongbing Xiang, Huazhong Univ. of Science and Technology (China) [11226-58]

**Wireless high definition neuroimaging system for fNIRS using single photosensor**, Muhammad Atif Yaqub, Usman Ghafoor, Seong-Woo Woo, Keum-Shik Hong, Pusan National Univ. (Korea, Republic of) ..... [11226-59]

**Fiber photometry for mapping axonal terminal activity in a restricted brain region in freely moving mice**, Ling Fu, Han Qin, Huazhong Univ. of Science and Technology (China) ..... [11226-60]

**Development of plastic embedding method suitable for various types of fluorescently labeled samples with precise whole-brain imaging**, Jiaojiao Tian, Miao Ren, Hui Gong, Xiangning Li, Huazhong Univ. of Science and Technology (China) ..... [11226-61]

**Resin embedding method suitable for fluorescently labeled large-volume biological tissues**, Ting Luo, Can Zhou, Shuai Shao, Hui Gong, Xiangning Li, Huazhong Univ. of Science and Technology (China) ..... [11226-62]

**Characterization of temporal and spatial frequency preference of cortical layers in six visual areas via three-photon microscopy in awake mice**, Murat Yildirim, Ming Hu, Mriganka Sur, Peter So, Massachusetts Institute of Technology (USA) ..... [11226-63]

**Establishment of cortical photothrombosis based on skull optical clearing**, Zhengwu Hu, Lu Deng, Dongyu Li, Tingting Yu, Dan Zhu, Huazhong Univ. of Science and Technology (China) ..... [11226-64]

**Optical methods for non-invasive assessment of arteriole flow impedance**, Jason Yang, Alexander Ruesch, Jana M. Kainerstorfer, Carnegie Mellon Univ. (USA) ..... [11226-65]

**Multimodal imaging integrating structural and functional information**, Jean-Paul Badjo, Po-Wei Tu, Univ. of Maryland, Baltimore County (USA) ..... [11226-66]

**TUESDAY 4 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) ..... TUE 8:10 AM TO 10:10 AM**

**Microscopy II**

Session Chair: **Sergio Fantini**, Tufts Univ. (USA)

8:10 am: **Clear optically matched panoramic access channel technique (COMPACT) for large volume deep brain imaging**, Meng Cui, Bowen Wei, Chenmao Wang, Zongyue Cheng, Purdue Univ. (USA); Wenbiao Gan, New York Univ. (USA) ..... [11226-19]

8:30 am: **Super-resolution localization microscopy for mosaic imaging of hundreds of cells**, Zhen-Li Huang, Wuhan National Research Ctr. for Optoelectronics (China) ..... [11226-20]

8:50 am: **Whole-brain imaging using wide-field fluorescence microscope with deep ultraviolet surface excitation**, Deepa K. Kasaragod, Meina Zhu, Hidenori Aizawa, Hiroshima Univ. (Japan) ..... [11226-21]

9:10 am: **Understanding opioid-induced metabolic changes in brain and neurons using label-free multimodal nonlinear optical imaging**, Chi Zhang, Jaena Park, Carlos Renteria, Eric Chaney, Stephen A. Boppart, Univ. of Illinois (USA) ..... [11226-22]

9:30 am: **System optimization of head-mounted fiber-optic nonlinear endomicroscope for brain imaging of freely behaving mice**, Ang Li, Honghua Guan, Hyeon-Cheol Park, Defu Chen, Johns Hopkins Univ. (USA); Yuanlei Yue, The George Washington Univ. (USA); Ming-Jun Li, Corning Incorporated (USA); Hui Lu, The George Washington Univ. (USA); Xingde Li, Johns Hopkins Univ. (USA) ..... [11226-23]

9:50 am: **Compressive sensing and binary holography for fast 3-D two-photon microscopy**, Chenyang Wen, Mindan Ren, Wenqi Ouyang, Shih-Chi Chen, The Chinese Univ. of Hong Kong (Hong Kong, China) [11226-24]

Coffee Break ..... Tue 10:10 am to 10:40 am

# CONFERENCE 11226

## SESSION 6

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . TUE 10:40 AM TO 12:00 PM

### OCT

Session Chair: **Oxana V. Semyachkina-Glushkovskaya**,  
Saratov State Univ. (Russian Federation)

10:40 am: **The optical property and morphometry of human cerebellum cortex with automatic serial sectioning polarization sensitive optical coherence tomography**, Hui Wang, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA); Viviana Siless, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Morgan Fogarty, Washington Univ. in St. Louis (USA); Iman Aganj, Douglas Greve, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Bruce Fischl, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) . . . . . [11226-25]

11:00 am: **In-vivo imaging of neurological signatures using coherent optical techniques**, David W. Blodgett, Carissa Rodriguez, Eyal Bar-Kochba, Clara Scholl, Nicole Steiner, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Austen Lefebvre, Marek Mirski, The Johns Hopkins Univ. School of Medicine (USA) . . . . . [11226-26]

11:20 am: **Multi-scale investigation of Alzheimer's disease brain tissue using 1060 nm swept source optical coherence tomography**, Matthias Salas, Johanna Gesperger, Antonia Lichtenegger, Michael Niederleithner, Laurin Ginner, Adelheid Woehrer, Bernhard Baumann, Tilman Schmall, Wolfgang Drexler, Rainer A. Leitgeb, Medizinische Univ. Wien (Austria) . . . . . [11226-27]

11:40 am: **Detection of cortical optical changes during seizure activity using optical coherence tomography**, Danielle Ornelas, Md. Hasan, Jenny Szu, Univ. of California, Riverside (USA); Oscar Gonzalez, Univ. of California, San Diego (USA); Timothy Myers, Koji Hirota, Melissa Eberle, Univ. of California, Riverside (USA); Maksim Bazhenov, Univ. of California, San Diego (USA); Devin Binder, B. Hyle Park, Univ. of California, Riverside (USA) [11226-28]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:40 pm

## SESSION 7

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 1:40 PM TO 3:00 PM

### Brain Activities I

Session Chair: **Francesco Saverio Pavone**,  
LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy)

1:40 pm: **Optical imaging of prefrontal deficits induced by cocaine: neurons versus dopamine D2-receptor expressing neurons**, Chelsea Pan, Stony Brook Univ. (USA) and Ward Melville High School (USA); Kevin Clare, Stony Brook Univ. (USA) . . . . . [11226-29]

2:00 pm: **Hue representation of the DKL color space at columnar resolution in the early visual cortex of macaques**, Hisashi Tanigawa, Xiao Du, Xinrui Jiang, Zhejiang Univ. (China); Ichiro Kuriki, Tohoku Univ. (Japan); Tao Zhou, Zhejiang Univ. (China) . . . . . [11226-30]

2:20 pm: **Model impact in resolving DCS CBF measurements from systemic variations in blood flow**, Melissa M. Wu, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Davide Tamborini, Kimberly A. Stephens, Dibbyan Mazumder, Parya Farzam, Suk-Tak Chan, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA); Jason Z. Qu, Massachusetts General Hospital (USA); Maria A. Franceschini, Stefan A. Carp, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) . . . . . [11226-31]

2:40 pm: **Role of cerebrovascular autoregulation in neurovascular coupling**, Deepshikha Acharya, Alexander Ruesch, Jason Yang, Samantha Schmitt, Jana M. Kainerstorfer, Matthew A. Smith, Carnegie Mellon Univ. (USA) . . . . . [11226-32]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

## SESSION 8

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 3:30 PM TO 5:30 PM

### Novel Techniques I

Session Chair: **Shih-Chi Chen**,  
The Chinese Univ. of Hong Kong (Hong Kong, China)

3:30 pm: **Data reduction for terabytes-scale brain wide neuron images via deep learning**, Qing Huang, Wuhan National Research Ctr. for Optoelectronics (China) . . . . . [11226-33]

3:50 pm: **A generalizable deep-learning approach to anatomical modeling of brain vasculature**, Waleed Tahir, Jiabei Zhu, Sreekanth Kura, Xiaojun Cheng, Boston Univ. (USA); Rafat Damseh, Frederic Lesage, Polytechnique Montréal (Canada); Sava Sakad'ic, Massachusetts General Hospital, Harvard Medical School (USA); David A. Boas, Lei Tian, Boston Univ. (USA) . . . . . [11226-34]

4:10 pm: **Accelerated line-scanning confocal microscope by deep learning**, Dejie Zhang, Zhangheng Ding, Xiaoyu Zhang, Chenyu Jiang, Kefu Ning, Mei Yao, Xiaoquan Yang, Hui Gong, Qingming Luo, Jing Yuan, Huazhong Univ. of Science and Technology (China) . . . . . [11226-35]

4:30 pm: **Ultrafast optical clearing method for three-dimensional imaging with cellular resolution**, Wei Gong, Zhejiang Univ. (China) . . . . . [11226-36]

4:50 pm: **Skull optical clearing for longitudinal non invasive optical imaging**, Haleh Soleimanzad, Marjorie Juchaux, Univ. Paris-Saclay (France) and CNRS (France); Hircac Gurden, CNRS (France) and Univ. de Paris (France); Delphine Crepin, CNRS (France) and Univ. Paris-Saclay (France); Frédéric Pain, Univ. Paris-Saclay (France) and CNRS (France) . . . . . [11226-37]

5:10 pm: **Wireless data transfer through biological tissues using near-infrared light: testing skull and skin phantoms**, Iqrar Ahmed, Alexander Bykov, Alexey Popov, Igor Meglinski, Marcos Katz, Univ. of Oulu (Finland) . . . . . [11226-38]

## WEDNESDAY 5 FEBRUARY

## SESSION 9

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . WED 8:20 AM TO 10:00 AM

### Brain Activities II

Session Chair: **Ling Fu**,  
Huazhong Univ. of Science and Technology (China)

8:20 am: **Imaging functional neuronal connections using 3D mesoscopic optical imaging technique**, Qinggong Tang, The Univ. of Oklahoma (USA) and Univ. of Maryland, College Park (USA); Vassiliy Tsytarev, Univ. of Maryland School of Medicine (USA) and Univ. of Maryland, College Park (USA); Reha S. Erzurumlu, Univ. of Maryland School of Medicine (USA); Yu Chen, Univ. of Maryland, College Park (USA) . . . . . [11226-39]

8:40 am: **Imaging neuronal and astrocytic Ca2+ transients and hemodynamic responses evoked by single stimulation in rodent cortex**, Wei Chen, Xiaochun Gu, Ki Park, Yingtian Pan, Congwu Du, Stony Brook Univ. (USA) . . . . . [11226-40]

9:00 am: **Longitudinal multimodal mapping of neural activity and blood flow reveals neurovascular dissociations in an awake mouse model of microinfarcts**, Fei He, Rice Univ. (USA); Colin Sullender, Hanlin Zhu, Theresa Jones, The Univ. of Texas at Austin (USA); Chong Xie, Rice Univ. (USA); Andrew K. Dunn, The Univ. of Texas at Austin (USA); Lan Luan, Rice Univ. (USA) . . . . . [11226-41]

9:20 am: **Wide-field multi-scale areal parcellation of neural circuits in mice**, Lindsey M. Brier, Jonathan R. Bumstead, Hunter B. Banks, Annie R. Bice, Joseph P. Culver, Washington Univ. in St. Louis (USA) . . . . . [11226-42]

9:40 am: **Minimally-invasive brain activity monitoring using voltage-sensitive dye fluorescence imaging**, Rebecca W. Pak, Jeeun Kang, Emad Boctor, Jin U. Kang, Johns Hopkins Univ. (USA) . . . . . [11226-43]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

**SESSION 10**

**LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . WED 10:30 AM TO 12:00 PM**

**Novel Techniques II**

Session Chair: **Jun Ding**, Stanford Univ. School of Medicine (USA)

10:30 am: **Multiphoton holographic manipulation of neural populations activity** (*Invited Paper*), Ian Oldenburg, Hayley Bounds, Hillel Adesnik, Univ. of California, Berkeley (USA) . . . . . [11226-44]

11:00 am: **Deep tissue focusing through scattering medium based on adaptive optics**, Ke Si, Zhejiang Univ. (China) . . . . . [11226-45]

11:20 am: **Compact microLED optrode device for patterned inter-cortical optogenetics**, Niall McAlinden, Yunzhou Cheng, Univ. of Strathclyde (United Kingdom); Robert Scharf, The Univ. of Utah (USA); Enyuan Xie, Erdan Gu, Univ. of Strathclyde (United Kingdom); Rohit Sharma, Prashant Tathireddy, Christopher F. Reiche, The Univ. of Utah (USA); Martin D. Dawson, Univ. of Strathclyde (United Kingdom); Loren Rieth, The Feinstein Institute for Medical Research (USA); Steve Blair, The Univ. of Utah (USA); Keith Mathieson, Univ. of Strathclyde (United Kingdom) . . . . . [11226-46]

11:40 am: **Optical gearbox for kHz frame rate imaging**, Meng Cui, Purdue Univ. (USA) . . . . . [11226-47]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:40 pm

**SESSION 11**

**LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . WED 1:40 PM TO 3:20 PM**

**Diseases**

Session Chair: **Ian A. Oldenburg**, Univ. of California, Berkeley (USA)

1:40 pm: **Label-free sorting of IPS cells during neuronal differentiation using FLIM**, Aleksandra V. Meleshina, Svetlana Rodimova, Privozhzsky Research Medical Univ. (Russian Federation); Erdem Dashinimaev, Koltzov Institute of Developmental Biology (Russian Federation); Dmitriy Reunov, Elena Zagaynova, Privozhzsky Research Medical Univ. (Russian Federation) [11226-48]

2:00 pm: **Discrimination of brain tumor regional samples using combined visible light optical coherence microscopy and fluorescence imaging**, Johanna Gesperger, Antonia Lichtenegger, Thomas Roetzer, Pablo Eugui Arrizabalaga, Barbara Kiesel, Danielle Jade Harper, Conrad William Merkle, Marco Augustin, Georg Widhalm, Adelheid Woehrer, Bernhard Baumann, Medizinische Univ. Wien (Austria) . . . . . [11226-49]

2:20 pm: **Characterization of new optical imaging biomarkers of peripheral nerve overstimulation**, Guillermo L. Monroy, U.S. Food and Drug Administration (USA); Mohsen Erfanzadeh, Wellman Ctr. for Photomedicine (USA); Harmain Rafi, U.S. Food and Drug Administration (USA); Ahhyun S. Nam, Wellman Ctr. for Photomedicine (USA); Mariela J. Hernandez, Michael A. Tao, U.S. Food and Drug Administration (USA); Benjamin J. Vakoc, Wellman Ctr. for Photomedicine (USA); Srikanth Vasudevan, Daniel X. Hammer, U.S. Food and Drug Administration (USA) . . . . . [11226-50]

2:40 pm: **Optical study of the structural alteration in hippocampal tissues in chronic stress using partial wave spectroscopy**, Prabhakar Pradhan, Mississippi State Univ. (USA); Pradeep K. Shukla, The Univ. of Tennessee Health Science Ctr. (USA); Shiva Bhandari, Prakash Adhikari, Mississippi State Univ. (USA); Radhakrishna Rao, The Univ. of Tennessee Health Science Ctr. (USA) . . . . . [11226-67]

3:00 pm: **Intracranial pressure estimated non-invasively in non-human primates and pediatric critical care**, Alexander Ruesch, Samantha Schmitt, Jason Yang, Deepshikha Acharya, Carnegie Mellon Univ. (USA); Jaskaran Rakkar, Michael S. Wolf, Michael M. Mcdowell, Elizabeth C. Tyler-Kabara, Robert S. B. Clark, Univ. of Pittsburgh (USA) and Univ. of Pittsburgh Medical Ctr. (USA); Matthew A. Smith, Jana M. Kainerstorfer, Carnegie Mellon Univ. (USA) . . . . . [11226-52]

**Photonics West Industry Stage**

Tuesday - Thursday • Hall DE  
Keynotes and panels open to all attendees  
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# CONFERENCE 11227

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11227

# Optogenetics and Optical Manipulation 2020

Conference Chairs: **Samarendra K. Mohanty**, Nanoscope Technologies, LLC (USA); **E. Duco Jansen**, Vanderbilt Univ. (USA); **Anna W. Roe**, Zhejiang Univ. (China)

Program Committee: **Antoine Adamantidis**, McGill Univ. (Canada); **George J. Augustine**, The Lee Kong Chian School of Medicine (Singapore); **Klaus B. Gerwert**, Ruhr-Univ. Bochum (Germany); **Xue Han**, Boston Univ. (USA); **Elizabeth M. Hillman**, Columbia Univ. (USA); **Richard Kramer**, Univ. of California, Berkeley (USA); **Alfred L. Nuttall**, Oregon Health & Science Univ. (USA); **Ulrich T. Schwarz**, Technische Univ. Chemnitz (Germany); **Shy Shoham**, Technion-Israel Institute of Technology (Israel); **John P. Welsh**, Univ. of Washington (USA); **Rafael Yuste**, Columbia Univ. (USA)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) ..... SAT 8:30 AM TO 9:00 AM

#### Keynote

Session Chair: **Samarendra K. Mohanty**,  
Nanoscope Technologies, LLC (USA)

8:30 am: **Optical tools for analyzing and controlling the brain** (Keynote Presentation), Edward S. Boyden, MIT Media Lab. (USA) ..... [11227-1]

### SESSION 2

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) ..... SAT 9:00 AM TO 11:10 AM

#### Optogenetics I

Session Chair: **Anna Wang Roe**, Zhejiang Univ. (China)

9:00 am: **Integrated photonics chip for neural activity investigation**, Corinna Kaspar, Julia Lehrich, Aleksander Ivananko, Jürgen Klingauf, Wolfram H. P. Pernice, Westfälische Wilhelms-Univ. Münster (Germany) ..... [11227-2]

9:20 am: **Optical modulation and functional mapping of cortical activities using molecular actuator-sensor**, Darryl Narcisse, Sourajit M. Mustafi, Michael Carlson, Subrata Batabyal, Weldon W. Wright, Samarendra K. Mohanty, Nanoscope Technologies, LLC (USA) ..... [11227-3]

9:40 am: **Going wireless: an optical imaging and optogenetics system for use in awake behaving primates**, Derek Zaraza, Mykyta Chernov, Robert M. Friedman, Oregon Health & Science Univ. (USA); Yiyuan Yang, John A. Rogers, Northwestern Univ. (USA); Anna W. Roe, Oregon Health & Science Univ. (USA) ..... [11227-4]

Coffee Break ..... Sat 10:00 am to 10:30 am

10:30 am: **Development on Utah optrode array for efficient neural stimulation and recording device**, Mehedy Hasan, Steve Blair, Robert Scharf, Christopher F. Reiche, Rohit Sharma, Prashant Tathireddy, The Univ. of Utah (USA); Niall McAlinden, Yunzhou Cheng, Univ. of Strathclyde (United Kingdom); Julian Haberland, Christine Kallmayer, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Loren Rieth, The Feinstein Institute for Medical Research (USA); Keith Mathieson, Enyuan Xie, Erdan Gu, Martin D. Dawson, Univ. of Strathclyde (United Kingdom) ..... [11227-5]

10:50 am: **An open resource for nonhuman primate optogenetics**, Sebastien Tremblay, Michael Platt, Univ. of Pennsylvania (USA) ..... [11227-6]

### SESSION 3

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) ..... SAT 11:10 AM TO 12:50 PM

#### Optogenetics II

Session Chair: **E. Duco Jansen**, Vanderbilt Univ. (USA)

11:10 am: **Evaluation of a model for deep tissue optogenetic stimulation**, Sonja Johannsmeier, Laser Zentrum Hannover e.V. (Germany); Johannes Wenzel, Sebastian Junge, Maria L. Torres-Mapa, Leibniz Univ. Hannover (Germany); Tammo Ripken, Dag Heinemann, Laser Zentrum Hannover e.V. (Germany); Alexander Heisterkamp, Leibniz Univ. Hannover (Germany) [11227-7]

11:30 am: **Large-scale femtosecond holography for near simultaneous optogenetic neural modulation**, Meng Cui, Purdue Univ. (USA) ..... [11227-8]

11:50 am: **Theoretical analysis of high-frequency bidirectional optogenetic control of neuronal firing**, Himanshu Bansal, Neha Gupta, Sukhdev Roy, Dayalbagh Educational Institute (India) ..... [11227-9]

12:10 pm: **Development of fiber-based all-optical system for neurovascular coupling mechanism study using optogenetics**, Minkyung Kim, Korea Institute of Science and Technology (Korea, Republic of) and Korea Univ. of Science and Technology (Korea, Republic of); Jinki Hong, Hyun-Joon Shin, Korea Institute of Science and Technology (Korea, Republic of) ..... [11227-10]

12:30 pm: **High-precision in vivo ablation in mammalian brain with amplified femtosecond pulses**, Meng Cui, Zongyue Cheng, Yiyong Han, Bowen Wei, Purdue Univ. (USA); Wenbiao Gan, New York Univ. (USA) [11227-11]

Lunch/Exhibition Break ..... Sat 12:50 pm to 2:10 pm

### SESSION 4

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) ..... SAT 2:10 PM TO 3:30 PM

#### Optogenetics III

Session Chair: **Samarendra K. Mohanty**,  
Nanoscope Technologies, LLC (USA)

2:10 pm: **Investigation of in vitro human iPSC-derived neuronal networks using holographic stimulation**, Felix Schmieder, Jürgen W. Czarske, TU Dresden (Germany) ..... [11227-12]

2:30 pm: **Repurposing protein degradation for optogenetic modulation of protein activities**, Payel Mondal, Univ. of Illinois (USA) ..... [11227-14]

2:50 pm: **The development of radiogenetically-controlled signaling proteins for novel applications to optogenetics**, Morgan S. Schmidt, Patrick Dennis, Ruth Pachter, Saber M. Hussain, Sanaz Farajollahi, Air Force Research Lab. (USA) ..... [11227-15]

3:10 pm: **Technology and application of ultrafast laser in stem-cell differentiation induction**, Shiyue Liu, Dihan Chen, The Chinese Univ. of Hong Kong (Hong Kong, China); Hao He, Shanghai Jiao Tong Univ. (China); Shih-Chi Chen, Ho-Pui Ho, Siu-Kai Kong, The Chinese Univ. of Hong Kong (Hong Kong, China) ..... [11227-16]

Coffee Break ..... Sat 3:30 pm to 4:00 pm

### SESSION 5

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) ..... SAT 4:00 PM TO 5:40 PM

#### Optogenetics IV

Session Chair: **Anna Wang Roe**, Zhejiang Univ. (China)

4:00 pm: **New methodologies for studying the function of the corneal nerves**, Matthew T. McPheeters, Brecken J. Blackburn, Case Western Reserve Univ. (USA); William J. Dupps, Case Western Reserve Univ. (USA) and Cleveland Clinic (USA); Andrew M. Rollins, Michael W. Jenkins, Case Western Reserve Univ. (USA) ..... [11227-17]

4:20 pm: **Highly directional high brightness OLEDs for treating vision loss**, Sabina Hillebrandt, Changmin Keum, Yali Deng, Univ. of St. Andrews (United Kingdom); Joël Navas, Charlie Galle, Thomas Hardin, GenSight Biologics S.A. (France); Malte C. Gather, Univ. of St. Andrews (United Kingdom) ... [11227-18]

4:40 pm: **Multifractal OCT for optical detection of retinal function**, Subrata Batabyal, Sanghoon Kim, Michael Carlson, Weldon W. Wright, Samarendra K. Mohanty, Nanoscope Technologies, LLC (USA) ..... [11227-19]

5:00 pm: **Spatially targeted in-vivo optical manipulation and gene delivery in retina guided by optical coherence tomography**, Sanghoon Kim, Subrata Batabyal, Michael Carlson, Samarendra K. Mohanty, Nanoscope Technologies, LLC (USA) ..... [11227-20]

5:20 pm: **Holographic display for optical retinal prosthesis: design and validation**, Shani Rosen, Moshe Gur, Technion-Israel Institute of Technology (Israel); Shy Shoham, NYU Langone Health (USA) ..... [11227-21]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
 BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 6

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 8:20 AM TO 10:00 AM

### INS I

Session Chair: **E. Duco Jansen**, Vanderbilt Univ. (USA)

- 8:20 am: **Assessment of variable block lengths during infrared neural inhibition**, Jeremy B. Ford, Vanderbilt Univ. (USA); Michael W. Jenkins, Hillel J. Chiel, Case Western Reserve Univ. (USA); E. Duco Jansen, Vanderbilt Univ. (USA) . . . . . [11227-22]
- 8:40 am: **Astrocyte sensitivity to pulsed infrared light: molecular, physiological, and mechanistic insights**, Wilson R. Adams, Ana I. Borrachero-Conejo, Vanderbilt Univ. (USA); Emanuela Saracino, Istituto per la Sintesi Organica e la Fotoreattività (Italy); Manqing Wang, Chongqing Univ. (China); Tamara Posati, Istituto per lo Studio dei Materiali Nanostrutturati (Italy); Graham A. Throckmorton, John Logan Jenkins, Jeremy B. Ford, Vanderbilt Univ. (USA); Roberto Zamboni, Istituto per la Sintesi Organica e la Fotoreattività (Italy); Marco Caprini, Univ. degli Studi di Bologna (Italy); Grazia Paola Nicchia, Univ. degli Studi di Bari Aldo Moro (Italy); E. Duco Jansen, Vanderbilt Univ. (USA); Valentina Benfenati, Istituto per la Sintesi Organica e la Fotoreattività (Italy); Anita Mahadevan-Jansen, Vanderbilt Univ. (USA) . . . . . [11227-23]
- 9:00 am: **Pulsed infrared light modulates microglial function**, John Logan Jenkins, Wilson R. Adams, Anita Mahadevan-Jansen, Vanderbilt Univ. (USA); Mark R. Hutchinson, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia); E. Duco Jansen, Vanderbilt Univ. (USA) . . . . . [11227-24]
- 9:20 am: **Computational and experimental evaluation of the mechanism of infrared neural inhibition in aplysia**, Jeremy B. Ford, Mohit Ganguly, Vanderbilt Univ. (USA); Junqi Zhou, Matthew T. McPheeters, Michael W. Jenkins, Hillel J. Chiel, Case Western Reserve Univ. (USA); E. Duco Jansen, Vanderbilt Univ. (USA) . . . . . [11227-25]
- 9:40 am: **Combining infrared neuromodulation (IRN) with isotonic glucose solution to lower the IR dose requirement**, Junqi Zhou, Matthew T. McPheeters, Elizabeth M. Jackson, Sachin S. Shankar, Case Western Reserve Univ. (USA); Mohit Ganguly, E. Duco Jansen, Vanderbilt Univ. (USA); Hillel J. Chiel, Michael W. Jenkins, Case Western Reserve Univ. (USA) . . . . . [11227-26]
- Coffee Break . . . . . Sun 10:00 am to 10:30 am

### SESSION 7

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 10:30 AM TO 12:10 PM

### INS II

Session Chair: **Samarendra K. Mohanty**, Nanoscope Technologies, LLC (USA)

- 10:30 am: **Comparing the efficacy of infrared diode and Ho:YAG lasers for infrared neural stimulation**, Graham A. Throckmorton, Wilson R. Adams, Zane C. Ricks, Jonathan M. Cayce, E. Duco Jansen, Anita Mahadevan-Jansen, Vanderbilt Univ. (USA) . . . . . [11227-27]
- 10:50 am: **Optoacoustic neuronal stimulation by nanotransducers operating at NIR II window**, Yimin Huang, Ying Jiang, Jiayingzi Wu, Ji-Xin Cheng, Chen Yang, Boston Univ. (USA) . . . . . [11227-28]
- 11:10 am: **Exploring the spatial precision of focal infrared neural stimulation in the cortex of GCaMP6f mice**, David Moreau, MINES Saint-Étienne (France); Attila Kaszas, Institut de Neurosciences de la Timone, CNRS (France) and Aix-Marseille Univ. (France); Rodney P. O'Connor, MINES Saint-Étienne (France); Ivo Vanzetta, Institut de Neurosciences de la Timone, CNRS (France) . . . . . [11227-29]
- 11:30 am: **Infrared modulation of synaptic activity at crayfish neuromuscular junction**, Xuedong Zhu, Jen-Wei Lin, Michelle Y. Sander, Boston Univ. (USA) . . . . . [11227-30]
- 11:50 am: **Mapping brain connections with infrared neural stimulation and fMRI**, Augix Guohua Xu, Zhejiang Univ. (China) . . . . . [11227-31]

### NEUROTECHNOLOGIES PLENARY SESSION

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 3:30 PM TO 5:30 PM

This session will highlight the breadth of exciting advances occurring in the field of neurophotonics and provide a unique forum for communication and networking for leaders and innovators in the neurophotonics community.

**Welcome and Opening Remarks**  
**David Boas**, Boston Univ. (USA) and **Elizabeth Hillman**, Columbia Univ. (USA)

- PRESENTATIONS:
- New tools for optical recording of neuronal function**  
**Robert Prevedel**, European Molecular Biology Lab. (Germany)
- Volitional control of neuromodulators as a novel form of neural interface**  
**David Kleinfeld**, Univ. of California, San Diego (USA)
- Wearable functional near infrared spectroscopy**  
**Audrey Bowden**, Vanderbilt Univ. (USA)
- Noninvasive monitoring of intracerebral pressure**  
**Jana Kainerstorfer**, Carnegie Mellon Univ. (USA)
- The role of NIBIB in neuro-technology development**  
**Bruce Tromberg**, National Institutes of Health (USA)

### BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

- Welcome and Award Presentation**  
**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President
- Presentation of 2020 SPIE Biophotonics Technology Innovator Award**  
 THE 2020 RECIPIENT  
**Nirmala Ramanujam**,  
 Duke University, Durham, North Carolina, USA
- Talk by 2014 Nobel Prize Winner in Physics:**  
**Spying on the Secret Lives of Cells**  
**Eric Betzig**, Univ. of California, Berkeley and  
 Howard Hughes Medical Institute (USA)

# CONFERENCE 11228

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH)

Monday–Wednesday 3–5 February 2020 • Proceedings of SPIE Vol. 11228

# Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV

Conference Chairs: **Joseph A. Izatt**, Duke Univ. (USA); **James G. Fujimoto**, Massachusetts Institute of Technology (USA)

Program Committee: **Peter E. Andersen**, Technical Univ. of Denmark (Denmark); **Kostadinka Bizheva**, Univ. of Waterloo (Canada); **Stephen A. Boppart**, Univ. of Illinois at Urbana-Champaign (USA); **Zhongping Chen**, Beckman Laser Institute and Medical Clinic (USA); **Johannes de Boer**, Vrije Univ. Amsterdam (Netherlands); **Wolfgang Drexler**, Medizinische Univ. Wien (Austria); **Grigory V. Gelikonov**, Institute of Applied Physics (Russian Federation); **Christoph K. Hitzenberger**, Medizinische Univ. Wien (Austria); **Robert A. Huber**, Univ. zu Lübeck (Germany); **Rainer A. Leitgeb**, Medizinische Univ. Wien (Austria); **Xingde Li**, Johns Hopkins Univ. (USA); **Yingtian Pan**, Stony Brook Univ. (USA); **Adrian Gh. Podoleanu**, Univ. of Kent (United Kingdom); **Andrew M. Rollins**, Case Western Reserve Univ. (USA); **Marinko V. Sarunic**, Simon Fraser Univ. (Canada); **Guillermo J. Tearney**, Wellman Ctr. for Photomedicine (USA); **Valery V. Tuchin**, Saratov State Univ. (Russian Federation); **Tomsk State Univ. (Russian Federation)**, Institute of Precision Mechanics and Control of the RAS (Russian Federation); **Ruikang K. Wang**, Univ. of Washington (USA); **Maciej Wojtkowski**, Nicolaus Copernicus Univ. (Poland); **Yoshiaki Yasuno**, Univ. of Tsukuba (Japan)

Conference Cosponsor:



## MONDAY 3 FEBRUARY

### SESSION 1

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . MON 8:30 AM TO 10:00 AM

#### OCT Angiography

Session Chair: **Joseph A. Izatt**, Duke Univ. (USA)

8:30 am: **OCT oximetry in retinal capillaries**, Shaohua Pi, Tristan T. Hormel, Xiang Wei, William Cepurna, Bingjie Wang, John Morrison, Yali Jia, Oregon Health & Science Univ. (USA). . . . . [11228-1]

8:45 am: **OCT-based methods for multiscale quantification of the relationships between choriocapillaris flow impairment and geographic atrophy growth**, Eric M. Moul, Massachusetts Institute of Technology (USA); A. Yasin Alibhai, New England Eye Ctr. (USA); Yue Yu, Massachusetts Institute of Technology (USA) and Peking Univ. (China); ByungKun Lee, Massachusetts Institute of Technology (USA); Stefan B. Ploner, Andreas Maier, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Jay S. Duker, Nadia K. Waheed, New England Eye Ctr. (USA); James G. Fujimoto, Massachusetts Institute of Technology (USA). . . . . [11228-2]

9:00 am: **Computational defocus correction methods for extended focus optical coherence tomography angiography**, ByungKun Lee, Paul Shin, Jongyoon Joo, Wang-Yuhl Oh, KAIST (Korea, Republic of). . . . . [11228-3]

9:15 am: **Tunable-lens-integrated miniature hand-held optical coherence tomography probe for pediatric and prematurity ophthalmic imaging**, Qinghua He, Junping Zhong, Ruikang Wang, Univ. of Washington (USA). . . . . [11228-4]

9:30 am: **Self-tracking real-time wide-field OCT angiography**, Xiang Wei, Tristan T. Hormel, Yukun Guo, Yali Jia, Oregon Health & Science Univ. (USA). . . . . [11228-5]

9:45 am: **ID-OCTA: SNR-adaptive OCT angiography enabled by statistical characterization of intensity and decorrelation with multi-variate time series model**, Peng Li, Luzhe Huang, Yiming Fu, Ruixiang Chen, Zhejiang Univ. (China). . . . . [11228-6]

Coffee Break. . . . . Mon 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) MON 10:30 AM TO 12:00 PM

#### Novel Light Sources and Their Applications

Session Chair: **James G. Fujimoto**, Massachusetts Institute of Technology (USA)

10:30 am: **Resolving absolute depth information in circular ranging OCT**, Norman Lippok, Benjamin J. Vakoc, Harvard Medical School (USA) . . . [11228-7]

10:45 am: **Reliable widely tunable electrically pumped 1050nm MEMS-VCSLs with amplifier in single butterfly co-package**, Chris Burgner, John Carter, Praevium Research, Inc. (USA); Alan Donaldson, Thorlabs Quantum Electronics (USA); Nate Bramham, Praevium Research, Inc. (USA); Benjamin Potsaid, Thorlabs, Inc. (USA) and Research Lab. of Electronics, Massachusetts Institute of Technology (USA); Oscar Carrasco-Zevallos, Siyu Chen, Eric M. Moul, James G. Fujimoto, Research Lab. of Electronics, Massachusetts Institute of Technology (USA); Peter Heim, Thorlabs Quantum Electronics (USA); Vijaysekhar Jayaraman, Praevium Research, Inc. (USA); Alex Cable, Thorlabs, Inc. (USA) . . . . . [11228-8]

11:00 am: **All-fiber few-mode OCT using a photonic lantern**, Martin Poininet de Sivry, Polytechnique Montréal (Canada); Simon Bolduc Beaudoin, Univ. de Sherbrooke (Canada); Xavier Attendu, Polytechnique Montréal (Canada); Nicolas Godbout, Caroline Boudoux, Polytechnique Montréal (Canada) and Castor Optics, Inc. (Canada) . . . . . [11228-9]

11:15 am: **A programmable phase-code mode locked laser for circular-ranging optical coherence tomography**, Tae Shik Kim, Benjamin J. Vakoc, Massachusetts General Hospital (USA) . . . . . [11228-10]

11:30 am: **Dual-band anti-aliasing of wavelength-comb-swept laser for extended ranging optical coherence tomography**, Seongjin Bak, Gyeong Hun Kim, Chang-Seok Kim, Pusan National Univ. (Korea, Republic of). . . . . [11228-11]

11:45 am: **Master-Slave principle applied to an electrically-tunable swept source-OCT system**, Manuel Jorge M. Marques, Ramona Cernat, Univ. of Kent (United Kingdom); Jason Ensher, Insight Photonic Solutions, Inc. (USA); Adrian Bradu, Adrian Podoleanu, Univ. of Kent (United Kingdom) . . . [11228-12]

Lunch/Exhibition Break . . . . . Mon 12:00 pm to 1:30 pm

**SESSION 3**

**LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . MON 1:30 PM TO 3:30 PM**

**Ophthalmic New Technology**

Session Chair: **Ruikang K. Wang**, Univ. of Washington (USA)

- 1:30 pm: **Robotically-aligned optical coherence tomography with 5-degree of freedom eye tracking for subject motion and gaze compensation**, Pablo Ortiz, Mark Draelos, Ryan P. McNabb, Anthony N. Kuo, Joseph A. Izatt, Duke Univ. (USA) . . . . . [11228-13]
- 1:45 pm: **Improved functional imaging of ganglion neuronal and photoreceptor cell layers in living human retina**, Gereon M. Hüttmann, Clara Pfäffle, Hendrik Spahr, Lisa Kutzner, Sazan Burhan, Felix Hilge, Yoko Miura, Univ. zu Lübeck (Germany); Dierck Hillmann, Thorlabs GmbH (Germany) . . . . . [11228-14]
- 2:00 pm: **Ultrahigh-resolution imaging of the human retina with scan modulation visible light optical coherence tomography**, Hao F. Zhang, Ian Rubinoff, Northwestern Univ. (USA); Yuanbo Wang, Opticent Health (USA); Zeinab Ghassabi, Hiroshi Ishikawa, Joel Schuman, New York Univ. (USA); Roman Kuranov, Northwestern Univ. (USA) . . . . . [11228-15]
- 2:15 pm: **Quantitative measurements of intraocular structures including subretinal microinjection bleb volumes using intraoperative optical coherence tomography**, Jianwei D. Li, Duke Univ. (USA); William Raynor, Ananth Sastry, Duke Univ. Medical Ctr. (USA); Al-Hafeez Dhalla, Duke Univ. (USA); Cynthia Toth, Duke Univ. Medical Ctr. (USA); Christian Viehland, Duke Univ. (USA); Lejla Vajzovic, Duke Univ. Medical Ctr. (USA); Joseph A. Izatt, Duke Univ. (USA) and Duke Univ. Medical Ctr. (USA) . . . . . [11228-16]
- 2:30 pm: **Handheld spectrally encoded coherence tomography and reflectometry for point-of-care ophthalmic OCT and OCTA**, Eric M. Tang, Joseph D. Malone, Josh Albert H. Miller, Ipek Oguz, Yuankai K. Tao, Vanderbilt Univ. (USA) . . . . . [11228-17]
- 2:45 pm: **In-vivo, non-contact, cellular resolution imaging of the human cornea with line-field SD-OCT at 2.5 kHz frame rate**, Le Han, Lin Kun Chen, Zohreh Hosseinaee, Kostadinka Bizheva, Univ. of Waterloo (Canada) [11228-18]
- 3:00 pm: **Whole anterior segment/retinal SS-OCT system for comprehensive imaging and biometry of the eye**, Ana Rodríguez Aramendía, Instituto de Microcirugía Ocular (Spain) and Univ. Politècnica de Catalunya (Spain); Fernando Díaz-Doutón, Pol Falgueras, Jaume Pujol, Univ. Politècnica de Catalunya (Spain); José Luis Güell, Instituto de Microcirugía Ocular (Spain); Ireneusz Grulkowski, Nicolaus Copernicus Univ. (Poland) . . . . . [11228-19]
- 3:15 pm: **Ophthalmic space division multiplexing optical coherence tomography**, Jason Jerwick, Zhao Dong, Yongyang Huang, Lehigh Univ. (USA); Adrienne Saludades, Joan DuPont, Alexander Brucker, Univ. of Pennsylvania (USA); Chao Zhou, Washington Univ. in St. Louis (USA) . . . . . [11228-20]
- Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

**SESSION 4**

**LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . MON 4:00 PM TO 6:00 PM**

**Brain and Neural Imaging**

Session Chair: **Maciej Wojtkowski**, Polish Academy of Sciences (Poland)

- 4:00 pm: **Coherence gated, time-of-flight resolved measurements of human brain blood flow dynamics**, Oybek Kholiqov, Wenjun Zhou, Du Le, Vivek J. Srinivasan, Univ. of California, Davis (USA) . . . . . [11228-21]
- 4:15 pm: **Functional imaging of neuronal layers in the human retina**, Clara Pfäffle, Hendrik Spahr, Lisa Kutzner, Sazan Burhan, Felix Hilge, Univ. zu Lübeck (Germany); Yoko Miura, Univ. zu Lübeck (Germany) and Medizinisches Laserzentrum Lübeck GmbH (Germany); Gereon M. Hüttmann, Univ. zu Lübeck (Germany) and Medizinisches Laserzentrum Lübeck GmbH (Germany) and Deutsches Zentrum für Lungenforschung (Germany); Dierck Hillmann, Univ. zu Lübeck (Germany) and Thorlabs GmbH (Germany) . . . . . [11228-22]
- 4:30 pm: **Detection of cortical optical changes during seizure activity using optical coherence tomography**, Danielle Ornelas, Md. Hasan, Jenny Szu, Univ. of California, Riverside (USA); Oscar Gonzalez, Univ. of California, San Diego (USA); Timothy Myers, Koji Hirota, Melissa Eberle, Univ. of California, Riverside (USA); Maksim Bazhenov, Univ. of California, San Diego (USA); Devin Binder, B. Hyle Park, Univ. of California, Riverside (USA) . . . . . [11228-23]
- 4:45 pm: **In vivo mouse brain imaging through the thinned skull with 1700 nm optical coherence microscopy**, Jun Zhu, Vivek J. Srinivasan, Univ. of California, Davis (USA) . . . . . [11228-24]

- 5:00 pm: **Quantifying changes in murine fetal brain vasculature due to prenatal exposure to teratogens with in utero optical coherence tomography**, Raksha Raghunathan, Chih-Hao Liu, Amur Kouka, Yogeshwari Ambekar, Connie Yan, Noemi Bustamante, Manmohan Singh, Univ. of Houston (USA); Rajesh C. Miranda, Texas A&M Health Science Ctr. (USA); Kirill V. Larin, Univ. of Houston (USA) . . . . . [11228-25]
- 5:15 pm: **Effect of contrast agents and enhancement of cerebrovascular on mouse brain microvasculature studies using 800nm Gaussian and Polarization sensitive (PS) OCT system**, Mounika Rapolu, Institute of Physical Chemistry (Poland); Hubert Dolezyczek, Nencki Institute of Experimental Biology PAS (Poland); Karol Karnowski, Paulina Niedzwiedziuk, Dawid Borycki, Monika Malinowska, Institute of Physical Chemistry PAS (Poland); Grzegorz Wilczynski, Nencki Institute of Experimental Biology PAS (Poland); Maciej Wojtkowski, Institute of Physical Chemistry PAS (Poland) . . . . . [11228-26]
- 5:30 pm: **In vivo imaging of human peripheral nerves using optical coherence tomography compared to histopathology slices**, Jens Möller, Ruhr-Univ. Bochum (Germany); Anne C. Carolus, Johannes van de Nes, Univ. Knappschaftskrankenhaus Bochum GmbH (Germany); Marcel Lenz, Ruhr-Univ. Bochum (Germany); Christopher Brenke, Kirsten Schmieder, Univ. Knappschaftskrankenhaus Bochum GmbH (Germany); Hubert Welp, Technische Fachhochschule Georg Agricola zu Bochum (Germany); Nils C. Gerhardt, Martin R. Hofmann, Ruhr-Univ. Bochum (Germany) . . . . . [11228-91]
- 5:45 pm: **1.7- $\mu$ m swept-source OCT system for deep brain tumor margin detection**, Tae Il Yoon, Gwangju Institute of Science and Technology (Korea, Republic of); Jae Sung Park, Seoul St. Mary's Hospital, The Catholic Univ. of Korea (Korea, Republic of); Byeong Ha, Gwangju Institute of Science and Technology (Korea, Republic of); Tae Joong Eom, Advanced Photonics Research Institute (Korea, Republic of) . . . . . [11228-28]

**POSTERS-MONDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Monday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

- Spatiotemporal optical coherence (STOC) manipulation achieves better performance than angular compounding in full-field swept-source optical coherence tomography**, Piotr Wegrzyn, Institute of Physical Chemistry (Poland) and Univ. of Warsaw (Poland); Dawid Borycki, Julia Sudyka, Maciej Wojtkowski, Institute of Physical Chemistry (Poland) . . . . . [11228-85]
- Multimodal optical coherence tomography for quantitative diagnosis in breast cancer subtypes**, Ekaterina V. Gubarkova, Privilzhsky Research Medical Univ. (Russian Federation); Alexander Sovetsky, Alexander A. Moiseev, Vladimir Y. Zaitsev, Institute of Applied Physics (Russian Federation); Dmitriy Vorontsov, Nizhny Novgorod Regional Oncology Hospital (Russian Federation); Lev A. Matveev, Alexander Matveyev, Institute of Applied Physics (Russian Federation); Sergey Kuznetsov, Marina A. Sirotkina, Privilzhsky Research Medical Univ. (Russian Federation); Alexey Vorontsov, Nizhny Novgorod Regional Oncology Hospital (Russian Federation); Gregory V. Gelikonov, Institute of Applied Physics (Russian Federation); Elena V. Zagaynova, Natalia D. Gladkova, Privilzhsky Research Medical Univ. (Russian Federation) . . . . . [11228-86]
- High-speed maximum a posteriori birefringence estimator for Jones matrix optical coherence tomography by GPU implementation**, Atsushi Kubota, Sky Technology Inc. (Japan); Shuichi Makita, Yoshiaki Yasuno, Univ. of Tsukuba (Japan) . . . . . [11228-87]
- Acceleration of eye motion correction processing utilizing Lissajous scanning pattern in optical coherence tomography with GPGPU**, Toshihiro Mino, Masahiro Shibutani, Shinnosue Azuma, Topcon Corp. (Japan); Shuichi Makita, Univ. of Tsukuba (Japan); Masahiro Miura, Tokyo Medical Univ. (Japan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan); Tatsuo Yamaguchi, Topcon Corp. (Japan) . . . . . [11228-88]
- Development of mouse retina test standards with glaucoma-like tissue alterations for performance analysis of high resolution OCT systems**, Álvaro Barroso Peña, Steffi Ketelhut, Björn Kemper, Jürgen Schneckeburger, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [11228-89]

# CONFERENCE 11228

**Automated segmentation of AMD biomarkers in off-axis full-field OCT images using deep learning**, Helge M. Sudkamp, Medizinisches Laserzentrum Lübeck GmbH (Germany); Timo Kepp, Univ. zu Lübeck (Germany); Claus von der Burchard, Christian-Albrechts-Univ. zu Kiel (Germany); Peter Koch, Michael Münst, Moritz Moltmann, Medizinisches Laserzentrum Lübeck GmbH (Germany); Johann Roeder, Christian-Albrechts-Univ. zu Kiel (Germany); Mattias P. Heinrich, Heiz Handels, Univ. zu Lübeck (Germany); Gereon M. Hüttmann, Medizinisches Laserzentrum Lübeck GmbH (Germany); Hendrik Schenke, Christian-Albrechts-Univ. zu Kiel (Germany) . . . . . [11228-90]

**A novel majorize-minimize algorithm for jointly estimating scattering coefficient and denoising speckle in optical coherence tomography images**, Divya Varadarajan, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Morgan Fogarty, Washington Univ. in St. Louis (USA); Caroline Magnain, Bruce Fischl, Hui Wang, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) . . . . . [11228-92]

**840-nm broadband SLED-SOA MOPA source integrated in 14-pin butterfly module with 100+ mW free-space output power**, Marcus Duell, Stefan Gloor, Jose Ojeda, Jean Dahdah, Nicolai Matuschek, Raffaele Rezzonico, Christian Velez, EXALOS AG (Switzerland) . . . . . [11228-93]

**Application of over-sampling nano-sensitive optical coherence tomography for monitoring corneal internal structural changes in corneal cross-linking**, Yi Zhou, Sergey Alexandrov, Andrew Nolan, Rajib Dey, Nandan Das, National Univ. of Ireland (Ireland); Kai Neuhaus, Compact Imaging Ireland Ltd. (Ireland); Martin Leahy, National Univ. of Ireland (Ireland) . . . . . [11228-94]

**Combined-SLED source for UHR-OCT and SLO integrated in 14-pin butterfly module**, Marcus Duell, Stefan Gloor, Jose Ojeda, Jean Dahdah, Nikolay Primerov, Christian Velez, EXALOS AG (Switzerland) . . . . . [11228-95]

**Segmented OCT data set for depth resolved brain tumor detection validated by histological analysis**, Paul Strenge, Birgit Lange, Medizinisches Laserzentrum Lübeck GmbH (Germany); Christin Grill, Wolfgang Draxinger, Univ. zu Lübeck (Germany); Matteo M. Bonsanto, Universitätsklinikum Schleswig-Holstein (Germany); Christian Hagel, Universitätsklinikum Hamburg-Eppendorf (Germany); Robert Huber, Univ. zu Lübeck (Germany); Ralf Brinkmann, Medizinisches Laserzentrum Lübeck GmbH (Germany) . . . . . [11228-96]

**Single-shot phase-shifting method for fringe-free tomographic images with FF-OCT**, Yue Zhu, Wanrong Gao, Nanjing Univ. of Science and Technology (China) . . . . . [11228-97]

**Lipid-sensitive OCT**, Laurin Ginner, Johanna Gesperger, Barbara Messner, Matthias Salas, Michael Niederleithner, Bettina Kapsch, Medizinische Univ. Wien (Austria); Marcus Duell, Stefan Gloor, Philipp Vorreau, EXALOS AG (Switzerland); Rainer Leitgeb, Medizinische Univ. Wien (Austria) . . . . . [11228-99]

**Imaging the newt lens regeneration process with optical coherence tomography**, Weihao Chen, Hui Wang, Tsissios Georgios, Del Rio-Tsonis Katia, Miami Univ. (USA) . . . . . [11228-100]

**Spectrally dependent signal rolloff in visible-light optical coherence tomography**, Hao F. Zhang, Ian Rubinoff, Brian Soetikno, David Miller, Northwestern Univ. (USA); Yuanbo Wang, Opticent Health (USA); Roman Kuranov, Northwestern Univ. (USA) . . . . . [11228-101]

**Superluminescent diodes of spectral range 730 – 790 nm based on strained SQW heterostructure**, Andrey Yu Andreev, Sigm Plus (Russian Federation); Andrey S. Anikeev, Opton Ltd. (Russian Federation) and National Univ. of Science and Technology "MISIS" (Russian Federation); Alexander Chamorovskiy, Superlum Diodes Ltd. (Ireland); Stepan N. Il'chenko, Opton Ltd. (Russian Federation); Maxim A. Ladugin, Alexander A. Marmalyuk, Anatoly A. Padalitsa, Sigm Plus (Russian Federation); Kirill M. Pankratov, Opton Ltd. (Russian Federation); Vladimir R. Shidlovski, Superlum Diodes Ltd. (Ireland); Sergey D. Yakubovich, MIREA - Russian Technological Univ. (Russian Federation); Irina V. Yarotskaya, Sigm Plus (Russian Federation) . . . . . [11228-102]

**High power low coherent light sources based on superluminescent diodes**, Alexander Chamorovskiy, Superlum Diodes Ltd. (Ireland); Stepan N. Il'chenko, Opton Ltd. (Russian Federation); Andrey S. Anikeev, Opton Ltd. (Russian Federation) and National Univ. of Science and Technology "MISIS" (Russian Federation); Vladimir R. Shidlovski, Superlum Diodes Ltd. (Ireland); Sergei D. Yakubovich, MIREA - Russian Technological Univ. (Russian Federation) . . . . . [11228-103]

**Numerical method of axial motion correction in optical coherence tomography**, Grigory V. Gelikonov, Institute of Applied Physics (Russian Federation) . . . . . [11228-104]

**Complex-based OCT angiography with phase-stable SS-OCT**, Jun Geun Shin, Gwangju Institute of Science and Technology (Korea, Republic of); Gyeong Hun Kim, Pusan National Univ. (Korea, Republic of); Hwi Don Lee, Massachusetts General Hospital, Harvard Medical School (USA); Myeong Jin Ju, Dankook Univ. (Korea, Republic of); Chang-Seok Kim, Pusan National Univ. (Korea, Republic of); Tae Joong Eom, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [11228-105]

**1.7 um polarization-sensitive swept-source OCT for deep tissue imaging**, Kwan Seob Park, Tae il Yoon, Byeong Ha Lee, Gwangju Institute of Science and Technology (Korea, Republic of); Eun Seo Choi, Chosun Univ. (Korea, Republic of); Tae Joong Eom, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [11228-106]

**Kasai-based estimator for speckle autocorrelation analysis in optical coherence tomography**, Lucas Ramos De Pretto, Gesse E. C. Nogueira, Instituto de Pesquisas Energéticas e Nucleares (Brazil); Siyu Chen, Massachusetts Institute of Technology (USA); Marcus P. Raele, Wagner de Rossi, Anderson Z. Freitas, Instituto de Pesquisas Energéticas e Nucleares (Brazil) . . . . . [11228-107]

**Transparent media thickness measurement employing low-coherence interferometry and a multi-element array**, Vlastimil Kropác, Manuel Jorge M. Marques, Adrian Podoleanu, Univ. of Kent (United Kingdom) . . . . . [11228-108]

**Development of HR-SD-OCT system using supercontinuum light source and its application in detecting nanoscale changes**, Rajib Dey, National Univ. of Ireland, Galway (Ireland) . . . . . [11228-109]

**K-clock retrieval from image in swept source OCT**, Chen Zhang, Tsinghua Univ. (China); Xinyu Liu, Singapore Eye Research Institute (Singapore) . . . . . [11228-110]

**Wavenumber stepped megahertz optical coherence tomography for human skin imaging in vivo**, Chaoliang Chen, Ryerson Univ. (Canada) . . . . . [11228-111]

**Detection and measurement of thin petroleum films on the surface of the water using spectroscopic optical coherence tomography**, Aleksandra M. Kaminska, Marcin R. Strakowski, Jerzy Plucinski, Gdansk Univ. of Technology (Poland) . . . . . [11228-112]

**Polarization assisted nano-sensitive optical coherence tomography to detect depth resolved ultra-structural tissue anisotropy and its alteration in precancer progress**, Nandan Kumar Das, Sergey Alexandrov, Yi Zhou, Rajib Dey, Anand Arangath, Róisín M. Dwyer, National Univ. of Ireland, Galway (Ireland); Nirmalya Ghosh, Indian Institute of Science Education and Research Kolkata (India); Martin Leahy, National Univ. of Ireland, Galway (Ireland) . . . . . [11228-113]

## TUESDAY 4 FEBRUARY

### SESSION 5

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . TUE 8:30 AM TO 10:00 AM

### AO and Microscopic OCT

Session Chair: **Christoph K. F. Hitzengerger**, Medizinische Univ. Wien (Austria)

8:30 am: **Extending the field of view with multiconjugate adaptive optics optical coherence tomography**, Muhammad Faizan Shirazi, Elisabeth F. Brunner, Medizinische Univ. Wien (Austria); Marie Laslandes, ALPAO S.A.S. (France); Christoph K. F. Hitzengerger, Michael Pircher, Medizinische Univ. Wien (Austria) . . . . . [11228-29]

8:45 am: **Sensorless adaptive optics optical coherence tomographic angiography (OCTA) of the retinal plexuses**, Acner Camino Benech, Pengxiao Zang, Yukun Guo, Oregon Health & Science Univ. (USA); Ringo Ng, Joey Huang, Simon Fraser Univ. (Canada); Yali Jia, David Huang, Yifan Jian, Oregon Health & Science Univ. (USA) . . . . . [11228-30]

9:00 am: **Digital adaptive optics in optical coherence tomography with phase unstable sources**, Sebastián Ruiz-Lopera, Univ. EAFIT (Colombia); René Restrepo, INTA Instituto Nacional de Técnica Aeroespacial (Spain) and Univ. EAFIT (Colombia); Carlos Cuartas-Vélez, Univ. of Twente (Netherlands) and Univ. EAFIT (Colombia); Néstor Uribe-Patarroyo, Wellman Ctr. for Photomedicine (USA); Brett E. Bouma, Wellman Ctr. for Photomedicine (USA) and Institute for Medical Engineering and Science (USA) . . . . . [11228-31]

9:15 am: **In vivo Mirau-type optical coherence microscopy with symmetrical illumination**, Tuan-Shu Ho, Ming-Rung Tsai, Chih-Wei Lu, Apollo Medical Optics, Ltd. (Taiwan) . . . . . [11228-32]

9:30 am: **In vivo validation of OCT hemodynamic measurement techniques with two-photon microscopy**, Paul-James Marchand, Xuecong Lu, Cong Zhang, Yuankang Lu, Frédéric Lesage, Polytechnique Montréal (Canada) . . . . . [11228-33]

9:45 am: **Quantitative three-dimensional collagen fiber modeling from spectral domain optical coherence tomography (OCT) images**, James P. McLean, Shuyang Fang, Kristin M. Myers, Christine P. Hendon, Columbia Univ. (USA) . . . . . [11228-34]

Coffee Break. . . . . Tue 10:00 am to 10:30 am

**SESSION 6**

**LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . TUE 10:30 AM TO 12:00 PM**

**Clinical Applications**

Session Chair: **Kostadinka Bizheva**, Univ. of Waterloo (Canada)

10:30 am: **Endobronchial optical coherence tomography for in vivo microscopic diagnosis of pulmonary fibrosis**, Lida P. Hariri, Sreyankar Nandy, Benjamin W. Roop, David C. Adams, Ashok Muniappan, Colleen M. Keyes, John C. Wain, Christopher R. Morse, Michael Lanuti, Hugh G. Auchincloss, Massachusetts General Hospital (USA); Thomas V. Colby, Mayo Clinic (USA); Angela Shih, Mari Mino-Kenudson, Eugene J. Mark, Richard L. Kradin, Amita Sharma, Lloyd Liang, Diane Davies, Margit V. Szabari, Andrew M. Tager, Melissa J. Suter, Massachusetts General Hospital (USA). . . . . [11228-35]

10:45 am: **Endoscopic polarization-sensitive optical coherence tomography in multiple lung diseases**, Joy Willemse, Vrije Univ. Amsterdam (Netherlands); Reinier Wener, The Netherlands Cancer Institute (Netherlands); Fabio Feroldi, Margherita Vaselli, Maximilian G. O. Graefe, Johannes F. de Boer, Vrije Univ. Amsterdam (Netherlands). . . . . [11228-36]

11:00 am: **Integration of light-induced autofluorescence and optical coherence tomography for dental applications**, Nhan Le, Shaozhen Song, Univ. of Washington (USA); Hrebesh M. Subhash, Latonya Kilpatrick, Colgate-Palmolive Co. (USA); Ruikang Wang, Univ. of Washington (USA) . . . . [11228-37]

11:15 am: **Stokes non-local-means despeckling in intravascular polarization-sensitive optical coherence tomography in vivo**, Carlos Cuartas-Vélez, Univ. EAFIT (Colombia) and Univ. of Twente (Netherlands); René Restrepo, Univ. EAFIT (Colombia) and Instituto Nacional de Técnica Aeroespacial (Spain); Martin Villiger, David C. Adams, Massachusetts General Hospital, Harvard Medical School (USA); Brett E. Bouma, Massachusetts General Hospital, Harvard Medical School (USA) and Massachusetts Institute of Technology (USA); Néstor Uribe-Patarroyo, Massachusetts General Hospital, Harvard Medical School (USA) . . . . . [11228-38]

11:30 am: **Stable fiber-based polarization sensitive optical coherence tomography/optical microangiography system for simultaneous birefringent and microvascular imaging**, Peijun Tang, Ruikang Wang, Univ. of Washington (USA) . . . . . [11228-39]

11:45 am: **Optical coherence tomography for complex diagnosis of vulvar diseases**, Marina A. Sirotkina, Privolzhsky Research Medical Univ. (Russian Federation); Lev A. Matveev, Institute of Applied Physics (Russian Federation); Nelly N. Vagapova, Nizhny Novgorod Regional Clinical Hospital named after N.A. Semashko (Russian Federation); Ivan K. Safonov, Privolzhsky Research Medical Univ. (Russian Federation); Irina A. Kuznetsova, Privolzhsky Research Medical Univ. (Russian Federation) and Nizhny Novgorod Regional Clinical Hospital named after N.A. Semashko (Russian Federation); Dmitry A. Karashtin, Alexander A. Moiseev, Grigory V. Gelikonov, Institute of Applied Physics (Russian Federation); Elena V. Zagaynova, Privolzhsky Research Medical Univ. (Russian Federation); Vladimir Y. Zaitsev, Institute of Applied Physics (Russian Federation); Natalia D. Gladkova, Privolzhsky Research Medical Univ. (Russian Federation) . . . . . [11228-40]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

**SESSION 7**

**LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . TUE 1:30 PM TO 3:30 PM**

**OCT New Technology**

Session Chair: **Johannes F. de Boer**, Vrije Univ. Amsterdam (Netherlands)

1:30 pm: **Switchable vertical/horizontal section imaging with line-field confocal optical coherence tomography**, Jonas Ogien, Olivier Leveccq, Hicham Azimani, DAMAE Medical (France); Arnaud Dubois, Lab. Charles Fabry (France) . . . . . [11228-41]

1:45 pm: **Multibeam OCT imaging based on an integrated, free-space interferometer architecture**, Benjamin J. Vakoc, Yongjoo Kim, Norman Lippok, Wellman Ctr. for Photomedicine (USA) . . . . . [11228-42]

2:00 pm: **Directly measuring spectrometer resolution from excess noise correlations**, Aaron M. Kho, Tingwei Zhang, Univ. of California, Davis (USA); Conrad W. Merkle, Univ. of California, Davis (USA) and Medizinische Univ. Wien (Austria); Vivek J. Srinivasan, Univ. of California, Davis (USA) . . . . . [11228-43]

2:15 pm: **From master-slave to down-conversion optical coherence tomography**, Adrian Podoleanu, Adrian Bradu, Ramona Cernat, Manuel Jorge M. Marques, Univ. of Kent (United Kingdom) . . . . . [11228-44]

2:30 pm: **Quantum-inspired detection for spectral domain OCT**, Sylwia M. Kolenderska, The Univ. of Auckland (New Zealand); Piotr Kolenderski, Nicolaus Copernicus Univ. (Poland); Frédérique Vanholsbeeck, The Univ. of Auckland (New Zealand) . . . . . [11228-45]

2:45 pm: **Synthesizing scanning-mode image formation in full-wave modelling of OCT**, Callum M. Macdonald, Peter R. T. Munro, Univ. College London (United Kingdom) . . . . . [11228-46]

3:00 pm: **Robust complex conjugate artifact removal in OCT using circularly polarized light as reference**, Xinyu Liu, Xinwen Yao, Leopold Schmetterer, Bingyao Tan, Singapore Eye Research Institute (Singapore) . . . . . [11228-47]

3:15 pm: **Extended focus, spectral-domain optical coherence tomography system for in-vivo imaging of the human cornea**, Zohreh Hosseinaee, Univ. of Waterloo (Canada); Paul-James Marchand, Polytechnique Montréal (Canada); Le Han, Lin Kun Chen, Kostadinka Bizheva, Univ. of Waterloo (Canada) . . . . . [11228-48]

Coffee Break. . . . . Tue 3:30 pm to 4:00 pm

**SESSION 8**

**LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . TUE 4:00 PM TO 6:00 PM**

**Signal/Image Processing**

Session Chair: **Andrew M. Rollins**, Case Western Reserve Univ. (USA)

4:00 pm: **Volumetric motion correction in high-speed catheter-based OCT**, Tan Huu Nguyen, Osman O. Ahsen, Kaicheng Liang, Jason Zhang, Massachusetts Institute of Technology (USA); Hiroshi Mashimo, VA Boston Healthcare System (USA); James G. Fujimoto, Massachusetts Institute of Technology (USA) . . . . . [11228-49]

4:15 pm: **Signal-to-noise corrected depolarization index and the detection of multiply scattered light**, Pelham Keahey, Wellman Ctr. for Photomedicine (USA); Felix Fanjul-Vélez, Univ. de Cantabria (Spain); Norman Lippok, Brett E. Bouma, Martin Villiger, Wellman Ctr. for Photomedicine (USA) . . . . . [11228-50]

4:30 pm: **Virtual multi-directional optical coherence tomography**, Daisuke Oida, Kensuke Oikawa, Univ. of Tsukuba (Japan); Tai-Ang Wang, Meng-Tsan Tsai, Chang Gung Univ. (Taiwan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan) . . . [11228-51]

4:45 pm: **Achieving the ideal point spread in swept source OCT**, Bart C. Johnson, Tim N. Ford, Seungbum Woo, Walid Atia, AXSUN Technologies Inc. (USA); Muzammil A. Arain, Tilman Schmall, Rick A. Williams, Carl Zeiss Meditec, Inc. (USA); Peter Whitney, AXSUN Technologies Inc. (USA) . . . . [11228-52]

5:00 pm: **Optimal decorrelation estimation for OCT velocimetry**, Maximilian G. O. Gräfe, Johannes F. de Boer, Vrije Univ. Amsterdam (Netherlands) . . . . . [11228-53]

5:15 pm: **Exact image-formation theory for high-NA high-resolution optical coherence tomography by four-dimensional formulation**, Naoki Fukutake, Nikon Corp. (Japan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan) . . . . [11228-54]

5:30 pm: **Motion correction in 600 kHz scanning 4D microscopic OCT**, Malte vom Endt, Medizinisches Laserzentrum Lübeck GmbH (Germany); Michael Münter, Univ. zu Lübeck (Germany); Gereon M. Hüttmann, Univ. zu Lübeck (Germany) and Medizinisches Laserzentrum Lübeck GmbH (Germany) and Deutsches Zentrum für Lungenforschung (Germany); Hinnerk Schulz-Hildebrandt, Medizinisches Laserzentrum Lübeck GmbH (Germany) and Univ. zu Lübeck (Germany) . . . . . [11228-55]

5:45 pm: **Cardiac optical coherence tomography image restoration**, Ziyi Huang, Columbia Univ. (USA); Yu Gan, The Univ. of Alabama (USA); Theresa Lye, Christine P. Hendon, Columbia Univ. (USA) . . . . . [11228-56]

**WEDNESDAY 5 FEBRUARY**

**SESSION 9**

**LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . WED 8:30 AM TO 10:00 AM**

**Full Field OCT**

Session Chair: **Zhongping Chen**, Beckman Laser Institute and Medical Clinic (USA)

8:30 am: **Crosstalk-free in vivo volumetric retinal imaging with Fourier-domain full-field OCT**, Egidijus Aukorius, Dawid Borycki, Maciej Wojtkowski, Institute of Physical Chemistry (Poland) . . . . . [11228-57]

8:45 am: **Motion artifact removal and signal enhancement to achieve in vivo dynamic full field OCT**, Jules Scholler, Pedro Mecé, Cassandra Groux, Viacheslav Mazlin, Claude Boccara, Institut Langevin Ondes et Images (France); Kate Grieve, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France) and Institut de la Vision (France) . . . . . [11228-58]

9:00 am: **Adaptive glasses-assisted Full-Field OCT for SNR enhanced 3D high-resolution retinal imaging**, Pedro Mecé, Jules Scholler, Cassandra Groux, Mathias Fink, Institut Langevin Ondes et Images (France); Kate Grieve, Institut de la Vision, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France); Claude Boccara, Institut Langevin Ondes et Images (France) . . . . . [11228-59]

# CONFERENCE 11228

9:15 am: **Spatiotemporal optical coherence (STOC) imaging**, Dawid Borycki, Piotr Wegrzyn, Egidijus Aukorius, Maciej Wojtkowski, Institute of Physical Chemistry (Poland) . . . . . [11228-60]

9:30 am: **Multifrequency-swept optical coherence microscopy for full-field in-vivo intracochlear vibration measurement**, Samuel Choi, Fumiaki Nin, Takeru Ota, Hiroshi Hibino, Niigata Univ. (Japan) and Japan Agency for Medical Research and Development (Japan) . . . . . [11228-61]

9:45 am: **D-FFOCT as a tool to assess oxygenation induced changes in cellular metabolism**, Siddharth Khare, Ravi Malpani, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA); Hyesoo Lee, Univ. of Maryland School of Dentistry (USA); Viswanath Gorti, Kosar Khaksari, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA); Jules Scholler, Institut Langevin Ondes et Images (France); Emilie Benoit, LLTech SAS (France); Claude Boccara, Institut Langevin Ondes et Images (France); Dan Sackett, Amir Gandjbakhche, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA) . . . [11228-62]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

## SESSION 10

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) .WED 10:30 AM TO 12:00 PM

### Small Animal/Preclinical

Session Chair: **Rainer A. Leitgeb**, Medizinische Univ. Wien (Austria)

10:30 am: **Imaging the transporting function of mouse oviduct in vivo using OCT**, Shang Wang, Riana Syed, Zheng-Chen Yao, Irina V. Larina, Baylor College of Medicine (USA) . . . . . [11228-63]

10:45 am: **Intra-tumor heterogeneity of glioblastoma samples revealed by visible light optical coherence microscopy**, Antonia Lichtenegger, Johanna Gesperger, Barbara Kiesel, Thomas Roetzer, Pablo Eugui, Danielle J. Harper, Matthias Salas, Marco Augustin, Conrad W. Merkle, Christoph K. F. Hitzberger, Georg Widhalm, Adelheid Wöhrer, Bernhard Baumann, Medizinische Univ. Wien (Austria) . . . . . [11228-64]

11:00 am: **Microscopic optical coherence tomography - 4D imaging of mucus transport**, Michael Münter, Mario Pieper, Univ. zu Lübeck (Germany); Malte vom Endt, Medizinisches Laserzentrum Lübeck GmbH (Germany); Peter König, Gereon M. Hüttmann, Hinnerk Schulz-Hildebrandt, Univ. zu Lübeck (Germany) . . . . . [11228-65]

11:15 am: **Human placenta-derived trophoblast organoid measurement using ultrahigh resolution optical coherence tomography**, Abigail J. Deloria, Sandra Haider, Bianca Dietrich, Martin Knöfler, Rainer Leitgeb, Mengyang Liu, Wolfgang Drexler, Richard Haindl, Medizinische Univ. Wien (Austria) . . . . . [11228-66]

11:30 am: **Ultra-high-resolution SD-OCM for pre-clinical imaging at 840 nm with a polarization-aligned combined-SLED source**, Richard Haindl, Medizinische Univ. Wien (Austria); Marcus Duell, Stefan Gloor, Jean Dahdah, EXALOS AG (Switzerland); Caterina Sturtzel, St. Anna Kinderkrebsforschung e.V. (Austria); Abigail J. Deloria, Mengyang Liu, Medizinische Univ. Wien (Austria); Martin Distel, St. Anna Kinderkrebsforschung e.V. (Austria); Wolfgang Drexler, Rainer Leitgeb, Medizinische Univ. Wien (Austria) . [11228-67]

11:45 am: **Heartbeat recovery after cardiac arrest and association of maximum pace-able heart rate with aging via optogenetic pacing and OCM imaging of Drosophila**, Jing Men, Lehigh Univ. (USA); Airong Li, Massachusetts General Hospital, Harvard Medical School (USA); Zhiwen Yang, Beihang Univ. (China); Jixu Yu, Rudolph Tanzi, Massachusetts General Hospital, Harvard Medical School (USA); Chao Zhou, Lehigh Univ. (USA) . . . . . [11228-68]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:30 pm

## SESSION 11

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . .WED 1:30 PM TO 3:30 PM

### Machine Learning

Session Chair: **Marinko V. Sarunic**, Simon Fraser Univ. (Canada)

1:30 pm: **Deep spectral learning for label-free optical imaging oximetry with uncertainty quantification**, Rongrong Liu, Northwestern Univ. (USA); Shiyi Cheng, Lei Tian, Ji Yi, Boston Univ. (USA) . . . . . [11228-69]

1:45 pm: **Progress on machine learning based methods for processing and classification of optical coherence tomography angiography**, Morgan L. Heisler, Julian Lo, Donghuan Lu, Francis Tran, Arman Athwal, Simon Fraser Univ. (Canada); Ivana Zadro, Sven Loncaric, Univ. of Zagreb (Croatia); Mirza Faisal Beg, Marinko V. Sarunic, Simon Fraser Univ. (Canada) . . . . . [11228-70]

2:00 pm: **Comparison of classification methods of Barret's and dysplasia in the esophagus from in vivo optical coherence tomography images**, Christos Photiou, George Plastiras, Costas Pitris, Univ. of Cyprus (Cyprus) . . . . . [11228-71]

2:15 pm: **Resolution enhancement with generative adversarial modelling of micro-optical coherence tomography**, Kaicheng Liang, Agency for Science, Technology and Research (A\*STAR) (Singapore); Xinyu Liu, Nanyang Technological Univ. (Singapore) and Singapore Eye Research Institute (Singapore); Si Chen, Jun Xie, Nanyang Technological Univ. (Singapore); Wei Qing Lee, National Univ. of Singapore (Singapore); Linbo Liu, Nanyang Technological Univ. (Singapore); Hwee Kuan Lee, Agency for Science, Technology and Research (A\*STAR) (Singapore) and Singapore Eye Research Institute (Singapore) and National Univ. of Singapore (Singapore) . . . [11228-72]

2:30 pm: **Real-time retinal layer segmentation of OCT images: from graph cut to deep learning**, Svetlana Borkovkina, Worawee Janpongsri, Simon Fraser Univ. (Canada); Acner Camino Benech, Casey Eye Institute (USA); Marinko V. Sarunic, Simon Fraser Univ. (Canada); Yifan Jian, Casey Eye Institute (USA) . . . . . [11228-73]

2:45 pm: **Drosophila heart 3D segmentation using LSTM neural network in optical coherence microscopy**, Zhao Dong, Lehigh Univ. (USA) . . . [11228-74]

3:00 pm: **Deep reinforcement learning for sensorless adaptive optics multimodal visible light optical coherence tomography**, Edward F. Durech, Daniel J. Wahl, Arman Athwal, Simon Fraser Univ. (Canada); Yifan Jian, Oregon Health & Science Univ. (USA); Marinko V. Sarunic, Simon Fraser Univ. (Canada) . . . . . [11228-75]

3:15 pm: **Deep learning enables extraction of capillary-level angiograms from single OCT volume**, Jianlong Yang, Cixi Institute of BioMedical Engineering, CNITECH (China); Peng Liu, Univ. of Electronic Science and Technology of China (China); Yan Hu, Cixi Institute of BioMedical Engineering, CNITECH (China); Lixin Duan, Jiang Liu, Univ. of Electronic Science and Technology of China (China) . . . . . [11228-76]

Coffee Break . . . . . Wed 3:30 pm to 4:00 pm

## SESSION 12

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . WED 4:00 PM TO 6:00 PM

### Novel Contrast Mechanisms

Session Chair: **Peter E. Andersen**, DTU Fotonik (Denmark)

4:00 pm: **Spectrally multiplexed detection of gold nanoparticles in optical coherence tomography enables wide-field lymph-angiography**, Edwin Yuan, Peng Si, Adam de la Zerda, Stanford Univ. (USA) . . . . . [11228-77]

4:15 pm: **Quantitative multi-contrast in vivo rodent imaging with optical coherence tomography and angiography**, Destiny Hsu, Ji Hoon Kwon, Ringo Ng, Jun Song, Simon Fraser Univ. (Canada); Myeong Jin Ju, Dankook Univ. (Korea, Republic of) and Simon Fraser Univ. (Canada); Marinko V. Sarunic, Simon Fraser Univ. (Canada) . . . . . [11228-78]

4:30 pm: **Quantitative microstructure sensing for epithelial characterization with optical coherence tomography**, Taylor M. Cannon, Harvard-MIT Health Sciences and Technology (USA); Brett E. Bouma, Néstor Uribe-Patarroyo, Wellman Ctr. for Photomedicine, Massachusetts General Hospital, Harvard Medical School (USA) . . . . . [11228-79]

4:45 pm: **Gold nanobipyramids as optical coherence tomography contrast agents in the second near infrared window for multiplexing study of tumor lymphatic flows**, Peng Si, Saba Shevdi, Edwin Yuan, Ke Yuan, Ziyu Lautman, Stefanie S. Jeffrey, George W. Sledge, Adam de la Zerda, Stanford Univ. School of Medicine (USA) . . . . . [11228-80]

5:00 pm: **In vivo quantification of RPE lipofuscin with visible light OCT-based fundus autofluorescent and A2E reference target**, Zahra Nafar, Florida International Univ. (USA); Rong Wen, Univ. of Miami Miller School of Medicine (USA); Ziqiang Guan, Duke Univ. School of Medicine (USA); Shuliang Jiao, Florida International Univ. (USA) . . . . . [11228-81]

5:15 pm: **Indocyanine green provides absorption and spectral contrast for optical coherence tomography at 840 nm in vivo**, Conrad W. Merkle, Marco Augustin, Danielle J. Harper, Bernhard Baumann, Medizinische Univ. Wien (Austria) . . . . . [11228-82]

5:30 pm: **Quantification of ex vivo tissue activity by short and long time-course analysis of multifunctional OCT signals**, Ibrahim Abd El-Sadek, Arata Miyazawa, Larina Shen, Shinichi Fukuda, Toshiharu Yamashita, Yuki Oka, Pradipta Mukherjee, Satoshi Matsusaka, Tetsuro Oshika, Hideaki Kano, Yoshiaki Yasuno, Univ. of Tsukuba (Japan) . . . . . [11228-83]

5:45 pm: **Background-free optical coherence tomography imaging with gold-seeded growth on magnetically responsive nanorods**, Wesley Poon, Zhiwei Li, B. Hyle Park, Yadong Yin, Univ. of California, Riverside (USA) . . . . . [11228-84]

# CONFERENCE 11229

LOCATION: ROOM 312 (LEVEL 3 SOUTH)

Sunday–Tuesday 2–4 February 2020 • Proceedings of SPIE Vol. 11229

# Advanced Biomedical and Clinical Diagnostic and Surgical Guidance Systems XVIII

BIOS

Conference Chair: **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA)

Program Committee: **Daniel X. Hammer**, U.S. Food and Drug Administration (USA); **Dirk J. Faber**, Amsterdam UMC (Netherlands); **Christine P. Hendon**, Columbia Univ. (USA); **Zhiwei Huang**, National Univ. of Singapore (Singapore); **Beop-Min Kim**, Korea Univ. (Korea, Republic of); **Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA); **Hui Min Leung**, Massachusetts General Hospital (USA); **Francisco E. Robles**, Georgia Institute of Technology & Emory Univ. School of Medicine (USA); **Tuan Vo-Dinh**, Fitzpatrick Institute For Photonics, Duke Univ. (USA)

## SUNDAY 2 FEBRUARY

### SESSION 1

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... SUN 8:50 AM TO 10:10 AM

#### Clinical Applications of Fluorescence I

Session Chair: **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA)

8:50 am: **Fluorescence Lifetime Imaging (FLIm) for intraoperative pathology detection in transoral robotic surgery**, Brent W. Weyers, Mark Marsden, Tianchen Sun, Julien Bec, Univ. of California, Davis (USA); Arnaud F. Bewley, Regina F. Gaudour-Edwards, Michael G. Moore, D. Gregory Farwell, Laura Marcu, UC Davis Medical Ctr. (USA) ..... [11229-1]

9:10 am: **Augmented reality visualization for intraoperative guidance and tumor delineation based on fluorescence lifetime**, Tianchen Sun, Univ. of California, Davis (USA); Jakob Unger, trinamiX GmbH (Germany); Richard J. Bold, Morgan A. Darrow, UC Davis Medical Ctr. (USA); Kwan-Liu Ma, Laura Marcu, Univ. of California, Davis (USA) ..... [11229-2]

9:30 am: **Multispectral fluorescence lifetime imaging system with Si avalanche photodetector: better image at lower cost**, Xiangnan Zhou, Julien Bec, Diego R. Yankelevich, Laura Marcu, Univ. of California, Davis (USA) ..... [11229-3]

9:50 am: **Deep UV fluorescence scanning microscopy for breast tumor margin detection**, Tongtong Lu, Marquette Univ. (USA); Julie Jorns, Mollie Patton, Medical College of Wisconsin (USA); Renee Fisher, Marquette Univ. (USA) and Medical College of Wisconsin (USA); Amanda Emmrich, Medical College of Wisconsin (USA); Todd Doehring, Abemis LLC (USA); Taly Gilat-Schmidt, Marquette Univ. (USA) and Medical College of Wisconsin (USA); Dong Hye Ye, Marquette Univ. (USA); Tina Yen, Medical College of Wisconsin (USA); Bing Yu, Marquette Univ. (USA) and Medical College of Wisconsin (USA) ..... [11229-5]

Coffee Break ..... Sun 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... SUN 10:40 AM TO 12:00 PM

#### Clinical Applications of Fluorescence II

Session Chair: **Laura Marcu**, Univ. of California, Davis (USA)

10:40 am: **Physicochemical characterization of near infrared autofluorescence present in parathyroid glands**, Giju Thomas, Melanie A. McWade, Emmanuel A. Mannoh, Vanderbilt Univ. (USA); Christine M. O'Brien, Dorota Grabowska, Washington Univ. School of Medicine in St. Louis (USA); Naira Baregamian, Carmen C. Solorzano, Vanderbilt Univ. Medical Ctr. (USA); Melinda E. Sanders, Washington Univ. School of Medicine in St. Louis (USA); W. Hayes McDonald, Vanderbilt Univ. (USA); Samuel Achilefu, Washington Univ. School of Medicine in St. Louis (USA); Anita Mahadevan-Jansen, Vanderbilt Univ. (USA) ..... [11229-6]

11:00 am: **Development of a portable imager for intraoperative real-time localization of parathyroid glands**, Eugene Oh, Children's National Medical Ctr. (USA) and Johns Hopkins Univ. (USA); Wan Wook Kim, Kyungpook National Univ. Medical Ctr. (Korea, Republic of); So-Hyun Nam, Dong-A Univ. Medical Ctr. (Korea, Republic of); Gyeong Woo Cheon, GE Global Research (USA); Bo Ning, Children's National Medical Ctr. (USA); Jaepyeong Cha, Children's National Health System (USA) and The George Washington Univ. (USA) ..... [11229-7]

11:20 am: **Development of phase-sensitive near-infrared autofluorescence detector for sensing of parathyroid glands during parathyroid/thyroidectomy**, Yikeun Kim, Pukyong National Univ. (Korea, Republic of); Sung Won Kim, Kang-Dae Lee, Kosin Univ. (Korea, Republic of); Yeh-Chan Ahn, Pukyong National Univ. (Korea, Republic of) ..... [11229-8]

11:40 am: **Development of methylene blue specific fluorescence imaging system: from evaluation to clinical application**, Chong Zhang, Institute of Automation (China); Daqing Jiang, Bo Huang, Yahong Luo, China Medical Univ. Hospital (China); Kun Wang, Jie Tian, Institute of Automation (China) ..... [11229-9]

Lunch/Exhibition Break ..... Sun 12:00 pm to 1:30 pm

### SESSION 3

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... SUN 1:30 PM TO 3:10 PM

#### OCT Applications

Session Chair: **Caroline Boudoux**, Polytechnique Montréal (Canada)

1:30 pm: **Application of optical coherence tomography for real-time lung tumor-located precise interspecimen tissue sampling before evaluation of pathological frozen section**, Miao Hui Lin, Tien-Yu Hsiao, Chia-Wei M. Sun, National Chiao Tung Univ. (Taiwan); Hung-Chang Liu, Mackay Memorial Hospital (Taiwan) ..... [11229-10]

1:50 pm: **Real-time angiographic OCT for guiding dermal filler injection**, Jungbin Lee, SeongHan Kim, Ikjong Park, Pohang Univ. of Science and Technology (Korea, Republic of); Byungho Oh, Yonsei Univ. College of Medicine (Korea, Republic of); Ki Hean Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11229-11]

2:10 pm: **Ultrahigh-speed, high-resolution, large-area optical coherence tomography (OCT) imaging for rapid evaluation of breast cancer surgical specimens**, Diana Mojahed, Columbia Univ. (USA); Matthew B. Applegate, Boston Univ. (USA); Richard Ha, Hanina Hibshoosh, Columbia Univ. Medical Ctr. (USA); Christine P. Hendon, Columbia Univ. (USA) ..... [11229-12]

2:30 pm: **In vivo imaging of renal microvasculature in murine ischemia-reperfusion injury models using optical coherence tomography angiography**, Woojae Kang, Inho Shin, KAIST (Korea, Republic of); Se-Hyun Oh, Eun-Joo Oh, Jang-Hee Cho, Kyungpook National Univ. (Korea, Republic of); Wang-Yuhl Oh, KAIST (Korea, Republic of) ..... [11229-13]

2:50 pm: **Common-path optical coherence tomography-guided autonomous "Big Bubble" device for cornea transplant surgery**, Shoujing Guo, Johns Hopkins Univ. (USA); Nicolas Sarfaraz, Department of Mechanical Engineering, University of Maryland, College Park (USA); William G. Gensheimer, Warfighter Eye Center, Malcolm Grow Medical Clinics and Surgery Center (USA); Axel Krieger, Department of Mechanical Engineering (USA); Jin U. Kang, Department of Electrical and Computer Engineering, Johns Hopkins University (USA) ..... [11229-14]

Coffee Break ..... Sun 3:10 pm to 3:40 pm

### SESSION 4

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... SUN 3:40 PM TO 5:40 PM

#### Deep Learning

Session Chair: **Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA)

3:40 pm: **Deep learning for classification of breast cancer in optical coherence tomography (OCT) imaging**, Rohan Bareja, Diana Mojahed, Christine P. Hendon, Columbia Univ. (USA) ..... [11229-15]

4:00 pm: **Point-of-care Lyme serodiagnostic using a multiplexed vertical flow assay and deep learning**, Hyou-Arm Joung, Zachary S. Ballard, Jing Wu, Derek K. Tseng, Halemariam Teshome, Linghao Zhang, Univ. of California, Los Angeles (USA); Raymond J. Dattwyler, Paul M. Arnaboldi, New York Medical College (USA); Omai Garner, Dino Di Carlo, Aydogan Ozcan, Univ. of California, Los Angeles (USA) ..... [11229-16]

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4:20 pm: **Monte Carlo investigation of deep learning tissue classification performance in OCT-based smart laser bone surgery**, Yakub Aqib Bayhaqi, Arsham Hamidi, Alexander Navarini, Philippe C. Cattin, Azhar Zam, Univ. Basel (Switzerland) . . . . . [11229-17]

4:40 pm: **OCT-sensor integrated intraretinal injector guided by a convolutional neural network(CNN)-based retinal layers tracking**, Soohyun Lee, Ruizhi Zuo, Jin U. Kang, Johns Hopkins Univ. (USA) . . . . . [11229-18]

5:00 pm: **Intelligent classification of brain tumor based on optical coherence tomography**, Li-Chieh Pai, Tien-Yu Hsiao, National Chiao Tung Univ. (Taiwan); Sanford P. C. Hsu, Chun-Fu Lin, Jui-To Wang, Shao-Ching Chen, Taipei Veterans General Hospital (Taiwan); Cheng-Kuang Lee, NVIDIA Corp. (Taiwan); Chia-Wei M. Sun, National Chiao Tung Univ. (Taiwan) . . . . . [11229-19]

5:20 pm: **Optical coherence tomography angiography in mouse brain based on deep learning**, Kwan Seob Park, Jun Geun Shin, Tae Joong Eom, Gwangju Institute of Science and Technology (Korea, Republic of) . . [11229-20]

11:40 am: **Intraoperative surgical instrument guidance for spinal screw placement procedures using diffuse reflectance spectroscopy**, Akash Swamy, Technische Univ. Delft (Netherlands) and Philips Research (Netherlands); Gustav Burström, Karolinska Institute (Sweden); Jarich W. Spliethoff, Drazenko Babic, Christian Reich, Joanneke Groen, Philips Research (Netherlands); Stefan Ruschke, Technische Univ. München (Germany); John M. Racadio, Cincinnati Children's Hospital Medical Ctr. (USA); Erik Edström, Adrian Elmi Terander, Karolinska Institute (Sweden); Jenny Dankelman, Technische Univ. Delft (Netherlands); Benno H. W. Hendriks, Technische Univ. Delft (Netherlands) and Philips Research (Netherlands) . . . . . [11229-29]

12:00 pm: **Highly interactive clinical neurofeedback therapy based on near-infrared spectroscopy (NIRS) and VR for children with Attention Deficit Hyperactivity Disorder(ADHD)**, Chieh-Hsun Tsai, National Chiao Tung Univ. (Taiwan) . . . . . [11229-30]

Lunch Break . . . . . Mon 12:20 pm to 1:20 pm

## MONDAY 3 FEBRUARY

### SESSION 5

LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . MON 8:30 AM TO 10:10 AM

#### Tomography and Imaging

Session Chair: **Hui Min Leung**, Massachusetts General Hospital (USA)

8:30 am: **Fiber-free parallel-plane continuous wave diffuse optical tomography system for breast imaging**, Cheng Ma, Ruibo Chen, Jing Zhao, Menglu Xu, Haoqi Wu, Yudong Shen, Yihan Wang, Shouping Zhu, Xidian Univ. (China) . . . . . [11229-21]

8:50 am: **Angular domain scatter rejection for improved spatial resolution in lymph node optical projection tomography**, Veronica C. Torres, Chengyue Li, Jovan G. Brankov, Kenneth M. Tichauer, Illinois Institute of Technology (USA) [11229-22]

9:10 am: **Forward scattered Raman-computed Tomography for 3D imaging of rheumatoid arthritis**, Mads S. Bergholt, King's College London (United Kingdom); Simon V. Pedersen, Anders R. Walther, Univ. of Southern Denmark (Denmark); Magnus Jensen, King's College London (United Kingdom); Martin A. B. Hedegaard, Univ. of Southern Denmark (Denmark) . . . . . [11229-23]

9:30 am: **Detection of critical structures and tumors in real-time using a next generation molecular chemical imaging endoscope**, Shona D. Stewart, Alyssa Zrimsek, Heather Gomer, Jihang Wang, Aaron Smith, Arash Samiei, James C. Post, Charles W. Gardner, ChemImage Corp. (USA); Jeffrey K. Cohen, Allegheny General Hospital (USA); Patrick J. Treado, ChemImage Corp. (USA) . . . . . [11229-24]

9:50 am: **Development of hybrid confocal Raman endomicroscopy**, Conor C. Horgan, Mads S. Bergholt, King's College London (United Kingdom) . . . . . [11229-25]

Coffee Break. . . . . 10:10 am to 10:40 am

### SESSION 6

LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . MON 10:40 AM TO 12:20 PM

#### Spectroscopy and Other Techniques

Session Chair: **Beop-Min Kim**, Korea Univ. (Korea, Republic of)

10:40 am: **Ultra-stable spectropolarimeter for dermatology**, Briséis Varin, Jean Dellinger, Jean Rehlinger, Cemal Draman, Marc P. Torzynski, Christian Heinrich, Jihad Zallat, Univ. de Strasbourg (France) . . . . . [11229-26]

11:00 am: **Clinical prediction of pressure injuries using multidistance diffuse correlation spectroscopy**, Alec Lafontant, Michael Neidrauer, Ian A. Robinson, Drexel Univ. (USA); Vaishali Purohit, Drexel Univ. College of Medicine (USA); Rose Ann DiMaria-Ghalili, Drexel Univ. (USA); Michael S. Weingarten, Drexel Univ. College of Medicine (USA); Peter A. Lewin, Leonid Zubkov, Drexel Univ. (USA) . . . . . [11229-27]

11:20 am: **Developing diffuse correlation spectroscopic tools for continuous, real-time, spatially-resolved monitoring of spinal cord blood flow**, David R. Busch, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA); Wei Lin, Chia Chieh Goh, Stony Brook Univ. (USA); Nicholas Larson, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA); Arjun G. Yodh, Univ. of Pennsylvania (USA); Thomas F. Floyd, The Univ. of Texas Southwestern (USA) . . . . . [11229-28]

### SESSION 7

LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . MON 1:20 PM TO 2:40 PM

#### Clinical Biophotonics Under Regulatory Evaluation

Session Chair: **Daniel X. Hammer**, U.S. Food and Drug Administration  
1:25 pm: **FDA and CLIA approval for biophotonics diagnostic technologies: perspective from academic-industrial partnership**, Hariharan Subramanian, Vadim Backman, Northwestern Univ. (USA) . . . . . [11229-68]

1:40 pm: **Patient Science Informing Regulatory Decision-Making Across the Total Product Lifecycle**, Heather Benz, Daniel X. Hammer, Michelle Tarver, US Food and Drug Administration (USA) . . . . . [11229-69]

1:55 pm: **Navigating the regulatory pathway for an innovative Bionic Vision System**, Karine Chevré, Pixium Vision (France) . . . . . [11229-70]

2:10 pm: **A Tale of Three Companies: Commercialization of Computational Imaging and Sensing Technologies**, Aydogan Ozcan, Univ of California Los Angeles (USA) . . . . . [11229-71]

2:25 pm: **The Pocket Colposcope: Concept to Scale**, Nimmi Ramanujam, Duke (USA) . . . . . [11229-72]

### PANEL DISCUSSION

LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . 2:40 PM TO 3:00 PM

#### Patient-Centered Studies, Humanitarian Devices, and Photonics for Vulnerable Populations

Moderator: **Daniel Hammer**, US Food and Drug Administration (USA)

Panelists:

**Karine Chevré**, Pixium Vision (France)

**Aydogan Ozcan**, Univ. of California, Los Angeles (USA)

**Nirmala Ramanujam**, Duke Univ. (USA)

**Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA)

**Hariharan Subramanian**, Northwestern Univ. (USA)

Coffee Break. . . . . Mon 3:00 pm to 3:30 pm

**SESSION 8**

**LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . MON 3:30 PM TO 5:10 PM**

**Therapeutics**

Session Chair: **Francisco E. Robles**, Georgia Institute of Technology & Emory Univ. School of Medicine (USA)

3:30 pm: **Optical and optoacoustical feedback system for minimally invasive smart laser osteotomy**, Azhar Zam, Univ. Basel (Switzerland) . . . . . [11229-31]

3:50 pm: **Fiber based black-body radiation thermal sensing for laser interstitial thermal therapy**, Paris L. Franz, Hui Wang, Miami Univ. (USA) . . . . . [11229-32]

4:10 pm: **Evaluation of the optimized surgical illuminant for enhancement of blood oxygen saturation**, Yoko Kurabuchi, Kazuya Nakano, Takashi Ohnishi, Toshiya Nakaguchi, Chiba Univ. (Japan); Markku Hauta-Kasari, Univ. of Eastern Finland (Finland); Hideaki Haneishi, Chiba Univ. (Japan) . . . . . [11229-33]

4:30 pm: **Laser vibrometric characterization and model development of a human vocal tract for acoustic therapy of deaf patients**, Michael Gruner, Christopher Taudt, Patrick Hoyer, Ronny Maschke, Peter Hartmann, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany) . [11229-34]

4:50 pm: **Ablation monitoring with integrated long-range OCT and Er:YAG laser for smart laserosteotomy**, Arsham Hamidi, Yakub Aqib Bayhaqi, Iris T. Schmidt, Ferda Canbaz, Univ. Basel (Switzerland); Yifan Jian, Casey Eye Institute (USA) and Oregon Health & Science Univ. (USA); Alexander Navarini, Philippe C. Cattin, Azhar Zam, Univ. Basel (Switzerland) . . . . . [11229-35]

**POSTERS-MONDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Monday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Biomechanical modeling of surgical treatment of unilateral sacral fractures**, Aleksandr S. Dol, Dmitrii V. Ivanov Sr., Kristina K. Levchenko, Sergey I. Kireev, Saratov State Univ. (Russian Federation); Igor V. Kazhanov, Sergey I. Mikityuk, Vadim A. Manukovsky, St. Petersburg I. I. Dzhanelidze Research Institute of Emergency Medicine (Russian Federation) . . . [11229-47]

**Recognition of the objects contours in CT and MRI images**, Aleksandr S. Dol, Dmitriy V. Ivanov Sr., Saratov State Univ. (Russian Federation) . . . . . [11229-48]

**Comparative biomechanical analysis of pathology and surgical treatment of the ascending aorta**, Kseniya Skripachenko, Anastasiya A. Golyadkina, Konstantin M. Morozov, Nikolai V. Ostrovsky, Saratov State Univ. (Russian Federation) . . . . . [11229-49]

**Quantitative and specific detection of exosomal miRNA using surface-enhanced Raman spectroscopy for accurate diagnosis of breast cancer**, Sang Jun Sim, Jong Uk Lee, Korea Univ. (Korea, Republic of) . . . . . [11229-50]

**Functionality of decision support system for spine and pelvic complex pathology: needs of orthopedic surgeons**, Anna S. Kolesnikova, Saratov State Univ. (Russian Federation); Aleksander S. Fedonnikov, Yulia Y. Rozhkova, Vladimir Y. Ulyanov, Saratov State Medical Univ. (Russian Federation); Irina V. Kirillova, Leonid Y. Kossovich, Saratov State Univ. (Russian Federation) . . . . . [11229-51]

**The dependence of Young's modulus of trabecular bony tissue on its density according to computed tomography**, Pavel Dmitriev, Anastasiya A. Golyadkina, Leonid V. Bessonov, Irina I. Kirillova, Alexander S. Falkovich, Leonid Y. Kossovich, Saratov State Univ. (Russian Federation) . . . . . [11229-52]

**Decision support systems development for spine and pelvic complex surgery: analysis of existing treatment approaches**, Anna S. Kolesnikova, Saratov State Univ. (Russian Federation); Alexander S. Fedonnikov, Vladimir Y. Ulyanov, Alexey E. Shulga, Sergey Likhachev, Saratov State Medical Univ. (Russian Federation); Leonid Y. Kossovich, Irina V. Kirillova, Saratov State Univ. (Russian Federation) . . . . . [11229-53]

**Development of vessel position estimation system based on pixel-wise refocusing using light field imaging**, Kayo Yoshimoto, Hideya Takahashi, Kohei Yamamoto, Osaka City Univ. (Japan); Kenji Yamada, Osaka Univ. (Japan) . . . . . [11229-54]

**Aspect ratio as a factor of cerebral aneurysm rupture**, Dmitriy V. Ivanov Sr., Aleksandr S. Dol, Saratov State Univ. (Russian Federation) . . . . . [11229-55]

**Geometric modeling of the heart based on computed tomography**, Alexander S. Beskrovny, Anastasiya A. Golyadkina, Konstantin M. Morozov, Nikolai V. Ostrovsky, Saratov State Univ. (Russian Federation) . . . . . [11229-56]

**Methods of constructing an outline simple closed contour for modeling functional spine unit on CT slice**, Dmitry Dol', Alexander S. Dol, Alexander S. Beskrovny, Leonid V. Bessonov, Nikolay V. Ostrovsky, Saratov State Univ. (Russian Federation) . . . . . [11229-57]

**Clinical decision support systems: architectural scalability**, Leonid V. Bessonov, Vugar M. Veliev, Andrey A. Varukhin, Leonid Y. Kossovich, Nikolai V. Ostrovskiy, Saratov State Univ. (Russian Federation) . . . . . [11229-58]

**Clinical decision support systems in spinal surgery: problems of implementation and approaches to solution**, Vladislav Zolotov, Igor V. Mathershev, Anton A. Kurchatkin, Leonid V. Bessonov, Saratov State Univ. (Russian Federation); Anatoly L. Kovtun, Advanced Research Foundation (Russian Federation) . . . . . [11229-59]

**Collection of medical data to solve the problem of predicting the results of treatment in spinal surgery**, Pavel Dmitriev, Igor V. Matershev, Leonid V. Bessonov, Uila V. Lysunkina, Alexander V. Kharlamov, Saratov State Univ. (Russian Federation); Alexander V. Krutko, Novosibirsk Research Institute of Traumatology and Orthopedics (Russian Federation); Kristina K. Levchenko, Saratov State Univ. (Russian Federation) . . . . . [11229-60]

**Development of personalized osteotomy technique for the first metatarsal bone**, Anastasiya A. Golyadkina, Asel V. Polienko, Sergey I. Kireev, Kristina K. Levchenko, Saratov State Univ. (Russian Federation); Viktor Protcko, Vladimir Kireev, Peoples' Friendship University of Russia (Russian Federation) . . . . . [11229-61]

**Computer algebra methods solving the problem of biomechanics of the functional spine segment**, Dmitry Sidorenko, Leonid V. Bessonov, Alexander S. Falkovich, Sergey I. Kireev, Saratov State Univ. (Russian Federation) . . . . . [11229-62]

**Development of the sensing system using indocyanine green for the sentinel lymph node during breast cancer surgery**, Yikeun Kim, Pukyong National Univ. (Korea, Republic of); Jin Hyuk Choi, Sung Won Kim, Kosin Univ. (Korea, Republic of); Yeh-Chan Ahn, Pukyong National Univ. (Korea, Republic of) . . . . . [11229-63]

**Optical coherence tomography integrated microscope for guided operation on the inflammatory disease of the middle ear**, Hayoung Kim, Kyungpook National Univ. (Korea, Republic of); Ruchire Eranga H. Wijesinghe, Kyungil Univ. (Korea, Republic of); Jaeyul Lee, Kanghae Kim, Sangyeob Han, Mansik Jeon, Jeehyun Kim, Kyungpook National Univ. (Korea, Republic of) . . . . . [11229-64]

**Application of artificial neural network technologies to vertebral segmentation according on CT data**, Alexander S. Beskrovny, Alexei Maxankov, Leonid V. Bessonov, Maksim Lemeshkin, Saratov State Univ. (Russian Federation) . . . . . [11229-65]

**Analysis of success criteria for surgical treatment of spino-pelvic complex**, Anastasiya A. Golyadkina, Dmitriy V. Ivanov Sr., Irina V. Kirillova, Leonid Y. Kossovich, Saratov State Univ. (Russian Federation) . . . . . [11229-66]

**Accurate cataract surgical instrument location for skill assessment**, Yuanyuan Gu, Huaying Hao, Lei Mou, Yan Hu, Cixi Institute of BioMedical Engineering (China); Ce Zheng, Shanghai Jiao Tong Univ. (China); Jiang Liu, Southern Univ. of Science and Technology of China (China) . . . . . [11229-67]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

TUESDAY 4 FEBRUARY

SESSION 9

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... TUE 8:30 AM TO 10:10 AM

Image Processing

Session Chair: Anita Mahadevan-Jansen, Vanderbilt Univ. (USA)

8:30 am: Fluorescence diffusion correction through a spatially variant deconvolution scheme, Maria Anastasopoulou, Dimitris Gorpas, Maximilian Koch, Technische Univ. München (Germany); Evangelos Liapis, Sarah Glasl, Uwe Klemm, Helmholtz Zentrum München GmbH (Germany); Angelos Karlas, Tobias Lasser, Vasilis Ntziachristos, Technische Univ. München (Germany) ..... [11229-36]

8:50 am: Spatial gradient based segmentation of vessels and quantitative measurement of the inner diameter and wall thickness from ICG fluorescence angiographies, Ady Naber, Daniel Berwanger, Karlsruher Institut für Technologie (Germany); Gary K. Steinberg, Stanford Univ. School of Medicine (USA); Werner Nahm, Karlsruher Institut für Technologie (Germany) ..... [11229-37]

9:10 am: Real-time processing and visualization of functional parameters in living tissue with 3D profile correction, Enagnon Aguénonon, Foudil Dadouche, Wilfried Uhring, Sylvain Gioux, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) ..... [11229-38]

9:30 am: Model for and analysis of intraoperative brain tumor boundary detection based on known spectral signatures in phantom tissues, Matthew Tucker, Weston Ross, Guangshen Ma, Patrick Codd, Duke Univ. (USA) ..... [11229-39]

9:50 am: A 3D resolution and aberration test target for confocal laser endomicroscopy, Yilun Su, Werner Nahm, Karlsruher Institut für Technologie (Germany) ..... [11229-40]

SESSION 10

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... TUE 10:40 AM TO 12:40 PM

Imaging

Session Chair: Anita Mahadevan-Jansen, Vanderbilt Univ. (USA)

10:40 am: Development of a clinically translatable hyperspectral endoscopy (HySE) system and analysis methods for the improved diagnosis of gastrointestinal disease, Jonghee Yoon, Univ. of Cambridge (United Kingdom) and Cancer Research UK Cambridge Institute (United Kingdom); Alexandru Grigoriu, Univ. of Cambridge (United Kingdom); James Joseph, Dale J. Waterhouse, Univ. of Cambridge (United Kingdom) and Cancer Research UK Cambridge Institute (United Kingdom); Siri Luthman, Univ. of Cambridge (United Kingdom); George Gordon, The Univ. of Nottingham (United Kingdom); Massimiliano di Pietro, Wladyslaw Januszewicz, Rebecca C. Fitzgerald, Hutchison/MRC Research Ctr. (United Kingdom); Sarah E. Bohndiek, Univ. of Cambridge (United Kingdom) and Cancer Research UK Cambridge Institute (United Kingdom) ..... [11229-41]

11:00 am: Multimodal imaging microscope for intraoperative detection of breast tumors positive margins, Mark T. Scimone, Gopi N. Magaluri, Jesung Park, John Grimble, Physical Sciences Inc. (USA); Savitri Krishnamurthy, The Univ. of Texas M. D. Anderson Cancer Ctr. (USA); Nicusor V. Iftimia Sr., Physical Sciences Inc. (USA) ..... [11229-42]

11:20 am: Multimodal detection of DPN with spatial frequency domain and laser speckle contrast imaging, Wyatt M. Austin, Karissa Tilbury, The Univ. of Maine (USA) ..... [11229-43]

11:40 am: Dual-wavelength photoacoustic approach to guide hysterectomies, Alycen Wiacek, Johns Hopkins Univ. (USA); Karen C. Wang, Johns Hopkins Medicine (USA); Muyinatu Bell, Johns Hopkins Univ. (USA) ..... [11229-44]

12:00 pm: Photoacoustic image guidance and robotic visual servoing to mitigate fluoroscopy during cardiac catheter interventions, Michelle Graham, Johns Hopkins Univ. (USA); Fabrizio Assis, Johns Hopkins Medicine (USA); Derek Allman, Alycen Wiacek, Eduardo Gonzalez, Mardava Gubbi, Huayu Hou, Jinxin Dong, Sarah Beck, Johns Hopkins Univ. (USA); Jonathan Chrispin, Johns Hopkins Medicine (USA); Muyinatu Bell, Johns Hopkins Univ. (USA) ..... [11229-45]

12:20 pm: Fast and sensitive delineation of brain tumor with clinically compatible moxifloxacin labeling and confocal microscopy, Seunghun Lee, Wonyeong Park, Seonghan Kim, Hoonchul Chang, Bumju Kim, Won Hyuk Jang, Pohang Univ. of Science and Technology (Korea, Republic of); Younghoon Shin, Gwangju Institute of Science and Technology (Korea, Republic of); Myoung Joon Kim, Lid Lab. (Korea, Republic of); Euiheon Chung, Gwangju Institute of Science and Technology (Korea, Republic of); Eui Hyun Kim, Yonsei Univ. College of Medicine (Korea, Republic of); Kyung Hwa Lee, Chonnam National Univ. Medical School (Korea, Republic of); Ki Hean Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11229-46]

# CONFERENCE 11230

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11230

## Optics and Biophotonics in Low-Resource Settings VI

Conference Chairs: **David Levitz**, MobileODT Ltd. (Israel); **Aydogan Ozcan**, Univ. of California, Los Angeles (USA)

Program Committee: **David Erickson**, Cornell Univ. (USA); **Gerard L. Coté**, Texas A&M Univ. (USA); **Wolfgang Drexler**, Medizinische Univ. Wien (Austria); **Matthew D. Keller**, Intellectual Ventures Lab. (USA); **Avi Rasooly**, National Institutes of Health (USA); **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA); **Chetan A. Patil**, Temple Univ. (USA); **Eric A. Swanson**, Acacia Communications, Inc. (USA); **Sebastian Wachsmann-Hogiu**, McGill Univ. (Canada); **Ian M. White**, Univ. of Maryland, College Park (USA)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . SAT 8:00 AM TO 10:00 AM

#### Optics for Low Resource Settings

Session Chair: **Aniruddha Ray**, The Univ. of Toledo (USA)

8:00 am: **Low cost handheld spectral imager for rapid skin assessment in low resource settings**, Luigi Belcastro, Hanna Jonasson, Tomas Strömberg, Rolf B. Saager, Linköping Univ. (Sweden) . . . . . [11230-1]

8:20 am: **Transcutaneous fluorescence spectroscopy as a tool for low-cost, non-invasive monitoring of gut function**, James Maurice, Aaron Lett, Alexandra Lim, Charlotte Skinner, Imperial College London (United Kingdom); Matthew Richardson, Imperial College Healthcare NHS Trust (United Kingdom); Khushi Vyas, Abdul Wadood Tadbier, Imperial College London (United Kingdom); Jonathan Hoare, Imperial College Healthcare NHS Trust (United Kingdom); Nikhil Vergis, Imperial College London (United Kingdom); Serge Miodragovic, Imperial College Healthcare NHS Trust (United Kingdom); Paul Kelly, Univ. of Zambia School of Medicine (Zambia); Francesca Cordeiro, Ara Darzi, Robert Goldin, Mark Thursz, Alex J. Thompson, Imperial College London (United Kingdom) . . . . . [11230-2]

8:40 am: **Pocket MUSE**, Yehe Liu, Andrew M. Rollins, Michael W. Jenkins, Case Western Reserve Univ. (USA) . . . . . [11230-3]

9:00 am: **Low cost microscope for malarial parasitemia quantification in microfluidically generated blood smears**, Paul Gordon, Kokou S. Dogbevi, Texas A&M Univ. (USA); Gerard Coté, Texas A&M Univ. (USA) and Texas A&M Engineering Experiment Station (USA) . . . . . [11230-4]

9:20 am: **Whole blood coagulation sensing with a smartphone-based optical sensor**, Masaki Hosoda, Diane M. Tshikudi, Massachusetts General Hospital (USA); Seemantini K. Nadkarni, Massachusetts General Hospital (USA) and Harvard Medical School (USA) . . . . . [11230-5]

9:40 am: **Paper-based vertical flow immunoassay and mobile reader for multiplexed point-of-care testing**, Hyou-Arm Joung, Zachary S. Ballard, Derek K. Tseng, Omai Garner, Dino Di Carlo, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-6]

Coffee Break . . . . . Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . SAT 10:30 AM TO 12:00 PM

#### Mobile Microscopy, Sensing and Diagnostics Technologies

Session Chair: **Gerard L. Coté**, Texas A&M Univ. (USA)

10:30 am: **Mobile phone microscopy for clinical and public health use in low-resource settings** (*Invited Paper*), Isaac Bogoch, Toronto General Hospital (Canada) . . . . . [11230-7]

11:00 am: **Smartphone-based measurement of serum phosphate levels for patients with kidney disease**, Aniruddha Ray, The Univ. of Toledo (USA); Sarah Esparza, Dimei Wu, Mark Hanudel, Hyou-Arm Joung, Barbara Gales, Isidro Salusky, Aydogan Ozcan, Univ. of California, Los Angeles (USA) [11230-8]

11:20 am: **Field-portable multi-modal chip-based fluorescence, bright field and quantitative phase microscopy using smartphone detecting system**, Dalip S. Mehta, Indian Institute of Technology Delhi (India) . . . . . [11230-9]

11:40 am: **Mobile-phone microscopy-based identification of pathogenic bacteria in complex samples**, Vilhelm Muller, Chalmers Univ. of Technology (Sweden); Jose M. Sousa, Praça Conde Agrolongo (Portugal); Hatice Ceylan Koydemir, Muhammed Veli, Derek K. Tseng, Univ. of California, Los Angeles (USA); Laura Cerqueira, Praça Conde Agrolongo (Portugal) and Univ. do Porto (Portugal); Aydogan Ozcan, Univ. of California, Los Angeles (USA) and California NanoSystems Institute (USA); Nuno Azevedo, Univ. do Porto (Portugal); Fredrik Westerlund, Chalmers Univ. of Technology (Sweden) . . . . . [11230-10]

Lunch/Exhibition Break . . . . . Sat 12:00 pm to 1:40 pm

#### SESSION 3

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . SAT 1:40 PM TO 3:00 PM

#### Machine Learning-enabled Microscopy and Sensing I

Session Chair: **Hatice Ceylan Koydemir**, Univ. of California, Los Angeles (USA)

1:40 pm: **A computational paper-based point-of-care assay for high-sensitivity c-reactive protein quantification**, Zachary S. Ballard, Hyou-Arm Joung, Artem Goncharov, Jesse Liang, Karina Nugroho, Dino Di Carlo, Omai Garner, Aydogan Ozcan, Univ. of California, Los Angeles (USA) [11230-11]

2:00 pm: **Live assessment of colposcopic image quality at the point of care using a machine learning classifier running on Android**, Yonit Zall, Nael A Aljawad, David Tsah, MobileODT Ltd. (Israel); Roland Y. Djaoui, Herbert Samuel Medical Ctr. (Israel); Ronen Nissim, David Levitz, MobileODT Ltd. (Israel) . . . . . [11230-12]

2:20 pm: **Deep learning enables high-throughput early detection and classification of bacterial colonies using time-lapse coherent imaging**, Hongda Wang, Hatice C. Koydemir, Yunzhe Qiu, Bijie Bai, Yibo Zhang, Yiyin Jin, Sabiha Tok, Univ. of California, Los Angeles (USA); Enis C. Yilmaz, Bahçesehir Univ. (Turkey); Esin Gumustekin, Yilin Luo, Yair Rivenson, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-13]

2:40 pm: **Utilization of machine learning classifiers in a cervical cancer screening camp in rural China**, Andrew T. Goldstein, Sarah Bedell, Ctr. for Vulvovaginal Disorders (USA); Cathy M. Sebag, Lior Lobel, David Levitz, MobileODT Ltd. (Israel) . . . . . [11230-14]

Coffee Break . . . . . Sat 3:00 pm to 3:30 pm

# CONFERENCE 11230

## SESSION 4

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . SAT 3:30 PM TO 4:30 PM

### Advances in Optical Coherence Tomography and Microscopy

Session Chair: **David Levitz**, MobileODT Ltd. (Israel)

3:30 pm: **High resolution volumetric imaging with a simple off-axis full-field optical coherence microscope**, Lena Gravel, Marie Reischke, Michael Müntz, Helge Sudkamp, Peter Koch, Medizinisches Laserzentrum Lübeck GmbH (Germany); Gereon Hüttmann, Medizinisches Laserzentrum Lübeck GmbH (Germany) and Univ. zu Lübeck (Germany) . . . . . [11230-16]

3:50 pm: **Point-of-care optical coherence tomography using a headset design**, Behnam Tayebi, Vanderbilt Univ. (USA); Al-Hafeez Dhalla, James Baker-McKee, JuneBrain, LLC (USA); Audrey K. Bowden, Vanderbilt Univ. (USA); Samantha Scott, JuneBrain, LLC (USA) . . . . . [11230-17]

4:10 pm: **Optimization of SNR, sensitivity values by evaluating the relative spacing between the partial mirror and scanning reference mirror for multiple reference optical coherence tomography**, Anand Arangath, Kai Neuhaus, Martin Leahy, National Univ. of Ireland (Ireland) . . . . . [11230-18]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 5

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . SUN 8:00 AM TO 10:00 AM

### Emerging Platforms for Imaging, Sensing and Diagnostics

Session Chair: **Jessica C. Ramella-Roman**, Florida International Univ. (USA)

8:00 am: **Microscopy using water and oil droplets on a cell phone screen**, Nicole Szydłowski, Ying S. Hu, Mohamed Alqashmi, Haoran Jing, Univ. of Illinois at Chicago (USA) . . . . . [11230-19]

8:20 am: **Field-testing of a mobile microscope for label-free detection of Schistosoma eggs in urine and stool samples**, Hatice Ceylan Koydemir, Univ. of California, Los Angeles (USA); Jean T. Coulibaly, Univ. Félix Houphouët-Boigny (Cote d'Ivoire); Derek K. Tseng, Univ. of California, Los Angeles (USA); Isaac Bogoch, Univ. of Toronto (Canada); Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-20]

8:40 am: **Light-assisted drying (LAD) for anhydrous preservation of biologics: using Raman spectroscopy to assess the uniformity of drying in processed samples**, Riley Q. McKeough, Daniel P. Furr, Susan R. Trammell, The Univ. of North Carolina at Charlotte (USA) . . . . . [11230-21]

9:00 am: **Visual field self-evaluation by free-focus retinal-scanning laser display technology**, Takeo Kageyama, Makoto Suzuki, Hideaki Ashikaga, Kenji Yasui, Hironori Miyauchi, Mitsuru Sugawara, QD Laser, Inc. (Japan) . . . . . [11230-22]

9:20 am: **Thin-film plastics used in microfluidic channels for microscopy imaging in low resource settings**, Kimberly Branan, Paul Gordon, Gerard Coté, Texas A&M Univ. (USA) . . . . . [11230-23]

9:40 am: **Turbidity analysis using a smartphone-based reader**, Hatice Ceylan Koydemir, Simran Rajpal, Esin Gumustekin, Doruk Karınca, Kyle Liang, Zoltán Göröcs, Derek K. Tseng, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-24]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

### SESSION 6

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . SUN 10:30 AM TO 12:00 PM

### Sensing Technologies for Low-Resource Settings

Session Chair: **Zachary Scott Ballard**, Univ. of California, Los Angeles (USA)

10:30 am: **Design of wearable devices for diverse populations (Invited Paper)**, Jessica C. Ramella-Roman, Florida International Univ. (USA) . . . . . [11230-25]

11:00 am: **Early detection of e.coli and total coliform using an automated fiber optics-based sensing system**, Sabiha Tok, Kevin de Haan, Derek K. Tseng, Univ. of California, Los Angeles (USA); Can Firat Usanmaz, Georgia Institute of Technology (USA); Hatice C. Koydemir, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-26]

11:20 am: **A surrogate-ssay for low-resource settings: equipment free detection of viral biomarkers at femtomolar levels**, Xiangchao Zhu, Mustafa Mutlu, Jose Fuentes, Ahmet A. Yanik, Univ. of California, Santa Cruz (USA) . . . . . [11230-27]

11:40 am: **Contact lens-based lysozyme detection in tear using a mobile and cost-effective sensor**, Zachary S. Ballard, Sarah Bazargan, Diane Jung, Shyama Sathianathan, Ashley Clemens, Daniel Shir, Univ. of California, Los Angeles (USA); Saba Al-Hashimi, UCLA Stein Eye Institute (USA); Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-28]

Lunch/Exhibition Break . . . . . Sun 12:00 pm to 1:00 pm

**SESSION 7**

**LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . SUN 1:00 PM TO 2:50 PM**

**Machine Learning-enabled  
Microscopy and Sensing II**

Session Chair: **David Levitz**, MobileODT Ltd. (Israel)

1:00 pm: **Infant habituation and novelty responses in The Gambia and the UK at 5 to 18 months** (*Invited Paper*), Anna Blasi Ribera, Medical Physics and Biomedical Engineering Dept; University College London (United Kingdom); Clare Elwell, University College London (United Kingdom) . . . . . [11230-37]

1:30 pm: **Deep learning-based sensing of viruses using a particle aggregation assay**, Yichen Wu, Aniruddha Ray, Qingshan Wei, Alborz Feizi, Xin Tong, Eva Chen, Yi Luo, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-29]

1:50 pm: **Deep learning enables color holographic microscopy of pathology slides from a single hologram**, Tairan Liu, Zhensong Wei, Yair Rivenson, Kevin de Haan, Yibo Zhang, Yichen Wu, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11230-30]

2:10 pm: **AI-driven imaging biomarkers for sensory cue integration during melanoma screening**, Daniel S. Gareau, Charles Vratatos, James Browning, Samantha Lish, Benjamin Firester, James G. Krueger, The Rockefeller Univ. (USA) . . . . . [11230-31]

2:30 pm: **Dual-modal oral cancer screening platform and automatic classification algorithm for low-resource settings**, Bofan Song, Wyant College of Optical Sciences (USA); Sumsum Sunny, Mazumdar Shaw Medical Ctr. (India); Ross D. Uthoff, Wyant College of Optical Sciences (USA); Sanjana Patrick, Biocon (India); Amritha Suresh, Trupti Kolor, Mazumdar Shaw Medical Ctr. (India); G. Keerthi, K.L.E. Society's Institute of Dental Sciences (India); Afarin Anbarani, Petra Wilder-Smith, Beckman Laser Institute and Medical Clinic (USA) and Univ. of California, Irvine (USA); Moni A. Kuriakose, Mazumdar Shaw Medical Ctr. (India); Praveen Birur, K.L.E. Society's Institute of Dental Sciences (India); Jeffrey J. Rodriguez, The Univ. of Arizona (USA); Rongguang Liang, Wyant College of Optical Sciences (USA) . . . . . [11230-32]

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**A portable device using a single-board computer for white light and fluorescence widefield images**, Patrick O. Feitosa, Marlon R. Garcia, Sebastião Pratavieira, Instituto de Física de São Carlos (Brazil) . . . . . [11230-33]

**A novel multiscale imaging system for brain studies**, Amarendra Nath Yatavakilla, Vignans Univ. (India) . . . . . [11230-34]

**New home care treatment for onychomycosis using photodynamic therapy**, Ana Paula da Silva, Instituto de Física de São Carlos (Brazil) and PDT Pharma Indústria e Comércio de Produtos Farmacêuticos (Brazil); Nayanne Assis, Centro Univ. Central Paulista, UNICEP São Carlos (Brazil); Fabiana Rodrigues de Lara Ferreira, Vanderlei S. Bagnato, Natália M. Inada, Instituto de Física de São Carlos (Brazil) . . . . . [11230-35]

**Low-cost system for cervical intraepithelial lesions treatment: a long-term follow up from a multicenter study**, Natália M. Inada, Instituto de Física de São Carlos (Brazil); Cynthia A. de Castro, Federal Univ. de São Carlos (Brazil); Wellington Lombardi, Woman Health Ambulatory, Univ. de Araraquara (Brazil); Vanderlei S. Bagnato, Instituto de Física de São Carlos (Brazil) . . . . . [11230-36]

**Multi-spectral vascular oximetry of rat dorsal spinal cord**, Victor J Ochoa-Gutierrez, Pavan C Konda, Julien Reboud, Andrew R Harvey, Jonathan M Cooper, Univ of Glasgow (United Kingdom) . . . . . [11230-38]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**  
THE 2020 RECIPIENT

**Nirmala Ramanujam**,  
Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**  
**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

**BIOS**

**BiOS Expo Industry Stage**

**Saturday – Sunday • Hall DE**

Keynotes and panels on the latest developments, open to all attendees.

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# CONFERENCE 11231

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11231

## Design and Quality for Biomedical Technologies XIII

*Conference Chairs:* **Jeeseong Hwang**, National Institute of Standards and Technology (USA); **Gracie Vargas**, The Univ. of Texas Medical Branch (USA)

*Conference Co-Chairs:* **T. Joshua Pfefer**, U.S. Food and Drug Administration (USA); **Gracie Vargas**, The Univ. of Texas Medical Branch (USA)

*Program Committee:* **David W. Allen**, National Institute of Standards and Technology (USA); **Anthony J. Durkin**, Beckman Laser Institute and Medical Clinic (USA); **Robert J. Nordstrom**, National Institutes of Health (USA); **Ramesh Raghavachari**, U.S. Food and Drug Administration (USA); **Eric J. Seibel**, Univ. of Washington (USA); **Behrouz Shabestari**, National Institutes of Health (USA); **Gracie Vargas**, The Univ. of Texas Medical Branch (USA); **Rudolf M. Verdaasdonk**, Vrije Univ. Medical Ctr. (Netherlands); **William C. Vogt**, U.S. Food and Drug Administration (USA); **Heidrun Wabnitz**, Physikalisch-Technische Bundesanstalt (Germany)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . SAT 8:30 AM TO 10:20 AM

#### Light Sources and Sensors in Design

Session Chairs: **Ramesh Raghavachari**,  
U.S. Food and Drug Administration (USA);

**Gracie Vargas**, The Univ. of Texas Medical Branch (USA)

8:30 am: **Development of a blue LED array for application on the skin to prevent surgical site infection** (*Invited Paper*), Kristen C. Maitland, Alan Glowczwski, April Lovelady, Texas A&M Univ. (USA) . . . . . [11231-1]

9:00 am: **Permanently aligned multi-line lasers: a simplified solution for optical integration in biomedical instrumentation and fluorescence microscopes**, Melissa Haahr, Håkan Karlsson, Elizabeth K. Illy, Magnus Rådmark, Gunnar Elgcrona, Cobolt AB (Sweden) . . . . . [11231-2]

9:20 am: **Spectra stitching for ultra-high resolution, low sensitivity decay and high-speed SD-OCT**, Michael Maria, Andrei G. Anisimov, Technische Univ. Delft (Netherlands); Maartje Stols-Witlox, Univ. of Amsterdam (Netherlands); Roger M. Groves, Technische Univ. Delft (Netherlands) [11231-3]

9:40 am: **Performance requirements for lasers and fibers suited for confocal microscopy and flow cell cytometry applications**, Volker Melzer, Qioptiq Photonics GmbH & Co. KG (Germany) . . . . . [11231-4]

10:00 am: **Optimizing and calibration of thermal camera for ocular surface imaging**, Palash Patodi, Ashutosh Richhariya, Utkarsha Dasamantarao, LV Prasad Eye Institute (India); Tarun Batra, Adoni Jayaram, AnaLinear Technologies (India) . . . . . [11231-5]

Coffee Break . . . . . Sat 10:20 am to 10:50 am

#### SESSION 2

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . SAT 10:50 AM TO 12:10 PM

#### Device Design in Biomedical Instruments

Session Chair: **Jeeseong Hwang**,  
National Institute of Standards and Technology (USA)

10:50 am: **LCA correction in diffractive intraocular lenses: an innovative optical design**, Jérôme Loicq, Ctr. Spatial de Liège (Belgium); Nicolas Willet, Liège Univ. (Belgium); Damien Gatinel, La Fondation Ophtalmologique Adolphe de Rothschild (France) . . . . . [11231-6]

11:10 am: **Development of miniature wide-angle lens for in-display fingerprint recognition**, Wei-Jei Peng, Yuan-Chieh Cheng, Taiwan Instrument Research Institute (Taiwan); Jhe-Syuan Lin, National Central Univ. (Taiwan); Ming-Fu Chen, Taiwan Instrument Research Institute (Taiwan); Wen-Shing Sun, National Central Univ. (Taiwan) . . . . . [11231-7]

11:30 am: **Optimization of optical clearing and large-scale 3D imaging of whole intact murine lung**, Lorenzo F. Ochoa, The Univ. of Texas Medical Branch (USA) . . . . . [11231-8]

11:50 am: **Prototyping tool for real-time ECG monitoring and analysis**, Almbrok Essa, Cleveland State Univ. (USA) . . . . . [11231-10]

Lunch/Exhibition Break . . . . . Sat 12:10 pm to 1:40 pm

#### SESSION 3

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . . SAT 1:40 PM TO 3:30 PM

#### Computation and Modeling in Biomedical Imaging

Session Chairs: **Rudolf M. Verdaasdonk**,  
Univ. of Twente (Netherlands); **Behrouz Shabestari**,  
National Institute of Biomedical Imaging and Bioengineering (USA)

1:40 pm: **Reconstructing the angiome: a new platform for characterizing disease progression and drug efficacy** (*Invited Paper*), Pavel Alexandrovich Govyadinov, Jiaming Guo, Guoning Chen, Jason Eriksen, David Mayerich, Univ. of Houston (USA) . . . . . [11231-11]

2:10 pm: **Non-destructive and rapid detection of blood quality in blood bags based on modified ACO wavelength selection algorithm**, Xingwei Hou, Gang Li, Ling Lin, Tianjin Univ. (China) . . . . . [11231-12]

2:30 pm: **The classification of blood cell via contrast-enhanced microholography and deep learning**, Chia Sheng Kuo, National Central Univ. (Taiwan) . . . . . [11231-13]

2:50 pm: **Suppressing the effect of the blood spatial distribution inhomogeneity on spectral analysis by optical path modulation method**, Mengqiu Zhang, Tianjin Univ. (China); Zhigang Fu, 983 Hospital of People's Liberation Army (China); Gang Li, Ling Lin, Tianjin Univ. (China) . . . . . [11231-14]

3:10 pm: **Tumor margin analysis in resected breast tissue using hyperspectral dark-field microscopy**, Hahn N. D. Le, National Institute of Standards and Technology (USA); David M. McClatchy III, Thayer School of Engineering at Dartmouth (USA); David W. Allen, Kimberly A. Briggman, National Institute of Standards and Technology (USA); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA); Wendy A. Wells, Dartmouth-Hitchcock Medical Ctr. (USA); Jeeseong Hwang, National Institute of Standards and Technology (USA) . . . . . [11231-32]

Coffee Break . . . . . Sat 3:30 pm to 4:00 pm

#### SESSION 4

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . . SAT 4:00 PM TO 6:00 PM

#### Quality Assurance of Devices and Measurements

Session Chair: **Robert J. Nordstrom**, National Cancer Institute (USA)

4:00 pm: **Lateral light losses in measurement of reflectance and transmittance using an integrating sphere: comparison of Monte Carlo with the adding-doubling algorithm**, Vinoin Devpaul Vincely, Karthik Vishwanath, Miami Univ. (USA) . . . . . [11231-15]

4:20 pm: **A comparison of fat reduction efficacy using combined non-invasive and minimally invasive laser lipolysis system**, Seokwon Oh, Ji-Young Lee, Han-Young Ryu, Young-Seok Seo, WONTECH Co., Ltd. (Korea, Republic of) . . . . . [11231-16]

4:40 pm: **Optical spectral analysis of radiochromic films irradiated with radiation therapy beams**, Daniel Mulrow, Borna Maraghechi, Tianyu Zhao, Rao Khan, Arash Darafsheh, Washington Univ. School of Medicine in St. Louis (USA) . . . . . [11231-17]

5:00 pm: **Simple approach to refractive index measurements of polystyrene microspheres**, Peter Naglic, Yevhen Zelinskyi, Boštjan Likar, Miran Bürmen, Univ. of Ljubljana (Slovenia) . . . . . [11231-18]

5:20 pm: **Residual heat of ablative surgical devices underestimated: methods to quantify and prevent potential side effects**, Rudolf M. Verdaasdonk, Univ. of Twente (Netherlands); Henk ten Cate Hoedemaker, Univ. Medical Ctr. Groningen (Netherlands); Gert Priem, GP Services (Netherlands) . . . . . [11231-19]  
 5:40 pm: **Using customized computational analyses to evaluate the feasibility and risk of endoscopes with an SNR analysis as an example**, David Vega, Wyant College of Optical Sciences (USA); Jennifer K. Barton, The Univ. of Arizona (USA) . . . . . [11231-33]

9:30 am: **International photoacoustic standardisation consortium (IPASC): community-led consensus-based standardisation for an emerging imaging modality (Invited Paper)**, Sarah E. Bohndiek, Univ. of Cambridge (United Kingdom) . . . . . [11231-22]  
 10:00 am: **Characterizing the pressure waves generated from photoacoustic phantoms (Invited Paper)**, Aaron Goldfain, Hanh Le, National Institute of Standards and Technology (USA); Sangmo Kang, Dong-A Univ. (Korea, Republic of); Kimberly A. Briggman, Jeeseong Hwang, National Institute of Standards and Technology (USA) . . . . . [11231-34]  
 Coffee Break . . . . . Sun 10:30 am to 11:00 am

**BIOS HOT TOPICS**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)  
 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**  
 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**  
 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)  
 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)  
 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)  
 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)  
 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)  
 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*  
 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)  
 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)  
 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)  
 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . SUN 8:00 AM TO 10:30 AM**

**Standardization in Biophotonics**

Session Chair: **William C. Vogt**, U.S. Food and Drug Administration (USA)

8:00 am: **Performance measures for fluorescence guided surgery systems (Invited Paper)**, Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11231-26]  
 8:30 am: **Safety and essential performance standards for oximeters (Invited Paper)**, Sandy Weininger, U.S. Food and Drug Administration (USA) . . . . . [11231-20]  
 9:00 am: **Successes and challenges in standards development for ophthalmic imaging technologies (Invited Paper)**, Matthew J. Everett, Carl Zeiss Meditec, Inc. (USA) . . . . . [11231-28]

**SESSION 6**

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . SUN 11:00 AM TO 12:30 PM**

**Standardization: Phantoms and Metrology**

Session Chair: **David W. Allen**, National Institute of Standards and Technology (USA)

11:00 am: **The expediency of having NIR fluorescent tissue phantoms carry SI units of light**, Maritoni Litorja, National Institute of Standards and Technology (USA) . . . . . [11231-27]  
 11:20 am: **Comparison of calibration and standardization approaches for biomedical Raman spectroscopy**, Andrew M. Fales, Joshua Pfefer, U.S. Food and Drug Administration (USA) . . . . . [11231-25]  
 11:40 am: **Comparison of 3D-printed phantoms for testing cerebral oximeter performance (Invited Paper)**, Ali Afshari, U.S. Food and Drug Administration (USA); Rolf B. Saager, Linköping Univ. (Sweden); Xuewen Zhou, Pejman Ghassemi, Sandy Weininger, Jianting Wang, U.S. Food and Drug Administration (USA); Anthony J. Durkin, Beckman Laser Institute and Medical Clinic (USA); Joshua Pfefer, U.S. Food and Drug Administration (USA) [11231-23]  
 12:10 pm: **Hybrid organosilicon/polyol phantoms for applications in biophotonics and beyond**, Lucia Cavigli, Sonia Centi, Claudia Borri, Giada Magni, Andrea Barucci, Marina Mazzoni, Roberto Pini, Fulvio Ratto, Istituto di Fisica Applicata "Nello Carrara" (Italy) . . . . . [11231-24]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**  
**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President  
**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**  
 THE 2020 RECIPIENT  
**Nirmala Ramanujam**, Duke University, Durham, North Carolina, USA  
**Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells**  
**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Prototype of three-dimensional-printing-based vaginal endoscope**, Myoungjae Jun, Osaka Univ. (Japan); Hieyong Jeong, Chonnam National Univ. (Korea, Republic of); Masayuki Endoh, Michiko Kodama, Yuko Ohno, Osaka Univ. (Japan) . . . . . [11231-9]

# CONFERENCE 11232

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH)

Saturday 1 February 2020 • Proceedings of SPIE Vol. 11232

## Multimodal Biomedical Imaging XV

Conference Chairs: **Fred S. Azar**, IBM Watson Health (USA); **Xavier Intes**, Rensselaer Polytechnic Institute (USA); **Qianqian Fang**, Northeastern Univ. (USA)

Program Committee: **Caroline Boudoux**, Ecole Polytechnique de Montréal (Canada); **Christophe Chef d'hotel**, Ventana Medical Systems, Inc. (USA); **Yu Chen**, Univ. of Maryland, College Park (USA); **Gultekin Gulsen**, Univ. of California, Irvine (USA); **Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA); **Arjun G. Yodh**, Univ. of Pennsylvania (USA)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . SAT 8:00 AM TO 10:00 AM

#### OCT

Session Chairs: **Fred S. Azar**, IBM Watson Health (USA); **Caroline Boudoux**, Polytechnique Montréal (Canada)

8:00 am: **Endoscopic optical coherence tomography (OCT) and autofluorescence imaging (AFI) of ex vivo fallopian tubes**, Jeanie Malone, Geoffrey Hohert, BC Cancer Research Ctr. (Canada); Lien Hoang, Dianne M. Miller, Jessica N. McAlpine, The Univ. of British Columbia (Canada); Calum E. MacAulay, Pierre M. Lane, BC Cancer Research Ctr. (Canada) . . . . . [11232-1]

8:20 am: **Organic fluorophore capped gold nanostars for enhanced detection of choroidal neovascularization in living rabbits using multimodal photoacoustic microscopy, optical coherence tomography, and fluorescence microscopy**, Van Phuc Nguyen, Yanxiu Li, Jessica Henry, Michael Aaberg, Sydney Jones, Thomas Qian, Wei Zhang, Univ. of Michigan-Kellogg Eye Ctr. (USA); Xueding Wang, Univ. of Michigan (USA); Yannis M. Paulus, Univ. of Michigan-Kellogg Eye Ctr. (USA) . . . . . [11232-2]

8:40 am: **Depth-resolved volumetric two-photon microscopy using paired Airy beams**, Hongsen He, Cihang Kong, Xiao-Jie Tan, Ka Yan Chan, Yuxuan Ren, Kevin K. Tsia, Kenneth K. Y. Wong, The Univ. of Hong Kong (Hong Kong, China) . . . . . [11232-3]

9:00 am: **The impact of index dips in double clad fibers and endoscopic optical coherence tomography**, Adrian Tanskanen, The Univ. of British Columbia (Canada); Geoffrey Hohert, Pierre M. Lane, BC Cancer Research Ctr. (Canada) . . . . . [11232-4]

9:20 am: **Bimodal bench-top imaging system for co-registered and concurrent optical coherence tomography and ultra-broadband single fiber reflectance spectroscopy**, Xavier Attendu, Polytechnique Montréal (Canada); Paul R. Bloemen, Daniel M. de Bruin, Dirk J. Faber, Amsterdam UMC (Netherlands); Caroline Boudoux, Polytechnique Montréal (Canada); Ton G. van Leeuwen, Amsterdam UMC (Netherlands) . . . . . [11232-5]

9:40 am: **Real-time co-localized OCT surveillance of laser therapy using motion corrected speckle decorrelation**, Raphaël Maltais-Tariant, Polytechnique Montréal (Canada); Caroline Boudoux, Polytechnique Montréal (Canada) and Castor Optics, Inc. (Canada); Néstor Uribe-Patarroyo, Wellman Ctr. for Photomedicine (USA) and Harvard Medical School (USA) and Massachusetts General Hospital (USA) . . . . . [11232-6]

Coffee Break . . . . . Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . SAT 10:30 AM TO 12:00 PM

#### Diffuse Optics

Session Chairs: **Qianqian Fang**, Northeastern Univ. (USA); **Farouk Nouzi**, John Tu & Thomas Yuen Ctr. for Functional Onco-Imaging (USA)

10:30 am: **Facilitating macroscopic lifetime imaging via deep learning (Invited Paper)**, Xavier Intes, Rensselaer Polytechnic Institute (USA) . . [11232-7]

11:00 am: **Gaussian weighted block sparse Bayesian learning strategy based on K-means clustering algorithm for accurate bioluminescence tomography in glioma**, Lin Yin, Kun Wang, Jie Tian, Institute of Automation (China) . . . . . [11232-8]

11:20 am: **A multi-modal compressive optical breast tomography system**, Miguel A. Mireles, ICFO - Institut de Ciències Fotòniques (Spain) . . . . [11232-9]

11:40 am: **Shedding diffuse light on the effects of radiation therapy on circulating tumor cells in mice**, Mark Niedre, Northeastern Univ. (USA) . . . . . [11232-10]

Lunch/Exhibition Break . . . . . Sat 12:00 pm to 1:40 pm

#### SESSION 3

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . SAT 1:40 PM TO 3:10 PM

#### Surgical Guidance

Session Chairs: **Xavier Intes**, Rensselaer Polytechnic Institute (USA); **Qianqian Fang**, Northeastern Univ. (USA)

1:40 pm: **Intraoperative margin assessment of breast-conserving surgery resections using x-ray micro-computed tomography and optical structured light**, Samuel S. Streeter, Benjamin W. Maloney, Thayer School of Engineering at Dartmouth (USA); Elizabeth J. Rizzo, Dartmouth-Hitchcock Medical Ctr. (USA); Michael Jermyn, Thayer School of Engineering at Dartmouth (USA); Wendy A. Wells, Richard J. Barth Jr., Dartmouth-Hitchcock Medical Ctr. (USA); Keith D. Paulsen, Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11232-11]

2:00 pm: **Real-time quantitative diffuse optical imaging for surgical guidance (Invited Paper)**, Sylvain Gioux, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) . . . . . [11232-12]

2:30 pm: **Fresh tissue elastography and UV-excited fluorescence imaging to assess the effect of pancreatic tumor microenvironment heterogeneity on tumor transport**, Phuong Vincent, Sathya Garg, Jason R. Gunn, Petr Bruza, Kimberley S. Samkoe, Geoffrey P. Luke, Thayer School of Engineering at Dartmouth (USA); Tayyaba Hasan, Wellman Ctr. for Photomedicine (USA); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11232-13]

2:50 pm: **Multimodal endoscopy for colorectal cancer detection by optical coherence tomography and near-infrared fluorescence imaging**, Yan Li, Zhikai Zhu, Jason J. Chen, Joseph C. Jing, Zhongping Chen, Univ. of California, Irvine (USA) . . . . . [11232-14]

Coffee Break . . . . . Sat 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . SAT 3:40 PM TO 5:10 PM

#### Tissue Imaging and Spectroscopy

Session Chairs: **Fred S. Azar**, IBM Watson Health (USA); **Caroline Boudoux**, Polytechnique Montréal (Canada)

3:40 pm: **Multimodal OCT/OPT and OCT/SPIM imaging of developing embryos (Invited Paper)**, Kirill V. Larin, Univ. of Houston (USA) . . . . . [11232-15]

4:10 pm: **Development of a compact multimodal imaging system for rapid characterisation of intrinsic optical properties of freshly excised tissue**, Jonghee Yoon, Univ. of Cambridge (United Kingdom) and Cancer Research UK Cambridge Institute (United Kingdom); Abby Wilson, Loughborough Univ. (United Kingdom); Dale J. Waterhouse, Univ. of Cambridge (United Kingdom) and Cancer Research UK Cambridge Institute (United Kingdom); Travis W. Sawyer, The Univ. of Arizona (USA); Massimiliano di Pietro, Rebecca C. Fitzgerald, Hutchison/MRC Research Ctr. (United Kingdom); Sarah E. Bohndiek, Univ. of Cambridge (United Kingdom) and Cancer Research UK Cambridge Institute (United Kingdom) . . . . . [11232-18]

4:30 pm: **A snapshot multi-wavelengths imaging device for in-vivo skin diagnostics**, Janis Spigulis, Zigmars Rupenheits, Margarita Matulenko, Ilze Oshina, Uldis Rubins, Univ. of Latvia (Latvia) . . . . . [11232-19]

4:50 pm: **Accuracy in anatomical modeling and its impact to model-based fNIRS data analysis**, Qianqian Fang, Northeastern Univ. (USA) . . . . [11232-20]

**BIOS HOT TOPICS**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

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**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Classification of brain lesions from MRI images using a novel neural network**, Udbhav Bamba, Deepanshu Pandey, Indian Institute of Technology (Indian School of Mines), Dhanbad (India); Vasudevan Lakshminarayanan, Univ. of Waterloo (Canada) . . . . . [11232-17]

**Quantitative comparison of Gegenbauer, filtered Fourier, and Fourier reconstruction for MRI**, Brid Roberts, Min Wan, Simon Kelly, John J. Healy, Univ. College Dublin (Ireland). . . . . [11232-21]

**Bowel wall in cases of acute ischemia: optical coherence tomography, FLIM macro-imaging and histological analysis data**, Elena B. Kiseleva, Maxim Ryabkov, Evgenia Bederina, Vladimir Beschastnov, Elena V. Zagaynova, Mikhail Baleev, Maria Lukina, Marina V. Shirmanova, Marina A. Sirotkina, Privolzhsky Research Medical Univ. (Russian Federation); Alexander A. Moiseev, Institute of Applied Physics (Russian Federation); Natalia D. Gladkova, Privolzhsky Research Medical Univ. (Russian Federation). . . . . [11232-22]

**Combined multispectral, FLIM and Raman imaging for skin diagnostics**, Janis Spigulis, Ilona Kuzmina, Vanesa Lukinsons, Mindaugas Tamosiunas, Ilze Oshina, Uldis Rubins, Laura Ozolina, Anna Maslobojeva, Maris Kuzminskis, Univ. of Latvia (Latvia) . . . . . [11232-23]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**  
 THE 2020 RECIPIENT

**Nirmala Ramanujam**,  
 Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**  
**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and  
 Howard Hughes Medical Institute (USA)

# CONFERENCE 11233

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11233

# Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications XX

Conference Chair: **Israel Gannot**, Johns Hopkins Univ. (USA), Tel Aviv Univ. (Israel)

Program Committee: **Olga Bibikova**, art photonics GmbH (Germany); **James P. Clarkin**, Polymicro Technologies, A Subsidiary of Molex Incorporated (USA); **Ilko Ilev**, U.S. Food and Drug Administration (USA); **Jin U. Kang**, Johns Hopkins Univ. (USA); **Karl-Friedrich Klein**, Technische Hochschule Mittelhessen (Germany); **Pierre Lucas**, The Univ. of Arizona (USA); **Yuji Matsuura**, Tohoku Univ. (Japan); **Katy Roodenko**, MAX IR Labs (USA); **Angela B. Seddon**, The Univ. of Nottingham (United Kingdom)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . SAT 8:00 AM TO 10:00 AM

#### Fiber Optic Sensors: Development and Characterization I

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

8:00 am: **Evanescent wave sensor using cellulose nanocrystals composite fiber for humidity measurement**, Wei-Chih Wang, Univ. of Washington (USA) and National Tsing Hua Univ. (Taiwan); Chun-Yen Hsieh, National Tsing Hua Univ. (Taiwan) . . . . . [11233-1]

8:20 am: **Etching-enabled extreme miniaturization of graded-index fiber based optical coherence tomography probes**, Alexandre Abid, Montreal Univ. (Canada); Shiv Mittal, Univ. of British Columbia (Canada); Christos Boutopoulos, Univ. de Montréal (Canada) . . . . . [11233-2]

8:40 am: **Improved SNR OFDR based sensing using enhanced Rayleigh backscattering optical fiber**, Mudabbir Badar, Ping Lu, Michael P. Buric, Paul R. Ohodnicki, National Energy Technology Lab. (USA) . . . . . [11233-3]

9:00 am: **Non-contact endoscopic temperature measurement**, Sergio Vilches, Çağlar Ataman, Hans Zappe, Univ. of Freiburg (Germany) . . . [11233-4]

9:20 am: **Sensitivity analysis of TiO<sub>2</sub> coated fibre Bragg grating sensor for far infrared detection of chemicals in Indian coal mines**, Sanjeev Kumar Raghuvanshi, Yadendra Singh, Indian Institute of Technology (Indian School of Mines), Dhanbad (India); Azhar Shadab, Indian Institute of Technology (Indian School of Mines), Dhanbad (India); Purnendu Shekhar Pandey, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . . . [11233-5]

9:40 am: **Performance analysis of reduced graphene oxide (rGO) coated long period fiber Bragg grating with different grating lengths for gas and chemical sensing**, Yadendra Singh, Sanjeev Kumar Raghuvanshi, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . [11233-6]

Coffee Break . . . . . Sat 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . SAT 10:30 AM TO 11:50 AM

#### Fiber Optic Tools for Medical Applications I

Session Chair: **Israel Gannot**, Johns Hopkins Univ. (USA)

10:30 am: **Ultra-high-resolution fiber-optic endoscopy for translational applications** (*Invited Paper*), Xingde Li, Scott Yuan, Hyeon-Cheol Park, Dawei Li, Defu Chen, Johns Hopkins Univ. (USA); Cadman L. Leggett, Rachel Sarabia Estrada, Alfredo Quiñones-Hinojosa, Kenneth K. Wang, Mayo Clinic (USA) . . . . . [11233-7]

11:10 am: **A biomimetic optical approach to skin cancer detection**, Kenneth J. Ewing, Kevin Major, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA) . . . . . [11233-9]

11:30 am: **Phosphorescence-based oxygen-sensing optrode for improved assessment of compartment syndrome**, Lilian Witthauer, Emmanuel Roussakis, Juan Pedro Cascales, Yenyu Chen, Xiaolei Li, Avery Goss, Conor L. Evans, Wellman Ctr. for Photomedicine, Massachusetts General Hospital (USA) and Harvard Medical School (USA) . . . . . [11233-10]

Lunch/Exhibition Break . . . . . Sat 11:50 am to 1:20 pm

### SESSION 3

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . SAT 1:20 PM TO 3:40 PM

#### Environmental Sensing

Session Chair: **Katy Roodenko**, Max-IR Labs., LLC (USA)

1:20 pm: **Per- and polyfluoroalkyl substances: how to determine their presence beyond the use of mass spectrometry**, Sudhir Dahal, Ruth Marfil-Vega, Shimadzu Scientific Instruments, Inc. (USA) . . . . . [11233-11]

1:40 pm: **Nitrogen sensor based on quantum cascade lasers (QCLs) for wastewater treatment process control and optimization**, Katy Roodenko, D. Hinojos, Max-IR Labs., LLC (USA); K. Hodges, The Univ. of Texas at Dallas (USA); B.-J. Pandey, Max-IR Labs., LLC (USA); J.-F. Veyan, The Univ. of Texas at Dallas (USA); K. P. Clark, D. I. Robbins, Max-IR Labs., LLC (USA) . [11233-12]

2:00 pm: **Microplastics analysis from aquatic sources: FTIR microscopy perspective**, Suja Sukumaran, Thermo Fisher Scientific Inc. (USA) . [11233-13]

2:20 pm: **Mid-IR fiber-optic sensor systems for online monitoring of the quality of water: for environmental protection and homeland security** (*Invited Paper*), Abraham Katzir, Tel Aviv Univ. (Israel); Yosef Raichlin, Ariel Univ. (Israel); Boris Mizaikoff, Univ. Ulm (Germany); Israel Gannot, Johns Hopkins Univ. (USA) . . . . . [11233-14]

2:40 pm: **Mid-IR quantum cascade laser based liquid chromatography for sensitive, real-time water quality monitoring and bioanalysis** (*Invited Paper*), Jeremy Rowlette, Craig Magee, DRS Daylight Solutions (USA) . . . . . [11233-15]

3:00 pm: **Water inspection using interferometric phase microscopy** (*Invited Paper*), Natan T. Shaked, Tel Aviv Univ. (Israel) . . . . . [11233-16]

3:20 pm: **Improving aromatic water-contaminant detection with machine-learning classification and regression for simultaneous Absorbance-Transmission Excitation Emission Matrix (A-TEEM) spectroscopy**, Adam M. Gilmore, Linxi Chen, Ross Keyashian, Cary J. Davies, HORIBA Scientific (USA) . . . . . [11233-55]

Coffee Break . . . . . Sat 3:40 pm to 4:00 pm

### SESSION 4

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . SAT 4:00 PM TO 6:20 PM

#### Fiber Optic Tools for Medical Applications II

Session Chair: **Pierre Lucas**, The Univ. of Arizona (USA)

4:00 pm: **Multicore photonic crystal fibre for shape sensing in medical applications**, Moe Amanzadeh, The Univ. of Queensland (Australia) [11233-17]

4:20 pm: **Mid-infrared fiber spectroscopy for detection of cartilage degeneration in osteoarthritis**, Olga A. Bibikova, Valentin Mironovich, Iskander Usenov, Elena Feliksberger, Alexey Bocharnikov, art photonics GmbH (Germany); Anastasia Surkova, Valeria Belikova, Samara State Technical Univ. (Russian Federation); Ervin Nippolainen, Isaac Afara, Univ. of Eastern Finland (Finland); Julian Haas, Institute of Analytical and Bioanalytical Chemistry, Univ. Ulm (Germany); Vesa Virtanen, Lassi Rieppo, Research Unit of Medical Imaging, Physics and Technology, Univ. of Oulu (Finland); Harold Brommer, René van Weeren, Utrecht Univ. (Netherlands); Michael Pleyer, Johannes Koeth, nanoplus Nanosystems and Technologies GmbH (Germany); Markus Nägele, OptoPrecision GmbH (Germany); Juha Töyräs, Univ. of Eastern Finland (Finland); Boris Mizaikoff, Institute of Analytical and Bioanalytical Chemistry, Univ. Ulm (Germany); Tatiana Sakharova, Viacheslav G. Artyushenko, art photonics GmbH (Germany) . . . . . [11233-18]

SUNDAY 2 FEBRUARY

SESSION 5

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . SUN 8:00 AM TO 10:00 AM

Fiber Optic Sensors: Development and Characterization II

Session Chair: Yuji Matsuura, Tohoku Univ. (Japan)

8:00 am: **Dynamic gain control of resonance frequency mapping for increasing number of identical weak FBG sensors**, Gyeong Hun Kim, Sang Min Park, Chang-Seok Kim, Pusan National Univ. (Korea, Republic of); Hyunjo Kim, Ga-ye Park, Chang-Hyun Jung, Jaesun Kim, Taihan Fiberoptics Co., Ltd. (Korea, Republic of); Hwi Don Lee, Harvard Medical School (USA) and Massachusetts General Hospital (USA) . . . . . [11233-24]

8:20 am: **PDMS-based Bragg diffraction grating glucose sensor integrable in a contact lens**, Carla Dumitrascu, Maria Morant, Laura Mercadé, Todor Angelova, Roberto Llorente, Nanophotonics Technology Center, Universitat Politècnica de València (Spain) . . . . . [11233-25]

8:40 am: **Optical characterization of polycrystalline silver halide materials by infrared spectroscopy: long-and-short-term water adsorption in extruded fibers**, Herbert Michael Heise, Sven Delbeck, Fachhochschule Südwestfalen (Germany) . . . . . [11233-26]

9:00 am: **Fiber bundles with integrated bandpass and notch filters for in-vivo Raman spectroscopy**, John Barton, Gary E. Carver, Sarah Locknar, Omega Optical, Inc. (USA); Manish Gupta, Nikira Labs, Inc. (USA) . . . [11233-27]

9:20 am: **2D temperature sensing obtained by multiplexing of optical backscattering reflectometry**, Aizhan Issatayeva, Aidana Beisenova, Sultan Sovetov, Sanzhar Korganbayev, Madina Jelbuldina, Zhannat Ashikbayeva, Nazarbayev Univ. (Kazakhstan); Wilfried Blanc, Univ. Côte d'Azur (France); Carlo Molardi, Daniele Tosi, Nazarbayev Univ. (Kazakhstan) [11233-28]

9:40 am: **Spatial multiplexing of refractive index distributed sensors by means of high-scattering MgO nanoparticle doped optical fiber**, Madina Shaimerdenova, Takhmina Ayupova, Sanzhar Korganbayev, Marzhan Sypabekova, Aliya Bekmurzayeva, Nazarbayev Univ. (Kazakhstan); Wilfried Blanc, Institut de Physique de Nice (France); Carlo Molardi, Daniele Tosi, Nazarbayev Univ. (Kazakhstan) . . . . . [11233-29]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

SESSION 6

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . SUN 10:30 AM TO 12:10 PM

Fiber Optic Tools for Medical Applications III

Session Chair: James P. Clarkin, Polymicro Technologies (USA)

10:30 am: **A rapid and highly sensitive optical platform for pathogen detection and antimicrobial sensitivity testing (Invited Paper)**, Mehmet F. Cansizoglu, Yusuf T. Tamer, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA) and Cecil H. and Ida Green Comprehensive Ctr. for Molecular, Computational, and Systems Biology (USA); Michael Farid, Johns Hopkins Univ. (USA); Andrew Y. Koh, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA); Erdal Toprak, The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA) and Cecil H. and Ida Green Comprehensive Ctr. for Molecular, Computational, and Systems Biology (USA) . . . . . [11233-30]

11:00 am: **Label free instant bacteria detection**, Israel Gannot, Eliran Dafna, Moinuddin Hassan, Opticul Diagnostics (USA) . . . . . [11233-31]

11:30 am: **Evaluating the cytotoxicity of Ge-Sb-Se chalcogenide glass optical fibres**, David Mabwa, The Univ. of Nottingham (United Kingdom) . . . . . [11233-32]

11:50 am: **Fiber optic biosensor based on polydimethylsiloxane (PDMS) and bioactive lipids**, Mildred S. Cano-Velázquez, Luz M. López-Marín, Juan Hernández-Cordero, Univ. Nacional Autónoma de México (Mexico) . . . . . [11233-33]

Lunch/Exhibition Break . . . . . Sun 12:10 pm to 1:40 pm

4:40 pm: **Characterizing collapse during obstructive sleep apnea through fiber optic manometry**, Alex Wall, John W. Arkwright, Simon Carney, Peter Catchside, Flinders Univ. (Australia); Peter Eastwood, The Univ. of Western Australia (Australia) . . . . . [11233-19]

5:00 pm: **Photosensitizing effect of Photolon® using optical fiber probe to laser-irradiate thyroid cancer cells: oxidative stress-directed cell death**, Ga-ye Park, HyeYeon Lee, Junho Lee, Byung Joo Kong, Derek M. Jung, Hyunjo Kim, Chang Hyun Jung, Jaesun Kim, ChiHwan Ouh, Taihan Fiberoptics Co., Ltd. (Korea, Republic of); Yun-Hee Rhee, Phil-Sang Chung, Laser Translational Clinical Trial Ctr. (Korea, Republic of) . . . . . [11233-20]

5:20 pm: **G-protein coupled receptor signaling probed by a microtoroid-proteolipid system**, Phuong Diem Nguyen, Adley Gin, Cheng Li, Judith Su, The Univ. of Arizona (USA) . . . . . [11233-21]

5:40 pm: **Antimicrobial peptide functionalized GaAs/AlGaAs biosensor for detection of Legionella pneumophila**, M. Amirul Islam, Walid M. Hassen, Univ. de Sherbrooke (Canada); Azam F. Tayabali, Environmental Health Ctr., Health Canada (Canada); Jan J. Dubowski, Univ. de Sherbrooke (Canada) . . . . . [11233-22]

6:00 pm: **Stability diagnosis of orthopedic implants based on resonance frequency analysis with fiber transmission of nanosecond laser pulse and acceleration sensor**, Katsuhiro Mikami, Kindai Univ. (Japan); Daisuke Nakashima, Shunsuke Kikuchi, Keio Univ. (Japan); Toshiyuki Kitamura, Noboru Hasegawa, National Institutes for Quantum and Radiological Science and Technology (Japan); Takeo Nagura, Keio Univ. (Japan); Masaharu Nishikino, National Institutes for Quantum and Radiological Science and Technology (Japan) . . . . . [11233-23]

BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

# CONFERENCE 11233

## SESSION 7

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . SUN 1:40 PM TO 3:20 PM

### Fiber Optic Tools for Medical Applications IV

Session Chair: **Viacheslav G. Artyushenko**,  
art photonics GmbH (Germany)

1:40 pm: **Tapered fiber sensor for head and neck cancer screening**, Cong Deng, Karolyn M. Hansen, Joseph Haus, Partha P. Banerjee, Univ. of Dayton (USA); Uttam K. Sinha, Univ. of Southern California (USA) . . . [11233-34]

2:00 pm: **Fiber solutions from 355nm to 16µm in advanced diagnostics and laser surgery**, Viacheslav G. Artyushenko, art photonics GmbH (Germany) . . . [11233-35]

2:20 pm: **Mid-infrared spectroscopy with a fibre-coupled tuneable quantum cascade laser for glucose sensing**, Ine L. Jernelv, Norwegian Univ. of Science and Technology (Norway); Karina Strøm, Norwegian Univ. of Science and Technology (Norway); Dag R. Hjelme, Astrid Aksnes, Norwegian Univ. of Science and Technology (Norway) . . . [11233-36]

2:40 pm: **Mid-infrared detection of organic compounds with a 2-10 µm supercontinuum source generated from concatenated fluoride and chalcogenide fibers**, Johann Troles, Univ. de Rennes 1 (France) and CNRS (France) and Institut des Sciences Chimiques de Rennes (France); Sébastien Venck, SelenOptics (France); Solenn Cozic, Le Verre Fluoré (France); Laurent Brilland, Radwan Chahal, SelenOptics (France); Marcello Meneghetti, Univ. de Rennes 1 (France) and CNRS (France) and Institut des Sciences Chimiques de Rennes (France); Jean-Luc Adam, Univ. de Rennes 1 (France) and CNRS (France) and Institut des Sciences Chimiques de Rennes (France); Catherine Boussard-Plédel, Univ. de Rennes 1 (France) and Institut des Sciences Chimiques de Rennes (France) and CNRS (France); Bruno Bureau, Univ. de Rennes 1 (France) and CNRS (France) and Institut des Sciences Chimiques de Rennes (France); Samuel Poulain, Laurine Bodin, Franck Joulain, Le Verre Fluoré (France); Marcel Poulain, Univ. de Rennes 1 (France) and Le Verre Fluoré (France) and CNRS (France); Thibaut Sylvestre, CNRS (France) and Institut Franche-Comte Electronique Mecanique Thermique et Optique (France); Guillaume Huss, LEUKOS (France) . . . [11233-37]

3:00 pm: **Single fiber OCT imager for breast tissue classification based on deep learning**, Xuan Liu, Yuwei Liu, New Jersey Institute of Technology (USA) . . . [11233-38]

Coffee Break. . . . . Sun 3:20 pm to 3:50 pm

## SESSION 8

LOCATION: ROOM 157 (UPPER MEZZANINE SOUTH) . . . SUN 3:50 PM TO 6:10 PM

### Fiber Optic Sensors: Development and Characterization III

Session Chair: **Karl-Friedrich Klein**,  
Technische Hochschule Mittelhessen (Germany)

3:50 pm: **Towards high-strength infrared optical fibers for bio-sensing**, Pierre Lucas, The Univ. of Arizona (USA); Shibin Jiang, AdValue Photonics, Inc. (USA); Garrett Coleman, Julien Ari, The Univ. of Arizona (USA); Tao Luo, AdValue Photonics, Inc. (USA) . . . [11233-39]

4:10 pm: **Transmission properties of dielectric-coated hollow optical fibers based on Ni-Ti tube**, Katsumasa Iwai, Hiroyuki Takaku, National Institute of Technology, Sendai College (Japan); Mitsunobu Miyagi, Miyagi Gakuin Women's Univ. (Japan); Yi-Wei Shi, Xiao-Song Zhu, Fudan Univ. (China); Yuji Matsuura, Tohoku Univ. (Japan) . . . [11233-40]

4:30 pm: **Twisting compensation of optical multicore fiber shape sensors for flexible medical instruments**, Ignazio Floris, Javier Madrigal, Univ. Politècnica de Valencia (Spain); Salvador Sales, Pedro A. Calderón, Univ. Politècnica de València (Spain); Jose M. Adam, Univ. Politècnica de Valencia (Spain) . . . [11233-41]

4:50 pm: **Photonic crystal fiber refractive index sensor with ultra-wide detection range based on surface plasmon resonance**, Guangyao Wang, Ying Lu, Liangcheng Duan, Jianquan Yao, Tianjin Univ. (China) . . . [11233-42]

5:10 pm: **3D shape sensing of an epidural needle based on simultaneous spatial multiplexing of optical backscattering reflectometry**, Carlo Molardi, Aidana Beisenova, Aizhan Issatayeva, Nazarbayev Univ. (Kazakhstan); Wilfried Blanc, Univ. Côte d'Azur (France); Daniele Tosi, Nazarbayev Univ. (Kazakhstan) . . . [11233-43]

5:30 pm: **Sensitivity analysis of a square shape apodized fibre Bragg grating chemical sensor assisted by high refractive index Bi-directional coupler on both sides**, Sanjeev Kumar Raghuwanshi, Yadvendra Singh, Indian Institute of Technology (Indian School of Mines), Dhanbad (India); Azhar Shadab, Purnendu Shekhar Pandey, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . [11233-44]

5:50 pm: **Study and analysis of nature and extent of cladding modes in TFBG structure and their correlation with various grating parameters for design of optimized sensors**, Yadvendra Singh, Ahana Sadhu, Sanjeev Kumar Raghuwanshi, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . [11233-45]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Performance comparison of the fiber axicon probe having extended Bessel focus with cleaved fiber tip probe**, Pooja Gupta, Kaushal Vairagi, CSIR - Central Scientific Instruments Organisation (India) and Academy of Scientific & Innovative Research (India); Samir K. Mondal, CSIR - Central Scientific Instruments Organisation (India) . . . [11233-46]

**Detection of gingival sulcus using optical coherence tomography with quantitative depth measurement algorithm**, Hoseong Cho, Naresh Kumar Ravichandran, Jaeyul Lee, Mansik Jeon, Jeehyun Kim, Jaewon Song, Kyungpook National Univ. (Korea, Republic of) . . . [11233-47]

**Analysis of the optimized conditions for refractive index change in a Yb-doped optical fiber for optical imaging applications**, Eun Sun Kim, Hwi One Kang, Seung Seok Lee, Eun-Seo Choi, Chosun Univ. (Korea, Republic of) . . . [11233-48]

**Rapid detection of Shiga toxin-producing Escherichia coli in aqueous samples using a pH sensitive fluorescent dye**, Noah Baker, Leonard Y. Nelson, Eric J. Seibel, Univ. of Washington (USA) . . . [11233-49]

**Reflection-mode fiber-optic temperature sensing probe based on quantum dots filled micro-cavity**, Qi Zhang, Jincheng Lei, Liwei Hua, Yongji Wu, Xuran Zhu, Hai Xiao, Clemson Univ. (USA) . . . [11233-50]

**Optical coherence tomography for compensating ophthalmic system using automatic temperature control of optical fiber**, Daewoon Seong, Sangyeob Han, Yoonseok Kim, Junsoo Lee, Mansik Jeon, Jeehyun Kim, Kyungpook National Univ. (Korea, Republic of) . . . [11233-51]

**Measurements of coupling efficiency of high power Er:YAG laser in different types of optical fibers**, Lina Marcela Beltran Bernal, Ferda Canbaz, Georg Rauter, Niklaus Friederich, Philippe Cattin, Azhar Zam, Univ. Basel (Switzerland) . . . [11233-52]

**Fiber taper refractive index sensor detection by optical backscatter reflectometer**, Madina Shaimerdenova, Takhmina Ayupova, Sanzhar Korganbayev, Marzhan Sypabekova, Aliya Bekmurzayeva, Nazarbayev Univ. (Kazakhstan); Wilfried Blanc, Institut de Physique de Nice (France); Carlo Molardi, Daniele Tosi, Nazarbayev Univ. (Kazakhstan) . . . [11233-53]

**Silver mirror coated deep seated negative axicon optical fiber tip for highly efficient Bessel-Gauss beam generation**, Kaushal Vairagi, Pooja Gupta, Aditi Chopra, CSIR - Central Scientific Instruments Organisation (India) and Academy of Scientific & Innovative Research (India); Umesh K. Tiwari, Samir K. Mondal, CSIR - Central Scientific Instruments Organisation (India) . . . [11233-54]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

# CONFERENCE 11234

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH)

Sunday–Wednesday 2–5 February 2020 • Proceedings of SPIE Vol. 11234

# Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis

*Conference Chairs:* **Robert R. Alfano**, The City College of New York (USA); **Stavros G. Demos**, Univ. of Rochester Laboratory for Laser Energetics (USA); **Angela B. Seddon**, The Univ. of Nottingham (United Kingdom)

*Program Committee:* **Nicole J. Crane**, Naval Medical Research Ctr. (USA); **Amir Gandjbakhche**, National Institutes of Health (USA); **Israel Gannot**, Johns Hopkins Univ. (USA), Tel Aviv Univ. (Israel); **Michael G Giacomelli**, Univ. of Rochester (USA); **Zhiwei Huang**, National Univ. of Singapore (Singapore); **Nicusor V. Iftimia**, Physical Sciences Inc. (USA); **Richard M. Levenson**, Univ. of California, Davis (USA); **Igor V. Meglinski**, Univ. of Oulu (Finland); **Yang Pu**, MicroPhotoAcoustics, Inc. (USA); **Milind Rajadhyaksha**, Memorial Sloan-Kettering Cancer Ctr. (USA); **Lingyan Shi**, Univ. of California, San Diego (USA); **Gennady B. Shvets**, Cornell Univ. (USA); **Ganesan Singaravelu**, Anna Univ., Chennai (India); **Min Xu**, Hunter College (USA)

*Conference Co-Sponsors:*



## SUNDAY 2 FEBRUARY

### SESSION 1

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . SUN 10:00 AM TO 10:15 AM

#### Supercontinuum 50th Birthday

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

10:00 am: **History of supercontinuum discovery: 50 years ago**,  
Robert R. Alfano, The City College of New York (USA) . . . . . [11234-1]

### SESSION 2

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . SUN 10:15 AM TO 11:15 AM

#### Supercontinuum Field: Introduction

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

10:15 am: **The science and technology of supercontinuum source development**, James R. Taylor, Imperial College London (United Kingdom). . . . . [11234-2]

10:45 am: **Generation of spectrally bright broad-band light in photonic crystal fibres**, Philip St. John Russell, Max-Planck-Institut für die Physik des Lichts (Germany). . . . . [11234-3]

### SESSION 3

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . SUN 11:15 AM TO 12:15 PM

#### Supercontinuum in Biomedical Science: Introduction

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

11:15 am: **Supercontinuum-enabled label-free optical biopsy of tumor margins, markers, and the microenvironment**, Stephen A. Boppart, Beckman Institute for Advanced Science and Technology (USA) . . . . . [11234-4]

11:45 am: **Dependence of ultrahigh resolution optical coherence tomography using supercontinuum**, Norihiko Nishizawa, Nagoya Univ. (Japan). . . . . [11234-5]

Lunch/Exhibition Break . . . . . Sun 12:15 pm to 1:30 pm

### SESSION 4

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . SUN 1:30 PM TO 2:45 PM

#### Cutting Edge Supercontinuum and Biomedical Science

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

1:30 pm: **Brain metabolism monitoring through CCO measurements using all-fiber-integrated super-continuum source**, Mohammed N. Islam, Univ. of Michigan (USA) . . . . . [11234-6]

2:15 pm: **Brighter, broader and better white laser light**, Alex Risos, The Univ. of Auckland (New Zealand) . . . . . [11234-7]

### SESSION 5

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . SUN 2:45 PM TO 3:15 PM

#### Fiber Mid-Infrared Supercontinuum: Introduction

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

2:45 pm: **Window of opportunity: exploiting the mid-infrared with chalcogenide active and passive glass fiber-optics for biomedical applications.**, Angela B. Seddon, David Furniss, Zhuoqi Tang, David Mabwa, Joel Nunes, Richard Crane, The Univ. of Nottingham (United Kingdom); Harriet Parnell, Granta Design Ltd. (United Kingdom) and ANSYS UK Ltd. (United Kingdom); Sindy Phang, Emma Barney, Mark Farries, Trevor Benson, The Univ. of Nottingham (United Kingdom); Lukasz Sojka, Wroclaw Univ. of Science and Technology (Poland); Slawomir Sujecki, The Univ. of Nottingham (United Kingdom). . . . . [11234-8]

Coffee Break. . . . . Sun 3:15 pm to 3:45 pm

# CONFERENCE 11234

## SESSION 6

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . SUN 3:45 PM TO 4:45 PM

### Fiber Mid-Infrared Supercontinuum and Biomedical Science

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

3:45 pm: **Mid-infrared supercontinuum sources and application to FTIR spectromicroscopy**, Sebastien Fevrier, XLIM (France); Laure Lavoute, Kirill Zaytsev, Dmitry Gaponov, NOVAE (France); Ferenc Borondics, Christophe Sandt, Paul Dumas, Synchrotron SOLEIL (France); Ammar Hideur, Complexe de Recherche Interprofessionnel en Aérothermochimie (France); Nicolas Ducros, NOVAE (France) . . . . . [11234-9]

4:15 pm: **High-pulse energy supercontinuum sources for multi-spectral photoacoustic imaging in the near-infrared wavelength region**, Manoj Kumar Dasa, Kyei Kwarkye, Technical Univ. of Denmark (Denmark); Gianni Nteroli, Univ. of Kent (United Kingdom); Oyewole Benjamin Efunbajo, Technical Univ. of Denmark (Denmark) and NKT Photonics A/S (Denmark); Magalie Bondu, NKT Photonics A/S (Denmark); Getinet Woyessa, Technical Univ. of Denmark (Denmark); Niels M. Israelsen, Technical Univ. of Denmark (Denmark) and NORBLIS IVS (Denmark); Adrian Bradu, Univ. of Kent (United Kingdom); Christian R. Petersen, Technical Univ. of Denmark (Denmark) and NORBLIS IVS (Denmark); Peter M. Moselund, Patrick Bowen, NKT Photonics A/S (Denmark); Christos Markos, Technical Univ. of Denmark (Denmark) and NORBLIS IVS (Denmark); Ole Bang, Technical Univ. of Denmark (Denmark) and NKT Photonics A/S (Denmark) and NORBLIS IVS (Denmark) . . . . . [11234-10]

## SESSION 7

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . SUN 4:45 PM TO 5:15 PM

### Industrial Supercontinuum Fiber Lasers

Session Chair: **Angela B. Seddon**,  
The Univ. of Nottingham (United Kingdom)

4:45 pm: **Industrialization of supercontinuum**, Peter Morten Moselund, Patrick Bowen, Thomas V. Andersen, Deepak Nair, NKT Photonics A/S (Denmark); Jesper K. Olsen, Technical Univ. of Denmark (Denmark) . [11234-60]

5:00 pm: **Applications of mid-infrared supercontinuum lasers and examples within optical coherence tomography for non-destructive testing**, Christian Petersen, NORBLIS IVS (Denmark); Niels M. Israelsen, Christos Markos, Ole Bang, Technical Univ. of Denmark (Denmark) . [11234-63]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

### Nirmala Ramanujam,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

### Spying on the Secret Lives of Cells

**Eric Betzig**, Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

## TUESDAY 4 FEBRUARY

### OPENING REMARKS

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . TUE 8:00 AM TO 8:05 AM

### Optical Biopsy: Opening Remarks

Session Chair: **Robert R. Alfano**, The City College of New York (USA)

## SESSION 8

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . TUE 8:10 AM TO 10:00 AM

### Spectral Imaging

Session Chairs: **Angela B. Seddon**, The Univ. of Nottingham (United Kingdom); **Stavros G. Demos**, Lab. for Laser Energetics (USA)

8:10 am: **Hand-held multispectral imager to study Cushing syndrome: moving from portable to point of care** (*Invited Paper*), Siddharth Khare, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA); Afrouz Anderson, The Focus Foundation (USA); Thien Nguyen, Kosar Khaksari, Constantine A. Stratakis, Amir H. Gandjbakhche, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA) . . . . . [11234-11]

8:40 am: **Monitoring acute subdural hematoma in real-time with near infrared diffuse optical tomography: a feasibility study**, Linyu Ni, Xueding Wang, Nikolaos Chronis, Univ. of Michigan (USA); Guan Xu, Univ. of Michigan Medical School (USA) . . . . . [11234-12]

9:00 am: **Fiber-based macroscale fluorescence lifetime imaging for real-time in situ tissue diagnostics**, Joao Lagarto, Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Vladislav I. Shcheslavskiy, Becker & Hickl GmbH (Germany); Francesco S. Pavone, Riccardo Cicchi, Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy) . . . . . [11234-13]

9:20 am: **Relative intensity noise dynamics in supercontinuum generation with varying repetition rates for multi-modal imaging applications**, Oyewole Benjamin Efunbajo, NKT Photonics A/S (Denmark) and Technical Univ. of Denmark (Denmark); Manoj Kumar Dasa, Kyei Kwarkye, Technical Univ. of Denmark (Denmark); Patrick Bowen, Peter M. Moselund, NKT Photonics A/S (Denmark); Peter E. Andersen, Ole Bang, Technical Univ. of Denmark (Denmark) . . . . . [11234-14]

9:40 am: **Automated analysis of tissue heterogeneity based on OCT images for improving personalized cancer therapy effectiveness**, Mark Scimone, Gopi Maguluri, Jesung Park, Nicusor V. Iftimia, Physical Sciences Inc. (USA) . . . . . [11234-15]

Coffee Break. . . . . Tue 10:00 am to 10:30 am

## SESSION 9

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . TUE 10:30 AM TO 11:50 AM

### Novel Techniques

Session Chairs: **Laura A. Sordillo**, The City College of New York (USA); **Lingyan Shi**, Univ. of California, San Diego (USA)

10:30 am: **Exploring diagnosing brain disease with quantum entanglement**, Enrique J. Galvez, Faith Williams, Baibhav Sharma, Aayam Bista, Behzad Khajavi, Jhonny Castrillon, Colgate Univ. (USA); Lingyan Shi, Univ. of California, San Diego (USA); Sandra Mamani, Lin Zhang, Laura A. Sordillo, Robert R. Alfano, The City College of New York (USA) . . . . . [11234-16]

10:50 am: **GPU-accelerated online Monte Carlo (MC) application for imitation of twisted light propagation in turbid tissue-like scattering media**, Alexander Doronin, Victoria Univ. of Wellington (New Zealand); Hee Ryung Lee, Tatiana Novikova, Ecole Polytechnique (France); Nicolás Vera, Juan Pablo Staforelli, Univ. de Concepción (Chile); Alexander Bykov, Univ. of Oulu (Finland); Igor V. Meglinski, Univ. of Oulu (Finland) and Aston Univ. (United Kingdom) . . . . . [11234-17]

11:10 am: **Generalized special functions are Majorana-like photons**, Sandra Mamani, The City College of New York (USA); Lingyan Shi, Univ. of California, San Diego (USA); Daniel A. Nolan, Corning Incorporated (USA); Robert R. Alfano, The City College of New York (USA) . . . . . [11234-18]

11:30 am: **Combined use of Stokes-vector and Mueller-matrix polarimetry approaches for Alzheimer's progression screening**, Mariia A. Borovkova, Alexander Bykov, Alexey Popov, Univ. of Oulu (Finland); Angelo Pierangelo, Tatiana Novikova, Ecole Polytechnique (France); Jens Pahnke, Univ. I Oslo (Norway); Igor V. Meglinski, Univ. of Oulu (Finland) and Aston Univ. (United Kingdom) . . . . . [11234-19]

Lunch/Exhibition Break . . . . . Tue 11:50 am to 1:40 pm

**Note conference resumes on Tuesday 4 February**

**SESSION 10**

**LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . TUE 1:40 PM TO 3:00 PM**

**Spectroscopic Methods I**

Session Chairs: **Israel Gannot**, Tel Aviv Univ. (Israel);  
**Enrique J. Galvez**, Colgate Univ. (USA); **Ganesan Singaravelu**,  
Anna Univ., Chennai (India)

1:40 pm: **Evaluating human breast cancer cell metastasis potential using resonance Raman spectroscopy and machine learning**, Lin Zhang, The City College of New York (USA); Binlin Wu, Southern Connecticut State Univ. (USA); Susie Boydston-White, Borough of Manhattan Community College (USA); Kenneth Jimenez, Southern Connecticut State Univ. (USA); Cheng-hui Liu, Robert R. Alfano, The City College of New York (USA) . . . . . [11234-20]

2:00 pm: **Enhancing in vivo nose cancer detection with rapid fiberoptic Raman and deep learning techniques**, Chi Shu, Hanshu Yan, Kan Lin, National Univ. of Singapore (Singapore); Chwee Ming Lim, Singapore General Hospital (Singapore) and Duke-NUS Graduate Medical School (Singapore); Wei Zheng, Jiashi Feng, Zhiwei Huang, National Univ. of Singapore (Singapore) . . . . . [11234-21]

2:20 pm: **A time-resolved near-infrared spectroscopy based on CMOS image sensor**, De Xing Lioe, Masashi Hakamata, Keita Yasutomi, Keiichiro Kagawa, Masatsugu Niwayama, Shizuoka Univ. (Japan); Yasuko Fukushi, Seiji Yamamoto, Hamamatsu Univ. School of Medicine (Japan); Shoji Kawahito, Shizuoka Univ. (Japan) . . . . . [11234-23]

2:40 pm: **Triplet and singlet oxygen measurements by time-correlated single photon counting technique**, Vladislav I. Shcheslavskiy, Becker & Hickl GmbH (Germany); Pavel Morozov, CJSC Superconducting Nanotechnology "SCONTEL" (Russian Federation); Maria Lukina, Marina Shirmanova, Privolzhsky Research Medical Univ. (Russian Federation); Konstantin Smirnov, CJSC Superconducting Nanotechnology "SCONTEL" (Russian Federation); Wolfgang Becker, Becker & Hickl GmbH (Germany) . . . . . [11234-24]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

**SESSION 11**

**LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . TUE 3:30 PM TO 6:10 PM**

**Spectroscopic Methods II**

Session Chairs: **Binlin Wu**, Southern Connecticut State Univ. (USA);  
**Min Xu**, Hunter College (USA)

3:30 pm: **Fast and label-free optical detection of dysplastic and tumour brain tissues**, Enrico Baria, Istituto Nazionale di Ottica (Italy); Flavio Giordano, Azienda Ospedaliera Univ. Anna Meyer (Italy); Anna M. Buccoliero, Univ. degli Studi di Firenze (Italy); Riccardo Cicchi, Istituto Nazionale di Ottica (Italy); Francesco S. Pavone, Univ. degli Studi di Firenze (Italy) . . . . . [11234-25]

3:50 pm: **Estimation of spectroscopic attenuation coefficient in retinal nerve fiber layer for detection of glaucoma**, Shuang Chang, Vanderbilt Univ. (USA); Theodore Leng, Stanford School of Medicine (USA); Sylvia Groth, Vanderbilt Univ. Medical Ctr. (USA); Audrey K. Bowden, Vanderbilt Univ. (USA) . . . . . [11234-26]

4:10 pm: **Classifying diffuse reflectance spectroscopy measurements of locations with mixed tissue types and DCIS**, Lisanne L. de Boer, Esther Kho, Marie-Jeanne T. F. D. Vrancken Peeters, Frederieke van Duijnhoven, The Netherlands Cancer Institute (Netherlands); Koen K. Van de Vijver, The Netherlands Cancer Institute (Netherlands) and Univ. Ziekenhuis Gent (Belgium); Joyce Sanders, The Netherlands Cancer Institute (Netherlands); Benno H. W. Hendriks, Technische Univ. Delft (Netherlands) and Philips Research (Netherlands); Henricus J. C. M. Sterenborg, The Netherlands Cancer Institute (Netherlands) and Amsterdam UMC (Netherlands); Theo J. M. Ruers, The Netherlands Cancer Institute (Netherlands) and Univ. of Twente (Netherlands) . . . . . [11234-27]

4:30 pm: **Human glioma tumor grading using visible resonance Raman spectroscopy and machine learning**, Binlin Wu, Southern Connecticut State Univ. (USA); Yan Zhou, The General Hospital of the Air Force, PLA (China); Shengjia Zhang, Jiangsu Raman Medical Equipment Co., Ltd. (China); Xinguang Yu, Gange Cheng, The General Hospital of the Air Force, PLA (China); Ke Zhu, Chinese Academy of Sciences (China); Cheng-Hui Liu, Robert R. Alfano, The City College of New York (USA) . . . . . [11234-28]

4:50 pm: **Analysis of diffuse scattering spectra from trace particles actively illuminated with a mid-infrared FTIR sensor**, Ramon A. Martinez, Kaiwen Guo, Fred L. Terry Jr., Univ. of Michigan (USA); Agustin I. Ifarraguerri, Leidos, Inc. (USA); Tianqu Zhai, Univ. of Michigan (USA); Brandon Demory, Omni Sciences Inc. (USA); Mohammed N. Islam, Univ. of Michigan (USA) and Omni Sciences Inc. (USA) . . . . . [11234-29]

5:10 pm: **Non-destructive determination of protein level in wheat flour with a super-continuum laser**, Kaiwen Guo, Univ. of Michigan (USA); Brandon Demory, Omni Sciences Inc. (USA); Ramon A. Martinez, Tianqu Zhai, Univ. of Michigan (USA); Mohammed N. Islam, Univ. of Michigan (USA) and Omni Sciences Inc. (USA) . . . . . [11234-30]

5:30 pm: **Label-free multi-modal multiphoton imaging for real-time point-of-procedure assessment of core-needle and fine-needle biopsy specimens**, Lingxiao Yang, Yi Sun, Darold R. Spillman Jr., Sixian You, Stephen A. Boppart, Univ. of Illinois (USA) . . . . . [11234-61]

5:50 pm: **S2 state optical property enhancement of indocyanine green due to optical exposure**, Sharad Gupta, Anshu Kumari, Amit Goverdhan, Indian Institute of Technology Indore (India) . . . . . [11234-31]

**POSTERS-TUESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the BiOS/LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Tuesday 10:00 AM – 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**SWIR windows as an adjunctive to biopsy for distinguishing and monitoring benign and malignant tissues**, Laura A. Sordillo, The City College of New York (USA); Diana C. Sordillo, The City Univ. of New York (USA); Lingyan Shi, Peter P. Sordillo, Robert R. Alfano, The City College of New York (USA) . . . . . [11234-50]

**In vivo detection of glioblastoma through multimodal fibre-probe spectroscopy**, Enrico Baria, Istituto Nazionale di Ottica (Italy); Enrico Pracucci, Vinoshene Pillai, NEST, the National Enterprise for nanoScience and nanoTechnology (Italy); Francesco S. Pavone, Univ. degli Studi di Firenze (Italy); Gian M. Ratto, NEST, the National Enterprise for nanoScience and nanoTechnology (Italy); Riccardo Cicchi, Istituto Nazionale di Ottica (Italy) . . . . . [11234-52]

**Improving temporal resolution of fNIRS-DOT by data-reduced pre-OT guidance**, Dongyuan Liu, Bingyuan Wang, Yao Zhang, Tiantian Pan, Yang Liu, Feng Gao, Tianjin Univ. (China) . . . . . [11234-53]

**A multi-channel diffuse correlation spectroscopy system for dynamic topography of blood flow index in deep tissues**, Jinbin Xie, XiangDong He, Feng Gao, ZhuanPing Qin, Tianjin Univ. (China) . . . . . [11234-54]

**A lock-in photon-counting based single pixel imaging toward real-time multi-wavelength SFD-DOT**, Mai Dan, Tongxin Li, Xi Hou, Feng Gao, Tianjin Univ. (China) . . . . . [11234-55]

**Color mapping of collagen spectra from near-infrared transparency window III to the visible spectrum**, Vivian Wang, Institute for Ultrafast Spectroscopy and Lasers (USA) and Pre-Clinical Imaging Core (USA); J. Stewart Russell, The City College of New York (USA); Youssef Zaim Wadghiri, Pre-Clinical Imaging Core, New York Univ. (USA) . . . . . [11234-56]

**Fluorescence microscopy with deep neural network analysis for detection of lymph node metastasis**, Tatsuya Matsumoto, Yasuaki Kumamoto, Kyoto Prefectural Univ. of Medicine (Japan); Hirohiko Niioka, Osaka Univ. (Japan); Hideo Tanaka, Kyoto Prefectural Univ. of Medicine (Japan); Jun Miyake, Osaka Univ. (Japan); Tetsuro Takamatsu, Kyoto Prefectural Univ. of Medicine (Japan) . . . . . [11234-57]

**Low cost smartphone-based colposcopy for early detection of uterine cervical cancer**, Daa-Young Kwon, Pukyong National Univ. (Korea, Republic of); Hanggoo Yun, Kosin Univ. (Korea, Republic of); Yikeun Kim, Huigyeong Jang, Hyunseo Park, Pukyong National Univ. (Korea, Republic of); Chulho Oak, Sung Won Kim, Kosin Univ. (Korea, Republic of); Yeh-Chan Ahn, Pukyong National Univ. (Korea, Republic of) . . . . . [11234-58]

**Abnormal tryptophan metabolism in Alzheimer's disease (ALZ): label-free spectroscopy suggests an alternative theory of ALZ causation**, Laura A. Sordillo, Peter P. Sordillo, Robert R. Alfano, The City College of New York (USA) . . . . . [11234-59]

**Transmission quantum tomography of thick brain tissue**, Baibhav Sharma, Enrique J. Galvez, Colgate Univ. (USA); Lingyan Shi, Univ. of California, San Diego (USA); Robert R. Alfano, The City College of New York (USA) . [11234-62]

## WEDNESDAY 5 FEBRUARY

### SESSION 12

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . WED 8:10 AM TO 10:00 AM

#### Optical Histology I

Session Chairs: **Yang Pu**, MicroPhotoAcoustics, Inc. (USA);  
**Lingyan Shi**, Univ. of California, San Diego (USA)

8:10 am: **Label-free multiphoton microscopy in human tissue enabled by an Er:fiber-laser based tunable source** (*Invited Paper*), Hsiang-Yu Chung, Deutsches Elektronen-Synchrotron (Germany) ..... [11234-32]

8:40 am: **Quantitative detection of breast cancer using confocal fluorescence polarization imaging**, Peter R. Jermain, Univ. of Massachusetts Lowell (USA); Dina Kandil, Univ. of Massachusetts Medical School (USA); Ashraf Khan, Baystate Medical Ctr. (USA); Anna N. Yaroslavsky, Univ. of Massachusetts Lowell (USA) ..... [11234-33]

9:00 am: **Terbium ion as RNA tag for slide-free histology with deep-ultraviolet excitation fluorescence**, Yasuaki Kumamoto, Kyoto Prefectural Univ. of Medicine (Japan) ..... [11234-34]

9:20 am: **Pilot study of micro optical coherence tomography for detection of invasive and pre-invasive cervical lesions**, Elham Abouei, The Univ. of British Columbia (Canada); Joseph A. Gardecki, Massachusetts General Hospital (USA); Michele Follen, King's County Hospital (USA); Calum MacAulay, The Univ. of British Columbia (USA); Jed Cutler, Lisa Ricketts-Holcomb, King's County Hospital (USA); Guillermo J. Tearney, Harvard Medical School (USA) ..... [11234-35]

9:40 am: **Development of a novel, label-free, depth-resolved Raman imaging approach for breast cancer margin assessment**, Rishikesh Pandey, CytoVeris Inc. (USA); Guoan Zheng, Shaowei Jiang, Pouria Hoveida, Univ. of Connecticut (USA); David Fournier, Alan D. Kersey, CytoVeris Inc. (USA) ..... [11234-36]

Coffee Break. ....Wed 10:00 am to 10:30 am

### SESSION 13

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) .WED 10:30 AM TO 11:20 AM

#### Optical Histology II

Session Chairs: **Yang Pu**, MicroPhotoAcoustics, Inc. (USA);  
**Yasuaki Kumamoto**, Osaka Univ. (Japan)

10:30 am: **Optical imaging of heavy water metabolism in cells and animals** (*Invited Paper*), Lingyan Shi, Univ. of California, San Diego (USA); Wei Min, Columbia Univ. (USA) ..... [11234-37]

11:00 am: **Low cost hand scanning OCT probe for biopsy guidance**, Gopi Maguluri, Mark Scimone, Jesung Park, John Grimbble, Physical Sciences Inc. (USA); Savitri Krishnamurthy, The Univ. of Texas M. D. Anderson Cancer Ctr. (USA); Nicusor V. Iftimia, Physical Sciences Inc. (USA) ..... [11234-38]

Lunch/Exhibition Break .....Wed 11:20 am to 1:20 pm

### SESSION 14

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . . WED 1:20 PM TO 3:10 PM

#### Optical Histology III

Session Chairs: **Anna N. Yaroslavsky**, Univ. of Massachusetts Lowell (USA); **Angela B. Seddon**, The Univ. of Nottingham (United Kingdom)

1:20 pm: **DUET, a novel, simple, rapid microscopy method for evaluation of fibrosis from donor-kidney frozen section slides**, Farzad Fereidouni, Austin Todd, Kuang-Yu Jen, Richard Levenson, Univ. of California, Davis (USA) ..... [11234-40]

1:40 pm: **Rapid label-free computational staining for cancer histopathology**, Bo Gao, Hunter College (USA); Xin Xie, Fairfield Univ. (USA); Ashraf Talukder, Hunter College (USA); Run Li, Fairfield Univ. (USA); Min Xu, Hunter College (USA) ..... [11234-41]

2:00 pm: **Imaging metabolic activities of deuterium labeled glucose with stimulated Raman scattering microscopy**, Lingyan Shi, Univ. of California, San Diego (USA); Wei Min, Columbia Univ. (USA) ..... [11234-42]

2:20 pm: **550 nm bandwidth optical coherence tomography system for simultaneous spectroscopic and structural imaging in the near infrared**, Mikkel Jensen, Niels M. Israelsen, Technical Univ. of Denmark (Denmark); Ole Bang, Technical Univ. of Denmark (Denmark) and NKT Photonics A/S (Denmark) ..... [11234-43]

2:40 pm: **Optical access to the brain through a transparent cranial implant** (*Invited Paper*), Mildred S. Cano-Velázquez, Univ. Nacional Autónoma de México (Mexico); Nami Davoodzadeh, David L. Halaney, Carrie R. Jonak, Devin K. Binder, Guillermo Aguilar, Univ. of California, Riverside (USA); Juan Hernández-Cordero, Univ. Nacional Autónoma de México (Mexico) ..... [11234-44]

Coffee Break. ....Wed 3:10 pm to 3:40 pm

### SESSION 15

LOCATION: ROOM 160 (UPPER MEZZANINE SOUTH) . . .WED 3:40 PM TO 5:40 PM

#### Optical Bioassay Platforms

Session Chairs: **Stavros G. Demos**, Lab. for Laser Energetics (USA);  
**Nicusor V. Iftimia**, Physical Sciences Inc. (USA)

3:40 pm: **Quantitative assessment of acute mesenteric ischemia in preclinical models using laser speckle contrast imaging (LSCI)**, So Hyun Nam, Children's National Health System (USA); Gyeong Woo Cheon, GE Global Research (USA); Eugene Oh, Bo Ning, Yujeong Cho, Jae-Ho Han, Timothy Kane, Anthony Sandler, Jaepyeong Cha, Children's National Health System (USA) ..... [11234-45]

4:00 pm: **Evaluation of blood circulation ability based on fNIRS in ECMO patients**, Yi-Chih Chen, Tzu-Hsin Fan, Chun-Jung Huang, National Chiao Tung Univ. (Taiwan); Hsiao-Huang Chang, Taipei Veterans General Hospital (Taiwan); Chia-Wei Sun, National Chiao Tung Univ. (Taiwan) ..... [11234-46]

4:20 pm: **Correlation of metabolites in saliva and in vivo tissue of oral cancer patients based on fluorescence spectral deconvolution**, Raja Pappu, Einstein Gnanatheepam, Anna Univ., Chennai (India); Sangeetha Ramamoorthy, Tamil Nadu Government Dental College and Hospital (India); Aruna Prakasharao, Anna Univ., Chennai (India); Jayachandran Sadaksharam, Tamil Nadu Government Dental College and Hospital (India); Ganesan Singaravelu, Anna Univ., Chennai (India) . . [11234-47]

4:40 pm: **Brain metabolism changes in cases of impaired breathing or blood circulation in rodents evaluated by real time optical spectroscopy methods**, Gennadii A. Piavchenko, Orel State Univ. named after I.S. Turgenev (Russian Federation) and Sechenov Univ. (Russian Federation); Evgeniya S. Seryogina, Ksenia Yu Kandurova, Valery V. Shupletsov, Olga A. Stelmashchuk, Orel State Univ. named after I.S. Turgenev (Russian Federation); Evgeny A. Zherebtsov, Viktor V. Dremin, Orel State Univ. named after I.S. Turgenev (Russian Federation) and Univ. of Oulu (Finland); Aleksander G. Alekseyev, Andrey V. Dunaev, Orel State Univ. named after I.S. Turgenev (Russian Federation); Igor V. Meglinski, Univ. of Oulu (Finland) ..... [11234-6]

5:00 pm: **Feasibility study of cerebral hypoxia evaluation through a transparent nanocrystalline yttria-stabilized zirconia cranial implant using Monte Carlo method**, Fredy Miranda-Casasola, Univ. Nacional Autónoma de México (Mexico); Nami Davoodzadeh, Univ. of California, Riverside (USA); Celia Sánchez-Pérez, Univ. Nacional Autónoma de México (Mexico); Guillermo Aguilar, Univ. of California, Riverside (USA); Enoch Gutierrez-Herrera, Univ. Nacional Autónoma de México (Mexico) and Univ. of California, Riverside (USA) ..... [11234-48]

5:20 pm: **Lipid metabolic imaging opens new avenue for human cancer diagnosis**, Shuhua Yue, Shuo Zhang, Beihang Univ. (China); Lin Yao, Liqun Zhou, Peking Univ. First Hospital (China) ..... [11234-49]

# CONFERENCE 11235

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH)

Saturday–Tuesday 1–4 February 2020 • Proceedings of SPIE Vol. 11235

# Microfluidics, BioMEMS, and Medical Microsystems XVIII

Conference Chairs: **Bonnie L. Gray**, Simon Fraser Univ. (Canada); **Holger Becker**, microfluidic ChipShop GmbH (Germany)

Program Committee: **Hatice Altug**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Brian W. Anthony**, Massachusetts Institute of Technology (USA); **Jaione Tirapan Azpiroz**, IBM Research - Brazil (Brazil); **Yolanda Fintschenko**, FounderTraction (USA); **Bruce K. Gale**, The Univ. of Utah (USA); **Albert K. Henning**, Aquarian Microsystems (USA); **Yu-Cheng Lin**, National Cheng Kung Univ. (Taiwan); **Yuehe Lin**, Pacific Northwest National Lab. (USA); **Ian Papautsky**, Univ. of Illinois at Chicago (USA); **Bastian E. Rapp**, Univ. of Freiburg (Germany); **Thomas Stieglitz**, Albert-Ludwigs-Univ. Freiburg (Germany); **Sindy Kam-Yan Tang**, Stanford Univ. (USA); **Hayden K. Taylor**, Univ. of California, Berkeley (USA); **Bernhard H. Weigl**, Intellectual Ventures Management, LLC (USA)

Conference Co-Sponsor: 

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . SAT 1:30 PM TO 3:00 PM

#### Manufacturing I

Session Chairs: **Holger Becker**, microfluidic ChipShop GmbH (Germany); **Bonnie L. Gray**, Simon Fraser Univ. (Canada)

1:30 pm: **Functional nanomeshes for scalable transparent microelectrode arrays** (*Invited Paper*), Hui Fang, Northeastern Univ. (USA) . . . . . [11235-1]

2:00 pm: **Sacrificial template replication: fabrication of arbitrary embedded microfluidic channels in transparent fused silica glass**, Frederik Kotz, Patrick Risch, Univ. of Freiburg (Germany); Michael Thiel, Alexander Quick, Nanoscribe GmbH (Germany); Dorothea Helmer, Bastian E. Rapp, Univ. of Freiburg (Germany) . . . . . [11235-2]

2:20 pm: **Generation of multi-level microstructures using a wavelength-selective photoresist and mask-less grayscale lithography**, Andrea Kick, Dorothea Helmer, Frederik Kotz, Bastian E. Rapp, Univ. of Freiburg (Germany) . . . . . [11235-3]

2:40 pm: **Fabrication for polymer microchannels with circular cross-section using photo-curable PDMS**, Ryota Nakazawa, Takaaki Ishigure, Keio Univ. (Japan) . . . . . [11235-4]

Coffee Break. . . . . Sat 3:00 pm to 3:30 pm

### SESSION 2

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . SAT 3:30 PM TO 5:00 PM

#### Devices I

Session Chair: **Hui Fang**, Northeastern Univ. (USA)

3:30 pm: **Adding a new sensing dimension to soft electronics: from the skin to below the skin** (*Invited Paper*), Sheng Xu, Univ. of California, San Diego (USA) . . . . . [11235-5]

4:00 pm: **Laser-patterned lateral-flow devices with multiple flow-paths for semi-quantitative measurement of the inflammatory biomarker, C-reactive protein**, Alice Iles, Peijun J. W. He, Ioannis N. Katis, Panagiotis Galanis, Anto J. Kumar, Jessica L. Teeling, Clive Holmes, Jay Amin, Robert W. Eason, Collin L. Sones, Univ. of Southampton (United Kingdom) . . . . . [11235-6]

4:20 pm: **Laser-based liquid jet injection from minimally invasive device**, Jan Krizek, Frédéric De Goumoëns, Christophe Moser, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11235-7]

4:40 pm: **Microspectrometry-FTIR based glucose and fructose biosensor with pseudo-continuous flow**, Hamza Landari, Mourad Roudjane, Younès Messaddeq, Amine Miled, Univ. Laval (Canada) . . . . . [11235-8]

### BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

# CONFERENCE 11235

## SUNDAY 2 FEBRUARY

### SESSION 3

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . SUN 9:00 AM TO 10:30 AM

#### Medical Devices

Session Chair: **Sheng Xu**, Univ. of California, San Diego (USA)

9:00 am: **Backscattering-based wireless communication and power transfer to small biomedical implants** (*Invited Paper*), Leena Ukkonen, Lauri Sydanheimo, Toni Bjorninen, Tampere Univ. (Finland) . . . . . [11235-9]

9:30 am: **Optical immuno-biochip for detection of oral cancer biomarkers with IoT platform**, Hsiang-Yu Lei, National Central Univ. (Taiwan) . . . [11235-10]

9:50 am: **Simulation and experimental results of a microfluidic dipole intended for brain experiments**, Nathaniel Brochu, Amine Miled, Univ. Laval (Canada) . . . . . [11235-11]

10:10 am: **Functional optical immunosensor microfluidic platform for acute myocardial infarction diagnosis**, Zhi-Zhong Wang, National Central Univ. (Taiwan) . . . . . [11235-12]

Coffee Break. . . . . Sun 10:30 am to 11:00 am

### SESSION 4

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . SUN 11:00 AM TO 12:00 PM

#### Devices II

Session Chair: **Leena Ukkonen**, Tampere Univ. (Finland)

11:00 am: **Impact of open surface area of multi-well microelectrode arrays (MW-MEA) on mammalian brain cells recording efficiency**, Roofia (Sara) Pishgar, Pierre Wijdenes, Fahad Iqbal, Kazim Haider, Atika Syeda, Naweed Syed, Colin Dalton, Univ. of Calgary (Canada) . . . . . [11235-13]

11:20 am: **Fabrication of thin composite emission filter for high-performance lens-free fluorescent imager**, Erus Rustami, Nara Institute of Science and Technology (Japan) . . . . . [11235-14]

11:40 am: **Facile integration of electronics in glass microfluidic devices for electrochemical synthesis and analysis**, Manuel Luitz, Patrick Risch, Dorothea Helmer, Frederik Kotz, Bastian E. Rapp, Univ. of Freiburg (Germany) . . . . . [11235-15]

Lunch/Exhibition Break . . . . . Sun 12:00 pm to 2:10 pm

### SESSION 5

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . SUN 2:10 PM TO 3:10 PM

#### Manufacturing II

Session Chair: **Sally Peyman**, Univ. of Leeds (United Kingdom)

2:10 pm: **Higher-order emulsion formation by combining 3D-printed materials with different wettability**, Max Männel, Julian Thiele, Leibniz-Institut für Polymerforschung Dresden e.V. (Germany) . . . . . [11235-17]

2:30 pm: **A novel gravity valve and its application in a 3D printed centrifugal fluidic-system for solid phase extraction (SPE)**, Wanjun Wang, Yong Zhang, Yunxia Wang, Jiwen Xiang, Zheng Qiao, Louisiana State Univ. (USA) . . . . . [11235-19]

2:50 pm: **Dual-arm robotic system for 3D biofabrication**, Kowther M. Kahin, Zainab Khan, Dana Alhattab, Charlotte Hauser, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11235-20]

Coffee Break. . . . . Sun 3:10 pm to 3:40 pm

### SESSION 6

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . SUN 3:40 PM TO 5:10 PM

#### Applications I

Session Chair: **Frederik Kotz**, Univ. of Freiburg (Germany)

3:40 pm: **Organ on chip models for the evaluation of microbubble based therapeutic delivery** (*Invited Paper*), Sally Peyman, Univ. of Leeds (United Kingdom) . . . . . [11235-21]

4:10 pm: **Ultra-low power pH sensor powered by microbial fueled cells**, Nathaniel Brochu, Mario Leclerc, Jesse Greener, Amine Miled, Univ. Laval (Canada) . . . . . [11235-22]

4:30 pm: **Biosensor for determining average iron content of ferritin by measuring its optical dispersion**, Ruchi Gupta, Univ. of Birmingham (United Kingdom); Nasser Alamrani, Gillian Greenway, Nicole Pamme, The Univ. of Hull (United Kingdom); Nicholas Goddard, Process Instruments (UK) Ltd. (United Kingdom) . . . . . [11235-23]

4:50 pm: **Sensing of diseased mitochondria proportion by DEP in organelle level without breaking the cells**, Pei Yin Chi, Academia Sinica (Taiwan); Ting Wei Chuang, Tzu-Tsai Chu, Chia-Tzu Kuo, Institute of Physics, Academia Sinica (Taiwan); Yu-Ting Wu, Ctr. for Mitochondrial Medicine and Free Radical Research, Changhua Christian Hospital (Taiwan); Vahid Farmehini, Nathan Swami, Univ. of Virginia (USA); Yau-Huei Wei, Ctr. for Mitochondrial Medicine and Free Radical Research, Changhua Christian Hospital (Taiwan); Chia-Fu Chou, Institute of Physics, Academia Sinica (Taiwan) . . . . . [11235-24]

#### POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

Poster Setup: Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**An inkjet-printed and reusable platform for single-cell impedance cytometry**, Kushal Joshi, Rahim Esfandyarpour, Univ. of California, Irvine (USA) . . . . . [11235-16]

**Microfluidic-assisted engineering of multi-layered microcapsules for 3D stem cell culture**, Pilar Carreras Romeo, National Research Center CSIC (Spain) and Hospital 12 Octubre (Spain); Miguel Gallardo, Alejandra Ortiz, CNIO (Spain) and Hospital 12 Octubre (Spain); Maria Luz Morales Fernandez, Teresa Cedena, Hospital 12 Octubre (Spain); Itziar Gonzalez, CSIC (Spain); Joaquin Martinez-Lopez, Hospital 12 Octubre (Spain) and CNIO (Spain) and UCM Complutense University (Spain) . . . . . [11235-35]

**Fluorescence lifetime-activated droplet sorting in microfluidic systems**, Sadat Hasan, David Geissler, Konstantin Wink, Universität Leipzig (Germany); Axel Hagen, PicoQuant GmbH (Germany); Josef J. Heiland, Universität Leipzig (Germany); Uwe Ortmann, Rainer Erdmann, PicoQuant GmbH (Germany); Detlev Belder, Universität Leipzig (Germany) . . . . . [11235-36]

#### BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

##### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

##### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

##### Talk by 2014 Nobel Prize Winner in Physics:

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

MONDAY 3 FEBRUARY

SESSION 7

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . MON 9:00 AM TO 12:30 PM

Microfluidics and Medical Micro Systems

Joint Session with 11235 and 11268

Session Chairs: **Holger Becker**, microfluidic ChipShop GmbH (Germany); **Udo Klotzbach**, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany)

9:00 am: **Recent advances in 3D printing of pure proteinaceous microstructures by femtosecond laser direct write** (*Invited Paper*), Daniela Serien, Hiroyuki Kawano, Atsushi Miyawaki, Koji Sugioka, RIKEN (Japan) . . . . . [11268-1]

9:30 am: **Kombispec: a combination of polymer-based microspectrometer and microfluidic consumables for the fast on-site analytics in food production**, Holger Becker, Sebastian Schattschneider, microfluidic ChipShop GmbH (Germany); Juliane Gottwald, Eurofins Germany (Germany); Jörg A. Schenk, Hybrotec GmbH (Germany); Richard Klemm, microfluidic ChipShop GmbH (Germany) . . . . . [11235-25]

9:50 am: **Characterization of biomedical glass devices fabricated by ultrafast laser assisted processes**, Jiyeon Choi, Korea Institute of Machinery & Materials (Korea, Republic of); Sung-il Kim, Korea Institute of Machinery & Materials (Korea, Republic of) and Hanbat National Univ. (Korea, Republic of); Sanghoon Ahn, Korea Institute of Machinery & Materials (Korea, Republic of); Yeun-Ho Joung, Chiwan Koo, Hanbat National Univ. (Korea, Republic of) . . . . . [11268-2]

10:10 am: **Control of cell arrangement on PMMA surface by femtosecond laser induced periodic nanostructures**, Naoki Shinohara, Masahiro Tsukamoto, Osaka Univ. (Japan); Yuji Sato, Japan Atomic Energy Agency (Japan) . . . . . [11268-3]

Coffee Break . . . . . Mon 10:30 am to 11:00 am

11:00 am: **Biological analysis in 3D optofluidic devices fabricated by femtosecond laser micromachining** (*Invited Paper*), Petra Paiè, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Roberto Memeo, Federico Sala, Andrea Bassi, Politecnico di Milano (Italy); Roberto Osellame, Francesca Bragheri, CNR-Istituto di Fotonica e Nanotecnologie (Italy) [11268-4]

11:30 am: **Effects of the dissolved gases in water on microbubble oscillation under photothermal heating**, Nao Hiroshige, Mitsubishi Electric Corp. (Japan); Kyoko Namura, Shunsuke Okai, Motofumi Suzuki, Kyoto Univ. (Japan) . . . . . [11268-5]

11:50 am: **Alteration of fluorescence in different pH environments for green fluorescent protein microstructures fabricated by femtosecond laser direct write**, Daniela Serien, Hiroyuki Kawano, Atsushi Miyawaki, Koji Sugioka, RIKEN (Japan) . . . . . [11235-26]

12:10 pm: **Rapid prototyping of alumina-based microfluidic reactors**, Frederik Kotz, Lucas M. Kneißl, Patrick Risch, Bastian E. Rapp, Univ. of Freiburg (Germany) . . . . . [11235-27]

Lunch Break . . . . . Mon 12:30 pm to 2:00 pm

SESSION 8

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . MON 2:00 PM TO 3:30 PM

Optofluidics

Session Chair: **Jungkyu Kim**, Texas Tech Univ. (USA)

2:00 pm: **Image-guided cell sorting and classification** (*Invited Paper*), Sung Hwan Cho, NanoCollect Biomedical, Inc. (USA) . . . . . [11235-28]

2:30 pm: **Single cell radiometry using droplet optofluidics**, Byunghang Ha, Stanford Univ. (USA); Tae Jin Kim, Luca Medical Systems (USA); Ejung Moon, Guillem Pratx, Stanford Univ. (USA) . . . . . [11235-29]

2:50 pm: **Integrated optofluidics: label-free isolation of nanoscale bioparticles from heterogenous samples**, Xiangchao Zhu, Univ. of California, Santa Cruz (USA); Ahmet Cicek, Burdur Mehmet Akif Ersoy Univ. (Turkey); Yixiang Li, Ahmet A. Yanik, Univ. of California, Santa Cruz (USA) . . . . [11235-30]

3:10 pm: **An implantable light source for in-vivo fluorescence image sensor**, Kiyotaka Sasagawa, Erus Rustami, Hironari Takehara, Makito Haruta, Jun Ohta, Nara Institute of Science and Technology (Japan) . . . . . [11235-31]

Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

SESSION 9

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . MON 4:00 PM TO 5:10 PM

Applications II

Session Chairs: **Bonnie L. Gray**, Simon Fraser Univ. (Canada); **Holger Becker**, microfluidic ChipShop GmbH (Germany)

4:00 pm: **A microengineered human ocular model for pathophysiological studies and drug development** (*Invited Paper*), Jungkyu Kim, Zachary Estlack, The Univ. of Utah (USA) . . . . . [11235-32]

4:30 pm: **Real-time optical monitoring of zinc-oxide nanowires in-situ growth within a microfluidic chamber**, Mazen Erfan, Lan Gao, Univ. Paris-Est Marne-la-Vallée (France) and ESIEE Paris (France) and CNRS (France); Marie Le Pivert, Martine Gnambodoe-Capochichi, Univ. Paris-Est Marne-la-Vallée (France); Yasser M. Sabry, Diaa Khalil, Ain-Shams Univ. (Egypt); Tarik Bourouina, Univ. Paris-Est Marne-la-Vallée (France) and ESIEE Paris (France); Yamin Leprince-Wang, Univ. Paris-Est Marne-la-Vallée (France) . . . . . [11235-33]

4:50 pm: **Autofluorescence-based label-free monitoring of bacteria proliferation in droplet microfluidics for antibiotic susceptibility testing**, Jakub Boguslawski, Institute of Physical Chemistry PAS (Poland); Natalia Pacocha, Insititue of Physical Chemistry (Poland); Kamil Lizewski, Piotr Garstecki, Maciej Wojtkowski, Institute of Physical Chemistry PAS (Poland) . . . . . [11235-34]

PANEL DISCUSSION

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . MON 5:20 PM TO 6:20 PM

Prospects and Future of Microfluidics

Moderator: **Holger Becker**, microfluidic ChipShop GmbH (Germany)

The commercialization of microfluidic devices and systems is rapidly progressing. The field starts to see significant economic impact and first large company valuations on the stock market. The discussion will look upon experiences made in the product development and market introduction phase of microfluidics enabled devices and will present lessons learned from various perspectives, from device performance to commercial organization. Experts from industry and academia will highlight recent developments and give an outlook towards future expectations.

BEST STUDENT PAPER AWARD

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . MON 6:20 PM TO 6:25 PM

Session Chairs: **Bonnie L. Gray**, Simon Fraser Univ. (Canada); **Holger Becker**, microfluidic ChipShop GmbH (Germany)

Best Student Paper Award

We are pleased to announce that a cash prize will be awarded to the best student paper in this conference. Qualifying papers and presentations will be evaluated by the awards committee and the winner will be notified at the end of or after the meeting.

AWARD SPONSORS:



BIOS

# CONFERENCE 11236

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11236

# Biomedical Vibrational Spectroscopy 2020: Advances in Research and Industry

Conference Chairs: **Wolfgang Petrich**, Roche Diagnostics GmbH (Germany); **Zhiwei Huang**, National Univ. of Singapore (Singapore)

Program Committee: **Andrew J. Berger**, Univ. of Rochester (USA); **Rohit Bhargava**, Univ. of Illinois at Urbana-Champaign (USA); **Niels Kröger-Lui**, Ruprecht-Karls-Univ. Heidelberg (Germany); **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA); **Airton Abrahão Martin**, Univ. Brasil (Brazil); **Michael D. Morris**, Univ. of Michigan (USA); **Dieter Naumann**, Robert Koch-Institut (Germany); **Jürgen Popp**, Institut für Photonische Technologien e.V. (Germany); **Nicholas Stone**, Gloucestershire Royal Hospital (United Kingdom)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . SAT 1:30 PM TO 3:15 PM

#### Vibrational Techniques in Biomedical Diagnosis I

Session Chair: **Zhiwei Huang**, National Univ. of Singapore (Singapore)

1:30 pm: **Intra-operative assessment of tumor resection margins by Raman spectroscopy to guide oral cancer surgery** (*Invited Paper*), Gerwin J. Puppels, RiverD International B.V. (Netherlands); Elisa M. L. Barroso, Yassine Aaboubout, Maria Rosa Nunes Soares, Erasmus MC (Netherlands); Viacheslav G. Artyushenko, Alexey Bocharnikov, Iskander Usenov, art photonics GmbH (Germany); Tom C. Bakker-Schut, Robert J. Baatenburg de Jong, Eppo Wolvius, Ivo ten Hove, Hetty Mast, Jose A. U. Hardillo, Aniel Sewnaik, Cees Meeuwis, Florence van Lanschot, Dominiek Monserez, Stijn Keereweer, Erasmus MC (Netherlands); Martin van der Wolf, Elena Sokolova, RiverD International B.V. (Netherlands); Senada Koljenovic, Erasmus MC (Netherlands) . . . . . [11236-1]

1:55 pm: **Raman and SERS for characterization of extracellular vesicles from prostate carcinoma patients**, Christoph Krafft, Eric Boateng Osei, Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany); Irina Nazarenko, Universitätsklinikum Freiburg (Germany) . . . . . [11236-2]

2:15 pm: **Fiber-optic Raman spectroscopy for early-stage osteoarthritis diagnostics**, Kimberley Kroupa, Man Wu, Wei Wong, Michael B. Albro, Boston Univ. (USA); Mads S. Bergholt, King's College London (United Kingdom) . . . . . [11236-3]

2:35 pm: **Deep learning-based fiberoptic Raman spectroscopy improves in vivo diagnosis of nasopharyngeal carcinoma at endoscopy**, Chi Shu, Hanshu Yan, Kan Lin, National Univ. of Singapore (Singapore); Chwee Ming Lim, Singapore General Hospital (Singapore) and Duke-NUS Graduate Medical School (Singapore); Wei Zheng, Jiashi Feng, Zhiwei Huang, National Univ. of Singapore (Singapore) . . . . . [11236-4]

2:55 pm: **Multispectral tissue analysis with fiber probes in 0,3-16µm range for tumor margin guidance**, Viacheslav G. Artyushenko, art photonics GmbH (Germany) . . . . . [11236-5]  
Coffee Break. . . . . Sat 3:15 pm to 3:45 pm

### SESSION 2

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . SAT 3:45 PM TO 5:55 PM

#### Vibrational Techniques in Biomedical Diagnosis II

Session Chair: **Niels Kröger-Lui**, Ruprecht-Karls-Univ. Heidelberg (Germany)

3:45 pm: **In vivo macro- and micro-Raman spectroscopy for clinical diagnosis and research applications** (*Invited Paper*), Haishan Zeng, BC Cancer Research Ctr. (Canada) and The Univ. of British Columbia (Canada) . . . . . [11236-6]

4:10 pm: **Human glioma tumors detection by a portable visible resonance Raman analyzer with a hand-held optical fiber probe** (*Invited Paper*), Yan Zhou, Air Force Medical Ctr. (China); Shengjia Zhang, Jiangsu Raman Medical Equipment Co., Ltd. (China); Binlin Wu, Southern Connecticut State Univ. (USA); Qinguang Yu, The General Hospital of the Air Force, PLA (China); Gangge Cheng, Air Force Medical Ctr. (China); Ke Zhu, Chinese Academy of Sciences (China); Mingyue Zhao, Air Force Medical Ctr. (China); Jichun Zheng, The General Hospital of the Air Force, PLA (China); Mingqian Zhang, Qijun Liang, China Academy of Space Technology (China); Yun Li Go, Heriot-Watt Univ. (Malaysia); Chunyuan Zhang, Cheng-Hui Liu, Robert R. Alfano, The City College of New York (USA) . . . . . [11236-7]

4:35 pm: **Skin penetration of topically applied products: quantitative in vivo analysis by Raman spectroscopy**, Gerwin J. Puppels, Claudio Nico, Tom C. Bakker-Schut, Johanna de Sterke, RiverD International B.V. (Netherlands); Peter J. Caspers, Erasmus MC (Netherlands) . . . . . [11236-8]

4:55 pm: **Comparative study of oral dysplasia by conventional and surface enhanced Raman spectroscopy of whole saliva**, Amuthachelvi Daniel, Genecy Calado, Isha Behl, Technological Univ. Dublin (Ireland); Stephen Flint, Sheila Galvin, Claire Healy, Dublin Dental Univ. Hospital (Ireland); Hugh J. Byrne, Fiona M. Lyng, Technological Univ. Dublin (Ireland) . . . [11236-9]

5:15 pm: **In-vivo and intraoperative SERS in the first and second near infrared windows**, Lucas Lane, Nanjing Univ. (China) . . . . . [11236-10]

5:35 pm: **Tissue phantom for breast cancer Raman study: understanding the role of turbidity on depth resolution**, Rishikesh Pandey, David Fournier, Machele Riccio, Gary Root, Tyler Peterson, Michael Sapack, CytoVeris Inc. (USA) . . . . . [11236-11]

### BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

SUNDAY 2 FEBRUARY

SESSION 3

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . SUN 8:15 AM TO 10:00 AM

Bioimaging and Biosensing I

Session Chair: **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA)

8:15 am: **Fast stimulated Raman and second harmonic generation imaging for intraoperative gastro-intestinal cancer detection** (*Invited Paper*), Hervé Rigneault, Barbara Sarri, Xavier Audier, Julien Wojak, Aix Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France); Fabrice Caillol, Flora Poizat, Marc Giovannini, Institut Paoli Calmettes (France) . . . . . [11236-17]

8:35 am: **Stimulated Raman scattering imaging of altered lipid metabolism in human cancers for precision medicine** (*Invited Paper*), Shuhua Yue, Shuo Zhang, Beihang Univ. (China); Lin Yao, Liqun Zhou, Peking Univ. First Hospital (China) . . . . . [11236-13]

9:00 am: **Large field of view macroscopic Raman line-scanning imaging system for neuro-oncology applications**, Francois Daoust, Polytechnique Montréal (Canada) and Ctr. de Recherche du Ctr. Hospitalier de l'Univ. de Montréal (Canada); Patrick Orsini, Jacques Bismuth, Marie-Maude de Denus-Baillargeon, OPTECH Montreal (Canada); Israel Veilleux, Polytechnique Montréal (Canada); Alexandre Wetter, Philippe McKoy, Isabelle Dicaire, Maroun Massabki, OPTECH Montreal (Canada); Kevin Petrecca, Montreal Neurological Institute and Hospital (Canada); Frédéric Leblond, Polytechnique Montréal (Canada) and Ctr. de Recherche du Ctr. Hospitalier de l'Univ. de Montréal (Canada) . . . . . [11236-14]

9:20 am: **Development of a multi-focus Raman platform for high-speed large-area Raman spectroscopy**, Hiroyuki Kawagoe, Osaka Univ. (Japan); Jun Ando, Institute for Molecular Science (Japan); Miwako Asanuma, Kosuke Dodo, Mikiko Sodeoka, RIKEN (Japan); Katsumasa Fujita, Osaka Univ. (Japan) and National Institute of Advanced Industrial Science and Technology (Japan) . . . . . [11236-15]

9:40 am: **Differentiating cancer cells using Raman spectroscopy**, Lance Buck, Dustin W. Shipp, Utah Valley Univ. (USA) . . . . . [11236-16]  
Coffee Break. . . . . Sun 10:00 am to 10:30 am

SESSION 4

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . SUN 10:30 AM TO 11:55 AM

Bioimaging and Biosensing II

Session Chair: **Shuhua Yue**, Beihang Univ. (China)

10:30 am: **Raman spectral histopathology** (*Invited Paper*), Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany) . . . . . [11236-12]

10:55 am: **Spatially offset Raman spectroscopy for in vivo bone strength prediction with minimized soft tissue influence**, Keren Chen, Christine M. Massie, Andrew J. Berger, Univ. of Rochester (USA) . . . [11236-18]

11:15 am: **Charge-shifting optical lock-in detection with shifted excitation Raman difference spectroscopy for the analysis of fluorescent heterogeneous samples**, Kay Sowoidnich, Ferdinand-Braun-Institut (Germany) and Leibniz-Institut für Höchstfrequenztechnik (Germany); Martin Maiwald, Bernd Sumpf, Ferdinand-Braun-Institut (Germany); Michael Towrie, Pavel Matousek, STFC Rutherford Appleton Lab. (United Kingdom) . [11236-19]

11:35 am: **Improved SERS performance from uniformly distributed Au nanoparticles by tannic acid treatment**, Ayoung Bang, Kyung Hee Univ. (Korea, Republic of); Hyung Woo Choi, Sogang Univ. (Korea, Republic of); Soogeun Kim, Samjin Choi, Kyung Hee Univ. (Korea, Republic of) . . . [11236-20]  
Lunch/Exhibition Break . . . . . Sun 11:55 am to 1:15 pm

SESSION 5

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . SUN 1:15 PM TO 3:05 PM

Technical Advances I

Session Chair: **Wolfgang Petrich**, Roche Diagnostics GmbH (Germany)

1:15 pm: **Detecting drugs in live cells by SERS microscopy** (*Invited Paper*), Katsumasa Fujita, Osaka Univ. (Japan) . . . . . [11236-21]

1:40 pm: **Ultrasensitive noise-free SERS detection of unlabeled neurotransmitters at the attomolar level by using optimization of spreading-coded light excitation**, Wonkyoung Lee, Electronics and Telecommunications Research Institute (Korea, Republic of) and Korea Advanced Institute of Science and Technology (Korea, Republic of); Byoung-Hoon Kang, Korea Advanced Institute of Science and Technology (Korea, Republic of); Bong-Kyu Kim, Electronics and Telecommunications Research Institute (Korea, Republic of); Yong Jeong, Ki-Hun Jeong, Korea Advanced Institute of Science and Technology (Korea, Republic of) . . . . . [11236-22]

2:00 pm: **Development of an insulin activity test based on cell culture monitoring by microdialysis and infrared spectrometry**, Herbert Michael Heise, Adrian Krolinski, Sven Delbeck, Yannick Dederich, Sandra Stoppelkamp, Fachhochschule Südwestfalen (Germany) . . . . . [11236-23]

2:20 pm: **Metasurface-enhanced infrared spectroscopy for continuous monitoring of live cells**, Steven H. Huang, Robert Delgado, Gennady B. Shvets, Cornell Univ. (USA) . . . . . [11236-24]

2:40 pm: **Genetic algorithm-driven design of SERS-active surfaces for early detection of diseases**, Buse Ebrem, Berkay Türkmen, Hülya Torun, Kemal Baysal, Ihsan Solaroglu, Mehmet Cengiz Onbasli, Koç Univ. (Turkey) . . . . . [11236-25]  
Coffee Break. . . . . Sun 3:00 pm to 3:30 pm

SESSION 6

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . SUN 3:30 PM TO 5:55 PM

Technical Advances II

Session Chair: **Wolfgang Petrich**, Roche Diagnostics GmbH (Germany)

3:30 pm: **High-throughput vibrational flow cytometry and beyond** (*Invited Paper*), Keisuke Goda, Yasuyuki Ozeki, Kotaro Hiramatsu, Yuta Suzuki, The Univ. of Tokyo (Japan) . . . . . [11236-26]

3:55 pm: **Simultaneous, label-free morphological and chemical profiling of individual drug-loaded liposomes and extracellular vesicles**, Yichuan Dai, Univ. of Science and Technology of China (China); Suwen Bai, Anhui Medical Univ. (China); Chuanzhen Hu, Kaiqin Chu, Univ. of Science and Technology of China (China); Bing Shen, Anhui Medical Univ. (China); Zachary J. Smith, Univ. of Science and Technology of China (China) . . . . . [11236-27]

4:15 pm: **Quantification of infrared spectral markers for ulcerative colitis using sera**, A. G. Unil Perera, Georgia State Univ. (USA) . . . . . [11236-28]

4:35 pm: **Enhanced model for predicting femoral fracture toughness in ovariectomized mice using Raman spectroscopy and x-ray imaging**, Christine M. Massie, Univ. of Rochester (USA); Emma Knapp, Univ. of Rochester Medical Ctr. (USA); Keren Chen, The Institute of Optics, Univ. of Rochester (USA); Hani A. Awad, Univ. of Rochester (USA) and Univ. of Rochester Medical Ctr. (USA); Andrew J. Berger, The Institute of Optics, Univ. of Rochester (USA) and Univ. of Rochester (USA) . . . . . [11236-29]

4:55 pm: **Molecular monitoring of different commercial insulins using FTIR-ATR spectroscopy for pharmaceutical quality control**, Herbert Michael Heise, Sven Delbeck, Fachhochschule Südwestfalen (Germany) . . . . . [11236-30]

5:15 pm: **Comparing cervical maturation in preterm and term birth mouse models with Raman spectroscopy**, Rekha Gautam, Vanderbilt Univ. (USA); Jennifer Herington, Naoko Brown, Vanderbilt Univ. Medical Ctr. (USA); Wilson Adam, Vanderbilt Univ. (USA); Jackson H. Rogers, Vanderbilt Univ. Medical Ctr. (USA); Jen Bateman, Vanderbilt Univ. (USA); Christine O'Brien, Vanderbilt Univ. (USA) and Washington Univ. School of Medicine (USA); Jeff Reese, Vanderbilt Univ. Medical Ctr. (USA); Anita Mahadevan-Jansen, Vanderbilt Univ. (USA) . . . . . [11236-31]

5:35 pm: **Minimalist computational models for vibrational spectroscopy interpretation: recent advances**, Herculano S. da Silva Martinho, Univ. Federal do ABC (Brazil) . . . . . [11236-38]

BIOS

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# CONFERENCE 11236

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**The effect of scattering on spatial resolution of Raman spectroscopy in tissue,** Jessica Jones, Dustin W. Shipp, Utah Valley Univ. (USA) . . . . [11236-32]

**Accelerated Monte Carlo modelling Raman scattering in tissues: validation and applications,** Alexander P. Dumont, Chetan A. Patil, Temple Univ. (USA) . . . . . [11236-33]

**Ultrasensitive SERS determination of avian influenza A H7N9 virus via exonuclease III-assisted cycling amplification,** Chunyuan Song, Nanjing Univ. of Posts and Telecommunications (China) . . . . . [11236-34]

**Characterization of hydrogen peroxide-induced oxidative challenge in human RPE cells by laser tweezers Raman spectroscopy and multivariate methods,** Yang Chen, Yan Huang, Yuxin Yao, Tingting Wang, Ting Xie, Fujian Medical Univ. (China); Yunchao Xu, Shangyuan Feng, Fujian Normal Univ. (China) . . . . . [11236-35]

**Effect of blue light irradiation on human skin by in vivo confocal Raman spectroscopy,** Airton Abrahão Martin, Univ. Brasil (Brazil) and DermoProbes (Brazil); Priscila P. Fávero, Gustavo Carlos, Univ. Brasil (Brazil) . . . . [11236-36]

**Features selection in Raman spectra using least absolute shrinkage and selection operator,** Rekha Gautam, Deandra Peoples, Kiana Jansen, Maggie O'Connor, Oscar Ayala, Andrea Locke, Sean Fitzgerald, Giju Thomas, Sandeep Vanga, Isaac Pence, Anita Mahadevan-Jansen, Vanderbilt Univ. (USA) . . . . . [11236-37]

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## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

**Welcome and Award Presentation**

**John G. Greivenkamp,** Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam,**

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**

**Spying on the Secret Lives of Cells**

**Eric Betzig,** Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

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### BiOS Expo Industry Stage

Saturday – Sunday • Hall DE

Keynotes and panels on the latest developments, open to all attendees.

Pages 56-59

# CONFERENCE 11237

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11237

# Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables

*Conference Chairs:* **Babak Shadgan**, International Collaboration On Repair Discoveries (Canada); **Amir H. Gandjbakhche**, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA)

*Program Committee:* **Willy N. J. M. Colier**, Artinis Medical Systems B.V. (Netherlands); **Marco Ferrari**, Univ. degli Studi dell'Aquila (Italy); **Takafumi Hamaoka**, Tokyo Medical Univ. (Japan); **Andrew J. Macnab**, The Univ. of British Columbia (Canada); **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA); **Patrick Neary**, Univ. of Regina (Canada); **Lonnie Petersen**, Univ. of California, San Diego (USA); **T. Joshua Pfefer**, U.S. Food and Drug Administration (USA); **W. Darlene Reid**, Univ. of Toronto (Canada); **Behrouz Shabestari**, National Institute of Biomedical Imaging and Bioengineering (USA); **Robert V. Warren**, Beckman Laser Institute and Medical Clinic (USA)

*Conference Co-Sponsor:* **HAMAMATSU**  
PHOTON IS OUR BUSINESS

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . SAT 8:30 AM TO 10:10 AM

#### Wearable Optical Sensing Techniques I

Session Chair: **Amir H. Gandjbakhche**,  
National Institutes of Health (USA)

8:30 am: **Wearable time-domain near-infrared spectroscopy system**, Michele Lacerenza, Mauro Buttafava, Marco Renna, Politecnico di Milano (Italy); Alessandro Torricelli, Politecnico di Milano (Italy) and Consiglio Nazionale Delle Ricerche (Italy); Alberto Tosi, Alberto Dalla Mora, Franco Zappa, Politecnico di Milano (Italy); Antonio Pifferi, Politecnico di Milano (Italy) and Consiglio Nazionale Delle Ricerche (Italy); Davide Contini, Politecnico di Milano (Italy) . . . . . [11237-1]

8:50 am: **Ambient noise reduction in cerebral NIRS based on frequency division multiplexing**, Shahbaz Askari, Zoya Bastany, Roberto Pagano, Guy D. Dumont, The Univ. of British Columbia (Canada) . . . . . [11237-2]

9:10 am: **Wearable oxymetry system for real-time deep tissue monitoring**, Siddharth M. Khare, Kosar Khaksari, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA); Afrouz Anderson, The Focus Foundation (USA); Hyesoo Lee, Univ. of Maryland School of Dentistry (USA); Ravi Malpani, Viswanath Gorti, Amir H. Gandjbakhche, Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA) . . . . [11237-3]

9:30 am: **Smell detection could be traced in the fNIRS signals recorded from subject's forehead**, Shima Moein, Sepideh Khoneiveh, Soroush Mirmobini, Institute for Research in Fundamental Sciences (Iran, Islamic Republic of); Ardy Wong, Kambiz Pourrezaei, Drexel Univ. (USA) . . . . . [11237-4]

9:50 am: **Combined low frequency EEG and NIRS measurement during hypoxic breathing**, Shahbaz Askari, Zoya Bastany, Guy D. Dumont, The Univ. of British Columbia (Canada) . . . . . [11237-5]

Coffee Break. . . . . Sat 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . SAT 10:40 AM TO 12:30 PM

#### Wearable Optical Sensing Techniques II

Session Chair: **Robert V. Warren**,  
Beckman Laser Institute and Medical Clinic (USA)

10:40 am: **A potential method for ambulatory wearables to evaluate the central autonomic network: simultaneous measurement of prefrontal fNIRS and high frequency heart rate variability**, Emma Condy, National Institutes of Health (USA); Bruce H. Friedman, Virginia Polytechnic Institute and State Univ. (USA); John Millerhagen, Amir H. Gandjbakhche, National Institutes of Health (USA) . . . . . [11237-6]

11:00 am: **Opportunities of wearable and implantable technologies on human health (Keynote Presentation)**, Bruce J. Tromberg, National Institute of Biomedical Imaging and Bioengineering (USA) . . . . . [11237-30]

11:30 am: **A lightweight, portable, and low-cost near infrared spectroscopy headband for in-field neuro-monitoring**, Anupam Kumar, Francis Tsow, Vanderbilt Univ. (USA); Hadi Hosseini, Stanford Univ. (USA); Audrey K. Bowden, Vanderbilt Univ. (USA) . . . . . [11237-7]

11:50 am: **A rigid-flex wearable probe for monitoring breast tumor hemodynamics during neoadjuvant chemotherapy**, Samuel Spink, Fei Teng, Vivian Pera, Hannah Peterson, Boston Univ. (USA); Adam Eggebrecht, Washington Univ. School of Medicine in St. Louis (USA); Naomi Ko, Boston Medical Ctr. (USA); Darren Roblyer, Boston Univ. (USA) . . . . . [11237-8]

12:10 pm: **Sensor fusion wearable textile wristband for multimodal monitoring of physiological parameters**, Katherine Le, The Univ. of British Columbia (Canada); Harishkumar Narayana, The Univ. of British Columbia (Canada) and Texavie (Canada); Yanan Shao, Su Thida Htun, Ayumi Imaizumi, Sapna Srinivasan, Texavie (Canada); Zenan Jiang, Amir Servati, The Univ. of British Columbia (Canada) and Texavie (Canada); Saeid Soltanian, Frank Ko, The Univ. of British Columbia (Canada); Peyman Servati, The Univ. of British Columbia (Canada) and Texavie (Canada) . . . . . [11237-9]

Lunch/Exhibition Break . . . . . Sat 12:30 pm to 1:30 pm

### SESSION 3

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . . SAT 1:30 PM TO 3:10 PM

#### Physiological Parameter Sensing

Session Chair: **Andrew J. Macnab**,  
The Univ. of British Columbia (Canada)

1:30 pm: **Cerebral hemodynamic effects of 30-minute supine rest and postural changes at normoxia and hypoxia using near infrared spectroscopy**, Jyotpal Singh, Taylor A. Teckchandani, Univ. of Regina (Canada); David Mac Quarrie, LLA Technologies Inc. (Canada); J. Patrick Neary, Univ. of Regina (Canada) . . . . . [11237-10]

1:50 pm: **Identification of human brown/beige adipose tissue using near-infrared time-resolved spectroscopy**, Takafumi Hamaoka, Sayuri Fuse, Miyuki Kuroiwa, Ryotaro Kime, Tasuki Endo, Riki Tanaka, Shiho Amagasa, Yuko Kurosawa, Tokyo Medical Univ. (Japan) . . . . . [11237-11]

2:10 pm: **Effects of normobaric hypoxia on mechanical cardiac function using seismocardiography**, Taylor A. Teckchandani, Univ. of Regina (Canada); David Mac Quarrie, LLA Technologies Inc. (Canada); Jyotpal Singh, J. Patrick Neary, Univ. of Regina (Canada) . . . . . [11237-12]

2:30 pm: **The effects of acute normobaric hypoxia on heart rate variability parameters**, Taylor A. Teckchandani, Jyotpal Singh, Univ. of Regina (Canada); David Mac Quarrie, LLA Technologies Inc. (Canada); J. Patrick Neary, Univ. of Regina (Canada) . . . . . [11237-13]

2:50 pm: **Muscle physiology detection in movement using multimodal wearable sensing e-textile**, Harishkumar Narayana, The Univ. of British Columbia (Canada) and Texavie (Canada); Yanan Shao, Texavie (Canada); Zenan Jiang, The Univ. of British Columbia (Canada); Sapna Srinivasan, Texavie (Canada); Katherine Le, The Univ. of British Columbia (Canada); Su Thida Htun, Ayumi Imaizumi, Texavie (Canada); Amir Servati, Saeid Soltanian, Frank Ko, Babak Shadgan, Peyman Servati, The Univ. of British Columbia (Canada) . . . . . [11237-14]

Coffee Break. . . . . Sat 3:10 pm to 3:40 pm

# CONFERENCE 11237

## SESSION 4

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . . SAT 3:40 PM TO 5:20 PM

### Sport and Exercise Monitoring

Session Chair: **Takafumi Hamaoka**, Tokyo Medical Univ. (Japan)

3:40 pm: **Quadriceps muscle oxygenation dynamics during an exhaustive cycling test as measured by a wearable near infrared spectroscopy device**, Elliott Boake, Michael Koehle, Assaf Yogeve, The Univ. of British Columbia (Canada); Behnam Molavi, Pathonix Innovation Inc. (Canada); Babak Shadgan, International Collaboration On Repair Discoveries (Canada) . . . . . [11237-15]

4:00 pm: **Cerebral hemodynamic correlates of executive function: the acute influence of moderate-intensity exercise**, Kevala Van Volkenburg, Brian Duffels, Tammy Klassen-Ross, Heath Matheson, Annie Duchesne, R. Luke Harris, Univ. of Northern British Columbia (Canada) . . . . . [11237-16]

4:20 pm: **Mitochondrial capacity using NIRS and incomplete recovery curves: the mito6 test**, Kevin McCully, The Univ. of Georgia (USA) and Infrared Rx, Inc. (USA); Maxwell Sumner, Samuel J. Beard, The Univ. of Georgia (USA) . . . . . [11237-17]

4:40 pm: **Effects of respiratory muscle endurance training on cerebral hemodynamics and self-reported effort perceptions during maximal exercise**, Johnna Somerville, Timothy Schwab, Brian Duffels, Chelsea Pelletier, R. Luke Harris, Univ. of Northern British Columbia (Canada) . . . . . [11237-18]

5:00 pm: **Optical property dynamics during exercise measured by near-infrared time-resolved spectroscopy in humans**, Tasuki Endo, Ryotaro Kime, Sayuri Fuse, Norio Murase, Yuko Kurosawa, Takafumi Hamaoka, Tokyo Medical Univ. (Japan) . . . . . [11237-19]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 5

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . SUN 8:20 AM TO 10:00 AM

### Optical Monitoring of Muscle Metabolism and Function

Session Chair: **Babak Shadgan**, International Collaboration On Repair Discoveries (Canada)

8:20 am: **Hemodynamics of human bone and muscle during resistance exercise**, Colton Jensen, Timothy Schwab, R. Luke Harris, Univ. of Northern British Columbia (Canada) . . . . . [11237-20]

8:40 am: **Real-time detection of fatigue effect on active muscle hemodynamics using diffuse correlation spectroscopy**, Kanichiro Nozaki, Mikie Nakabayashi, Masashi Ichinose, Yumie Ono, Meiji Univ. (Japan) . . . . . [11237-22]

9:00 am: **Comparison of forearm muscle oxygenation dynamics during isotonic and isometric contractions monitored by near infrared spectroscopy**, Amanda Cheung, Lorna Tu, Farnaz Sahragard, Babak Shadgan, The Univ. of British Columbia (Canada) . . . . . [11237-23]

9:20 am: **Hemodynamic changes during ankle range of motion in spastic versus non-spastic calf muscles assessed using near-infrared spectroscopy**, Jessica McDougall, Eric Chow, Patricia B. Mills, The Univ. of British Columbia (Canada); R. Luke Harris, Univ. of Northern British Columbia (Canada) . . . . . [11237-24]

9:40 am: **Limited muscle oxygen diffusive transport during exercise in humans**, Ryotaro Kime, Tokyo Medical Univ. (Japan) . . . . . [11237-25]

Coffee Break . . . . . Sun 10:00 am to 10:30 am

### SESSION 6

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . SUN 10:30 AM TO 11:50 AM

### Body Function and Health Monitoring

Session Chair: **Behrouz Shabestari**, National Institute of Biomedical Imaging and Bioengineering (USA)

10:30 am: **Optical evaluation of microvascular function at early and chronic stages of diabetes**, Shotaro Sasaki, Mikie Nakabayashi, Yumie Ono, Masashi Ichinose, Meiji Univ. (Japan) . . . . . [11237-26]

10:50 am: **Development and testing of portable NIRS for sleep studies**, Robert V. Warren, Rui Sekine, Bryce Mander, Ruth Benca, Univ. of California, Irvine (USA) . . . . . [11237-27]

11:10 am: **Simultaneous wireless functional near infrared spectroscopy of the brain and bladder: a feasibility study**, Andrew J. Macnab, The Univ. of British Columbia (Canada); Isabelle van Dongen, Mathijs Bronkhorst, Artinis Medical Systems B.V. (Netherlands); Lynn Stothers, The Univ. of British Columbia (Canada) . . . . . [11237-28]

11:30 am: **Neuroimaging during hemodialysis using near infrared spectroscopy (NIRS)**, Ardy Wong, Lucy Robinson, Drexel Univ. (USA); Edom Girma, Drexel Univ. College of Medicine (USA); Seena Soroush, Drexel Univ. (USA); Dia Yang, Aditi Suresh, Drexel Univ. College of Medicine (USA); Antonia Brown, Perelman School of Medicine, Univ. of Pennsylvania (USA); Dheeraj Jalluri, Drexel Univ. College of Medicine (USA); Kelechi Madu, Kambiz Pourrezaei, Drexel Univ. (USA); Meera Harhay, Drexel Univ. College of Medicine (USA) . . . . . [11237-29]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

**Welcome and Award Presentation**  
**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**  
THE 2020 RECIPIENT  
**Nirmala Ramanujam**,  
Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**  
**Spying on the Secret Lives of Cells**  
**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

# CONFERENCE 11238

LOCATION: ROOM 311 (LEVEL 3 SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11238

# Optical Interactions with Tissue and Cells XXXI

Conference Chairs: **Bennett L. Ibey**, Air Force Research Lab. (USA); **Norbert Linz**, Univ. zu Lübeck (Germany)

Program Committee: **Joel N. Bixler**, Air Force Research Lab. (USA); **Randolph Glickman**, The Univ. of Texas Health Science Ctr. at San Antonio (USA); **Steven L. Jacques**, Oregon Health & Science Univ. (USA); **Beop-Min Kim**, Korea Univ. (Korea, Republic of); **Alexander J. Makowski**, Prozess Technologie (USA); **Anouk L. Post**, The Netherlands Cancer Institute (Netherlands); **Jessica C. Ramella-Roman**, Florida International Univ. (USA); **William P. Roach**, Vanderbilt Univ. (USA); **Marissa Nicole Rylander**, Virginia Polytechnic Institute and State Univ. (USA); **Zachary D. Taylor**, Univ. of California, Los Angeles (USA)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... SAT 8:30 AM TO 10:00 AM

#### Novel Applications of Lasers and Light in Biomedicine

Session Chair: **Bennett L. Ibey**, Air Force Research Lab. (USA)

8:30 am: **Broadband diffuse reflectance spectroscopy for colorectal surgical guidance** (*Invited Paper*), Marcelo Saito Nogueira, Siddra Maryam, Michael Amisshah, Huihui Lu, Stefan Andersson-Engels, Tyndall National Institute, Univ. College Cork (Ireland) ..... [11238-1]

9:00 am: **Free-electron-mediated effects of single femtosecond pulses and pulse series in the (irradiance/fluence) parameter space**, Norbert Linz, Xiao-Xuan Liang, Sebastian Freidank, Alfred Vogel, Univ. zu Lübeck (Germany) ..... [11238-2]

9:20 am: **Characterisation of a Bessel beam optical cell sorting system using microsphere**, Masixole Lugongolo, Saturnin Ombinda-Lemboumba, Sello Lebohang Manoto, Patience Mthunzi-Kufa, CSIR National Laser Ctr. (South Africa) ..... [11238-3]

9:40 am: **Global optimization on precision system in microcirculation**, Hua Liu, Luoyang Electro-optical Equipment Research Institute (China) ..... [11238-4]

Coffee Break. .... Sat 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... SAT 10:30 AM TO 12:30 PM

#### Numerical Approaches Simulating Laser-Tissue Interactions and Response

Session Chair: **Norbert Linz**, Univ. zu Lübeck (Germany)

10:30 am: **Optical radiation propagation based on Green's functions in biological skin tissues for enhanced coherence contrast**, José L. Ganoza-Quintana, Félix Fanjul-Vélez, José L. Arce-Diego, Univ. de Cantabria (Spain) ..... [11238-5]

10:50 am: **Numerical simulation of selective retinal photocoagulation in laser treatment of diabetic retinopathy**, Bin Chen, Dong Li, Yibo Zhao, Xi'an Jiaotong Univ. (China) ..... [11238-6]

11:10 am: **Retinal image analysis defining the angular subtense of the apparent source for eye safety evaluations**, Sebastian Kotzur, Annette Frederiksen, Robert Bosch GmbH (Germany); Siegfried Wahl, Eberhard Karls Univ. Tübingen (Germany) ..... [11238-7]

11:30 am: **Neural network generation for estimation of tissue optical properties**, Eddie M. Gil, Texas A&M Univ. (USA); Joel N. Bixler, Air Force Research Lab. (USA); Brett H. Hokr, Radiance Technologies, Inc. (USA) ..... [11238-8]

11:50 am: **Modeling of a photoplethysmographic (PPG) waveform through monte carlo as a method of deriving blood pressure in individuals with obesity**, Tananant Boonya-ananta, Andres J. Rodriguez, Joshua D. Hutcheson, Jessica C. Ramella-Roman, Florida International Univ. (USA) ..... [11238-9]

12:10 pm: **User-friendly graphical user interface for simulating tissue optical properties and fluence rates: improving students learning in tissue optics**, Marcelo Saito Nogueira, Tyndall National Institute, Univ. College Cork (Ireland); Jacqueline Elizabeth Gunther, Tyndall National Institute (Ireland); Katarzyna Komolibus, Stefan Andersson-Engels, Tyndall National Institute, Univ. College Cork (Ireland) ..... [11238-10]

Lunch Break. .... Sat 12:30 pm to 2:00 pm

### SESSION 3

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... SAT 2:00 PM TO 3:00 PM

#### Photothermal Interactions

Session Chair: **Anouk L. Post**, The Netherlands Cancer Institute (Netherlands)

2:00 pm: **Porcine skin damage thresholds for multiple-pulse laser exposure at 1940 nm**, Michael P. DeLisi, Amanda M. Peterson, Gary D. Noojin, Kurt J. Schuster, SAIC (USA); Morgan S. Schmidt, Aurora D. Shingledecker, Semih S. Kumru, Benjamin A. Rockwell, Air Force Research Lab. (USA) ..... [11238-11]

2:20 pm: **Multiple-pulse damage thresholds on the retinal pigment epithelium layer using top hat profiles**, Scarlett Ramos, Robert Bosch GmbH (Germany) and Karlsruher Institut für Technologie (Germany); Nico Heußner, Robert Bosch GmbH (Germany); Wilhelm Stork, Karlsruher Institut für Technologie (Germany) ..... [11238-12]

2:40 pm: **Human cadaver retina model for retinal heating during OCT assisted femtosecond laser cataract surgery**, Hui Sun, Academy of Opto-Electronics (China) ..... [11238-13]

Coffee Break. .... Sat 3:00 pm to 3:30 pm

### SESSION 4

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... SAT 3:30 PM TO 4:40 PM

#### Mechanisms of Pulsed Laser Ablation

Session Chair: **Alexander J. Makowski**, Sciton, Inc. (USA)

3:30 pm: **Skin functionalization by laser microperforation and immune cell inclusion through BA-LIFT technology** (*Invited Paper*), Rocio Candorcio, Sara Lauzurica, Andrés Márquez, Univ. Politécnica de Madrid (Spain); Miguel Gómez-Fontela, Elena Lorente Galán, Pilar Lauzurica, Instituto de Salud Carlos III (Spain); Carlos Molpeceres, Univ. Politécnica de Madrid (Spain) ..... [11238-14]

4:00 pm: **Characterization of photoablation versus incident angle in soft tissue laser surgery**, Guangshen Ma, Matthew Tucker, Weston Ross, Patrick Codd, Duke Univ. (USA) ..... [11238-15]

4:20 pm: **Optical fiber sensors-based temperature profiling in ex vivo magnetite nanoparticle-mediated laser tissue ablation**, Madina Jelbuldina, Nazerke Kulmukhanova, Nazarbayev Univ. (Kazakhstan); Sanzhar Korganbayev, Politecnico di Milano (Italy); Dana Koshen, Carlo Molardi, Daniele Tosi, Nazarbayev Univ. (Kazakhstan) ..... [11238-16]

### SESSION 5

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... SAT 4:40 PM TO 5:20 PM

#### Optical Monitoring of Tissue Mechanics

Session Chair: **Alexander J. Makowski**, Sciton, Inc. (USA)

4:40 pm: **Probing cell mechanoelastic properties in response to nanosecond pulsed electric fields**, Zachary Coker, Maria Troyanova-Wood, Vladislav V. Yakovlev, Texas A&M Univ. (USA); Bennett L. Ibey, Air Force Research Lab. (USA) ..... [11238-17]

5:00 pm: **Quantitatively analyzing the different endometrium phases in a menstrual cycle from polarimetric imaging based on statistical learning**, Yue Yao, Lu Si, Hui Ma, Tsinghua-Berkeley Shenzhen Institute (China) ..... [11238-18]

# CONFERENCE 11238

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 6

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . SUN 8:30 AM TO 10:20 AM

#### Optical Properties of Tissues I

Session Chair: **Zachary Taylor**,  
The Henry Samueli School of Engineering (USA)

- 8:30 am: **Interaction of optical angular momentum with biological tissues and tissue-like scattering medium** (*Invited Paper*), Igor V. Meglinski, Univ. of Oulu (United Kingdom) . . . . . [11238-19]
- 9:00 am: **Subdiffuse model relating reflectance to tissue optical properties for single fiber reflectance spectroscopy**, Anouk L. Post, The Netherlands Cancer Institute (Netherlands) and Amsterdam UMC (Netherlands); Dirk J. Faber, Amsterdam UMC (Netherlands); Dick J. C. M. Sterenborg, The Netherlands Cancer Institute (Netherlands) and Amsterdam UMC (Netherlands); Ton G. van Leeuwen, Amsterdam UMC (Netherlands) . . . . . [11238-20]
- 9:20 am: **Pathlength distribution of sub-diffusively reflected light**, Dirk J. Faber, Anouk L. Post, Henricus J. C. M. Sterenborg, Ton G. van Leeuwen, Amsterdam UMC (Netherlands) . . . . . [11238-21]
- 9:40 am: **Compressed ultrafast hyperspectral Raman for imaging tissues and cellular structures**, Mark A. Keppler, Eddie M. Gil, Sean P. O'Connor, Texas A&M Univ. (USA); Gary D. Noojin, SAIC (USA); Vladislav V. Yakovlev, Texas A&M Univ. (USA); Joel N. Bixler, Air Force Research Lab. (USA) . . . . . [11238-22]
- 10:00 am: **Analysis and calibration of linear birefringence orientation parameter derived from Mueller matrix for multi-layered tissues**, Weipeng Li, Honghui He, Tao Sun, Hui Ma, Tsinghua Univ. (China) . . . [11238-23]
- Coffee Break . . . . . Sun 10:20 am to 10:50 am

### SESSION 7

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . SUN 10:50 AM TO 12:40 PM

#### Optical Properties of Tissues II

Session Chair: **Joel N. Bixler**, Air Force Research Lab. (USA)

- 10:50 am: **Prediction of tissue optical properties using Monte Carlo modeling of photon transport in turbid media and integrating spheres** (*Invited Paper*), Patrick D. Cook, Fort Hays State Univ. (USA) and SAIC (USA); Joel N. Bixler, Robert J. Thomas, Air Force Research Lab. (USA); Edward A. Early, SAIC (USA) . . . . . [11238-24]
- 11:20 am: **Machine learning estimations of tissue optical properties for a multi-layered model**, Joel N. Bixler, Air Force Research Lab. (USA); Brett H. Hokr, Radiance Technologies, Inc. (USA) . . . . . [11238-25]
- 11:40 am: **Optical properties extracted from 3D confocal images to assay 3D-printed scleroderma disease model**, Daniel S. Gareau, Bart Halibart, Julia Adelman, James Krueger, Noa Kalfus, The Rockefeller Univ. (USA) . . . . . [11238-26]
- 12:00 pm: **Characterizing long lived intralipid-infused tissue phantoms scattering using imaging sensors**, Glenn H. Chapman, Sean Paulsen, Yutian Zhang, Simon Fraser Univ. (Canada) . . . . . [11238-27]
- 12:20 pm: **Phase functions with large domain size for improved estimation of optical properties from subdiffusive reflectance**, Yevhen Zelinskyi, Peter Naglič, Boštjan Likar, Franjo Pernuš, Miran Bürmen, Univ. of Ljubljana (Slovenia) . . . . . [11238-28]
- Lunch Break . . . . . Sun 12:40 pm to 2:10 pm

### SESSION 8

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . SUN 2:10 PM TO 3:10 PM

#### Ultrafast pulsed laser interactions

Session Chair: **William P. Roach**,  
Air Force Office of Scientific Research (USA)

- 2:10 pm: **Visualizing retinal hemorrhage thresholds for Q-switched Nd:YAG Lasers in a novel porcine model**, Morgan S. Schmidt, Air Force Research Lab. (USA); Brian Lund, Gary D. Noojin, SAIC (USA); Aurora D. Shingledecker, Air Force Research Lab. (USA); Amanda Tijerina, Kurt J. Schuster, SAIC (USA); Benjamin A. Rockwell, Air Force Research Lab. (USA) . . . . . [11238-29]
- 2:30 pm: **Colorectal cancer resection using ultrashort laser pulses**, Rainer J. Beck, Ioannis Bitharas, Heriot-Watt Univ. (United Kingdom); Thomas I. Maisey, Mike Shires, Univ. of Leeds (United Kingdom); Andrew J. Moore, Heriot-Watt Univ. (United Kingdom); David G. Jayne, Univ. of Leeds (United Kingdom); Jonathan D. Shephard, Heriot-Watt Univ. (United Kingdom) . . . . . [11238-30]
- 2:50 pm: **Human cadaver retina model for retinal heating during OCT assisted femtosecond laser cataract surgery**, Hui Sun, Academy of Opto-Electronics (China); Zhixuan Sui, Department of Physics, Beijing Normal University (China) . . . . . [11238-31]
- Coffee Break . . . . . Sun 3:10 pm to 3:40 pm

### SESSION 9

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . SUN 3:40 PM TO 5:00 PM

#### Cellular Biomolecular Response

Session Chair: **Bennett L. Ibey**, Air Force Research Lab. (USA)

- 3:40 pm: **Evaluating muscular membrane perturbation upon pulsed electric field exposure**, Reinhard Knerr, James Mancillas, Anna V. Sedelnikova, Bryan Gamboa, Mara Casebeer, Ronald A. Barnes, Gleb P. Tolstyk, Bennett L. Ibey, Christopher M. Valdez, Air Force Research Lab. (USA) . . . . . [11238-32]
- 4:00 pm: **Evaluating muscular calcium dynamics upon pulsed electric field exposure**, James Mancillas, Reinhardt Knerr, Anna V. Sedelnikova, Bryan Gamboa, Mara Casebeer, Ronald A. Barnes, Gleb P. Tolstyk, Bennett L. Ibey, Christopher M. Valdez, Air Force Research Lab. (USA) . . . . . [11238-33]
- 4:20 pm: **Infrared laser-induced fast thermal gradient affects the excitability of primary hippocampal neurons**, Gleb P. Tolstyk, General Dynamics Information Technology (USA); Bennett L. Ibey, Air Force Research Lab. (USA); Anna V. Sedelnikova, SAIC (USA); Christopher M. Valdez, Ibtissam Echchgadda, Air Force Research Lab. (USA) . . . . . [11238-34]
- 4:40 pm: **Pulsed infrared laser activates intracellular signaling in NG108 cells**, Gleb P. Tolstyk, General Dynamics Information Technology (USA); Anna V. Sedelnikova, SAIC (USA); Bennett L. Ibey, Ibtissam Echchgadda, Christopher M. Valdez, Air Force Research Lab. (USA) . . . . . [11238-35]

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Double-integrating-sphere system to measure the optical properties of turbid samples,** Jaqueline R. S. Fernandes, Luismar B. C. Junior, Luciano Bachmann, Univ. de São Paulo (Brazil) . . . . . [11238-36]

**Numerical and experimental study of the influence of device pressure on PPG signal acquisition,** Qun Wang, Di Sheng, Zhiguo Zhou, Zhiwen Liu, Beijing Institute of Technology (China) . . . . . [11238-37]

**Laser biospeckle metrology in investigating plant-sound interactions,** Minoru Hirai, Daiki Endo, Uma M. Rajagopalan, Shibaura Institute of Technology (Japan); Hiroki Gonome, Yamagata Univ. (Japan); Takahiro Kono, Jun Yamada, Shibaura Institute of Technology (Japan) . . . . . [11238-38]

**Monte-Carlo based simulations of photothermal response of nerve tissue for laser wavelengths of 1455 nm, 1490 nm, 1550 nm,** Merve Türker Burhan, Serhat Tozburun, Izmir Biomedicine and Genome Ctr., Dokuz Eylül Üniv. (Turkey) . . . . . [11238-39]

**Ultrahigh accurate Statistical Interferometric Technique utilizing uniformity of speckle phase in the study of plant physiology,** Uma M. Rajagopalan, Shibaura Institute of Technology (Japan); Hirofumi Kadono, Mahjabin Kabir, Saitama Univ. (Japan) . . . . . [11238-40]

**Infrared laser stimulation of the rat vagus nerves,** Ozan Yetis, Ibrahim Akkaya, Izmir Biomedicine and Genome Ctr., Dokuz Eylül Üniv. (Turkey); Asli Celik, Basar Koc, Dokuz Eylül Üniv. (Turkey); Ensari Guneli, Serhat Tozburun, Izmir Biomedicine and Genome Ctr., Dokuz Eylül Üniv. (Turkey) . . . . . [11238-41]

**Investigation of ROS generation in cells and tissues during autofluorescence photobleaching,** Alexey Lihachev, Univ. of Latvia (Latvia); Mindaugas Tamošiūnas, Vytautas Magnus Univ. (Lithuania); Ilze Lihacova, Univ. of Latvia (Latvia) . . . . . [11238-42]

**Tissue temperature monitoring during laser vaporization through black body radiation at wavelengths less than 1.8 um,** Paris Franz, Miami Univ. (USA); Hui Zhu, The Cleveland Clinic Foundation (USA); Xiaomei Wang, Shanghai Normal Univ. (China); Ray Chia, Tom Hasenberg, Boston Scientific Corp. (USA); Hui Wang, Miami Univ. (USA) . . . . . [11238-44]

**Fast fourier transform versus wavelet transform analyses on photoacoustic spectral data of breast tumor progression,** Jackson Rodrigues, Manipal Academy of Higher Education (India); Ashwini G. Amin, Manipal Institute of Technology, Manipal Academy of Higher Education (India); Subhash Chandra, Raghushaker Chandavalli Ramappa, Manipal Academy of Higher Education (India); Subramanya G. Nayak, Manipal Institute of Technology, Manipal Academy of Higher Education (India); Kapaettu Satyamoorthy, Krishna Kishore Mahato, Manipal Academy of Higher Education (India) . . . . . [11238-45]

**Quantification and influence of skin chromophores for remote detection of anemic conditions,** Akhil Kallepalli, David B. James, Cranfield Univ. (United Kingdom) . . . . . [11238-46]

**Photochemical decomposition of uric acid crystals by ultra-short laser pulses,** Carlos Moises Carrillo-Delgado, Univ. de Guanajuato (Mexico); Bryan Alejandro Rodriguez-Silva, Univ. Politécnica del Bicentenario (Mexico); Juan Carlos Hernandez-Garcia, Univ. de Guanajuato (Mexico) and Consejo Nacional de Ciencia y Tecnología (Mexico); Julián Moises Estudillo-Ayala, Daniel Jáuregui-Vázquez, Juan Manuel Sierra-Hernández, Roberto Rojas-Laguna, Univ. de Guanajuato (Mexico) . . . . . [11238-47]

**Multi-modality imaging measurement of fluorescence and backscattering on in vitro tissues,** Yuanhuan Zhu, Hui Ma, Tsinghua Univ. (China) . . [11238-48]

**Effect of microtubule resonant frequencies on neurons,** Yousef Rafati, Air Force Research Lab. (USA); Anna V. Sedelnikova, SAIC (USA); Jody C. Cantu, Gleb P. Tolstykh, General Dynamics Information Technology (USA); Xomalin G. Peralta, National Academy of Sciences NRC Research Associateship (USA); Christopher M. Valdez, Ibtissam Echchgadda, Air Force Research Lab. (USA) . . . . . [11238-49]

**Optimization of curcumin aqueous formulations for fluorescence-based applications,** Marcelo Saito Nogueira, Tyndall National Institute, Univ. College Cork (Ireland); Fabio Francisco Pinto Jr., Raphael Antonio Caface, Univ. de São Paulo (Brazil); Kléber Thiago de Oliveira, Univ. Federal de São Carlos (Brazil); Vanderlei Salvador Bagnato, Francisco Eduardo Gontijo Guimarães, Univ. de São Paulo (Brazil) . . . . . [11238-50]

**Characterization of teeth fluorescence properties after coffee pigmentation: towards optimization of quantitative light-induced fluorescence for tooth color assessment,** Marcelo Saito Nogueira, Tyndall National Institute (Ireland); Vitor Hugo Panhóca, Vanderlei Salvador Bagnato, Univ. de São Paulo (Brazil) . . . . . [11238-51]

**Calculation of whiteness indexes using colorimetry or RGB images: application for teeth shade evaluation,** Marcelo Saito Nogueira, Tyndall National Institute, Univ. College Cork (Ireland); Vitor Hugo Panhóca, Vanderlei Salvador Bagnato, Univ. de São Paulo (Brazil) . . . . . [11238-52]

**Salted cadaver brain measurement for light attenuation of PDT,** Emiyu Ogawa, Kitasato Univ. (Japan); Jiro Akimoto, Shinjiro Fukami, Tokyo Medical Univ. (Japan); Tsunenori Arai, Keio Univ. (Japan); Hiroshi Kumagai, Kitasato Univ. (Japan) . . . . . [11238-53]

**Biosensing chip fabrication and application to cancer cells for impedance and photoelectrochemical response analysis,** Chia-Cheng Huang, National Chung Cheng Univ. (Taiwan); I-Chen Wu, National Chiao Tung Univ. (Taiwan); Ming Tsang Wu, Kaohsiung Medical Univ. (Taiwan); Chun-Ping Jen, National Chung Cheng Univ. (Taiwan); Vladimir Fedorov, Institute of Biomedical Chemistry (Russian Federation); Hsiang-Chen Wang, National Chung Cheng Univ. (Taiwan) . . . . . [11238-43]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp,** Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam,**

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells**

**Eric Betzig,** Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

# CONFERENCE 11239

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY)

Saturday–Monday 1–3 February 2020 • Proceedings of SPIE Vol. 11239

## Dynamics and Fluctuations in Biomedical Photonics XVII

*Conference Chairs:* **Valery V. Tuchin**, Saratov State Univ. (Russian Federation), Tomsk State Univ. (Russian Federation), Institute of Precision Mechanics and Control of the RAS (Russian Federation); **Martin J. Leahy**, National Univ. of Ireland, Galway (Ireland); **Ruikang K. Wang**, Univ. of Washington (USA)

*Program Committee:* **Wei R. Chen**, Univ. of Central Oklahoma (USA); **Joseph P. Culver**, Washington Univ. School of Medicine in St. Louis (USA); **Turgut Durduran**, ICFO - Institut de Ciències Fotòniques (Spain); **Ling Fu**, Huazhong Univ. of Science and Technology (China); **Ekaterina I. Galanzha**, Univ. of Arkansas for Medical Sciences (USA); **Jana M. Kainerstorfer**, Carnegie Mellon Univ. (USA); **Brendan F. Kennedy**, The Univ. of Western Australia (Australia); **Sean J. Kirkpatrick**, Michigan Technological Univ. (USA); **Vesa Kiviniemi**, Univ. of Oulu (Finland); **Jürgen M. Lademann**, Charité Universitätsmedizin Berlin (Germany); **Kirill V. Larin**, Univ. of Houston (USA); **Irina V. Larina**, Baylor College of Medicine (USA); **Jan Laufer**, Martin-Luther-Univ. Halle-Wittenberg (Germany); **Qingming Luo**, Hainan Univ. (China); **Teemu S. Myllylä**, Univ. of Oulu (Finland); **Inga Saknite**, Vanderbilt Univ. Medical Ctr. (USA); **Melissa C. Skala**, Univ. of Wisconsin-Madison (USA); **Peter H. Tomlins**, Queen Mary Univ. of London (United Kingdom); **Vladislav Toronov**, Ryerson Univ. (Canada); **Anna N. Yaroslavsky**, Univ. of Massachusetts Lowell (USA); **Vladimir P. Zharov**, Univ. of Arkansas for Medical Sciences (USA); **Dan Zhu**, Huazhong Univ. of Science and Technology (China)

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . SAT 1:00 PM TO 3:20 PM

#### Tissue and Cell Dynamics at Micro and Nano Scale

Session Chairs: **Valery V. Tuchin**, Saratov State Univ. (Russian Federation), Tomsk State Univ. (Russian Federation), Institute of Precision Mechanics and Control of the RAS (Russian Federation); **Dan Zhu**, Huazhong Univ. of Science and Technology (China)

1:00 pm: **Optical clearing skull window for cortical vascular imaging and laser operation** (*Invited Paper*), Dan Zhu, Huazhong Univ. of Science and Technology (China). . . . . [11239-1]

1:30 pm: **Genetically-produced and bioinspired magnetic nanoparticles as novel photoacoustic contrast agents** (*Invited Paper*), Julia Watts, Mikyung Han, Mustafa Sarimollaoglu, Univ. of Arkansas for Medical Sciences (USA); Zeid A. Nima, Fumiya Watanabe, Univ. of Arkansas at Little Rock (USA); Azemat Jamshidi-Parsian, Univ. of Arkansas for Medical Sciences (USA); Alexandru Biris, Univ. of Arkansas at Little Rock (USA); Vladimir Zharov, Ekaterina Galanzha, Univ. of Arkansas for Medical Sciences (USA) . . . [11239-2]

2:00 pm: **A study on low frequency oscillations by diffuse speckle contrast analysis in healthy subject foot**, Chaebeom Yeo, Hanbeen Jung, Kijoon Lee, Cheol Song, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of). . . . . [11239-3]

2:20 pm: **Time-domain diffuse correlation spectroscopy of turbid media with mixed dynamics**, Dawid Borycki, Institute of Physical Chemistry (Poland); Saeed Samaei, Michal Kacprzak, Piotr Sawosz, Adam Liebert, Nalecz Institute of Biocybernetics and Biomedical Engineering (Poland) . . . . . [11239-4]

2:40 pm: **Biophotonics using immunologically modified carbon nanotubes and checkpoint inhibitor for cancer treatment**, Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . . [11239-5]

3:00 pm: **AI-Eigen assisted STED nanoscopy and its application for super resolved cellular visualization**, Dongyu Li, Zhejiang Univ. (China) and Huazhong Univ. of Science and Technology (China); Junle Qu, Key Lab. of Optoelectronic Devices and Systems, Ministry of Education, Shenzhen Univ. (China); Dan Ding, Nankai Univ. (China); Benzhong Tang, Chinese National Engineering Research Ctr. for Tissue (China); Jun Qian, Zhejiang Univ. (China) . . . . . [11239-6]

Coffee Break. . . . . Sat 3:20 pm to 3:50 pm

#### SESSION 2

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . SAT 3:50 PM TO 5:40 PM

#### Optical Coherence Tomography

Session Chairs: **Ruikang K. Wang**, Univ. of Washington (USA); **Peter H. Tomlins**, Queen Mary Univ. of London (United Kingdom)

3:50 pm: **Probing temporal structural changes within cornea using 200 kHz swept source nano sensitive optical coherence tomography (nsOCT)** (*Invited Paper*), Cerine Lal, Sergey Alexandrov, Sweta Rani, Thomas Ritter, Martin Leahy, National Univ. of Ireland, Galway (Ireland). . . . . [11239-7]

4:20 pm: **Quantitative 4D OCT imaging of tubular mouse embryonic heart reveals its localized pumping mechanism**, Shang Wang, Baylor College of Medicine (USA) and Stevens Institute of Technology (USA); Riana Syed, Irina V. Larina, Baylor College of Medicine (USA) . . . . . [11239-8]

4:40 pm: **In vivo nano-scale vibrometry in apical-basal ends of contractile outer hair cells in the mammalian cochlea by supercontinuum source spectral-domain OCT**, Fumiaki Nin, Takeru Ota, Samuel Choi, Hiroshi Hibino, Niigata Univ. (Japan). . . . . [11239-9]

5:00 pm: **Visualization of OCT signal pulsatility at variable tissue depth with optical microangiography**, Zhiying Xie, Qinqin Zhang, Ruikang K. Wang, Geng Wang, Minh Nhan Le, Univ. of Washington (USA). . . . . [11239-10]

5:20 pm: **Optical coherence angiography reveals changes in murine fetal brain vasculature due to maternal exposure to nicotine**, Raksha Raghunathan, Chih-Hao Liu, Amur Kouka, Yogeshwari Ambekar, Connie Yan, Noemi Bustamante, Manmohan Singh, Univ. of Houston (USA); Rajesh C. Miranda, Texas A&M Health Science Ctr. (USA); Kirill Larin, Univ. of Houston (USA) . . . . . [11239-11]

**BIOS HOT TOPICS**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**SESSION 3**

**LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 8:30 AM TO 9:50 AM**

**Spectroscopy and Applications I**

Session Chairs: **Martin J. Leahy**, National Univ. of Ireland, Galway (Ireland); **Joseph P. Culver**, Washington Univ. School of Medicine in St. Louis (USA)

- 8:30 am: **Novel detector solutions for diffuse correlation spectroscopy at 1064 nm** (*Invited Paper*), Megan Blackwell, Robert Berger, George Jordy, Jonathan Frechette, Brian Aull, Erik K. Duerr, MIT Lincoln Lab. (USA); Mitchell Robinson, Harvard-MIT Health Sciences and Technology (USA); Davide Tamborini, Stefan A. Carp, Maria Angela Franceschini, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) . . . . . [11239-12]
- 9:00 am: **Assessing distribution features of fibrous structures using Mueller matrix derived parameters: a quantitative method for breast carcinoma tissues detection and staging** (*Invited Paper*), Yuanxing Shen, Wei Sheng, Honghui He, Weipeng Li, Hui Ma, Tsinghua Univ. (China) [11239-13]
- 9:30 am: **Simulation of time domain diffuse correlation spectroscopy (TD-DCS) performance for measuring brain blood flow in the presence of noise with realistic sources and detectors**, Dibbyan Mazumder, Davide Tamborini, Melissa M. Wu, Maria Angela Franceschini, Stefan A. Carp, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) and Harvard Medical School (USA) . . . . . [11239-14]
- Coffee Break. . . . . Sun 9:50 am to 10:20 am

**SESSION 4**

**LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 10:20 AM TO 12:10 PM**

**Spectroscopy and Applications II**

Session Chairs: **Martin J. Leahy**, National Univ. of Ireland, Galway (Ireland); **Sean J. Kirkpatrick**, Michigan Technological Univ. (USA)

- 10:20 am: **Diffuse correlation spectroscopy in the Fourier domain with holographic camera-based detection**, Edward James, Univ. College London (United Kingdom); Samuel Powell, The Univ. of Nottingham (United Kingdom) . . . . . [11239-15]
- 10:40 am: **Compensating for variations of optical properties in laser speckle micro-rheology of breast lesions**, Zeinab Hajjarian Kashany, Elena Brachtel, Diane Tshikudi, Seemantini Nadkarni, Harvard Medical School (USA) . . . . . [11239-16]
- 11:00 am: **A near infrared spectroscopy-based method to evaluate the hemodynamic oxygen carrying capacity of in-vitro blood**, Chenyang Gao, Ting Li, Chinese Academy of Medical Sciences & Peking Union Medical College (China) . . . . . [11239-17]
- 11:20 am: **Holistic quantification of cutaneous microcirculation with spatial frequency domain imaging (SFDI) and coherent hemodynamics spectroscopy (CHS) based on a dynamic microcirculation PIPE model**, Min Xu, The City Univ. of New York (USA); Yang Zheng, Xinlin Chen, Weihao Lin, Bixin Zeng, Wenzhou Medical Univ. (China) . . . . . [11239-18]
- Lunch Break . . . . . Sun 11:40 am to 1:10 pm
- 11:40 am: **Multicolor two-photon microscopy by phase-shaping selective excitation using broadband fiber-continuum** (*Invited Paper*), Xinyuan Huang, Ling Fu, Huazhong Univ. of Science and Technology (China) . . . . . [11239-19]

**SESSION 5**

**LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 1:10 PM TO 3:20 PM**

**Functional Imaging and Evaluations**

Session Chairs: **Melissa C. Skala**, Morgridge Institute for Research (USA); **Irina V. Larina**, Baylor College of Medicine (USA)

- 1:10 pm: **Towards registration of optical and MR signal changes in subcutaneous tumor volume in vivo after optical skin clearing** (*Invited Paper*), Alexei A. Bogdanov Jr., Univ. of Massachusetts Medical School (USA) . . . . . [11239-20]
- 1:40 pm: **Stress and repair in retinal pigmented epithelium cell culture imaged with dynamic full-field OCT**, Cassandra Groux, Institut Langevin Ondes et Images, Ecole Supérieure de Physique et de Chimie Industrielles (France) and Univ. PSL (France) and CNRS (France); Jules Scholler, Pedro Mecê, Institut Langevin Ondes et Images (France); Sacha Reichman, Institut de la Vision, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France); Valérie Fradot, Michel Pâques, Institut de la Vision (France); Claude Boccora, Institut Langevin Ondes et Images (France); Katharine Grieve, Institut de la Vision (France) . . . . . [11239-21]
- 2:00 pm: **Decoupled fluorescence Monte Carlo model for fluorescence molecular tomography**, Kaixian Liu, Xu Jiang, Yongzhou Hua, Ling Fu, Yong Deng, Huazhong Univ. of Science and Technology (China) . . . . [11239-22]
- 2:20 pm: **Laser Doppler holography for full-field and high-speed blood flow imaging in the human retina**, Michael Atlan, Institut Langevin Ondes et Images (France); Jose-Alain Sahel, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France); Mathias Fink, Leo Puyo, Institut Langevin Ondes et Images (France); Michel Paques, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France) . . . . . [11239-23]
- 2:40 pm: **In-Vivo imaging of physiological signatures using coherent optical techniques**, Carissa Rodriguez, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Austen Lefebvre, The Johns Hopkins Univ. School of Medicine (USA); Eyal Bar-Kochba, Nicole Steiner, Clara Scholl, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Marek Mirski, The Johns Hopkins Univ. School of Medicine (USA); David Blodgett, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) . . . . . [11239-24]
- 3:00 pm: **Heart rate app at 10: How to write a biophotonics app that reaches more than 500 million people**, Martin J. Leahy, National Univ. of Ireland, Galway (Ireland) . . . . . [11239-25]
- Coffee Break. . . . . Sun 3:20 pm to 3:50 pm

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# CONFERENCE 11239

## SESSION 6

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 3:50 PM TO 5:00 PM

### Biophotonics of Embryo Dynamics: Monitoring, Imaging, and Functional Control

3:50 pm: **Optical imaging and pacing of drosophila heart function** (*Invited Paper*), Chao Zhou, Washington Univ. in St. Louis (USA) . . . . . [11239-26]

4:10 pm: **OCT analysis of mouse reproduction and early development in vivo: dynamics of cilia, eggs and sperm** (*Invited Paper*), Irina V. Larina, Baylor College of Medicine (USA) . . . . . [11239-27]

4:40 pm: **Controlling the embryonic heart beat through optogenetics**, Andrew L. Lopez III, Irina V. Larina, Baylor College of Medicine (USA) [11239-32]

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## PANEL DISCUSSION

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . 5:00 PM TO 5:40 PM

### Biophotonics of Embryo Dynamics: Monitoring, Imaging, and Functional Control

Panel Moderator: **Martin J. Leahy**, National Univ. of Ireland, Galway

Panelists:

**Scott E. Fraser**, The Univ. of Southern California (USA)

**Mary E. Dickinson**, Baylor College of Medicine (USA)

**Chao Zhou**, Washington Univ. in St. Louis (USA)

**Andrew M. Rollins**, Case Western Reserve Univ. (USA)

**Michael W. Jenkins**, Case Western Reserve Univ. (USA)

**Brian E. Applegate**, The Univ. of Southern California (USA)

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## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

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## MONDAY 3 FEBRUARY

### POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Monitoring of effects induced by topically applied optical clearing agents to skin ex vivo and in vivo**, Irina Y. Yanina, Saratov State Univ. (Russian Federation) and National Research Tomsk State Univ. (Russian Federation); Maxim E. Darvin, Charité Universitätsmedizin Berlin (Germany); Valery V. Tuchin, Saratov State Univ. (Russian Federation) and National Research Tomsk State Univ. (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation); Jürgen Lademann, Charité Universitätsmedizin Berlin (Germany) . . . . . [11239-28]

**Advanced tissue optical clearing methods for whole-organ imaging**, Tingting Yu, Yusha Li, Jingtan Zhu, Jianyi Xu, Peng Wan, Dan Zhu, Huazhong Univ. of Science and Technology (China) . . . . . [11239-29]

**An optical clearing skull window for cerebrovascular imaging and manipulation**, Chao Zhang, Institute of Clinical Medical Science, Central People's Hospital of Zhanjiang (China); Dan Zhu, Wuhan National Research Ctr. for Optoelectronics, Huazhong Univ. of Science and Technology (China) . . . . . [11239-30]

**Evaluation of diabetes-induced skin disorders by tissue optical imaging method**, Wei Feng, Central People's Hospital of Zhanjiang (China); Dan Zhu, Huazhong Univ. of Science and Technology (China) . . . . . [11239-31]

**Development of coronary microvasculature in embryonic hearts**, Maryse Lapierre-Landry, Case Western Reserve Univ. (USA); Hana Kolesova, Charles Univ. (Czech Republic); Yehe Liu, Michiko Watanabe, Michael W. Jenkins, Case Western Reserve Univ. (USA) . . . . . [11239-33]

**Abnormal AVJ conduction and endocardial cushions in the looping heart caused by ethanol exposure**, Shan Ling, Hope Yashnik, Junqi Zhuo, Michael W. Jenkins, Michiko Watanabe, Andrew M. Rollins, Case Western Reserve Univ. (USA) . . . . . [11239-34]

**Characterization of nano sensitive sub-micron scale tissue-structural multifractality and its alteration in tumor progress**, Nandan Kumar Das, Sergey A. Alexandrov, Róisín M. Dwyer, National Univ. of Ireland, Galway (Ireland); Rolf Saager, Linköping University (Sweden); Nirmalya Ghosh, Indian Institute of Science Education and Research Kolkata (India); Martin J. Leahy, National Univ. of Ireland, Galway (Ireland) . . . . . [11239-35]

CONFERENCE 11240  
LOCATION: ROOM 201 (LEVEL 2 SOUTH)

Sunday-Wednesday 2-5 February 2020 • Proceedings of SPIE Vol. 11240

# Photons Plus Ultrasound: Imaging and Sensing 2020

Conference Chairs: **Alexander A. Oraevsky**, TomoWave Labs, Inc. (USA); **Lihong V. Wang**, Caltech (USA)

Program Committee: **Mark A. Anastasio**, Washington Univ. in St. Louis (USA); **Paul C. Beard**, Univ. College London (United Kingdom); **A. Claude Boccara**, Institut Langevin Ondes et Images (France); **Peter Burgholzer**, Research Ctr. for Non Destructive Testing GmbH (Austria); **Stanislav Y. Emelianov**, Georgia Institute of Technology (USA); **Rinat O. Esenaliev**, The Univ. of Texas Medical Branch (USA); **Martin Frenz**, Univ. Bern (Switzerland); **Miya Ishihara**, National Defense Medical College (Japan); **Chulhong Kim**, Pohang Univ. of Science and Technology (Korea, Republic of); **Changhui Li**, Peking Univ. (China); **Pai-Chi Li**, National Taiwan Univ. (Taiwan); **Andreas Mandelis**, Univ. of Toronto (Canada); **Srirang Manohar**, Univ. of Twente (Netherlands); **Vasilis Ntziachristos**, Helmholtz Zentrum München GmbH (Germany); **Matthew O'Donnell**, Univ. of Washington (USA); **Günther Paltauf**, Karl-Franzens-Univ. Graz (Austria); **Wiendelt Steenbergen**, Univ. of Twente (Netherlands); **Roger J. Zemp**, Univ. of Alberta (Canada); **Vladimir P. Zharov**, Univ. of Arkansas for Medical Sciences (USA); **Qifa Zhou**, The Univ. of Southern California (USA); **Quing Zhu**, Washington Univ. in St. Louis (USA)

Conference Co-Sponsor:



## SUNDAY 2 FEBRUARY

LOCATION: ROOM 201 (LEVEL 2 SOUTH) .....8:00 AM TO 8:15 AM

### Opening Remarks

#### SESSION 1

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SUN 8:15 AM TO 10:15 AM

### Clinical Imaging I: In Vivo

Session Chairs: **Alexander A. Oraevsky**, TomoWave Labs, Inc. (USA); **Lihong V. Wang**, Caltech (USA)

8:15 am: **Two Dimensional and Three Dimensional Functional Photoacoustic/Ultrasound Imaging for Assessment of Breast Tumors: Preliminary Clinical Study Findings**, Ming Wang, Peking Union Medical College Hospital (China) and Chinese Academy of Medical Sciences & Peking Union Medical College (China); Yao Wei, Na Su, Meng Yang, Yuxin Jiang, Peking Union Medical College Hospital (China); Fang Yang, Shenzhen Mindray Bio-Medical Electronics Co., Ltd. (China); Lingyi Zhao, Changhui Li, Peking Univ. (China) ..... [11240-194]

8:30 am: **High resolution 3D photoacoustic scanner for the assessment of inflammatory disease\***, Nam Trung Huynh, Olivia Francies, Thomas J. Allen, Edward Zhang, Ben Cox, Andrew Plumb, Paul C. Beard, Univ. College London (United Kingdom) ..... [11240-1]

8:45 am: **Multispectral photoacoustic assessment of thyroid cancer nodules in vivo**, Jeesu Kim, Byullee Park, Pohang Univ. of Science and Technology (Korea, Republic of); Jeonghoon Ha, The Catholic Univ. of Korea (Korea, Republic of); Idan Steinberg, Stanford Univ. (USA); Eun-Yeong Park, Wonseok Choi, Pohang Univ. of Science and Technology (Korea, Republic of); Sarah Hooper, Sanjiv S. Gambhir, Stanford Univ. (USA); Dong-Jun Lim, The Catholic Univ. of Korea (Korea, Republic of); Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11240-2]

9:00 am: **Towards in vivo PA imaging of vulnerable plaques in carotid arteries**, Min Wu, Eicke Vloedgraven, Roy P. M. van Hees, Jan-Willem Muller, Technische Univ. Eindhoven (Netherlands); Marc Van Sambeek, Catharina Hospital (Netherlands) and Technische Univ. Eindhoven (Netherlands); Frans van de Vosse, Richard G. P. Lopata, Technische Univ. Eindhoven (Netherlands) ..... [11240-3]

9:15 am: **Wide-field multispectral photoacoustic imaging of human melanomas in vivo**, Byullee Park, Changyeop Lee, Jeesu Kim, Wonseok Choi, Chul Hwan Bang, Ji Hyun Lee, Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11240-4]

9:30 am: **Identification of intestinal fibrosis using spectroscopic photoacoustic imaging: feasibility study in human subjects**, Yunhao Zhu, Laura A. Johnson, Jonathan M. Rubin, Univ. of Michigan (USA); Jie Yuan, Nanjing Univ. (China); Xueding Wang, Peter D. R. Higgins, Guan Xu, Univ. of Michigan (USA) ..... [11240-5]

9:45 am: **Photoacoustic Bone Assessment – A Clinical Feasibility In vivo Study Based on Human Calcaneus Bone**, Ting Feng, Yunhao Zhu, Karen Cummings, Yue Zhou, Qian Cheng, Ken Kozloff, Univ. of Michigan (USA); Richard Morris, IF, LLC (USA); Xueding Wang, Univ. of Michigan (USA) [11240-6]

10:00 am: **All-optical reflection-mode microscopic histology of unstained human tissues**, Saad Rasheed Abbasi, Martin Le, Serene O. Abu-Sardanah, Benjamin R. Ecclestone, Univ. of Waterloo (Canada); Kevan Bell, Deepak Dinakaran, illumiSonics Inc. (Canada); Gilbert Bigras, Univ. of Alberta (Canada); John R. Mackey, illumiSonics Inc. (Canada); Parsin H. Reza, Univ. of Waterloo (Canada) ..... [11240-7]

Coffee Break ..... Sun 10:15 am to 10:45 am

#### SESSION 2

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SUN 10:45 AM TO 12:15 PM

### Clinical Imaging II: Ex Vivo

Session Chairs: **Rinat O. Esenaliev**, The Univ. of Texas Medical Branch (USA); **Chulhong Kim**, Pohang Univ. of Science and Technology (Korea, Republic of)

10:45 am: **Assessment of human colorectal cancer using co-registered photoacoustic and ultrasound tomography system**, Guang Yang, Eghbal Amidi, William Chapman Jr., Sreyankar Nandy, Atahar Mostafa, Heba Abdelal, Zahra Alipour, Deyali Chatterjee, Matthew Mutch, Quing Zhu, Washington Univ. in St. Louis (USA) ..... [11240-8]

11:00 am: **An all optical photoacoustic needle probe for assessing the aggressiveness of prostate cancer**, Guan Xu, Linyu Ni, Javed Siddiqui, Aaron Udager, Xueding Wang, Univ. of Michigan Medical School (USA) [11240-9]

11:15 am: **Evaluation of skin aging using photoacoustic microscopy**, Hiroki Hattori, Takeshi Namita, Kengo Kondo, Makoto Yamakawa, Tsuyoshi Shiina, Kyoto Univ. (Japan) ..... [11240-10]

11:30 am: **Monte Carlo simulation for improving spectral photoacoustic imaging-based oxygen saturation estimation of human placental tissue**, Kristie Huda, Carolyn L. Bayer, Tulane Univ. (USA) ..... [11240-11]

11:45 am: **The best kidney: Using photoacoustic imaging for assessing pre-transplantation kidney quality**, Eno Hysi, Ryerson Univ. (Canada) and Institute for Biomedical Engineering, Science and Technology (Canada); Xiaolin He, St. Michael's Hospital (Canada); Muhannad N. Fadhel, Ryerson Univ. (Canada) and Institute for Biomedical Engineering, Science and Technology (Canada); Darren A. Yuen, St. Michael's Hospital (Canada); Michael C. Kolios, Ryerson Univ. (Canada) and Institute for Biomedical Engineering, Science and Technology (Canada) ..... [11240-12]

12:00 pm: **Photoacoustic spectrum analysis for quick identification and grading of prostate cancer**, Yingna Chen, Shengsong Huang, Tongji Univ. (China); Guan Xu, Univ. of Michigan (USA); Chengdang Xu, Tongji Univ. (China); Xueding Wang, Univ. of Michigan (USA); Denglong Wu, Qian Cheng, Tongji Univ. (China) ..... [11240-13]

Lunch Break ..... Sun 12:15 pm to 1:45 pm



# CONFERENCE 11240

## SESSION 3

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SUN 1:45 PM TO 2:30 PM

### Clinical Imaging III: Ex Vivo

Session Chairs: **Wiendelt Steenbergen**, Univ. of Twente (Netherlands); **Miya Ishihara**, National Defense Medical College (Japan)

1:45 pm: **Photoacoustic imaging of fresh human surgical and endoscopic gastrointestinal specimens: a pilot study**, Miya Ishihara, National Defense Medical College (Japan); Hiroaki Ikematsu, National Cancer Ctr. (Japan); Dai Murakoshi, Kaku Irisawa, FUJIFILM Corp. (Japan); Shinpei Okawa, National Defense Medical College (Japan); Toshihiko Omori, Satoshi Ozawa, FUJIFILM Corp. (Japan); Atsushi Ochiai, National Cancer Ctr. (Japan) ..... [11240-14]

2:00 pm: **Chromophore selective multi-wavelength photoacoustic remote sensing**, Nicholas Pellegrino, Saad Rasheed Abbasi, Kevan Bell, Univ. of Waterloo (Canada); Deepak Dinakaran, illumiSonics Inc. (Canada); Gilbert Bigras, Univ. of Alberta (Canada); John R. Mackey, illumiSonics Inc. (Canada); Paul Fieguth, Parsin Haji Reza, Univ. of Waterloo (Canada) ..... [11240-15]

2:15 pm: **Developments in transcranial photoacoustic imaging in humans**, Simon R. Powell, Aisen C. Chacin, Rinat O. Esenaliev, The Univ. of Texas Medical Branch (USA) ..... [11240-16]

## SESSION 4

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SUN 2:30 PM TO 3:15 PM

### Towards Clinical Imaging

Session Chairs: **Wiendelt Steenbergen**, Univ. of Twente (Netherlands); **Miya Ishihara**, National Defense Medical College (Japan)

2:30 pm: **Deep learning-based speed of sound aberration correction in photoacoustic images**, Seungwan Jeon, Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11240-17]

2:45 pm: **3D photoacoustic/ultrasound handheld scanner for clinical translation**, Changyeop Lee, Wonseok Choi, Jesus Kim, Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11240-18]

3:00 pm: **A preclinical small animal imaging platform combining multi-angle photoacoustic and fluorescence projections into co-registered 3D maps.**, Weylan Thompson, PhotoSound Technologies, Inc. (USA); Anthony Yu, Georgia Institute of Technology (USA); Diego S. Dumani, Univ. de Costa Rica (Costa Rica) and Georgia Institute of Technology (USA); Mark A. Anastasio, Univ. of Illinois (USA); Sergey A. Ermilov, PhotoSound Technologies, Inc. (USA); Stanislav Y. Emelianov, Georgia Institute of Technology (USA) ..... [11240-130]

Coffee Break. .... Sun 3:15 pm to 3:45 pm

## SESSION 5

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... SUN 3:45 PM TO 5:15 PM

### Small-Animal Imaging

Session Chairs: **Vasilis Ntziachristos**, Technische Univ. München (Germany); **Daniel Razansky**, ETH Zurich (Switzerland)

3:45 pm: **LED-based photoacoustic imaging for early detection of joint inflammation in rodents – Towards achieving 3Rs in rheumatoid arthritis research**, Francis Kalloo Joseph, Univ. of Twente (Netherlands); Marvin Xavierselvan, Tufts Univ. (USA); Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Srivalleesha Mallidi, Massachusetts General Hospital (USA); Conny van der Laken, Amsterdam UMC (Netherlands); Fons van de Loo, Radboud Univ. Medical Ctr. (Netherlands); Wiendelt Steenbergen, Univ. of Twente (Netherlands) ..... [11240-20]

4:00 pm: **Multi-view Fabry Perot scanner for whole-body small animal imaging**, Olumide Ogunlade, Robert Ellwood, Edward Zhang, Paul C. Beard, Ben T. Cox, Univ. College London (United Kingdom) ..... [11240-22]

4:15 pm: **Toward whole-brain in vivo photoacoustic angiography of rodents**, Pavel Vladimirovich Subochev, Institute of Applied Physics (Russian Federation) ..... [11240-23]

4:30 pm: **Photoacoustic monitoring of angiogenesis in experimental tumors**, Anna Gennadjevna Orlova, Institute of Applied Physics (Russian Federation) ..... [11240-24]

4:45 pm: **Light emitting diode based photoacoustic/ultrasound imaging reveals fast dynamic contrast in liver and changes in blood oxygenation**, James Joseph, Univ. of Cambridge (United Kingdom); Mithun Kuniyil Ajith Singh, Naoto Sato, Cyberdyne, Inc. (Japan); Sarah E. Bohndiek, Univ. of Cambridge (United Kingdom) ..... [11240-25]

5:00 pm: **Mapping tumor vasculature and oxygenation in vivo with LED-based photoacoustic imaging system and validation with histology**, Marvin Xavierselvan, Tufts Univ. (USA); Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Srivalleesha Mallidi, Tufts Univ. (USA) and Wellman Ctr. for Photomedicine (USA) ..... [11240-26]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Single-element transducer based photoacoustic tomography: a study of system parameters**, Chao Tian, Kang Shen, Songde Liu, Zhiming Hu, Univ. of Science and Technology of China (China); Ting Feng, Nanjing Univ. of Science and Technology (China) ..... [11240-103]

**Refraction and anisotropy correction for photoacoustic imaging of bone**, Jami Shepherd, The Univ. of Auckland (New Zealand); Guillaume Renaud, Sorbonne Univ. (France); Kasper van Wijk, The Univ. of Auckland (New Zealand) ..... [11240-104]

**Photoacoustic sensing system using continuous-wave lasers toward non-invasive glucose measurement**, Yujiro Tanaka, Takuro Tajima, Michiko Seyama, NTT Device Technology Labs. (Japan) ..... [11240-105]

**In vivo evaluation of cerebral venous sinus morphology using pulsed-laser-diode-based desktop photoacoustic tomography system**, Praveenbalaji Rajendran, Samiran Sahu, Rhonnie Austria Dienzo, Manojit Pramanik, Nanyang Technological Univ. (Singapore) ..... [11240-107]

**Photoacoustic imaging of live chicken embryo at multiple developmental stages**, Arunima Sharma, Nanyang Technological Univ. (Singapore); Noreen Ishak, Agency for Science, Technology and Research (A\*STAR) (Singapore); Teoh Swee-Hin, Nanyang Technological Univ. (Singapore); Christine Cheung, Agency for Science, Technology and Research (A\*STAR) (Singapore); Manojit Pramanik, Nanyang Technological Univ. (Singapore) ..... [11240-108]

**In vivo monitoring of neural activity with photoacoustic potassium ion sensitive probe imaging**, Xiangwei Lin, City Univ. of Hong Kong (China); Juwei Ning, Yanqing Tian, Southern Univ. of Science and Technology of China (China); Lidai Wang, City Univ. of Hong Kong (China) ..... [11240-109]

**Dual-pulse photoacoustic flowmetry with single laser source**, Chao Liu, Lidai Wang, City Univ. of Hong Kong (Hong Kong, China); Yizhi Liang, Jinan Univ. (China) ..... [11240-110]

**Assessment of the Hessian-based vesselness filter for vasculature enhancement in OA tomography**, Antonia Longo, Helmholtz Zentrum München GmbH (Germany) and Technische Univ. München (Germany) and iThera Medical GmbH (Germany); Stefan Morscher, iThera Medical GmbH (Germany); Christian Zakian, Helmholtz Zentrum München GmbH (Germany); Vasilis Ntziachristos, Helmholtz Zentrum München GmbH (Germany) and Technische Univ. München (Germany) ..... [11240-111]

**Microvascular network evaluation with full-angle photoacoustic spectrum**, Mengjiao Zhang, Yingna Chen, Tongji Univ. (China); Xueding Wang, Univ. of Michigan (USA); Qian Cheng, Tongji Univ. (China) ..... [11240-112]

**Real time & 3D photoacoustic remote sensing**, Saad Rasheed Abbasi, Nicholas Pellegrino, Serene O. Abu-Sardana, Benjamin R. Ecclestone, Univ. of Waterloo (Canada); Kevan Bell, illumiSonics Inc. (Canada); Paul Fieguth, Parsin H. Reza, Univ. of Waterloo (Canada) ..... [11240-113]

**Wavelet transform-based photoacoustic signal analysis for assessment of bone quality**, Weiya Xie, Ting Feng, Tongji Univ. (China); Xueding Wang, Univ. of Michigan (USA); Qian Cheng, Tongji Univ. (China) ..... [11240-114]

**Functional optical-resolution photoacoustic microscopy in vivo using a backward-mode Fabry-Pérot scanner**, Elisabeth Baumann, Max-Delbrück-Ctr. für Molekulare Medizin Berlin-Buch (Germany); Ulrike Pohle, Martin-Luther-Univ. Halle-Wittenberg (Germany); Thomas J. Allen, Edward Zhang, Univ. College London (United Kingdom); Holger Gerhardt, Max-Delbrück-Ctr. für Molekulare Medizin Berlin-Buch (Germany); Jan Laufer, Martin-Luther-Univ. Halle-Wittenberg (Germany) ..... [11240-115]

**Deep learning-enhanced LED-based photoacoustic imaging**, Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Kathyayini Sivasubramanian, Stanford Univ. School of Medicine (USA); Naoto Sato, Fumiyuki Ichihashi, Yoshiyuki Sankai, Cyberdyne, Inc. (Japan); Lei Xing, Stanford Univ. School of Medicine (USA) ..... [11240-116]

**In vivo visualization of blood vessels in mouse ear by photoacoustic microscopy with transmissive liquid-crystal adaptive optics**, Yusuke Notsuka, Saga Univ. (Japan); Makoto Kurihara, Nobuyuki Hashimoto, Citizen Watch Co., Ltd. (Japan); Eiji Takahashi, Yoshihisa Yamaoka, Saga Univ. (Japan) ..... [11240-117]

**Label-free lipid contrast imaging using contact-free near-infrared photoacoustic remote sensing**, Pradyumna Kedariseti, Nathaniel J. Haven, Brendon S. Restall, Matthew T. Martell, Roger J. Zemp, Univ. of Alberta (Canada) ..... [11240-118]

**High resolution ultraviolet photoacoustic remote sensing microscopy for virtual histopathology**, Nathaniel J. Haven, Pradyumna Kedariseti, Brendon S. Restall, John D. Lewis, Roger J. Zemp, Univ. of Alberta (Canada) [11240-119]

**Integrated photoacoustic remote sensing microscopy and fluorescence imaging system**, Brendon S. Restall, Pradyumna Kedariseti, Nathaniel J. Haven, Roger J. Zemp, Univ. of Alberta (Canada) [11240-120]

**A novel fiber endface diffuser design for endo-cavity photoacoustic imaging**, Hongbo Luo, Guang Yang, Qing Zhu, Washington Univ. in St. Louis (USA) [11240-121]

**Pickering bubbles of perfluoropropane stabilized by modified graphene oxide as dual-modality ultrasound and photoacoustic contrast agent**, Al Christopher de Leon, Peiran Wei, Case Western Reserve Univ. (USA); Dana Wegierak, Filip Bordera, Ryerson Univ. (Canada); Madelyn McMillen, David Yan, Christina Hemmingsen, Case Western Reserve Univ. (USA); Michael C. Kolios, Ryerson Univ. (Canada); Emily Pentzer, Agata A. Exner, Case Western Reserve Univ. (USA) [11240-122]

**Characterization of ultrasound continuous wave acousto-optic modulated diffuse correlation spectroscopy: theory, simulation, and phantom experiments**, Mitchell B. Robinson, Harvard-MIT Health Sciences and Technology, Massachusetts Institute of Technology (USA) and Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA); Sava Sakadzic, Stefan A. Carp, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA); David A. Boas, Neurophotonics Ctr., Boston Univ. (USA); Maria Angela Franceschini, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) [11240-123]

**Detection and excitation defined systems in photoacoustic remote sensing microscopy**, Benjamin R. Ecclestone, Univ. of Guelph (Canada); Saad Rasheed Abbasi, Kevan Bell, Parsin H. Reza, Univ. of Waterloo (Canada) [11240-124]

**Unsupervised learning for photoacoustic spectral unmixing**, Deepit Abhishek Durairaj, Sumit Agrawal, Kerrick Johnstonbaugh, Christopher Fadden, The Pennsylvania State Univ. (USA); Sri-Phani Krishna Karri, National Institute of Technology, Andhra Pradesh (India); Sri-Rajasekhar Kothapalli, The Pennsylvania State Univ. (USA) [11240-125]

**Design and implementation of linear laser scanning system for photoacoustic imaging**, Hassan S. Salehi, John D. Schad, California State Univ., Chico (USA) [11240-126]

**Computed extended depth of field optical-resolution photoacoustic microscope using wavelet transform fusion**, Xianlin Song, Jianshuang Wei, Huazhong Univ. of Science and Technology (China) [11240-127]

**Food based contrast agents for photoacoustic imaging**, Kathyayini Sivasubramanian, Stanford Univ. School of Medicine (USA); Jeesu Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Kai Cheng, Stanford Univ. School of Medicine (USA); Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Lei Xing, Stanford Univ. School of Medicine (USA) [11240-128]

**Optoacoustic imaging and monitoring of hematomas, inflammation, and wounds**, Sergei Perkov, Skolkovo Institute of Science and Technology (Russian Federation) and St. Petersburg Academic Univ. (Russian Federation); Vasily Chernyshev, Skolkovo Institute of Science and Technology (Russian Federation); Evgeny A. Shirshin, M.V. Lomonosov Moscow State Univ. (Russian Federation); Simon R. Powell, Rinat O. Esenaliev, The Univ. of Texas Medical Branch (USA); Dmitry A. Gorin, Skolkovo Institute of Science and Technology (Russian Federation) [11240-129]

**Design optimization of P(VDF-TrFE) film sensor element to detect deep-seated contrast agents**, Takeshi Hirasawa, Kazuyoshi Tachi, Shinpei Okawa, Miya Ishihara, National Defense Medical College (Japan) [11240-131]

**Photoacoustic tomography reconstructing absorption coefficient and effect of regularization minimizing p-norm**, Shinpei Okawa, Takeshi Hirasawa, Toshihiro Kushibiki, Masanori Fujita, Miya Ishihara, National Defense Medical College (Japan) [11240-132]

**Photo-mediated ultrasound therapy for treatment of corneal neovascularization in rabbit eyes**, Yu Qin, Tongji Univ. (China) and Univ. of Michigan (USA); Yixin Yu, Univ. of Michigan (USA); Xinyi Xie, Nanjing Medical Univ. (China); Julia Fu, Yanxiu Li, Tao Wang, Wei Zhang, Univ. of Michigan (USA); Yannis M. Paulus, Univ. of Michigan-Kellogg Eye Ctr. (USA); Xinmai Yang, The Univ. of Kansas (USA); Xueding Wang, Univ. of Michigan (USA) [11240-106]

**Vascular and functional imaging by a fast mechanical-scanning dual-wavelength photoacoustic microscopy (PAM) system**, Yang Pu, MicroPhotoAcoustics, Inc. (USA); Renzhe Bi, Malini Olivo, Singapore Bioimaging Consortium (Singapore) [11240-19]

**The International Photoacoustic Standardisation Consortium (IPASC): Meet the leadership team and learn how you can get involved**, Sarah Elizabeth Bohndiek, Joanna Brunker, Univ. of Cambridge (United Kingdom); Benjamin L. Cox, Univ. of Wisconsin-Madison (USA); Janek Gröhl, Deutsches Krebsforschungszentrum (Germany); Lina Hacker, James Joseph, Univ. of Cambridge (United Kingdom); William C. Vogt, U.S. Food and Drug Administration (USA) [11240-223]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

**MONDAY 3 FEBRUARY**

**SESSION 6**

**LOCATION: ROOM 201 (LEVEL 2 SOUTH) . . . . . MON 8:30 AM TO 10:15 AM**

**Optical Sensing and Generation of US I**

Session Chairs: **Paul C. Beard**, Univ. College London (United Kingdom); **Guenther Paltauf**, Karl-Franzens-Univ. Graz (Austria)

8:30 am: **SNR-enhanced fiber-laser ultrasound sensors for photoacoustic tomography\***, Yizhi Liang, Long Jin, Jun Ma, Lidai Wang, Jinan Univ. (China) [11240-27]

8:45 am: **24-fold noise reduction in resonator-based optical detection of ultrasound via phase monitoring**, Lucas Riobó, Yoav Hazan, Amir Rosenthal, Technion-Israel Institute of Technology (Israel) [11240-28]

9:00 am: **Fully parallelised read-out of a Fabry-Perot ultrasound sensor using an InGaAs camera for fast photoacoustic imaging**, Thomas J. Allen, Edward Zhang, Paul C. Beard, Univ. College London (United Kingdom) [11240-29]

9:15 am: **Flatness of planar Fabry-Pérot cavities: a critical parameter for high sensitivity sensors for photoacoustic imaging**, Dylan Marques, James A. Guggenheim, Rehman Ansari, Edward Z. Zhang, Paul C. Beard, Peter R. T. Munro, Univ. College London (United Kingdom) [11240-30]

9:30 am: **Simultaneous multi-channel ultrasound detection via optical phase modulated pulse interferometry**, Yoav Hazan, Amir Rosenthal, Technion-Israel Institute of Technology (Israel) [11240-31]

9:45 am: **Hybrid ultrasound-detection platform based on silicon photonics and transparent polymers**, Resmi R. Kumar, Evgeny Hahamovich, Shai Tseses, Yoav Hazan, Assaf Grinberg, Amir Rosenthal, Technion-Israel Institute of Technology (Israel) [11240-32]

10:00 am: **Tunable high-finesse fiber optic Fabry-Perot interferometer for photoacoustic tomography**, Bohua Chen, Yuwen Chen, Cheng Ma, Tsinghua Univ. (China) [11240-33]

Coffee Break. . . . . Mon 10:15 am to 10:45 am

# CONFERENCE 11240

## SESSION 7

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... MON 10:45 AM TO 12:15 PM

### Optical Sensing and Generation of US II

Session Chairs: **Peter Burgholzer**,  
Research Ctr. for Non Destructive Testing GmbH (Austria);  
**Alexander A. Oraevsky**, TomoWave Labs, Inc. (USA)

10:45 am: **Tuneability of Fabry-Pérot sensors for parallelised photoacoustic signal acquisition: effect of electro-optical and electro-mechanical properties**, Claus Villringer, Technische Hochschule Wildau (Germany) and Martin-Luther-Univ. Halle-Wittenberg (Germany); Patrick Steglich, Leibniz-Institut für innovative Mikroelektronik (Germany); Silvio Pulwer, Sigurd Schrader, Technische Hochschule Wildau (Germany); Jan Laufer, Martin-Luther-Univ. Halle-Wittenberg (Germany) ..... [11240-34]

11:00 am: **Ultra-high sensitive all-optical photoacoustic transducers**, Robin Singh, Anu Agarwal, Brian W. Anthony, Massachusetts Institute of Technology (USA) ..... [11240-35]

11:15 am: **Design, fabrication and first testing of a novel opto-mechanical ultrasound sensor in silicon photonics**, Wouter J. Westerveld, Md. Mahmud-Ul-Hasan, Xavier Rottenberg, Simone Severi, Veronique Rochus, IMEC (Belgium) ..... [11240-36]

11:30 am: **All-optical ultrasound sensing in photonic crystal slabs aided by PMMA**, Eric Y. Zhu, Maria C. Charles, Cory Rewcastle, Raanan Gad, Li Qian, Ofer Levi, Univ. of Toronto (Canada) ..... [11240-37]

11:45 am: **Deep optical resolution photoacoustic remote sensing microscopy**, Benjamin R. Ecclestone, Univ. of Guelph (Canada); Amirmohammad Farzaneh, Kevan Bell, Parsin H. Reza, Univ. of Waterloo (Canada) ..... [11240-38]

12:00 pm: **Using structured optical beams as the readout of planar Fabry-Pérot based ultrasound sensors**, Oliver J. Sheppard, James A. Guggenheim, Paul C. Beard, Peter R. T. Munro, Univ. College London (United Kingdom) ..... [11240-39]

Lunch Break ..... Mon 12:15 pm to 1:45 pm

## SESSION 8

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... MON 1:45 PM TO 3:15 PM

### Contrast Agents

Session Chairs: **Stanislav Y. Emelianov**, Georgia Tech Research Institute (USA); **Pai-Chi Li**, National Taiwan Univ. (Taiwan)

1:45 pm: **A steered beam approach for precision sono-photoacoustics activation of phase-change contrast agents\***, David S. Li, John Pitre Jr., Geng-Shi Jeng, Ivan Pelivanov, Thomas Matula, Matthew O'Donnell, Lilo Pozzo, Univ. of Washington (USA) ..... [11240-40]

2:00 pm: **Semiconducting polymer nanoparticles for targeted PA imaging of prostate cancer in NIR-II window**, Jiayingzi Wu, Ji-Xin Cheng, Boston Univ. (USA); Jianguo Mei, Purdue Univ. (USA); Hyeon Jeong Lee, Boston Univ. (USA); Liyan You, Xuyi Luo, Purdue Univ. (USA); Kai-Chih Huang, Peng Lin, Boston Univ. (USA) ..... [11240-41]

2:15 pm: **Visualization of microparticle flow in the mouse brain in an intracardiac perfusion model**, Xosé Luís Deán-Ben, Univ. Zürich (Switzerland); Oleksiy Degtyaruk, Helmholtz Zentrum München GmbH (Germany); Daniel Razansky, Univ. Zürich (Switzerland) ..... [11240-42]

2:30 pm: **Calcium-sensitive photoacoustic probe for noninvasive extracellular calcium monitoring**, Frank DeLuna, Nicholas McMahon, The Univ. of Texas at San Antonio (USA); Mayeul Collot, Univ. de Strasbourg (France); Jing Yong Ye, The Univ. of Texas at San Antonio (USA) ..... [11240-43]

2:45 pm: **Ferricyanide mediated photoacoustic enhancement of metal chalcogenide-coated gold nanorods.**, Yash Mantri, Jesse V. Jokerst, Univ. of California, San Diego (USA) ..... [11240-44]

3:00 pm: **Iodide-doped gold/silver hybrid nanoparticle for increased sensitivity to reactive oxygen species using photoacoustic imaging**, Yash Mantri, Univ. of California, San Diego (USA); Barak Davidi, Fairfield Univ. (USA); Jesse V. Jokerst, Univ. of California, San Diego (USA) ..... [11240-45]

Coffee Break ..... Mon 3:15 pm to 3:45 pm

## SESSION 9

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... MON 3:45 PM TO 5:30 PM

### Phantoms and Standardization Activities

Session Chairs: **Sarah Elizabeth Bohndiek**, Univ. of Cambridge (United Kingdom); **Mark A. Anastasio**, Univ. of Illinois (USA)

3:45 pm: **International photoacoustic standardisation consortium (IPASC): Progress in the phantom development theme**, James Joseph, Joanna Bruncker, Univ. of Cambridge (United Kingdom) ..... [11240-46]

4:00 pm: **Test-objects and phantoms for characterization and optimization of hybrid 3D PA-US systems**, Maura Dantuma, Javier Ortega Julia, Univ. of Twente (Netherlands); Saskia Kruitwagen, Univ. of Twente (Netherlands) and Medisch Spectrum Twente (Netherlands); Damien Gasteau, Srirang Manohar, Univ. of Twente (Netherlands) ..... [11240-47]

4:15 pm: **Tissue-mimicking phantoms for validation of photoacoustic thermometry techniques**, Marina Bakaric, Univ. College London (United Kingdom); Bajram Zeqiri, National Physical Lab. (United Kingdom); Ben T. Cox, Bradley E. Treeby, Univ. College London (United Kingdom) ..... [11240-48]

4:30 pm: **International Photoacoustic Standardization Consortium (IPASC): Progress in the study design working group**, William C. Vogt, U.S. Food and Drug Administration (USA); Sarah E. Bohndiek, Univ. of Cambridge (United Kingdom) ..... [11240-49]

4:45 pm: **International Photoacoustic Standardisation Consortium (IPASC): Progress in the data acquisition and management theme**, Janek Gröhl, Deutsches Krebsforschungszentrum (Germany); Lina Hacker, Cancer Research UK (United Kingdom) ..... [11240-50]

5:00 pm: **Development of a polymer-in-oil tissue-mimicking material with tuneable optical and acoustic characteristics for technical validation of photoacoustic imaging systems**, Lina Hacker, Univ. of Cambridge (United Kingdom); Aoife Ivory, National Physical Lab. (United Kingdom); James Joseph, Univ. of Cambridge (United Kingdom); Srinath Rajagopal, Bajram Zeqiri, National Physical Lab. (United Kingdom); Sarah E. Bohndiek, Univ. of Cambridge (United Kingdom) ..... [11240-51]

5:15 pm: **Realistic three-dimensional optoacoustic tomography imaging trials using the VICTRE breast phantom of FDA**, Seonyeong Park, Univ. of Illinois (USA); Umberto Villa, Washington Univ. in St. Louis (USA); Richard Su, Alexander Oraevsky, TomoWave Labs, Inc. (USA); Frank J. Brooks, Mark A. Anastasio, Univ. of Illinois (USA) ..... [11240-52]

## POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Monday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Prospective respiration-gated photoacoustic microscopy for removing motion artifacts**, Jianshuang Wei, Xianlin Song, Qun Wang, Qingming Luo, Xiaoquan Yang, Huazhong Univ. of Science and Technology (China) [11240-133]

**Photoacoustic imaging using a transvaginal ultrasound probe: A comparison of image reconstruction methods**, Guilherme Fernandes, Theo Pavan, Univ. de São Paulo (Brazil) ..... [11240-134]

**Clinically-approved carbon nanoparticles based in vivo photoacoustic mapping of sentinel lymph node**, Songde Liu, Hang Wang, Chenxi Zhang, Chao Tian, Univ. of Science and Technology of China (China) ..... [11240-135]

**Combining ultrasound and diffuse reflection spectroscopy for classification and thickness estimation of tissue layers for resection margin assessment during colorectal cancer surgery**, Freija Geldof, Michelle van der Spek, The Netherlands Cancer Institute (Netherlands); Behdad Dashtbozorg, The Netherlands Cancer Institute (Netherlands) and Technische Univ. Eindhoven (Netherlands); Lisanne Baltussen, The Netherlands Cancer Institute (Netherlands); Benno Hendriks, Philips Research (Netherlands) and Technische Univ. Delft (Netherlands); Dick Sterenberg, The Netherlands Cancer Institute (Netherlands) and Amsterdam UMC (Netherlands); Theo Ruers, The Netherlands Cancer Institute (Netherlands) and Univ. of Twente (Netherlands) ..... [11240-136]

**A deep learning method based on U-Net for quantitative photoacoustic imaging**, Tingting Chen, Tong Lu, Shaoze Song, Shichao Miao, Feng Gao, Jiao Li, Tianjin Univ. (China) ..... [11240-137]

**Ultrapure plasmonic chain-like gold nanoparticle-enhanced multimodal photoacoustic microscopy and optical coherence tomography for the identification of choroidal neovascularization in living rabbits**, Van Phuc Nguyen, Yanxiu Li, Univ. of Michigan-Kellogg Eye Ctr. (USA); Wei Qian, Bing Liu, IMRA America, Inc. (USA); Wei Zhang, Univ. of Michigan Health System (USA); Jessica Henry, Michael Aaberg, Sydney Jones, Thomas Qian, Univ. of Michigan-Kellogg Eye Ctr. (USA); Xueding Wang, Univ. of Michigan (USA); Yannis M. Paulus, Univ. of Michigan-Kellogg Eye Ctr. (USA) . . . . . [11240-138]

**Spectroscopic photoacoustic imaging of cartilage damage**, Min Wu, Bente van Tefleem, Rene van Donkelaar, Keita Ito, Frans van de Vosse, Richard G. P. Lopata, Technische Univ. Eindhoven (Netherlands) . . . [11240-139]

**Breaking the resolution limit in photoacoustic imaging using positivity and sparsity**, Peter Burgholzer, Johannes Bauer-Marschallinger, Research Ctr. for Non Destructive Testing GmbH (Austria); Markus Haltmeier, Univ. Innsbruck (Austria) . . . . . [11240-140]

**Improved real-time delay-multiply-and-sum beamforming with coherence factor**, Seungwan Jeon, Eun-Yeong Park, Wonseok Choi, Pohang Univ. of Science and Technology (Korea, Republic of); Ravi Managuli, Univ. of Washington (USA); Ki jong Lee, Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11240-141]

**Surface-crosslinked multi-functional nanodroplets for photoacoustic/ultrasound image-guided high intensity focused ultrasound therapy**, Wonseok Choi, Hyunski Choi, Chulhong Kim, Sei Kwang Hahn, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11240-142]

**3D photoacoustic imaging system based on optical tracking**, Jie Yuan, Nanjing Univ. (China); Xueding Wang, Guan Xu, Univ. of Michigan (USA); Qian Cheng, Tongji Univ. (China) . . . . . [11240-143]

**Photoacoustic mesoscopy using tunable Fabry-Perot interferometric ultrasound sensor**, Yuwen Chen, Bohua Chen, Cheng Ma, Tsinghua Univ. (China) . . . . . [11240-144]

**Monte Carlo simulations and photoacoustic experiments to compare imaging depth at 532 nm, 800 nm, and 1064 nm**, Arunima Sharma, Nanyang Technological Univ. (Singapore); Srishti Srishti, Indian Institute of Technology (BHU), Varanasi (India); Vijitha Periyasamy, Manojit Pramanik, Nanyang Technological Univ. (Singapore) . . . . . [11240-145]

**Combining photoacoustics and laser-induced ultrasound for tomographic imaging**, David Thompson, Damien Gasteau, Jeffrey Nagel, Hindrik Kruit, Johan van Hespren, Srirang Manohar, Univ. of Twente (Netherlands) [11240-146]

**Quantitative analysis of photoacoustic clutter artifact reduction using short-lag spatial coherence metric**, Guilherme Fernandes, Theo Pavan, Univ. de São Paulo (Brazil) . . . . . [11240-147]

**High-resolution sonofluorescence imaging for deep tissue applications**, Tomas Jordan, Geoffrey P. Luke, Dartmouth College (USA) . . . . . [11240-148]

**Polarization-based common path interferometric quadrature photoacoustic remote sensing**, Matthew T. Martell, Cory Rewcastle, Roger J. Zemp, Univ. of Alberta (Canada) . . . . . [11240-149]

**Fast MEMS-mirror non-contact ultraviolet photoacoustic remote sensing**, Nathaniel J. Haven, Brendon S. Restall, Pradyumna Kedariseti, Roger J. Zemp, Univ. of Alberta (Canada) . . . . . [11240-150]

**Long-term cortex-wide imaging of the awake mouse brain using multi-parametric photoacoustic microscopy**, Vincent M. Sciortino, Angela L. Tran, Rui Cao, Naidi Sun, Yu-Yo Sun, Song Hu, Univ. of Virginia (USA) . . . [11240-151]

**3D super-resolution photoacoustic imaging with a sparse array and sparsity-constrained model-based reconstruction**, Guillaume Godefroy, Sergey Vilov, Bastien Arnal, Emmanuel Bossy, Lab. Interdisciplinaire de Physique (France) and Univ. Grenoble Alpes (France) and CNRS (France) . . . . . [11240-152]

**In-vivo three-dimensional raster scan photoacoustic mesoscopy using frequency domain inversion**, Qutaiba Mustafa, Technische Univ. München (Germany) and Helmholtz Zentrum München GmbH (Germany); Murad Omar, Pouyan Mohajerani, Ludwig Prade, Antonios Stylogiannis, Vasilis Ntziachristos, Technische Univ. München (Germany) . . . . . [11240-153]

**Multispectral photoacoustic remote sensing microscopy using 532nm and 266nm excitation wavelengths**, Brendon S. Restall, Nathaniel J. Haven, Pradyumna Kedariseti, Roger J. Zemp, Univ. of Alberta (Canada) . . [11240-154]

**A 3D modelling toolchain to simulate time-dependent photoacoustic imaging in the carotid artery**, Jan-Willem Muller, Joerik de Ruijter, Min Wu, Frans van de Vosse, Technische Univ. Eindhoven (Netherlands); Marc van Sambeek, Catharina Hospital (Netherlands); Richard G. P. Lopata, Technische Univ. Eindhoven (Netherlands) . . . . . [11240-155]

**Optimizing irradiation geometry in LED-based photoacoustics: Towards point-of-care deep tissue functional imaging**, Maju Kuriakose, Michael Kennedy, Tufts Univ. (USA); Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Srivalleesha Mallidi, Tufts Univ. (USA) and Wellman Ctr. for Photomedicine (USA) . . . . . [11240-156]

**MEMS scanning multi-scale photoacoustic microscopy for tumor anti-angiogenic therapy monitoring**, Chengbo Liu, Chen Zhang, Liang Song, Shenzhen Institutes of Advanced Technology (China) . . . . . [11240-157]

**Towards quantitative photoacoustic tomography for partial view array transducers**, Eghbal Amidi, Guang Yang, K. M. Shihab Uddin, Hongbo Luo, Washington Univ. in St. Louis (USA); Stephen Rogers, Allan Doctor, Washington Univ. School of Medicine in St. Louis (USA); Quing Zhu, Washington Univ. in St. Louis (USA) . . . . . [11240-158]

**Massive parallel photoacoustic and ultrasound PC-based system**, Vassili Ivanov, Hans-Peter Brecht, Sergey A. Ermilov, PhotoSound Technologies, Inc. (USA) . . . . . [11240-159]

**Ultrasound-modulated optical tomography through human skulls**, Yan Liu, Ruizhi Cao, Haowen Ruan, Jian Xu, Changhui Yang, Caltech (USA) [11240-160]

**Photoacoustic flow measurements using a fast pulsed laser diode and a CMUT array**, Reza Pakdaman Zangabad, Sophinese Iskander-Rizk, Pieter Kruizinga, Antonius F. W. van der Steen, Gijs van Soest, Erasmus MC (Netherlands) . . . . . [11240-161]

**Focusing light through scattering media with a fast photoacoustic feedback algorithm**, Tianrui Zhao, King's College London (United Kingdom); Tom Vercauteren, Wenfeng Xia, King's College London (United Kingdom) and Univ. College London (United Kingdom) . . . . . [11240-162]

**Deep-tissue photoacoustic imaging at the second near-infrared region using newly synthesized nickel(II) dithioloene-containing polymeric nanoparticles**, Byullee Park, Jesus Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Kyoung Min Kim, Seoul National Univ. (Korea, Republic of); Changho Lee, Chonnam National Univ. Hwasun Hospital (Korea, Republic of); Hyungwoo Kim, Chonnam National Univ. (Korea, Republic of); Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11240-21]

**TUESDAY 4 FEBRUARY**

**SESSION 10**

**LOCATION: ROOM 201 (LEVEL 2 SOUTH) . . . . . TUE 8:30 AM TO 10:15 AM**

**Endoscopy and Minimally-Invasive**

Session Chairs: **Qifa Zhou**, The Univ. of Southern California (USA); **Lihong V. Wang**, Caltech (USA)

8:30 am: **Capsule optoacoustic endoscopy for esophageal imaging\***, Hailong He, Antonios Stylogiannis, Parastoo Afshari, Tobias Wiedemann, Helmholtz Zentrum München GmbH (Germany); Katja Steiger, Technische Univ. München (Germany); Andreas Buehler, Christian Zakian, Vasilis Ntziachristos, Helmholtz Zentrum München GmbH (Germany) . . . . . [11240-53]

8:45 am: **Co-registered ultrasound and acoustic-resolution photoacoustic endoscopy for rectal cancer imaging in a pilot patient study\***, Xiangdong Leng, Washington Univ. in St. Louis (USA); William Chapman Jr., Washington Univ. School of Medicine in St. Louis (USA); Hongbo Luo, Guang Yang, Washington Univ. in St. Louis (USA); Matthew Mutch, Washington Univ. School of Medicine in St. Louis (USA); Quing Zhu, Washington Univ. in St. Louis (USA) . . . . . [11240-54]

9:00 am: **Dual modality probe for photoacoustic tomography and widefield endoscopy\***, Rehman Ansari, Nam Trung Huynh, Edward Zhang, Paul C. Beard, Univ. College London (United Kingdom) . . . . . [11240-55]

9:15 am: **Characterizing intestinal obstruction using a photoacoustic-ultrasound catheter**, Yunhao Zhu, Univ. of Michigan (China); Linyu Ni, Laura A. Johnson, Univ. of Michigan (USA); Jie Yuan, Nanjing Univ. (China); Xueding Wang, Peter D. R. Higgins, Guan Xu, Univ. of Michigan (USA) . . . . . [11240-56]

9:30 am: **Towards a miniaturized all-fiber photoacoustic endoscope**, Qiang Li, Yizhi Liang, Long Jin, Bai-Ou Guan, Jinan Univ. (China) . . . . . [11240-57]

9:45 am: **Development of a miniature balloon probe for light-enhanced transesophageal echocardiography: towards transnasal deployment**, Li Li, Hemanth K. Gutti, Zhiqiang Wang, Fouad Attioui, Jia Liu, Guillermo J. Tearney, Massachusetts General Hospital (USA) . . . . . [11240-172]

10:00 am: **Characterizing the biomechanical marker of intestinal fibrosis using endoscopic strain-photoacoustic imaging**, Linyu Ni, Univ. of Michigan (USA); Yunhao Zhu, Nanjing Univ. (China); Laura A. Johnson, Jonathan M. Rubin, Univ. of Michigan Medical School (USA); Jie Yuan, Nanjing Univ. (China); Xueding Wang, Peter D. R. Higgins, Univ. of Michigan (USA); Guan Xu, Univ. of Michigan Medical School (USA) . . . . . [11240-59]

Coffee Break. . . . . Tue 10:15 am to 10:45 am

# CONFERENCE 11240

## SESSION 11

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... TUE 10:45 AM TO 12:15 PM

### Multi-modality Imaging

Session Chairs: **Quing Zhu**, Washington Univ. in St. Louis (USA);  
**Albert Claude Boccara**, Institut Langevin Ondes et Images (France)

10:45 am: **Seamlessly integrated optical and acoustical imaging systems through transparent ultrasonic transducer**, Jeongwoo Park, Byullee Park, Taeyeong Kim, Donghyun Lee, Uijung Yong, Jinah Jang, Unyong Jeong, Hyung Ham Kim, Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11240-62]

11:00 am: **Non-invasive photothermal strain imaging for diagnosis of non-alcoholic fatty liver disease**, Changhoon Choi, Wonseok Choi, Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11240-63]

11:15 am: **Simultaneous optoacoustic, pulse-echo and transmission ultrasound tomography of mice**, Elena Mercep, iThera Medical GmbH (Germany); Joaquin L. Herraiz, Univ. Complutense de Madrid (Spain); Xosé Luis Deán-Ben, Daniel Razansky, Univ. Zürich (Switzerland) ... [11240-66]

11:30 am: **High-speed VIS-NIR Raman fiber laser for combined photoacoustic microscopy and optical coherence tomography**, Soon-Woo Cho, Soo-Jin Kim, Hansol Jang, Chang-Seok Kim, Pusan National Univ. (Korea, Republic of) ..... [11240-68]

11:45 am: **LED-based photoacoustic imaging system - why it achieves the same signal-to-noise ratio as solid-state-laser-based system**, Toshitaka Agano, Osaka Univ. (Japan) ..... [11240-69]

12:00 pm: **Tomographic imaging with an LED-based photoacoustic-ultrasound system**, Francis Kalloor Joseph, Damien Gasteau, Univ. of Twente (Netherlands); Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Wiendelt Steenbergen, Univ. of Twente (Netherlands) ..... [11240-71]

Lunch Break ..... Tue 12:15 pm to 1:45 pm

## SESSION 12

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... TUE 1:45 PM TO 3:15 PM

### Microscopy I

Session Chairs: **Lihong V. Wang**, Caltech (USA);  
**Changhui Li**, Peking Univ. (China)

1:45 pm: **Combined spectral-domain optical coherence tomography and photoacoustic remote sensing microscopy**, Matthew T. Martell, Cory Rewcastle, Roger J. Zemp, Univ. of Alberta (Canada) ..... [11240-72]

2:00 pm: **Ultra-high-speed wide-field photoacoustic microscopy using a polygon mirror scanner**, Junjie Yao, Bangxin Lan, Wei Liu, Duke Univ. (USA); Qifa Zhou, The Univ. of Southern California (USA); Jun Zou, Texas A&M Univ. (USA); Ulrike Hoffmann, Wei Yang, Duke Univ. (USA) ..... [11240-73]

2:15 pm: **High-speed label-free galvo mirror scanning-based ultraviolet photoacoustic microscopy for histological imaging**, Xiufeng Li, Lei Kang, Yan Zhang, Terence Wong, Hong Kong Univ. of Science and Technology (Hong Kong, China) ..... [11240-74]

2:30 pm: **High-speed wide-field multi-parametric photoacoustic microscopy**, Fenghe Zhong, Univ. of Virginia (USA); Ruimin Chen, Qifa Zhou, The Univ. of Southern California (USA); Song Hu, Univ. of Virginia (USA) ..... [11240-75]

2:45 pm: **In vivo cuticle intact Drosophila mushroom body imaging using laser scanning optical resolution photoacoustic microscopy**, Kai-Yao Chang, Wen-Hung Shih, Shun-Chi Wu, National Tsing Hua Univ. (Taiwan); Kwok Ho Lam, The Hong Kong Polytechnic Univ. (China); Yen-Yin Lin, Ann-Shyn Chiang, Meng-Lin Li, National Tsing Hua Univ. (Taiwan) ... [11240-76]

3:00 pm: **Ultra-sensitive photoacoustic microscopy based on high numerical aperture acoustic lens**, Mingsheng Li, Jiangbo Chen, Lidai Wang, City Univ. of Hong Kong (Hong Kong, China) ..... [11240-77]

Coffee Break ..... Tue 3:15 pm to 3:45 pm

## SESSION 13

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... TUE 3:45 PM TO 5:30 PM

### Microscopy II

Session Chairs: **Paul C. Beard**, Univ. College London (United Kingdom); **Roger J. Zemp**, Univ. of Alberta (Canada)

3:45 pm: **Fast optical and acoustic-resolution photoacoustic microscopy using structured interrogation of a Fabry-Pérot sensor**, Ulrike Pöhle, Martin-Luther-Univ. Halle-Wittenberg (Germany); Elisabeth Baumann, Max-Delbrück-Ctr. für Molekulare Medizin Berlin-Buch (Germany); Claus Villringer, Silvio Pulwer, Technische Hochschule Wildau (Germany); Edward Zhang, Thomas J. Allen, Univ. College London (United Kingdom); Robert Nuster, Karl-Franzens-Univ. Graz (Austria); Jan Laufer, Martin-Luther-Univ. Halle-Wittenberg (Germany) ..... [11240-78]

4:00 pm: **Photoacoustic microscopy by spatial overlap modulation using femtosecond optical pulse train**, Yoshihisa Yamaoka, Koki Matsumoto, Yusuke Notsuka, Eiji Takahashi, Saga Univ. (Japan) ..... [11240-79]

4:15 pm: **Ultra-low energy photoacoustic microscopy in ocular imaging and safety evaluation**, Wei Zhang, Yanxiu Li, Van Phuc Nguyen, Yannis M. Paulus, Xueding Wang, Univ. of Michigan (USA) ..... [11240-80]

4:30 pm: **A comprehensive characterization of a stimulated Raman scattering fiber-laser source for multi-wavelength dependent photoacoustic microscopy techniques**, Serene O. Abu-Sardana, Chandravadni Subramaniam, Saad Rasheed Abbasi, Parsin Haji Reza, Univ. of Waterloo (Canada) ..... [11240-81]

4:45 pm: **Functional optical-resolution photoacoustic microscopy with ultra-short pulse delay**, Yingying Zhou, The Hong Kong Polytechnic Univ. (Hong Kong, China); Siyi Liang, Lidai Wang, City Univ. of Hong Kong (Hong Kong, China); Puxiang Lai, The Hong Kong Polytechnic Univ. (Hong Kong, China) ..... [11240-82]

5:00 pm: **Simple high-speed multimode fibre calibration for photoacoustic endomicroscopy**, Tianrui Zhao, King's College London (United Kingdom); Tom Vercauteren, Wenfeng Xia, King's College London (United Kingdom) and Univ. College London (United Kingdom) ..... [11240-83]

5:15 pm: **Photoacoustic and fluorescence microscopy through a multimode fiber by use of optical wavefront shaping**, Sylvain Mezil, Irène Wang, Philippe Moreau, Théodore Remark, Antonio M. Caravaca-Aguirre, Emmanuel Bossy, Lab. Interdisciplinaire de Physique (France) and Univ. Grenoble Alpes (France) and CNRS (France) ..... [11240-84]

## POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the BIOS/LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Tuesday 10:00 AM – 5:00 PM

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**Photoacoustic signal waveform numerical simulation**, Jinjun Xia, Lawrence Technological Univ. (USA) ..... [11240-163]

**Transfer function computation of neurovascular coupling: advantages and pitfalls**, Davide Boido, Ali-Kemal Aydin, Yannick Goulam-Houssen, Serge Charpak, INSERM (France) ..... [11240-164]

**Three-dimensional photoacoustic image-guidance of biopsy needles**, Hang Wang, Songde Liu, Tong Wang, Chenxi Zhang, Chao Tian, Univ. of Science and Technology of China (China) ..... [11240-165]

**X-Ray induced acoustic tomography for real-time monitoring during external beam radiotherapy with rabbit in vivo**, Wei Zhang, Hao Lei, Ibrahim Oraiqat, Issam El Naqa, Xueding Wang, Univ. of Michigan (USA) ..... [11240-166]

**Simultaneous multi-modality optical coherence tomography, photoacoustic microscopy and fluorescence microscopy imaging of rabbits eye in vivo**, Wei Zhang, Yanxiu Li, Yixin Yu, Van Phuc Nguyen, Yannis M. Paulus, Xueding Wang, Univ. of Michigan (USA) ..... [11240-167]

**3D X-ray induced acoustic computed tomography: a phantom study**, Seongwook Choi, Donghyun Lee, Eun-Yeong Park, Pohang Univ. of Science and Technology (Korea, Republic of); Jung-Joon Min, Changho Lee, Chonnam National Univ. Hwasun Hospital (Korea, Republic of); Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) ..... [11240-168]

**The effect of phase control in photo-mediated ultrasound therapy.** Yu Qin, Tongji Univ. (China) and Univ. of Michigan (USA); Yixin Yu, Univ. of Michigan (USA); Xinyi Xie, Nanjing Medical Univ. (China); Wei Zhang, Julia Fu, Univ. of Michigan (USA); Yannis M. Paulus, Univ. of Michigan-Kellogg Eye Ctr. (USA); Xinmai Yang, The Univ. of Kansas (USA); Xueding Wang, Univ. of Michigan (USA) . . . . . [11240-169]

**Highly efficient conversion of microwave into ultrasound wave through a split ring resonator,** Lu Lan, Yueming Li, Tiffany Yang Tran, Yingchun Cao, Ji-Xin Cheng, Boston Univ. (USA) . . . . . [11240-170]

**Photoacoustic histology of oxidative stress-induced hippocampal cell death in a mouse brain,** Hyojin Kim, Jin Woo Baik, Jin Young Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Myeongjoo Son, Gachon Univ. (Korea, Republic of); Kyunghye Byun, Gachon Univ. of Medicine and Science (Korea, Republic of); Hae Young Choi, Daegu-Gyeongbuk Medical Innovation Foundation (Korea, Republic of); Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11240-171]

**Label-free photoacoustic imaging for healing process monitoring of Achilles tendon rupture,** Eunwoo Park, Yong-Jae Lee, Jun Geun Shin, Gwangju Institute of Science and Technology (Korea, Republic of); Myung-Sun Kim, Chonnam National Univ. Medical School (Korea, Republic of); Changho Lee, Chonnam National Univ. Hwasun Hospital (Korea, Republic of); Tae Joong Eom, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [11240-173]

**The assessment of rheumatoid arthritis using of a multi-modal photoacoustic/ultrasonic imaging system: a preliminary clinical study,** Chenyang Zhao, Xixi Tao, Sirui Liu, Zhenhong Qi, Jianchu Li, Peking Union Medical College Hospital (China); Fang Yang, Lei Zhu, Shenzhen Mindray Bio-Medical Electronics Co., Ltd. (China); Meng Yang, Yuxin Jiang, Peking Union Medical College Hospital (China) . . . . . [11240-174]

**3D Simulation of the photoacoustic signal generation and propagation in human calcaneus bone,** Ting Feng, Tongji Univ. (China); Yunhao Zhu, Nanjing Univ. (China); Chengcheng Liu, Weiya Xie, Qian Cheng, Tongji Univ. (China); Xueding Wang, Univ. of Michigan (USA) . . . . . [11240-175]

**Intraplaque haemorrhage detection with single-wavelength photoacoustic imaging in the carotid artery,** Roy P. M. van Hees, Min Wu, Richard G. P. Lopata, Marcel C. M. Rutten, Technische Univ. Eindhoven (Netherlands) . . . . . [11240-176]

**Evaluation of inflammatory degree using model rats by multi-wavelength photoacoustic imaging system,** Kohei Ogawa, Takeshi Namita, Kengo Kondo, Makoto Yamakawa, Tsuyoshi Shiina, Kyoto Univ. (Japan) . . . [11240-177]

**Multi-wavelength optical resolution photoacoustic microscopy using fiber based near infrared and Raman laser,** Jiangbo Chen, Lidai Wang, City Univ. of Hong Kong (Hong Kong, China) . . . . . [11240-178]

**Improvement of LED-based photoacoustic image quality using intermittent pulse echo acquisitions,** Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Naoto Sato, Fumiyuki Ichihashi, Yoshiyuki Sankai, Cyberdyne, Inc. (Japan) . . . . . [11240-179]

**Detecting and evaluating lipid-rich artery plaque using a handheld photoacoustic imaging system,** Kazuma Shiotani, Takeshi Namita, Kengo Kondo, Makoto Yamakawa, Tsuyoshi Shiina, Kyoto Univ. (Japan) . . . . . [11240-180]

**Bridging the gap between simulated and in vivo photoacoustic images with a deep learning enabled simulation pipeline,** Kris Dreher, Tim Adler, Janek Gröhl, Thomas Kirchner, Lena Maier-Hein, Deutsches Krebsforschungszentrum (Germany) . . . . . [11240-181]

**A GPU approach to real-time coherence-based photoacoustic imaging and its application to photoacoustic visual servoing,** Eduardo Gonzalez, Muyinatu Bell, Johns Hopkins Univ. (USA) . . . . . [11240-182]

**Going with photoacoustics,** Dana Wegierak, Filip Bodera, Ryerson Univ. (Canada); Al Christopher De Leon, Peiran Wei, Madelyn McMillen, David Yan, Christina Hemmings, Emily Pentzer, Agata A. Exner, Michael C. Kolios, Case Western Reserve Univ. (USA) . . . . . [11240-183]

**Evaluation of spectral unmixing accuracy during photoacoustic imaging of gold nanorods at various blood oxygenation levels,** William C. Vogt, Andrew M. Fales, Joshua Pifer, U.S. Food and Drug Administration (USA) . . . . . [11240-184]

**A modular approach to neonatal whole-brain photoacoustic tomography,** Ajay Dangi, Haoyang Chen, Christopher Fadden, Sumit Agrawal, Christopher Wible, Songning Zhu, Mohamed Osman, Sri-Rajasekhar Kothapalli, The Pennsylvania State Univ. (USA) . . . . . [11240-185]

**Light emitting diode based multispectral photoacoustic tomography,** Sumit Agrawal, Christopher Fadden, Ajay Dangi, Xinyi Yang, Hussain Albahrani, Neilesh Frings, Sara Heidari Zadi, Sri-Rajasekhar Kothapalli, The Pennsylvania State Univ. (USA) . . . . . [11240-186]

**Photoacoustic imaging capabilities of Light Emitting Diodes (LED) and laser sources: A comparison study,** Sumit Agrawal, Ajay Dangi, Christopher Fadden, Xinyi Yang, Hussain Albahrani, Sara Heidari Zadi, The Pennsylvania State Univ. (USA); Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Sri-Rajasekhar Kothapalli, The Pennsylvania State Univ. (USA) . . . . . [11240-187]

**Functional, molecular, and structural imaging using an LED-based photoacoustic and ultrasound imaging system,** Sumit Agrawal, The Pennsylvania State Univ. (USA); Mithun Kuniyil Ajith Singh, Cyberdyne, Inc. (Netherlands); Ajay Dangi, Christopher Fadden, Xinyi Yang, Sara Heidari Zadi, Sri-Rajasekhar Kothapalli, The Pennsylvania State Univ. (USA) . . . . [11240-188]

**Characterization of a photoacoustic-fluorescence tomography system,** Maryam Basij, Yan Yan, Wayne State Univ. (USA); Sergey A. Ermilov, Hans-Peter Brecht, Weylan Thompson, PhotoSound Technologies, Inc. (USA); Mohammad Mehrmohammadi, Wayne State Univ. (USA) . . . . . [11240-189]

**Camera-based tabletop photoacoustic imaging system,** Robert Nuster, Günther Paltauf, Karl-Franzens-Univ. Graz (Austria) . . . . . [11240-190]

**Compact photoacoustic add-on for a reflectance confocal microscope,** Guenther Paltauf, Robert Nuster, Karl-Franzens-Univ. Graz (Austria); Rainer Hofmann-Wellenhof, Medizinischen Univ. Graz (Austria) . . . [11240-191]

**A new photoacoustic breast cancer tomography system that images the patient in standing pose,** Jun Xia, Nikhila Nyayapathi, Huijuan Zhang, Melinda Tiao, Univ. at Buffalo (USA); X. Cynthia Fan, Windsong Radiology (USA); Ermelinda Bonaccio, Kazuaki Takabe, Roswell Park Comprehensive Cancer Ctr. (USA) . . . . . [11240-192]

**Minimally invasive photoacoustic imaging for device guidance and monitoring of radiofrequency ablation,** Francis Kalloor Joseph, Hindrik Kruit, Srirang Manohar, Univ. of Twente (Netherlands) . . . . . [11240-58]

WEDNESDAY 5 FEBRUARY

SESSION 14

LOCATION: ROOM 201 (LEVEL 2 SOUTH) . . . . . WED 8:30 AM TO 10:00 AM

Functional, Molecular, and Quantitative I

Session Chairs: **Ben T. Cox**, Univ. College London (United Kingdom); **Pai-Chi Li**, National Taiwan Univ. (Taiwan)

8:30 am: **Ultrafast imaging of cardiac electromechanical wave propagation with volumetric optoacoustic tomography\***, Çağla Özsoy, ETH Zurich (Switzerland); Ali Özbek, Helmholtz Zentrum München GmbH (Germany); Xosé Luis Deán-Ben, Daniel Razansky, Univ. Zürich (Switzerland) . . [11240-85]

8:45 am: **Fundamental studies comparing nanobubbles and microbubbles as vascular disrupting agents: Elucidating on the mechanism of action using photoacoustic imaging,** Eno Hysi, Muhannad N. Fadhel, Ryerson Univ. (Canada) and Institute for Biomedical Engineering, Science and Technology (Canada); Anoja Giles, Sunnybrook Research Institute (Canada) and Sunnybrook Health Sciences Ctr. (Canada); Yanjie Wang, Joseph A. Sebastian, Ryerson Univ. (Canada) and Institute for Biomedical Engineering, Science and Technology (Canada); Gregory J. Czarnota, Sunnybrook Health Sciences Ctr. (Canada); Agata A. Exner, Case Western Reserve Univ. (USA); Michael C. Kolios, Ryerson Univ. (Canada) and Institute for Biomedical Engineering, Science and Technology (Canada) . . . . . [11240-86]

9:00 am: **Quantitative photoacoustic oximetry using convolutional neural networks,** Kevin Hoffer-Hawlik, Austin Van Namen, Geoffrey P. Luke, Thayer School of Engineering at Dartmouth (USA) . . . . . [11240-87]

9:15 am: **Nanosensor-enabled in vivo photoacoustic potassium imaging,** Joel W. Y. Tan, Jeff Folz, Raoul Kopelman, Xueding Wang, Univ. of Michigan (USA) . . . . . [11240-88]

9:30 am: **A photoacoustic whole-breast three-dimensional imaging prototype: initial results,** Guangjie Zhang, Tao Han, Changhui Li, Peking Univ. (China) . . . . . [11240-89]

9:45 am: **Photoacoustic microscopy of metabolic dysfunction in neonatal hypoxic-ischemic encephalopathy,** Naidi Sun, Rui Cao, Yu-Yo Sun, Yiming Wang, Hong-Ru Chen, Chia-Yi Kuan, Song Hu, Univ. of Virginia (USA) . . . . . [11240-90]

Coffee Break. . . . . Wed 10:00 am to 10:30 am

# CONFERENCE 11240

## SESSION 15

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 12:00 PM

### Functional, Molecular, and Quantitative II

Session Chairs: **Roger J. Zemp**, Univ. of Alberta (Canada);  
**Matthew O'Donnell**, Univ. of Washington (USA)

10:30 am: **Towards accurate quantitative photoacoustic imaging of vascular sO<sub>2</sub> with deep learning\***, Ciaran Bench, Univ. College London (United Kingdom); Andreas Hauptmann, Univ. of Oulu (Finland); Simon Arridge, Paul C. Beard, Ben T. Cox, Univ. College London (United Kingdom) . [11240-60]

10:45 am: **Label-free collagen-selective photoacoustic imaging system based on a 1560 nm pulsed fiber laser**, Yong-Jae Lee, Eunwoo Park, Jun Geun Shin, Gwangju Institute of Science and Technology (Korea, Republic of); Changho Lee, Chonnam National Univ. Hwasun Hospital (Korea, Republic of); Tae Joong Eom, Gwangju Institute of Science and Technology (Korea, Republic of) . [11240-61]

11:00 am: **Polyacrylamide hydrogel phantoms for performance evaluation of multispectral photoacoustic imaging systems**, Ali Hariri, Univ. of California, San Diego (USA); Keith A. Wear, Joshua Pfefer, U.S. Food and Drug Administration (USA); Jesse V. Jokerst, Univ. of California, San Diego (USA); William C. Vogt, U.S. Food and Drug Administration (USA) . [11240-64]

11:15 am: **3D photoacoustic and ultrasound imaging of chicken embryo vasculature using a sparse array**, Guillaume Godefroy, Bastien Arnal, Sergey Vilov, Emmanuel Bossy, Lab. Interdisciplinaire de Physique (France), Univ. Grenoble Alpes (France), CNRS (France) . [11240-65]

11:30 am: **Thermal-energy memory based photoacoustic thermometry (TEMPT) in deep tissue**, Junjie Yao, Duke Univ. (USA); Yuan Zhou, Tsinghua Univ. (China); Mucong Li, Duke Univ. (USA); Jianwen Luo, Tsinghua Univ. (China); Pei Zhong, Duke Univ. (USA) . [11240-67]

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11:45 am: **Low complexity and flexible baseband delay-multiply-and-sum photoacoustic array imaging**, Meng-Lin Li, National Tsing Hua Univ. (Taiwan); Che-Chou Shen, National Taiwan Univ. of Science and Technology (Taiwan) . [11240-70]

Lunch Break ..... Wed 12:00 pm to 1:30 pm

## SESSION 16

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... WED 1:30 PM TO 3:00 PM

### Functional, Molecular, and Quantitative III

Session Chairs: **Chulhong Kim**, Pohang Univ. of Science and Technology (Korea, Republic of); **Vasilis Ntziachristos**, Technische Univ. München (Germany)

1:30 pm: **Modelling of uncertainties in ultrasound sensor locations in photoacoustic tomography**, Teemu Sahlström, Aki Pulkkinen, Jenni Tick, Jarkko Leskinen, Univ. of Eastern Finland (Finland); Tanja Tarvainen, Univ. of Eastern Finland (Finland) and Univ. College London (United Kingdom) . [11240-91]

1:45 pm: **Methemoglobin quantification for monitoring vascular targeted cancer therapy using photoacoustic imaging**, Muhannad N. Fadhel, Sila Appak-Baskoy, Yanjie Wang, Eno Hysi, Maurice Pasternak, Michael C. Kolios, Ryerson Univ. (Canada) . [11240-92]

2:00 pm: **Efficient segmentation of multi-modal optoacoustic and ultrasound images using convolutional neural networks**, Berkan Lafci, ETH Zurich (Switzerland), Univ. Zürich (Switzerland); Elena Mercep, iThera Medical GmbH (Germany), Technische Univ. München (Germany); Stefan Morscher, iThera Medical GmbH (Germany); Xosé Luís Deán-Ben, Daniel Razansky, Univ. Zürich (Switzerland), ETH Zurich (Switzerland) . [11240-93]

2:15 pm: **Reflection mode acousto-optic imaging using a 1-D ultrasound array**, Lukasz Nowak, Wiendelt Steenbergen, Univ. of Twente (Netherlands) . [11240-94]

2:30 pm: **Deep learning-based oxygenation estimation and tissue classification for multispectral photoacoustic imaging**, Janek Gröhl, Thomas Kirchner, Tim Adler, Lena Maier-Hein, Deutsches Krebsforschungszentrum (Germany) . [11240-95]

2:45 pm: **Fluence compensation for real-time photoacoustic system**, Minwoo Kim, Geng-Shi Jeng, Ivan Pelivanov, Matthew O'Donnell, Univ. of Washington (USA) . [11240-96]

Coffee Break ..... Wed 3:00 pm to 3:30 pm

## SESSION 17

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... WED 3:30 PM TO 4:45 PM

### Novel Approaches and Applications

Session Chairs: **Vladimir P. Zharov**, Univ. of Arkansas for Medical Sciences (USA); **Matthew O'Donnell**, Univ. of Washington (USA)

3:30 pm: **Photoacoustic computed tomography guided microrobots for targeted navigation in intestines in vivo\***, Lei Li, Zhiguang Wu, Yiran Yang, Peng Hu, Wei Gao, Lihong V. Wang, Caltech (USA) . [11240-97]

3:45 pm: **Transparent capacitive micromachined ultrasound transducer linear arrays for high-resolution photoacoustic imaging applications**, Afshin Kashani Ilkhechi, Zhenhao Li, Roger J. Zemp, Univ. of Alberta (Canada) . [11240-98]

4:00 pm: **Overlapping volumes, acousto-optic modulated diffuse correlation spectroscopy for increased depth sensitivity**, Mitchell B. Robinson, Harvard-MIT Health Sciences and Technology (USA) and Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA); Stefan A. Carp, Sava Sakadzic, Adriano Peruch, Davide Tamborini, Maria Angela Franceschini, Athinoula A. Martinos Ctr. for Biomedical Imaging, Massachusetts General Hospital (USA) . [11240-99]

4:15 pm: **In vivo superresolution photoacoustic computed tomography by localization of single dyed droplets**, Lei Li, Caltech (USA); Pengfei Zhang, Tianjin Univ. (China); Lihong V. Wang, Caltech (USA) . [11240-100]

4:30 pm: **Aberrant hippocampal neurogenesis prevention using nano-pulsed laser therapy**, Adelaide Micci, Emanuele Mocciaro, Auston Grant, Irene Y. Petrov, Yuriy Petrov, Donald S. Prough, Elizabeth Bishop, Margaret A. Parsley, Jutatip Guptarak, Ian J. Bolding, Kathia M. Johnson, Rinat O. Esenaliev, The Univ. of Texas Medical Branch (USA) . [11240-102]

## BEST PAPER AWARD

LOCATION: ROOM 201 (LEVEL 2 SOUTH) ..... 5:00 PM TO 5:15 PM

### Seno Medical Best Paper Award Session

The Best Paper is selected by the Organizing Committee and the Award is presented by the sponsor, **Seno Medical Instruments, Inc.**

*Award candidate papers are presented in the conference sessions and marked with \* (see program):*

11240-1, 11240-27, 11240-40, 11240-53, 11240-54, 11240-55, 11240-60, 11240-72, 11240-85, 11240-97

# CONFERENCE 11241

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY)

Monday 3 February 2020 • Proceedings of SPIE Vol. 11241

## Biophotonics and Immune Responses XV

Conference Chair: **Wei R. Chen**, Univ. of Central Oklahoma (USA)

Program Committee: **Sandra O. Gollnick**, Roswell Park Comprehensive Cancer Ctr. (USA); **Michael R. Hamblin**, Wellman Ctr. for Photomedicine (USA); **Tomas Hode**, Immunophotonics, Inc. (USA); **Yih-Chih Hsu**, Chung Yuan Christian Univ. (Taiwan); **Mladen Korbelik**, BC Cancer Research Ctr. (Canada); **Hong Liu**, The Univ. of Oklahoma (USA); **Mark F. Naylor**, Dermatology Associates of San Antonio (USA); **Junle Qu**, Shenzhen Univ. (China); **Oxana V. Semyachkina-Glushkovskaya**, Saratov State Univ. (Russian Federation); **Robert T. van Kooten**, Amsterdam UMC (Netherlands); **Xunbin Wei**, Shanghai Jiao Tong Univ. (China); **Da Xing**, South China Normal Univ. (China); **Zhihong Zhang**, Huazhong Univ. of Science and Technology (China); **Feifan Zhou**, Shenzhen Univ. (USA)

### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . MON 8:30 AM TO 10:05 AM

#### Phototherapy and Immunotherapy

Session Chairs: **Mark F. Naylor**, Baylor Scott & White Health (USA); **Oxana V. Semyachkina-Glushkovskaya**, Saratov State Univ. (Russian Federation)

8:30 am: **Comparison of PDT with various thermal tumor ablation therapies** (*Invited Paper*), Mladen Korbelik, BC Cancer Research Ctr. (Canada) . . . . . [11241-1]

8:55 am: **Pilot study of transcranial photobiomodulation of lymphatic clearance of beta-amyloid from the mouse brain: breakthrough strategies for non-pharmacologic therapy of Alzheimer's disease** (*Invited Paper*), Oxana V. Semyachkina-Glushkovskaya, Ekaterina Zinchenko, Maria Klimova, Andrey Terskov, Arkady Abdurashitov, Alexander Dubrovsky, Inna Blokhina, Alexander Khorovodov, Ilana Agranovich, Saratov State Univ. (Russian Federation); Nikita Navolokin, Saratov State Medical Univ. (Russian Federation); Alexander Shirokov, Institute of Biochemistry and Physiology of Plants and Microorganisms (Russian Federation); Elena Saranceva, Aysel Mamedova, Saratov State Univ. (Russian Federation); Valery Tuchin, Saratov State Univ. (Russian Federation) and Tomsk State Univ. (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation); Juergen Kurths, Saratov State Univ. (Russian Federation) and Humboldt-Univ. zu Berlin (Germany) and Potsdam-Institut für Klimafolgenforschung (Germany). [11241-2]

9:20 am: **A distinct role of skin-resident dendritic cells in augmenting the efficacy of intradermal vaccine with non-pulsed near-infrared laser adjuvant** (*Invited Paper*), Satoshi Kashiwagi, Massachusetts General Hospital (USA); Wataru Katagiri, Massachusetts General Hospital (USA) and Keio Univ. (Japan); Yoshifumi Kimizuka, National Defense Medical College (Japan). . . . . [11241-3]

9:45 am: **The current state of immunotherapy and the potential impact of new approaches using immunophotonics**, Mark F. Naylor, Baylor Scott & White Health (USA); Wei R. Chen, Univ. of Central Oklahoma (USA). . . [11241-4]

Coffee Break . . . . . Mon 10:05 am to 10:35 am

#### SESSION 2

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . MON 10:35 AM TO 12:05 PM

#### Nanotechnology-Based Photo-Immunotherapy

Session Chairs: **Feifan Zhou**, Shenzhen Univ. (China); **Wei R. Chen**, Univ. of Central Oklahoma (USA)

10:35 am: **Photo-nano immunotherapy for metastatic cancer** (*Invited Paper*), Feifan Zhou, Shenzhen Univ. (China); Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . . [11241-5]

11:00 am: **Nanotechnology-based phototherapy for cancer treatment** (*Invited Paper*), Wei R. Chen, Univ. of Central Oklahoma (USA); Benqing Zhou, Meng Wang, Feifan Zhou, Shenzhen Univ. (China). . . . . [11241-6]

11:25 am: **Biodegradable polymeric nanoparticles enhanced the effectiveness of topical PDT for squamous cell carcinoma**, Lei Shi, Xiuli Wang, Shanghai Skin Disease Hospital (China) . . . . . [11241-7]

11:45 am: **Polypyrrole nanoparticles as drug delivery and photothermal agents**, Connor L. West, Austin C. Doughty, Kaili Liu, Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . . [11241-8]

Lunch Break . . . . . Mon 12:05 pm to 1:35 pm

#### SESSION 3

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . MON 1:35 PM TO 3:25 PM

#### Monitoring Immune Responses

Session Chairs: **Zhihong Zhang**, Huazhong Univ. of Science and Technology (China); **Ekaterina I. Galanzha**, Univ. of Arkansas for Medical Sciences (USA)

1:35 pm: **Visualization of tumor metastasis and anti-tumor immune response in liver** (*Invited Paper*), Zhihong Zhang, Huazhong Univ. of Science and Technology (China) . . . . . [11241-9]

2:00 pm: **Integrated lymph and blood photoacoustic test for advanced diagnosis of early circulating tumor cells** (*Invited Paper*), Mikyung Han, Julia Watts, Azemat Jamshidi-Parsian, Univ. of Arkansas for Medical Sciences (USA); Urooba Nadeem, The Univ. of Chicago Medicine (USA); Mustafa Sarimollaoglu, Eric R. Siegel, Vladimir P. Zharov, Ekaterina I. Galanzha, Univ. of Arkansas for Medical Sciences (USA). . . . . [11241-10]

2:25 pm: **Transcriptional profiling of breast tumor cells responding to phototherapy and immunological stimulation**, Kaili Liu, Ashley Hoover, Connor L. West, Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . [11241-11]

2:45 pm: **Photoacoustic imaging applied to liver hepatic lobule imaging and Kupffer cell localization in vivo**, Deqiang Deng, Zhihong Zhang, Huazhong Univ. of Science and Technology (China) . . . . . [11241-12]

3:05 pm: **Real time monitoring of daily variation of circulating tumor cells by in vivo flow cytometry**, Xi Zhu, Qi Liu, Xunbin Wei, Shanghai Jiao Tong Univ. (China) . . . . . [11241-13]

Coffee Break . . . . . Mon 3:25 pm to 3:55 pm

#### SESSION 4

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . MON 3:55 PM TO 5:45 PM

#### Novel Detection Technologies

Session Chairs: **Yuchen Qiu**, The Univ. of Oklahoma (USA); **Dmitry A. Gorin**, Skolkovo Institute of Science and Technology (Russian Federation)

3:55 pm: **Utilizing a transferring model to classify epithelium and stroma on digital histopathological images for ovarian cancer patients** (*Invited Paper*), Xuxin Chen, The Univ. of Oklahoma (USA); Roy Zhang, Kar-Ming Fung, The Univ. of Oklahoma Health Sciences Ctr. (USA); Hong Liu, Bin Zheng, Yuchen Qiu, The Univ. of Oklahoma (USA) . . . . . [11241-14]

4:20 pm: **Multifunctional bimodal optoacoustic & fluorescent probes** (*Invited Paper*), Dmitry A. Gorin, Skolkovo Institute of Science and Technology (Russian Federation). . . . . [11241-15]

4:45 pm: **Photoacoustic microscopy for bone microstructure analysis**, John A. Merrill, Siqi Wang, Yue Zhao, Yizhou Li, Dustin Arellano, Liangzhong Xiang, The Univ. of Oklahoma (USA) . . . . . [11241-16]

5:05 pm: **Two-photon flow cytometry with laser scanning 2D Airy beams**, Chunqiang Li, Aurelio Paez, Gilberto Navarro, The Univ. of Texas at El Paso (USA) . . . . . [11241-17]

5:25 pm: **Insights on non-invasive photothermal therapy of tumors with conical fiber tip**, Austin C. Doughty, Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . . [11241-18]

# CONFERENCE 11241

## POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Kinetic analysis of DNA and DOX binding process using fluorescence lifetime imaging**, Sheng Ren, Yihua Zhao, Junle Qu, Liwei Liu, Shenzhen Univ. (China) . . . . . [11241-19]

**The protective effect on ulcerative colitis of san huang shu ai decoction by inhibited the IL-1 $\beta$  and telomerase**, Jianping Deng, Guangdong Pharmaceutical Univ. (China); Tong-Sheng Chen, Institute of Laser Life Science, South China Normal Univ. (China); Yifei Wang, Institute of Biological Medicine, Jinan Univ. (China); Zhi-Ping Wang, Guangdong Pharmaceutical Univ. (China) . . . . . [11241-20]

**Carbon nanotube hydrogel for tumor photoacoustic imaging and temperature monitoring**, Feifan Zhou, Siyu Liu, Meng Wang, Shenzhen Univ. (China) . . . . . [11241-21]

**Evaluation the effect on ulcerative colitis of traditional Chinese medicine formula huanglian-huangqin herbal pair**, Zhi-Ping Wang, Guangdong Pharmaceutical Univ. (China); Tong-Sheng Chen, Institute of Laser Life Science, South China Normal Univ. (China) . . . . . [11241-22]

**Evaluation the effect on ulcerative colitis of traditional Chinese medicine formula lianzhixiaoyan tablet**, Jianping Deng, Guangdong Pharmaceutical Univ. (China); Tong-Sheng Chen, Institute of Laser Life Science, South China Normal Univ. (China); Zhi-Ping Wang, Guangdong Pharmaceutical Univ. (China) . . . . . [11241-23]

**Evaluation the effect on ulcerative colitis of traditional Chinese medicine formula Hu zhen tong feng capsule**, Jintao Huang, Guangdong Pharmaceutical Univ. (China); Tong-Sheng Chen, Institute of Laser Life Science, South China Normal Univ. (China); Zhi-Ping Wang, Guangdong Pharmaceutical Univ. (China) . . . . . [11241-24]

**Evaluation the effect on ulcerative colitis of traditional Chinese medicine formula qing kai ling oral liquid**, Kang Du, Zhi-Ping Wang, Guangdong Pharmaceutical Univ. (China); Tong-Sheng Chen, Institute of Laser Life Science, South China Normal Univ. (China) . . . . . [11241-25]

**Evaluation the effect on ulcerative colitis of traditional Chinese medicine formula ya dan zi oil oral emulsion**, Zi-Cong Wu, Guangdong Pharmaceutical Univ. (China); Tong-Sheng Chen, Institute of Laser Life Science, South China Normal Univ. (China); Zhi-Ping Wang, Guangdong Pharmaceutical Univ. (China) . . . . . [11241-26]

**Investigating the potential of reduced graphene oxide-low-density lipoprotein nanoparticles for photo-immunotherapy**, Kyra A. Gallagher, Austin C. Doughty, Elivia Layton, Sara Zukerman, Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . . [11241-27]

**Label-free counting of circulating melanoma cells in deep vessels with photoacoustic flow cytometry**, Qi Liu, Quanyu Zhou, Yuting Fu, Lechan Tao, Xi Zhu, Xunbin Wei, Shanghai Jiao Tong Univ. (China) . . . . . [11241-28]

**Virtual screened peptides with high affinity and specificity to tumors**, Zhihao Han, Shuaishuai Gong, China Pharmaceutical Univ. (China); Zhiyu Qian, Nanjing Univ. of Aeronautics and Astronautics (China); Yueqing Gu, China Pharmaceutical Univ. (China) . . . . . [11241-29]

**Impact of presowing laser irradiation on germination and sowing qualities of coniferous seeds**, Alexey Iakovlev, ITMO Univ. (Russian Federation) . . . . . [11241-30]

**Temperature feedback-controlled photothermal treatment of nasopharyngeal cancer: numerical evaluations**, Zhifang Li, ZhaoWei Zhong, Dezi Li, Fujian Normal Univ. (China); Yongping Lin, Xiamen Univ. of Technology (China); Feifan Zhou, Shenzhen Univ. (China) . . . . . [11241-31]

**GC effect on KCRL migration in a nested matrix model**, Zoe Andrews, Melville B. Vaughan, Univ. of Central Oklahoma (USA) . . . . . [11241-32]

**Developing a low cost image marker to identify lymph node metastasis for cervical cancer patients: an initial study**, Wei Liu, Xi'an Univ. of Posts and Telecommunications (China); Xuxin Chen, The Univ. of Oklahoma (USA); Theresa Thai, Camille Gunderson, Kathleen Moore, Robert Mannel, The Univ. of Oklahoma Health Sciences Ctr. (USA); Hong Liu, Bin Zheng, Yuchen Qiu, The Univ. of Oklahoma (USA) . . . . . [11241-33]

**Intracellular trafficking of immunostimulant in mouse primary bone marrow derived dendritic cells**, Sara Zukerman, Connor L. West, Univ. of Central Oklahoma (USA); Austin C. Doughty, The Univ. of Central Oklahoma (USA); Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . . [11241-34]

**OVA antigen-modified MnFe<sub>2</sub>O<sub>4</sub> nanoparticles loaded with immunoadjuvant for photothermal therapy and improved immunotherapy of breast cancer**, Benqing Zhou, Qiang Wu, Jun Song, Junle Qu, Shenzhen Univ. (China); Wei R. Chen, Univ. of Central Oklahoma (USA) . . . . . [11241-35]

**Application of carborane chitosan hydrogel as a new boron agent in boron neutron capture therapy**, Miao Wang, Meng Wang, Feifan Zhou, Yongpeng Tong, Shenzhen Univ. (China) . . . . . [11241-36]

**Two mathematical models of temperature distribution in tumor tissue and surrounding healthy tissue treated by laser combined with indocyanine green**, Yuanyuan Xu, Fourth Medical Ctr., Chinese PLA General Hospital (China); Shan Long, Nankai Univ. (China); Yunning Yang, Wenjie Li, Xiaosong Li, Fourth Medical Ctr., Chinese PLA General Hospital (China) . . . . . [11241-37]

**In vivo imaging revealed the immunosurveillance function of caloric restriction mimetics on the elimination of liver metastases**, Bolei Dai, Zhihong Zhang, Huazhong Univ. of Science and Technology (China) . [11241-38]

**The feasibility of utilizing the mid-energy in-line phase sensitive x-ray imaging in the breast cancer screening: Particularly, in large and dense breasts**, Farid H. Omoumi, Muhammad U. Ghani, Yuhua Li, Hong Liu, The Univ. of Oklahoma (USA) . . . . . [11241-39]

# CONFERENCE 11242

LOCATION: ROOM 307 (LEVEL 3 SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11242

# Optical Elastography and Tissue Biomechanics VII

Conference Chairs: **Kirill V. Larin**, Univ. of Houston (USA); **Giuliano Scarcelli**, Univ. of Maryland, College Park (USA)

Program Committee: **Steven G. Adie**, Cornell Univ. (USA); **Albert Claude Boccara**, Institut Langevin Ondes et Images (France); **Brett E. Bouma**, Wellman Ctr. for Photomedicine (USA); **Stefan Catheline**, Institut National de la Santé et de la Recherche Médicale (France); **Zhongping Chen**, Beckman Laser Institute and Medical Clinic (USA); **Jürgen W. Czarske**, TU Dresden (Germany); **Kishan Dholakia**, Univ. of St. Andrews (United Kingdom); **Christine P. Hendon**, Columbia Univ. (USA); **Davide Iannuzzi**, Vrije Univ. Amsterdam (Netherlands); **Brendan F. Kennedy**, The Univ. of Western Australia (Australia); **Sean J. Kirkpatrick**, Michigan Technological Univ. (USA); **Matthew O'Donnell**, Univ. of Washington (USA); **Amy L. Oldenburg**, The Univ. of North Carolina at Chapel Hill (USA); **Gabriel Popescu**, Univ. of Illinois (USA); **Jannick P. Rolland**, The Institute of Optics (USA); **David D. Sampson**, Univ. of Surrey (United Kingdom); **Ian A. Sigal**, Univ. of Pittsburgh (USA); **Kandice Tanner**, National Cancer Institute (USA); **Peter Török**, Imperial College London (United Kingdom); **Ruikang K. Wang**, Univ. of Washington (USA); **Tianshi Wang**, Erasmus MC (Netherlands); **Vladislav V. Yakovlev**, Texas A&M Univ. (USA); **Seok Hyun A. Yun**, Wellman Ctr. for Photomedicine (USA); **Vladimir Y. Zaitsev**, Institute of Applied Physics of the RAS (Russian Federation); **Qifa Zhou**, The Univ. of Southern California (USA)

Conference Co-Sponsor: **THORLABS**

## SATURDAY 1 FEBRUARY

### WELCOME

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... 8:00 AM TO 8:10 AM

Conference Chairs: **Kirill V. Larin**, Univ. of Houston (USA);  
**Giuliano Scarcelli**, Univ. of Maryland, College Park (USA)

### SESSION 1

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SAT 8:10 AM TO 10:00 AM

#### Optical Coherence Elastography I

Session Chairs: **Qifa Zhou**, The Univ. of Southern California (USA);  
**Albert Claude Boccara**, Institut Langevin Ondes et Images (France)

8:10 am: **OCT-based strain mapping and compression optical coherence elastography to study and control laser-assisted modification of avascular collagenous tissues** (*Invited Paper*), Vladimir Y. Zaitsev, Alexander L. Matveyev, Lev A. Matveev, Alexander A. Sovetsky, Institute of Applied Physics (Russian Federation); Olga I. Baum, Institute of Laser and Information Technologies (Russian Federation) and Federal Research Ctr. "Crystallography and Photonics" (Russian Federation); Alexey V. Yuzhakov, Institute of Photonic Technologies (Russian Federation); Emil N. Sobol, IPG Medical Corp. (USA) ..... [11242-1]

8:40 am: **Photonic force optical coherence elastography for spectroscopic microrheological quantification of hydrogel viscoelasticity**, Nichaluk Leartprapun, Yuechuan Lin, Steven G. Adie, Cornell Univ. (USA) ..... [11242-2]

9:00 am: **Accelerated magnetomotive optical coherence elastography platform for thermal dosimetry of in vivo melanoma-bearing mice**, Pin-Chieh Huang, Eric J. Chaney, Ronit Barkalifa, Rishyashring R. Iyer, Yuan-Zhi Liu, Darold R. Spillman Jr., Stephen A. Boppart, Univ. of Illinois (USA) ..... [11242-3]

9:20 am: **Heartbeat OCE: Corneal biomechanical response to simulated heartbeat pulsation**, Achuth Nair, Manmohan Singh, Salavat R. Aglyamov, Kirill V. Larin, Univ. of Houston (USA) ..... [11242-4]

9:40 am: **Characterizing the elasticity of thin silk biomaterials using quantitative micro-elastography**, Matt Hepburn, Harry Perkins Institute of Medical Research (Australia); Filippo Valente, Ear Science Institute Australia (Australia); Phillip Wijesinghe, Univ. of St. Andrews (United Kingdom); Rodney J. Dille, Ear Science Institute Australia (Australia); Brendan F. Kennedy, Harry Perkins Institute of Medical Research (Australia) ..... [11242-5]

Coffee Break ..... Sat 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SAT 10:30 AM TO 12:10 PM

#### Novel Methods I

Session Chairs: **Ian A. Sigal**, Lab. of Ocular Biomechanics (USA);  
**Jürgen W. Czarske**, TU Dresden (Germany)

10:30 am: **Label-free high-throughput light microscopy in virtual fluidic channels: single cell rheology and tissue mechanics** (*Invited Paper*), Oliver Otto, Fabian Czerwinski, Muzaffar H. Panhwar, Bob Fregin, Venkata A. S. Dabburu, Doreen Biedenweg, Ricardo H. Pires, Ernst Moritz Arndt Univ. Greifswald (Germany) ..... [11242-6]

11:00 am: **Complex elastic wave propagation in micro-elastography**, Stefan Catheline, Gabrielle Laloy-Borgna, Ali Zorgani, Bruno Giammarinaro, Lab. of Therapeutic Applications of Ultrasound (France); Pol Grasland-Mongrain, Lab. de Physique de l'ens de Lyon (France) ..... [11242-7]

11:20 am: **Towards endoscopic optical coherence elastography in cardiology and pulmonology**, Tianshi Wang, Merel Hellemons, Erasmus MC (Netherlands); Tom Pfeiffer, Univ. zu Lübeck (Germany); Ali Akyildiz, Heleen van Beusekom, Jan von der Thusen, Erasmus MC (Netherlands); Antonius F. W. van der Steen, Erasmus MC (Netherlands) and Shenzhen Institutes of Advanced Technology (China) and Technische Univ. Delft (Netherlands); Robert Huber, Univ. zu Lübeck (Germany); Marlies Wijsenbeek, Gijs van Soest, Erasmus MC (Netherlands) ..... [11242-8]

11:40 am: **In vivo measurements of the deformation response of the human optic nerve head using optic coherence tomography and digital volume correlation** (*Invited Paper*), Thao Nguyen, Johns Hopkins Univ. (USA) [11242-9]

Lunch Break ..... Sat 12:10 pm to 1:30 pm

### SESSION 3

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SAT 1:30 PM TO 2:10 PM

#### Keynote

Session Chair: **Kirill V. Larin**, Univ. of Houston (USA)

1:30 pm: **Shear wave elastography: from ultrasound to optics: past and future** (*Keynote Presentation*), Mathias Fink, Institut Langevin Ondes et Images (France) ..... [11242-10]

# CONFERENCE 11242

## SESSION 4

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SAT 2:10 PM TO 3:10 PM

### Tissue Mechanics

Session Chairs: **Brendan F. Kennedy**,  
Harry Perkins Institute of Medical Research (Australia);  
**Christine P. Hendon**, Columbia Univ. (USA)

2:10 pm: **4D traction force optical coherence microscopy for the analysis of tumor spheroid growth and invasion in collagen**, Jeffrey A. Mulligan, Lu Ling, Claudia Fischbach-Teschl, Steven G. Adie, Cornell Univ. (USA) ..... [11242-11]

2:30 pm: **Laser speckle micro-rheology for biomechanical profiling of breast cancer**, Zeinab Hajjarian Kashany, Elena F. Brachtel, Diane M. Tshikudi, Seemantini K. Nadkarni, Harvard Medical School (USA) ..... [11242-12]

2:50 pm: **Compressional optical coherence elastography for performing histology-like segmentation in application to discrimination of tumor subtypes, determining margins and assessment of efficiency of anti-tumor therapies**, Vladimir Y. Zaitsev, Institute of Applied Physics (Russian Federation); Ekaterina V. Gubarkova, Anton A. Plekhanov, Marina A. Sirotkina, Privolzhsky Research Medical Univ. (Russian Federation); Alexander A. Sovetsky, Alexander L. Matveyev, Lev A. Matveev, Institute of Applied Physics (Russian Federation); Elena V. Zagaynova, Natalia D. Gladkova, Privolzhsky Research Medical Univ. (Russian Federation) ..... [11242-13]

Coffee Break. .... Sat 3:10 pm to 3:40 pm

## SESSION 5

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SAT 3:40 PM TO 5:50 PM

### Brillouin Elastography

Session Chairs: **Seok-Hyun Yun**, Wellman Ctr. for Photomedicine (USA); **Peter Török**, Nanyang Technological Univ. (Singapore)

3:40 pm: **Mapping the phonon dispersion in biological matter using angle-resolved Brillouin light scattering microspectroscopy** (*Invited Paper*), Kareem Elsayad, Vienna Biocenter Core Facilities GmbH (Austria) . . . [11242-14]

4:10 pm: **Rapid biomechanical imaging with line-scanning Brillouin microscopy**, Jitao Zhang, Giuliano Scarcelli, Univ. of Maryland, College Park (USA) ..... [11242-15]

4:30 pm: **Dynamic Brillouin microscopy imaging**, Vladislav V. Yakovlev, Texas A&M Univ. (USA) ..... [11242-16]

4:50 pm: **Collective vibrations probe tissue biomechanics on a micro-scale through Brillouin scattering spectroscopy**, Francesca Palombo, Univ. of Exeter (United Kingdom) ..... [11242-17]

5:10 pm: **Multi-wavelength excitation improves accuracy of Brillouin shift measurements**, Maria A. Troyanova-Wood, Vladislav V. Yakovlev, Texas A&M Univ. (USA) ..... [11242-18]

5:30 pm: **Long-term Brillouin imaging of live cells with reduced photodamage at 660nm wavelength reveals cell mechanical response to environmental cues**, Milos Nikolic, Univ. of Maryland, College Park (USA); Kandice Tanner, National Cancer Institute (USA); Giuliano Scarcelli, Univ. of Maryland, College Park (USA) ..... [11242-19]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 6

LOCATION: ROOM 303 (LEVEL 3 SOUTH) ..... SUN 8:20 AM TO 10:00 AM

### Ocular Biomechanics

Joint Session with Conferences 11242 and 11218

Session Chairs: **Kirill V. Larin**, Univ. of Houston (USA);  
**0Giuliano Scarcelli**, Univ. of Maryland, College Park (USA)

8:20 am: **Clinical assessment of ocular biomechanics** (*Invited Paper*), Cynthia J. Roberts, The Ohio State Univ. (USA) ..... [11242-20]

8:40 am: **Characterization of biomechanical properties of crystalline lens using Brillouin microscopy and optical coherence elastography**, Yogeshwari Ambekar, Univ. of Houston (USA); Jitao Zhang, Univ. of Maryland, College Park (USA); Achuth Nair, Manmohan Singh, Salavat R. Aglyamov, Univ. of Houston (USA); Giuliano Scarcelli, Univ. of Maryland, College Park (USA); Kirill V. Larin, Univ. of Houston (USA) ..... [11218-28]

8:55 am: **All-optical correlative micro-spectroscopies in the investigation of stromal collagen morpho-mechanics**, Raffaella Mercatelli, Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Sara Mattana, Istituto Nazionale di Ottica (Italy); Laura Capozzoli, Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche (Italy) and Istituto di Chimica dei Composti Organometallici (Italy); Fulvio Ratto, Istituto di Fisica Applicata "Nello Carrara" (Italy); Francesca Rossi, Istituto di Fisica Applicata "Nello Carrara", Consiglio Nazionale delle Ricerche (Italy); Roberto Pini, Istituto di Fisica Applicata "Nello Carrara" (Italy); Daniele Fioretto, Univ. degli Studi di Perugia (Italy); Francesco Saverio Pavone, Istituto Nazionale di Ottica (Italy) and Univ. degli Studi di Firenze (Italy); Silvia Caponi, Istituto Officina dei Materiali, Consiglio Nazionale delle Ricerche (Italy); Riccardo Cicchi, Istituto Nazionale di Ottica (Italy) ..... [11218-29]

9:10 am: **Customized swept-source optical coherence tomography system for air-puff induced corneal deformation imaging on multiple meridians**, Andrea Curatolo, Judith Birkenfeld, Eduardo Martínez, James A. Germann, Consejo Superior de Investigaciones Científicas (Spain); Jesús Palaci, 2Eyes Vision SL (Spain); Daniel Pascual, Geethika Muralidharan, Consejo Superior de Investigaciones Científicas (Spain); Jedrzej Solarzski, Karol Karnowski, Maciej Wojtkowski, Institute of Physical Chemistry (Poland); Susana Marcos, Consejo Superior de Investigaciones Científicas (Spain) ..... [11218-30]

9:25 am: **Phase-decorrelation OCT for detection of corneal softening in an enzymatic ex vivo model of ectasia**, Brecken J. Blackburn, John P. Murray, Case Western Reserve Univ. (USA); Matthew R. Ford, Cleveland Clinic (USA); Michael W. Jenkins, Case Western Reserve Univ. (USA); William J. Dupps Jr., Cleveland Clinic (USA); Andrew M. Rollins, Case Western Reserve Univ. (USA) ..... [11218-31]

9:40 am: **Corneal dynamic imaging and second harmonic generation to evaluate in vivo corneal cross-linking** (*Invited Paper*), Susana Marcos, Instituto de Óptica "Daza de Valdés" (Spain) ..... [11242-21]

Coffee Break ..... Sun 10:00 am to 10:30 am

**SESSION 7**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SUN 10:30 AM TO 12:00 PM**

**Novel Methods II**

Session Chairs: **Steven G. Adie**, Cornell Univ. (USA); **Tianshi Wang**, Erasmus MC (Netherlands)

10:30 am: **Optical resonators and lasers for monitoring of mechanical activity in cells and tissue** (*Invited Paper*), Malte C. Gather, Univ. of St. Andrews (United Kingdom) ..... [11242-22]

11:00 am: **Super-shear evanescent waves (SEW) for elasticity evaluation in soft media**, John J. Pitre Jr., Mitchell A. Kirby, David S. Li, Liang Gao, Tueng T. Shen, Ruikang K. Wang, Matthew O'Donnell, Ivan M. Pelivanov, Univ. of Washington (USA) ..... [11242-23]

11:20 am: **Full field passive elastography using digital holography**, Agathe Marmin, ICube (France); Stefan Catheline, Lab. of Therapeutic Applications of Ultrasound (France); Amir Nefas, ICube (France) ..... [11242-24]

11:40 am: **Endoscopic strain-photoacoustic imaging for quantifying the stiffness of intestinal strictures**, Guan Xu, Linyu Ni, Yunhao Zhu, Laura A. Johnson, Nikhil Gandikota, Jonathan M. Rubin, Univ. of Michigan Medical School (USA); Yuan Jie, Nanjing Univ. (China); Xueding Wang, Peter D. R. Higgins, Univ. of Michigan Medical School (USA) ..... [11242-25]

Lunch Break ..... Sun 12:00 pm to 1:00 pm

**SESSION 8**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SUN 1:00 PM TO 2:30 PM**

**Computational Methods for Biomechanics**

Session Chairs: **Matthew O'Donnell**, Univ. of Washington (USA); **Stefan Catheline**, Lab. of Therapeutic Applications of Ultrasound (France)

1:00 pm: **Review of Raman spectral features for soft biomaterials under mechanical deformation** (*Invited Paper*), Ghatu Subhash, Hui Zhou, Chelsey S. Simmons, Malisa Sarntinoranont, Univ. of Florida (USA) ..... [11242-26]

1:30 pm: **Multi-scale elastography: imaging the collagen fibers and their interactions during mechanical testing**, Bin Yang, Po-Yi Lee, Yi Hua, Bryn Brazile, Ziyi Zhu, Fengting Ji, Ian A. Sigal, Univ. of Pittsburgh (USA) ..... [11242-27]

1:50 pm: **An anisotropic model for evaluation of corneal elasticity in dynamic OCE**, Mitchell A. Kirby, John J. Pitre Jr., David S. Li, Tueng T. Shen, Ruikang K. Wang, Matthew O'Donnell, Ivan M. Pelivanov, Univ. of Washington (USA) ..... [11242-28]

2:10 pm: **Early metastatic colonization of the liver by breast cancer cells: the role of extracellular matrix mechanics and implications for treatment and diagnostics**, Anna Guller, The Univ. of New South Wales (Australia) and Sechenov Univ. (Russian Federation); Vlada Rozova, Inga Kuschnerus, Annemarie Nadort, Zahra Khabir, Alfonso Garcia-Bennett, Luen Liang, Yi Qian, Andrei V. Zvyagin, Macquarie Univ. (Australia); Ewa M. Goldys, The Univ. of New South Wales (Australia) ..... [11242-29]

**SESSION 9**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... SUN 2:30 PM TO 5:40 PM**

**Optical Coherence Elastography II**

Session Chairs: **Amy L. Oldenburg**, The Univ. of North Carolina at Chapel Hill (USA); **Zhongping Chen**, Beckman Laser Institute and Medical Clinic (USA)

2:30 pm: **Optical coherence tomography based Vibrometry as a probe of cochlear mechanics** (*Invited Paper*), Brian E. Applegate, The Univ. of Southern California (USA) ..... [11242-30]

3:00 pm: **Mechanical changes in the crystalline lens during oxidation cataract progression in vitro assessed with optical coherence elastography**, Hongqiu Zhang, Salavat R. Aglyamov, Kirill V. Larin, Univ. of Houston (USA) ..... [11242-31]

3:20 pm: **Elastic characterization of heterogeneous tissues using longitudinal shear waves in optical coherence elastography**, Fernando Zvietcovich, Gary R. Ge, Humberto Mestre, Univ. of Rochester (USA); Michael Giannetto, Maiken Nedergaard, Ctr. for Translational Neuromedicine (USA); Jannick P. Rolland, The Institute of Optics (USA); Kevin J. Parker, Univ. of Rochester (USA) ..... [11242-32]

Coffee Break ..... Sun 3:40 pm to 4:10 pm

4:10 pm: **Assessment of steam injury on ex vivo porcine airways with anatomic optical coherence elastography**, Ruofei Bu, Santosh Balakrishnan, Hillel B. Price, Carlton J. Zdanski, Amy L. Oldenburg, The Univ. of North Carolina at Chapel Hill (USA) ..... [11242-34]

4:30 pm: **Simultaneously imaging and quantifying in vivo mechanical properties of crystalline lens and cornea using optical coherence elastography with acoustic radiation force excitation**, Yan Li, Jiang Zhu, Jason J. Chen, Univ. of California, Irvine (USA); Qifa Zhou, The Univ. of Southern California (USA); Zhongping Chen, Univ. of California, Irvine (USA) ..... [11242-35]

4:50 pm: **Comparison between two handheld quantitative micro elastography methods**, Qi Fang, Harry Perkins Institute of Medical Research (Australia) and The Univ. of Western Australia (Australia); Luke Frewer, Renate Zilkens, The Univ. of Western Australia (Australia); Lixin Chin, Harry Perkins Institute of Medical Research (Australia); Ken Y. Foo, The Univ. of Western Australia (Australia); Rowan Sanderson, Devina Lakhiani, James D. Anstie, Harry Perkins Institute of Medical Research (Australia); Ben F. Dessauvage, Fiona Stanley Hospital (Australia); Bruce Latham, PathWest Lab. Medicine WA (Australia); Christobel M. Saunders, The Univ. of Western Australia (Australia); Brendan F. Kennedy, Harry Perkins Institute of Medical Research (Australia) ..... [11242-36]

5:10 pm: **ApT-driven Dynamic OCE: Review of Recent Progress** (*Invited Paper*), Ivan M. Pelivanov, John J. Pitre Jr., Mitchell A. Kirby, David S. Li, Liang Gao, Tueng T. Shen, Ruikang K. Wang, Matthew O'Donnell, Univ. of Washington (USA) ..... [11242-33]

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Fast measurement of mechanical properties with impulsive stimulated Brillouin microscopy on hydrogels and beyond**, Benedikt Krug, Jürgen W. Czarske, Nektarios Koukourakis, TU Dresden (Germany) ..... [11242-37]

**Light intensity distribution from corneal Scheimpflug images as a predictor of eye diseases**, Alejandra Consejo, Polish Academy of Sciences (Poland); Karol Karnowski, Jedrzej Solarzski, Institute of Physical Chemistry PAS (Poland); D. Robert Iskander, Wrocław Univ. of Science and Technology (Poland); Maciej Wojtkowski, Institute of Physical Chemistry PAS (Poland) ..... [11242-38]

**Tissue analysis using optical and mechanical tissue properties obtained by polarization-sensitive optical coherence elastography**, Arata Miyazawa, Shuichi Makita, En Li, Univ. of Tsukuba (Japan); Kohei Yamazaki, Masaki Kobayashi, Shingo Sakai, KAO Corp. (Japan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan) ..... [11242-39]

# CONFERENCE 11242

**Polyvinyl chloride-plastisol: a soft tissue-mimicking phantom dedicated to multi-modality elastography**, Simon Chatelin, Amir Nahas, Elodie Breton, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France); Ajeethan Arulrajah, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) and Institute for Image-Guided Surgery (France); Manon Schmidt, Sylvain Gioux, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France); Céline Giraudeau, Institute of Image-Guided Surgery (France); Benoit Wach, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France); Laurence Meylheuc, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) and Institut National de Sciences Appliquées (France); Jonathan Vappou, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) . . . . . [11242-40]

**Confocal shear wave ARF-OCE to quantify the elasticity of the ONH and peripheral retina in excised whole rabbit eye globes**, Youmin He, Yueqiao Qu, Univ. of California, Irvine (USA); Qifa Zhou, The Univ. of Southern California (USA); Yan Li, Zhongping Chen, Univ. of California, Irvine (USA) . . . . . [11242-41]

**Tissue biomechanics detected at high excitation frequencies: collagen gelatin hydrogels as tissue phantoms**, Francesca Palombo, Univ. of Exeter (United Kingdom) . . . . . [11242-42]

**Spatial coordinate corrected motion tracking for optical coherence elastography**, Xuan Liu, New Jersey Institute of Technology (USA); Basil Hubbi, Rutgers New Jersey Medical School (USA); Xianlian Zhou, New Jersey Institute of Technology (USA); Stephen Peters, Rutgers New Jersey Medical School (USA) . . . . . [11242-43]

**Phase profile characterization and optimization of swept-source lasers for optical coherence elastography applications**, Jason J. Chen, Youmin He, Beckman Laser Institute (USA) and Univ. of California, Irvine (USA); Sucbei Moon, Beckman Laser Institute (USA) and Kookmin Univ. (Korea, Republic of); Zhongping Chen, Beckman Laser Institute (USA) and Univ. of California, Irvine (USA) . . . . . [11242-44]

**Multimodal optical elastography: combining optical coherence elastography and Brillouin microscopy**, Yogeshwari Ambekar, Manmohan Singh, Univ. of Houston (USA); Jitao Zhang, Univ. of Maryland, College Park (USA); Achuth Nair, Salavat R. Aglyamov, Kelsey A. Mussio, Kristela Guillen, Univ. of Houston (USA); Giuliano Scarcelli, Univ. of Maryland, College Park (USA); Kirill V. Larin, Univ. of Houston (USA) . . . . . [11242-45]

**Diagnostic accuracy of optical palpation for breast tumor margin assessment**, Ken Y. Foo, Lixin Chin, The Univ. of Western Australia (Australia) and Harry Perkins Institute of Medical Research (Australia); Kelsey M. Kennedy, Harry Perkins Institute of Medical Research (Australia) and Columbia Univ. (USA); Renate Zilkens, The Univ. of Western Australia (Australia); Wes M. Allen, Qi Fang, Rowan Sanderson, James D. Anstie, The Univ. of Western Australia (Australia) and Harry Perkins Institute of Medical Research (Australia); Benjamin F. Dessauvagie, The Univ. of Western Australia (Australia) and Fiona Stanley Hospital (Australia); Bruce Latham, Fiona Stanley Hospital (Australia); Christobel M. Saunders, The Univ. of Western Australia (Australia) and Fiona Stanley Hospital (Australia) and Royal Perth Hospital (Australia); Brendan F. Kennedy, The Univ. of Western Australia (Australia) and Harry Perkins Institute of Medical Research (Australia) . . . . . [11242-46]

**Effects of radiation exposure on dermal collagen: A multi modal approach**, Anna R. Maeva, Univ. College London (United Kingdom); Jeffrey C. Bamber, The Institute of Cancer Research (United Kingdom); Ina Seviaryna, Univ. of Windsor (Canada); Colin Hopper, Univ. College London (United Kingdom); Conal Perrett, Univ. College London Hospitals NHS Foundation Trust (United Kingdom); Laurent Bozec, Univ. of Toronto (Canada) . . . . . [11242-47]

**In vivo human corneal elasticity using the elastic wave optical coherence elastography**, Sisi Chen, Meixiao Shen, Jin Zi, Yuanyuan Wang, Dexi Zhu, Fan Lu, Wenzhou Medical Univ. (China) . . . . . [11242-48]

**Use of optical coherence yomography to access corneal vibrational resonance**, Ryan McAuley, Andrew Nolan, Sergey A. Alexandrov, Martin J. Leahy, National Univ. of Ireland, Galway (Ireland) and IMCUSTOMEYE (Spain) . . . . . [11242-49]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

John G. Greivenkamp, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells

**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

# CONFERENCE 11243

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11243

## Imaging, Manipulation, and Analysis of Biomolecules, Cells, and Tissues XVIII

Conference Chairs: **Daniel L. Farkas**, Univ. of Southern California (USA), SMI (USA); **Attila Tarnok**, Univ. Leipzig (Germany)

Conference Co-Chair: **James F. Leary**, Purdue Univ. (USA)

Program Committee: **Vadim Backman**, Northwestern Univ. (USA); **Christopher H. Contag**, Michigan State Univ. (USA); **Paul M. W. French**, Imperial College London (United Kingdom); **Yuval Garini**, Bar-Ilan Univ. (Israel); **Sona Hosseini**, Jet Propulsion Lab. (USA); **Jae Youn Hwang**, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of); **Anna Khimchenko**, Massachusetts General Hospital (USA); **Charles P. Lin**, Wellman Ctr. for Photomedicine (USA); **Sacha Loiseau**, Mauna Kea Technologies (France); **Ramesh Raghavachari**, U.S. Food and Drug Administration (USA); **Sebastian Wachsmann-Hogju**, McGill Univ. (Canada)

### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . MON 8:00 AM TO 10:30 AM

#### Translational Biophotonics: 30th Anniversary I

Session Chair: **Daniel L. Farkas**,  
Univ. of Southern California (USA), SMI (USA)

8:30 am: **Fluorescence lifetime imaging in the biomedical sciences** (*Invited Paper*), Ammasi Periasamy, Univ. of Virginia (USA) . . . . . [11243-2]

9:00 am: **Multiphoton imaging in biomedical optics** (*Invited Paper*), Peter T. C. So, Massachusetts Institute of Technology (USA) . . . . . [11243-3]

9:30 am: **Optical Microscopy - the last 30 years** (*Invited Paper*), Tony Wilson, Univ. of Oxford (United Kingdom) . . . . . [11243-78]

10:00 am: **Multimode imaging in clinical photonics** (*Invited Paper*), Daniel L. Farkas, Univ. of Southern California (USA) and SMI (USA) . . . . . [11243-4]

Coffee Break . . . . . Mon 10:30 am to 11:00 am

#### SESSION 2

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . MON 11:00 AM TO 12:40 PM

#### Functional Imaging I

Session Chair: **Daniel L. Farkas**,  
Univ. of Southern California (USA), SMI (USA)

11:00 am: **Particle-tracking microrheology of mucus using magnetomotive micro-optical coherence tomography**, Anna Khimchenko, Hui Min Leung, Wellman Ctr. for Photomedicine (USA) and Harvard Medical School (USA); Susan E. Birket, Adegboyego T. Adewale, Courtney M. Fernandez Petty, Steven M. Rowe, The Univ. of Alabama at Birmingham School of Medicine (USA); Guillermo J. Tearney, Wellman Ctr. for Photomedicine (USA) and Harvard Medical School (USA) and Massachusetts General Hospital (USA) . . . [11243-6]

11:20 am: **Blood pressure measurement using InGaP photodiode with 50% increased EQE and higher signal to noise ratio**, Amarendra Kumar, Chia-Liang Hsu, Yi-Chieh Lin, Epistar Corp. (Taiwan); Chang-Po Chao, Yung-Hua Kao, National Chiao Tung Univ. (Taiwan) . . . . . [11243-7]

11:40 am: **Lipid concentration measurement of rodents meibomian gland using spatial frequency domain imaging (SFDI)**, Hyeonbeom Kim, Hyeoyoon Goo, Kyong Jin Cho, Dankook Univ. (Korea, Republic of); Phil-Sang Chung, Dankook Univ. (Korea, Republic of) and Beckman Laser Institute Korea (Korea, Republic of); Anthony J. Durkin, Beckman Laser Institute and Medical Clinic (USA); Bruce J. Tromberg, National Institutes of Health (USA); Ilyong Park, Dankook Univ. (Korea, Republic of) . . . . . [11243-8]

12:00 pm: **Monitoring of Met-myoglobin proportion to qualifying merchantability of meat by diffuse optical spectroscopy**, Sungchul Kim, Youngjoo Lee, Thien Nguyen, Jae Gwan Kim, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [11243-9]

12:20 pm: **Intelligent quantitative diagnosis of various skin diseases using a smartphone-based autofluorescence imaging system**, Sewoong Kim, Thiago Cavalcanti Coutinho, Jae Youn Hwang, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of); Dong Hun Lee, Seoul National Univ. College of Medicine (Korea, Republic of) . . . . . [11243-10]

Lunch Break . . . . . Mon 12:40 pm to 2:00 pm

#### SESSION 3

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . MON 2:00 PM TO 3:20 PM

#### Translational Biophotonics/30th Anniversary II

2:00 pm: **Neural photonics: from preclinical imaging to intra-operative guidance of brain cancer surgery** (*Invited Paper*), Xingde Li, Johns Hopkins Univ. (USA) . . . . . [11243-81]

2:30 pm: **Nanotechnologies in biomedical optics** (*Invited Paper*), Dan V. Nicolau, McGill Univ. (Canada) . . . . . [11243-1]

3:00 pm: **Longitudinal monitoring of cell metabolism in biopharmaceutical production using Label-free Fluorescence Lifetime Imaging Microscopy (FLIM)**, Prabuddha Mukherjee, Beckman Institute for Advanced Science and Technology (USA) and Univ. of Illinois (USA); Shawn M. Sternisha, Florida State Univ. (USA) and GlaxoSmithKline (USA); Aneesh Alex, GlaxoSmithKline (USA) and In Vitro/In Vivo Translation (USA); Eric J. Chaney, Beckman Institute for Advanced Science and Technology (USA); Ronit Barkalifa, GlaxoSmithKline (USA) and Beckman Institute for Advanced Science and Technology (USA); Boyong Wan, GlaxoSmithKline (USA); Jang Hyuk Lee, Jose J. Rico-Jimenez, Mantas Zuraszkas, Darold R. Spillman Jr., GlaxoSmithKline (USA) and Beckman Institute for Advanced Science and Technology (USA); Sobhana A. Sripada, GlaxoSmithKline (USA); Marina Marjanovic, GlaxoSmithKline (USA) and Beckman Institute for Advanced Science and Technology (USA) and Univ. of Illinois (USA); Zane A. Arp, GlaxoSmithKline (USA) and In Vitro/In Vivo Translation (USA); Dharmesh S. Bhanushali, Biopharm Product Development (USA); Steve R. Hood, GlaxoSmithKline (USA) and In Vitro/In Vivo Translation (USA); Sayantan Bose, Biopharm Product Development (USA); Stephen A. Boppart, Univ. of Illinois (USA) and Beckman Institute for Advanced Science and Technology (USA) . . . . . [11243-11]

Coffee Break . . . . . Mon 3:20 pm to 3:50 pm

#### SESSION 4

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . MON 3:50 PM TO 5:20 PM

#### Functional Imaging II

Session Chair: **Daniel L. Farkas**,  
Univ. of Southern California (USA), SMI (USA)

3:50 pm: **Pathological crystal imaging using computational polarized light microscopy**, Bijie Bai, Hongda Wang, Tairan Liu, Yair Rivenson, John Fitzgerald, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11243-15]

4:10 pm: **High-resolution mapping of changes in properties in dermal collagen**, Anna Maeva, Adam P. Strange, Colin Hopper, Univ. College London (United Kingdom); Conal Perrett, Univ. College London Hospitals NHS Foundation Trust (United Kingdom); Inna Seviaryna, Institute for Diagnostic Imaging Research (Canada); Hugh Trahair, Oliver Devine, Arne Akbar, Univ. College London (United Kingdom) . . . . . [11243-16]

4:30 pm: **Multimodal system for deep learning-based quantification of metastatic potentials of cancer cells**, Sangyeon Youn, Kyungsu Lee, Jeehoon Son, Jae Youn Hwang, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) . . . . . [11243-17]

4:50 pm: **Estimation of melanin concentration, blood concentration, and oxygen saturation in skin tissue layers with different depths unaffected by shading**, Kaito Iuchi, Chiba Univ. (Japan) . . . . . [11243-18]

# CONFERENCE 11243

5:10 pm: **Digital imaging biomarkers for quantitative guidance of pluripotent stem cell passaging**, Daniel S. Gareau, Jack Tapay, Tomomi Haremake, James Browning, The Rockefeller Univ. (USA) . . . [11243-19]

5:30 pm: **Dual-color on-chip light sheet microscopy of drosophila embryos**, Petra Paiè, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Roberto Memeo, Federico Sala, Politecnico di Milano (Italy); Thomas Vaccari, Univ. degli Studi di Milano (Italy); Andrea Bassi, Politecnico di Milano (Italy); Roberto Osellame, Francesca Bragheri, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . [11243-20]

## POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Indirect and direct pharmacokinetic parameter reconstruction in dynamic diffuse fluorescence tomography by adaptive extended Kalman filtering scheme**, Zhichao Zhao, Tianjin Univ. (China); Limin Zhang, Tianjin Univ. (China) and Tianjin Key Lab. of Biomedical Detecting Techniques and Instruments (China); Yanqi Zhang, Han Liu, Ke Shi, Tianjin Univ. (China); Jiao Li, Zhongxing Zhou, Feng Gao, Tianjin Univ. (China) and Tianjin Key Lab. of Biomedical Detecting Techniques and Instruments (China) . . . [11243-60]

**Hybrid Laplacian joint regularization for morphological reconstruction of fluorescence molecular tomography in glioma**, Xuelei He, Institute of Automation (China) and Northwest Univ. (China); Hui Meng, Institute of Automation (China); Xiao wei He, Northwest Univ. (China); Kun Wang, Institute of Automation (China); Jie Tian, Institute of Automation CAS (China) . [11243-61]

**Rapid monitoring of bacterial viability using a low-cost and portable fibre-based fluorometer**, Fang Ou, Julia Robertson, Cushla M. McGovern, Simon Swift, Frédérique Vanholsbeeck, The Univ. of Auckland (New Zealand) . . . [11243-62]

**Enhancement of Xe-NMR signals at low magnetic field using optical pumping hyperpolarization**, Shun Takeda, Hiroshi Kumagai, Kitasato Univ. (Japan); Mineyuki Hattori, National Institute of Advanced Industrial Science and Technology (Japan) . . . [11243-63]

**CARS as an exploratory method for the detection of toxic pollutants: case of phthalates on a Zebrafish model**, Lucrèce Ebersold, Eric Battaglia, Carole Cossu-Leguille, Univ. de Lorraine - Ingénierie Moléculaire et Physiopathologie Articulaire, CNRS (France) and Ingénierie - Biologie - Santé Lorraine, CNRS (France) and Lab. Interdisciplinaire des Environnements Continentaux, CNRS (France); Alexandre Specht, Univ. de Strasbourg (France) and Lab. de Conception et Application de Molécules Bioactives, CNRS (France); Martin A. Toderi, Bibiana D. Riquelme, Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina) and Univ. Nacional de Rosario (Argentina); Dominique Dumas, Univ. de Lorraine - Ingénierie Moléculaire et Physiopathologie Articulaire, CNRS (France) and Ingénierie - Biologie - Santé Lorraine, CNRS (France) and Lab. Interdisciplinaire des Environnements Continentaux, CNRS (France) . . . [11243-64]

**Manipulation and analysis of physical properties of living neurons using laser tweezers**, Ga-Young Lee, You-Na Jang, Kee Joo Lee, Kipom Kim, Korea Brain Research Institute (Korea, Republic of) . . . [11243-65]

**The development of a mechano-biological assessment of leukemia cells using optical tweezers**, Eric Brost, Mayo Clinic (USA); Jamison Brooks, City of Hope (USA); Adam S. Green, Univ. of St. Thomas (USA); Susanta Hui, City of Hope (USA) . . . [11243-66]

**Lipid/cholesterol thickness quantification in the in-vitro model for the vulnerable plaque by measuring near infrared spectroscopy via the IoT system for data acquisition.**, Yehyun Cho, Jaehyun Lim, Daekeun Kim, Dankook Univ. (Korea, Republic of) . . . [11243-46]

## TUESDAY 4 FEBRUARY

### SESSION 5

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . TUE 8:45 AM TO 10:25 AM

## Biomedical Imaging using a DMD or Other MEMS Array

Joint Session with 11243 and 11294

Session Chairs: **Karel J. Zuzak**, Univ. of Texas Southwestern Medical Ctr. (USA), The Lab. of Biomedical Imaging and Engineering, LBI-51, LLC (USA); **Bin Yang**, Duquesne Univ. (USA)

8:45 am: **Digital micromirror device-based angle-multiplexed optical diffraction tomography for high throughput 3D imaging of cells**, Yanping He, Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . [11294-1]

9:05 am: **Spectral illumination system utilizing spherical reflection optics**, Samantha Gunn Mayes, Samuel A. Mayes, Craig M. Browning, Marina Parker, Thomas C. Rich, Silas J. Leavesley, Univ. of South Alabama (USA) . . [11243-22]

9:25 am: **A high throughput synthetic aperture phase microscope**, Shiyuan Wei, Yi Xiao, Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . [11294-2]

9:45 am: **Imaging layered mucosa with visible modulated light**, Min Xu, The City Univ. of New York (USA); Yang Zheng, Da Pan, Xiafei Qian, Weihao Lin, Bixin Zeng, Wenzhou Medical Univ. (China) . . . [11243-23]

10:05 am: **DMD-based scattering assisted imaging with unknown speckle patterns**, Marco Leonetti, Alfonso Grimaldi, Silvia Ghirga, Giancarlo Ruocco, Giuseppe Antonacci, Istituto Italiano di Tecnologia (Italy) . . . [11294-3]

Coffee Break . . . . . Tue 10:25 am to 10:55 am

### SESSION 6

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . TUE 10:55 AM TO 12:20 PM

## Biomedical Fabrication Using a DMD or Other MEMS Array

Joint Session with 11243 and 11294

Session Chairs: **Jorge Moguel**, Digital Light Innovations (USA); **Attila Tárnok**, Univ. Leipzig (Germany)

10:55 am: **DMD-based rapid 3D bioprinting for precision tissue engineering and regenerative medicine (Keynote Presentation)**, Shaochen Chen, Univ. of California, San Diego (USA) . . . [11294-4]

11:40 am: **High-resolution biopatterning with beam pen lithography**, Andrey Ivankin, Jared Magoline, Shaowei Ding, William Hutson, TERA-print, LLC (USA) . . . [11294-5]

12:00 pm: **Time-resolved multi-dimensional fluorescence imaging using a Digital-Micromirror-Device and a SPAD-array detector**, Andrea Farina, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Laura Di Sieno, Giulia Acconcia, Angelo Gulinatti, Politecnico di Milano (Italy); Gianluca Valentini, Politecnico di Milano (Italy) and Istituto di Fotonica e Nanotecnologie (Italy); Ivan Rech, Politecnico di Milano (Italy); Cosimo D'Andrea, Politecnico di Milano (Italy) and Istituto Italiano di Tecnologia (Italy) . . . [11243-24]

Lunch Break . . . . . Tue 12:20 pm to 1:20 pm

### SESSION 7

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . . TUE 1:20 PM TO 3:30 PM

## Cytomics II

Session Chair: **Attila Tárnok**, Univ. Leipzig (Germany)

1:20 pm: **Developments of single cell analysis for highest multiplexed biomarker analysis. (Invited Paper)**, Attila Tárnok, Univ. Leipzig (Germany) . . . [11243-25]

1:50 pm: **A simple, compact and robust phase and fluorescence microscope for cell cycle study**, Ondrej Mandula, Univ. Grenoble Alpes (France) and Lab. d'Electronique de Technologie de l'Information (France) and DTBS-LSIV (France); Cédric Allier, Dainel Fiore, Univ. Grenoble Alpes (France) and Lab. d'Electronique de Technologie de l'Information (France) and DTBS-LSIV (France); Jean-Philippe Kleman, Françoise Lacroix, Univ. Grenoble Alpes (France) and Institut de Biologie Structurale, CNRS (France); Lionel Hervé, Sophie Morales, Univ. Grenoble Alpes (France) and Lab. d'Electronique de Technologie de l'Information (France) and DTBS-LSIV (France) . . . [11243-26]

WEDNESDAY 5 FEBRUARY

SESSION 9

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . WED 8:20 AM TO 10:30 AM

Spectral Imaging I

Session Chair: **Attila Tárnok**, Univ. Leipzig (Germany)

8:20 am: **Fluorescence Resonance Energy Transfer (FRET)-based polymer dots for multicolor imaging under single excitation wavelength**, Ji-Eun Jeong, Hee-Chang Kim, Sang-Hee Shim, Han Young Woo, Korea Univ. (Korea, Republic of) . . . . . [11243-38]

8:40 am: **Ultrathin multi-aperture microscope**, Stephan Schacke, Fraunhofer-Projektzentrum für Mikroelektronische und Optische Systeme für die Biomedizin (Germany); René Berlich, Bernd Höfer, Peter Dannberg, Ben Zaage, Erik Beckert, Norbert Danz, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) . . . . . [11243-39]

9:00 am: **Partial wave spectroscopy study of the structural properties of human prostate tumor tissues obtained by xenografting of drug-sensitive and drug-resistant prostate cancer cells**, Prakash Adhikari, Mississippi State Univ. (USA); Prashanth K. B. Nagesh, The Univ. of Texas Rio Grande Valley (USA); Fatemah Alharthi, Mississippi State Univ. (USA); Murali M. Yallapu, The Univ. of Texas Rio Grande Valley (USA); Prabhakar Pradhan, Mississippi State Univ. (USA) . . . . . [11243-40]

9:20 am: **Fiber-based instrument for simultaneous exogenous fluorescence and endogenous fluorescence lifetime imaging of engineered vascular tissue**, Cai Li, Alba Alfonso Garcia, Lauren Uyesasaka, Benjamin E. Sherlock, Univ. of California, Davis (USA); Leigh G. Griffiths, Mayo Clinic (USA); Laura Marcu, Univ. of California, Davis (USA) . . . . [11243-41]

9:40 am: **Optical, label-free metabolic imaging** (*Invited Paper*), Irene Georgakoudi, Tufts Univ. (USA) . . . . . [11243-79]

10:10 am: **Optical imaging methods for label free detection of microplastics in cells, tissues and environmental organisms**, Alvaro Barroso Pena, Steffi Ketelhut, Westfälische Wilhelms-Univ. Münster (Germany); Matthias Godejohann, MG Optical Solutions GmbH (Germany); Björn Kemper, Jürgen Schnekenburger, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [11243-43]

Coffee Break . . . . . Wed 10:30 am to 10:50 am

SESSION 10

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . WED 10:50 AM TO 12:30 PM

Spectral Imaging II

Session Chair: **Irene Georgakoudi**, Tufts Univ. (USA)

10:50 am: **Enfaced multimodal endoscopic system based on multispectral and high-frequency ultrasound imaging for in situ tumor characterizations**, Jihun Kim, Sangyeon Youn, Hahmin Lew, Multimodal Biomedical Imaging and System Lab. (Korea, Republic of); Jin-Hyung Park, Sungkyunkwan Univ. (Korea, Republic of); Jin Ho Chang, Sogang Univ. (Korea, Republic of); Jae Youn Hwang, Multimodal Biomedical Imaging and System Lab. (Korea, Republic of) . . . . . [11243-44]

11:10 am: **Deep UV microscopy of prostate cancer tissue**, Soheil Soltani, Ashkan Ojaghi, Atsutse Kludze, Francisco E. Robles, Georgia Institute of Technology (USA) . . . . . [11243-45]

11:30 am: **Optical manipulation of neuronal activity using thermo-plasmonic nano-transducer attached optical fiber**, Hongki Kang, KAIST (Korea, Republic of); Woongki Hong, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of); Yujin Jin An, Yoonkey Nam, KAIST (Korea, Republic of) . . . . . [11243-76]

11:50 am: **INS-fOCT: a label-free, all-optical method for simultaneously manipulating and mapping brain function**, Ying Zhang, Fen Yang, Lin Yao, Xuemei Song, Zhejiang Univ. (China); Anna Wang Roe, Zhejiang Univ. (China) and Oregon Health & Science Univ. (USA); Peng Li, Zhejiang Univ. (China) . . . . . [11243-47]

12:10 pm: **Laser-assisted cell transfection in a microfluidic setup**, Hans Georg Breunig, Univ. des Saarlandes (Germany) and JenLab GmbH (Germany); Ana Maria Gonçalves Batista, Univ. des Saarlandes (Germany); Karsten König, Univ. des Saarlandes (Germany) and JenLab GmbH (Germany) . . . . . [11243-48]

Lunch Break . . . . . Wed 12:30 pm to 2:00 pm

2:10 pm: **Optimizing white blood cell contrast in graded-field capillaroscopy using capillary tissue phantoms**, Gregory N. McKay, Taylor L. Bobrow, Srivathsan Kalyan, Soojung Claire Hur, Nicholas J. Durr, Johns Hopkins Univ. (USA) . . . . . [11243-27]

2:30 pm: **Genomics imaging and nanoscale analysis (GINA) platform bridges 4-D chromatin organization with molecular function**, Adam Eshehin, Yue Li, Ranya Virk, Luay M. Almassalha, Wenli Wu, Jane Frederick, Greta Wodarczyk, Scott Gladstein, Aya Eid, David VanDerway, Vasundhara Agrawal, John E. Chandler, Nicholas Anthony, The-Quyen Nguyen, Allen Taflove, Vinayak P. Dravid, Cheng Sun, Hao F. Zhang, Igal Szleifer, Vadim Backman, Northwestern Univ. (USA) . . . . . [11243-28]

2:50 pm: **Flow cytometry visualisation and real-time processing with a CMOS SPAD array and high-speed hardware implementation algorithm**, Hanning Mai, The Univ. of Edinburgh (United Kingdom); Simon P. Poland, King's College London (United Kingdom); Francesco Mattioli Della Rocca, Ahmet T. Erdogan, The Univ. of Edinburgh (United Kingdom); Richard Walker, Photon Force Ltd. (United Kingdom); Istvan Gyongy, The Univ. of Edinburgh (United Kingdom); Simon M. Ameer-Beg, King's College London (United Kingdom); Robert K. Henderson, The Univ. of Edinburgh (United Kingdom) . . . . . [11243-29]

3:10 pm: **Instance segmentation of immune cells in human lupus nephritis using deep learning: Comparing performance on sample preparation and staining panels**, Madeleine S. Durkee, Adam R. Sibley, Benjamin A. Cifu, Junting Ai, Rebecca Abraham, The Univ. of Chicago (USA); Vladimír M. Liarski, The Univ. of Chicago Medicine (USA); Marcus R. Clark, Maryellen L. Giger, The Univ. of Chicago (USA) . . . . . [11243-30]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

SESSION 8

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . . TUE 4:00 PM TO 6:10 PM

Cytomics III

Session Chair: **Attila Tárnok**, Univ. Leipzig (Germany)

4:00 pm: **Multi-wavelength diffractive beam shaper for rectangular flattop spots in flow cytometer** (*Invited Paper*), Jingjing Zhao, Stanford Univ. (USA); Yong Han, Zeheng Jiao, Zixi Chao, Tsinghua Univ. (China); Attila Tárnok, Institut für Medizinische Informatik, Statistik und Epidemiologie (Germany) and Fraunhofer-Institut für Zelltherapie und Immunologie IZI (Germany) and Tsinghua Univ. (China); Zheng You, Tsinghua Univ. (China) . . . . . [11243-31]

4:30 pm: **Dynamic signatures of lipid droplets reveal cellular metabolic changes associated with stimuli and drug treatments**, Chi Zhang, Stephen A. Boppart, Univ. of Illinois (USA) . . . . . [11243-32]

4:50 pm: **Time-gated fluorescence imaging and sensing using long lifetime near infrared quantum dots**, Thomas Pons, Sophie Bouccara, Manon Debayle, Vincent Loriette, Nicolas Lequeux, Alexandra Fragola, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (France) . . . . . [11243-33]

5:10 pm: **High-throughput three-dimensional imaging cytometer for subnuclear foci quantification**, Cheng Zheng, Massachusetts Institute of Technology (USA); Dushan N. Wadduwa, Harvard Univ. (USA); Jong Park, Christy Chao, Jenny Kay, Norah Owiti, Massachusetts Institute of Technology (USA); Zachary Nagel, Harvard Univ. (USA); Bevin P. Engelward, Peter T. C. So, Massachusetts Institute of Technology (USA) . . . . . [11243-34]

5:30 pm: **Comparison of spectral FRET microscopy approaches for single-cell analysis**, Joshua Deal, John Robert Griswold, Malvika Lall, Alia Tayara, Aliyah Odom, Craig M. Browning, Marina Parker, Thomas C. Rich, Silas J. Leavesley, Univ. of South Alabama (USA) . . . . . [11243-35]

5:50 pm: **Oblique plane microscope platereader for time lapse 3D imaging of live cells in collagen**, Nathan Curry, Hugh Sparks, Imperial College London (United Kingdom); Lucas Dent, Vicky Bousgouni, The Institute of Cancer Research (United Kingdom); Vincent Maioli, Ranjeet Kumar, Sunil Kumar, Imperial College London (United Kingdom); Chris Bakal, The Institute of Cancer Research (United Kingdom); Christopher W. Dunsby, Imperial College London (United Kingdom) . . . . . [11243-36]

# CONFERENCE 11243

## SESSION 11

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . . WED 2:00 PM TO 3:20 PM

### Monitoring and Regenerative Medicine I

Session Chair: **Attila Tárnok**, Univ. Leipzig (Germany)

2:00 pm: **FLIM and Raman imaging for detecting micro-environmental changes in bovine pericardium upon genipin cross-linking**, Tanveer Ahmed Shaik, Leibniz-Institut für Photonische Technologien e.V. (Germany); Alba Alfonso Garcia, Univ. of California, Davis (USA); Martin Richter, Friedrich-Schiller-Univ. Jena (Germany); Florian Korinth, Leibniz-Institut für Photonische Technologien e.V. (Germany); Anne K. Haudenschild, James F. Mcmasters, Univ. of California, Davis (USA); Christoph Krafft, Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany); Laura Marcu, Univ. of California, Davis (USA) . . . . . [11243-49]

2:20 pm: **Classification of meat freshness based on deep learning using data from diffuse reflectance spectroscopy**, Youngjoo Lee, Sungho Shin, Sungchul Kim, Gwangju Institute of Science and Technology (Korea, Republic of); Nguyen Thien, Gwangju Institute of Science and Technology (Viet Nam); Kyoobin Lee, Jae Gwan Kim, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [11243-50]

2:40 pm: **Probing metabolic alteration of differentiating induced pluripotent stem cells using label-free FLIM**, Aleksandra V. Meleshina, Svetlana A. Rodimova, Privozhzsky Research Medical Univ. (Russian Federation); Erdem Dashinimaev, Koltzov Institute of Developmental Biology (Russian Federation); Dmitry Reunov, Elena V. Zagaynova, Privozhzsky Research Medical Univ. (Russian Federation) . . . . . [11243-51]

3:00 pm: **Fabrication protocol of personalized engineered cornea using optical coherence tomography (OCT) imaging and 3D printing**, Yujin Ahn, Ulsan National Institute of Science and Technology (Korea, Republic of); Sang Woo Kim, Univ. of Ulsan College of Medicine (Korea, Republic of); Jun Woo Lim, Jae Hyun Jung, Soongsil Univ. (Korea, Republic of); Woonggyu Jung, Ulsan National Institute of Science and Technology (Korea, Republic of) . . . . . [11243-52]

Coffee Break . . . . . Wed 3:20 pm to 3:50 pm

## SESSION 12

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . . WED 3:50 PM TO 5:30 PM

### Monitoring and Regenerative Medicine II

Session Chair: **Attila Tárnok**, Univ. Leipzig (Germany)

3:50 pm: **Near-field scanning optical microscopy study of living cells**, Medet Shatayev, Yingqiu Xie, Haiyan Fan, Nazarbayev Univ. (Kazakhstan); Giovanni Dietler, Sergey K. Sekatskii, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Kanat Dukenbayev, Nazarbayev Univ. (Kazakhstan) . . . . . [11243-53]

4:10 pm: **Imaging biomarkers quantify therapeutic effect in 3D-printed skin cancer constructs**, Daniel S. Gareau, James Browning, The Rockefeller Univ. (USA); Marc Ferrer, National Institutes of Health (USA); John A. Carucci, New York Univ. (USA) . . . . . [11243-54]

4:30 pm: **Value of scanning electron microscopy in liver tissue engineering**, Laila M. Montaser, Sherin M. Fawzy, Menoufia Univ. (Egypt) . . . . . [11243-55]

4:50 pm: **Multiscale multimodal biomicroscopic system based on confocal optical and high-frequency ultrasound imaging for 3D spheroid characterizations**, Seonho Shin, Jihun Kim, Jae Youn Hwang, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) . . [11243-56]

5:10 pm: **Discrimination between acute otitis media and otitis media with effusion using a multimode smartphone-based otoscope**, Thiago Cavalcanti Coutinho, Sewoong Kim, Jae Youn Hwang, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) . . [11243-42]

## THURSDAY 6 FEBRUARY

### SESSION 13

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . . THU 8:30 AM TO 9:30 AM

### Bioinformatics and Analysis

Session Chair: **Attila Tárnok**, Univ. Leipzig (Germany)

8:30 am: **Fully automatic deep learning-based model for quantification of time-resolved calcium response of cells to ultrasound stimulation**, Kyungsu Lee, Jae Youn Hwang, Multimodal Biomedical Imaging and System Lab. (Korea, Republic of) . . . . . [11243-57]

8:50 am: **Convolutional neural network (CNN) based needle-tracking for OCT-guided cornea "Big Bubble" procedure**, Ruizhi Zuo, Jin U. Kang, Soohyun Lee, Shoujing Guo, Shuwen Wei, Johns Hopkins Univ. (USA) . . . . . [11243-58]

9:10 am: **Automated 4-D myocardial nuclei segmentation method to quantify cardiac contractility for understanding Notch signaling during development**, Tanveer Ashwini Teranikar, Nabid Salehin, Cheng-Jen Chuong, Juhyun Lee, The Univ. of Texas at Arlington (USA) . . . . . [11243-77]

Coffee Break . . . . . Thu 9:30 am to 10:00 am

9:30 am: **Imaging of periodontal tissue using swept-source optical coherence tomography for measurement of gingival sulcus depth**, Jaeyul Lee, Jaeseok Park, Kyungpook National Univ. (Korea, Republic of); Muhammad Faizan Shirazi, Medizinische Univ. Wien (Austria); Hosung Jo, Pilun Kim, Kyungpook National Univ. (Korea, Republic of); Ruchire Eranga H. Wijesinghe, Kyungil Univ. (Korea, Republic of); Mansik Jeon, Jeehyun Kim, Kyungpook National Univ. (Korea, Republic of) . . . . . [11243-21]

### SESSION 14

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . THU 10:00 AM TO 11:50 AM

### Functional Imaging III

Session Chair: **Daniel L. Farkas**, Univ. of Southern California (USA), SMI (USA)

10:00 am: **Raman spectroscopy for the analysis of exosomes (Invited Paper)**, Sebastian Wachsmann-Hogiu, McGill Univ. (Canada) . . . . . [11243-80]

10:30 am: **Lymph node micrometastases detection is improved using a paired agent staining and rinsing protocol**, Chengyue Li, Veronica C. Torres, Yusheng He, Illinois Institute of Technology (USA); Xiaochun Xu, Dartmouth College (USA); Jovan G. Brankov, Kenneth M. Tichauer, Illinois Institute of Technology (USA) . . . . . [11243-12]

10:50 am: **Development of a time lapse tumor cell spheroid imaging system with a high-resolution spectral-domain optical coherence microscopy system**, You-Nan Tsai, Yu-Wei Chang, Chia-Chun Ni, Ting-Hao Chen, Ting-Yen Tsai, Ying-Peng Huang, Chih-Chung Yang, Hsiang-Chieh Lee, National Taiwan Univ. (Taiwan) . . . . . [11243-13]

11:10 am: **Structural remodeling of fibrillar collagens in posterior tibial tendinopathy in three dimensional space identified using multiphoton and second harmonic generation imaging**, Thomas Abraham, Rebecca Koob, Nurgul Carkaci-Salli, Umur Aydogan, Penn State College of Medicine (USA) . . . . . [11243-14]

11:30 am: **Increased sensitivity of photoacoustic imaging by resonance frequency of microbubble**, Haemin Kim, Jinwoo Kim, Hohyeon Lee, Hyuncheol Kim, Jin Ho Chang, Sogang Univ. (Korea, Republic of) . . [11243-75]

# CONFERENCE 11244

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH)

Sunday–Tuesday 2–4 February 2020 • Proceedings of SPIE Vol. 11244

# Multiphoton Microscopy in the Biomedical Sciences XX

**Conference Chairs:** Ammasi Periasamy, Univ. of Virginia (USA); Peter T. C. So, Massachusetts Institute of Technology (USA); Karsten König, Univ. des Saarlandes (Germany), JenLab GmbH (Germany)

**Program Committee:** Holly Aaron, Univ. of California, Berkeley (USA); Margarida Barroso, Albany Medical College (USA); Wolfgang Becker, Becker & Hickl GmbH (Germany); Paul J. Campagnola, Univ. of Wisconsin-Madison (USA); Ji-Xin Cheng, Purdue Univ. (USA); Alberto Diaspro, Istituto Italiano di Tecnologia (Italy); Michelle Digman, Univ. of California, Irvine (USA); Chen-Yuan Dong, National Taiwan Univ. (Taiwan); Kevin W. Eliceiri, Univ. of Wisconsin-Madison (USA); Scott Fraser, The Univ. of Southern California (USA); Katsumasa Fujita, Osaka Univ. (Japan); Enrico Gratton, Univ. of California, Irvine (USA); Min Gu, RMIT Univ. (Australia); Stefan W. Hell, Max-Planck-Institut für Biophysikalische Chemie (Germany); Na Ji, Univ. of California, Berkeley (USA); Fu-Jen Kao, National Yang-Ming Univ. (Taiwan); Arnd K. Krueger, Newport Spectra-Physics GmbH (Germany); Darryl McCoy, Coherent Scotland Ltd. (United Kingdom); Wei Min, Columbia Univ. (USA); Junjie Qu, Shenzhen Univ. (China); Angelika C. Rueck, Univ. Ulm (Germany); Lingyan Shi, Univ. of California, San Diego (USA); Klaus Suhling, King's College London (United Kingdom); Yuansheng Sun, ISS, Inc. (USA); Karissa Tilbury, Univ. of Maine (USA); Steven S. Vogel, National Institutes of Health (USA); Xiaoliang S. Xie, Peking Univ. (USA); Chris Xu, Cornell Univ. (USA); Elena V. Zagaynova, Nizhny Novgorod State Medical Academy (Russian Federation); Bernhard Zimmermann, Carl Zeiss Jena GmbH (Germany)

Conference Cosponsors:



## SUNDAY 2 FEBRUARY

### OPENING REMARKS

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . . . 8:00 AM TO 8:15 AM  
Session Chair: Ammasi Periasamy, Univ. of Virginia (USA)

### SESSION 1

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . SUN 8:15 AM TO 9:45 AM

#### Keynote Session

Session Chair: Ammasi Periasamy, Univ. of Virginia (USA)

- 8:15 am: **Leaving any number of photons behind: Adventures in structural neurobiology** (Keynote Presentation), Winfried Denk, Max-Planck-Institut für Neurobiologie (Germany) . . . . . [11244-1]
- 8:45 am: **Evolution of multiphoton microscopy over three decades: Current perspectives and future directions** (Keynote Presentation), Paras N. Prasad, Univ. at Buffalo (USA) . . . . . [11244-2]
- 9:15 am: **Spectral phasors by the sin-cos filter method in a two-photon excitation microscope** (Keynote Presentation), Enrico Gratton, Alexander Dvornikov, Univ. of California, Irvine (USA) . . . . . [11244-3]

### SESSION 2

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . SUN 9:45 AM TO 12:10 PM

#### Multiphoton Microscopy and Applications I

Session Chair: Karsten König, JenLab GmbH (Germany)

- 9:45 am: **Early applications of multiphoton microscopy at Cornell** (Invited Paper), Warren R. Zipfel, Cornell Univ. (USA) . . . . . [11244-4]
- Coffee Break. . . . . Sun 10:05 am to 10:30 am
- 10:30 am: **Multicolor spatial cumulant analysis to measure dopamine receptor dynamics on the plasma membrane** (Invited Paper), Daniel J. Foust, Allesandro Ustione, David Piston, Washington Univ. in St. Louis (USA) . . . . . [11244-5]
- 10:50 am: **Imaging deeper, wider, and faster** (Invited Paper), Chris Xu, Cornell Univ. (USA) . . . . . [11244-6]
- 11:10 am: **Advances in adaptive optics for multi-photon microscopy** (Invited Paper), Martin J. Booth, Univ. of Oxford (United Kingdom) . . . [11244-7]
- 11:30 am: **High-speed multiphoton microscopy for imaging the brain** (Invited Paper), Na Ji, Univ. of California, Berkeley (USA) . . . . . [11244-8]
- 11:50 am: **Label-free classification of T cell activation** (Invited Paper), Melissa C. Skala, Morgridge Institute for Research (USA) and Univ. of Wisconsin-Madison (USA); Alex J. Walsh, Kelsey Tweed, Morgridge Institute for Research (USA); Katie Mueller, Univ. of Wisconsin-Madison (USA); Isabel Jones, Steven M. Trier, Morgridge Institute for Research (USA); Krishanu Saha, Univ. of Wisconsin-Madison (USA) . . . . . [11244-9]



# CONFERENCE 11244

## LUNCH

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . . . 12:10 PM TO 1:20 PM

### Celebrating 30 years Multiphoton Microscopy

Authors of conference 11244 are welcome to join us for lunch to  
Celebrate 30 Years of Multiphoton Microscopy

Registration Badges are required to attend

## SESSION 3

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . SUN 1:20 PM TO 3:00 PM

### Multiphoton Microscopy and Applications II

Session Chair: **Peter T. C. So**,  
Massachusetts Institute of Technology (USA)

1:20 pm: **Translation of two-photon microscopy to the clinic: Multiphoton CARS tomography of in vivo human skin** (*Invited Paper*), Karsten König, Hans Georg Breunig, Univ. des Saarlandes (Germany) and JenLab GmbH (Germany); Ana Maria Gonçalves Batista, Univ. des Saarlandes (Germany); Andreas Schindele, JenLab GmbH (Germany); Michael Zieger, Martin Kaatz, SRH Wald-Klinikum Gera GmbH (Germany) . . . . . [11244-10]

1:40 pm: **Multimodal non-linear imaging for tissue diagnosis, therapy and therapy-monitoring** (*Invited Paper*), Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany) . . . . . [11244-11]

2:00 pm: **Rapid non-linear image scanning microscopy** (*Invited Paper*), Ingo Gregor, Jörg Enderlein, Georg-August-Univ. Göttingen (Germany); Robert Ros, Arizona State Univ. (USA) . . . . . [11244-12]

2:20 pm: **Two-photon time-resolved anisotropy, FCS, and photon antibunching reveal excitonic coupling between fluorescent proteins.** (*Invited Paper*), Steven S. Vogel, National Institutes of Health (USA) . . [11244-13]

2:40 pm: **Visible-wavelength two-photon excitation for high-resolution microscopy and microfabrication** (*Invited Paper*), Katsumasa Fujita, Osaka Univ. (Japan) . . . . . [11244-14]

Coffee Break. . . . . Sun 3:00 pm to 3:30 pm

## SESSION 4

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . SUN 3:30 PM TO 5:00 PM

### Multiphoton Microscopy and Applications III

Session Chair: **Angelika C. Rueck**, Univ. Ulm (Germany)

3:30 pm: **New paradigms in femtosecond lasers for non-linear imaging of the brain and other tissues**, Marco Arrigoni, Coherent, Inc. (USA); Darryl McCoy, Coherent Scotland Ltd. (United Kingdom) . . . . . [11244-15]

3:45 pm: **Developments in ultrafast laser technology enable advancements in in vivo imaging and optogenetics**, Sebastian Peck, Spectra-Physics, a division of MKS Instruments (USA) . . . . . [11244-16]

4:00 pm: **Free-electron-mediated modifications of biomolecules: from photodamage in nonlinear microscopy to intentional photomodification of cells and tissues** (*Invited Paper*), Alfred Vogel, Xiao-Xuan Liang, Sebastian Freidank, Norbert Linz, Univ. zu Lübeck (Germany) . . . . . [11244-17]

4:20 pm: **Fluorescence lifetime trajectory of the mouse pre-implantation embryo using the phasor approach predicts its viability** (*Invited Paper*), Michelle Digman, Univ. of California, Irvine (USA) . . . . . [11244-18]

4:40 pm: **Eliminating drug-resistant bacteria and fungal infections via one-photon and multi-photon bleaching of intrinsic chromophores** (*Invited Paper*), Ji-Xin Cheng, Boston Univ. (USA) . . . . . [11244-19]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at  
<http://spie.org/PWPosterGuidelines>

Session Chairs: **Holly Aaron**, Univ. of California, Berkeley (USA);  
**Lingyan Shi**, Univ. of California, Berkeley (USA);  
**Paolo Bianchini**, Istituto Italiano di Tecnologia (Italy);  
**Alzbeta Marček Chorvátová**, International Laser Ctr. (Slovakia)

**A high-fat diet impacts collagen organization in breast tumor tissues but not in healthy ones**, Yang Zhang, Zhiyi Liu, Tufts Univ. (USA); Lisa Arendt, Univ. of Wisconsin-Madison (USA); Irene Georgakoudi, Tufts Univ. (USA) . . [11244-67]

**Multicolor imaging of endogenous and exogenous fluorophores in living zebrafish larvae**, Marco Andreada, Medizinische Univ. Wien (Austria); Caterina Sturtzel, St. Anna Kinderkrebsforschung e.V. (Austria); Wolfgang Drexler, Medizinische Univ. Wien (Austria); Martin Distel, St. Anna Kinderkrebsforschung e.V. (Austria); Angelika Unterhuber, Medizinische Univ. Wien (Austria) . . . . . [11244-68]

**Automated spherical aberration correction applied to multiphoton microscopy**, Carlo-Amadeo C. Alonzo, Olympus Corp. of the Americas (USA) . . . . . [11244-69]

**Bleed-through elimination method in a dual-channel fluorescence microscopy system**, Reddikumar Maddipatla, Patrice Tankam, Indiana Univ. (USA) . . . . . [11244-70]

**Time-resolved anisotropy for cellular metabolic interpretations**, Jenu V. Chacko, Kevin W. Elceiri, Univ. of Wisconsin-Madison (USA) . . . . . [11244-71]

**Ambient-light-on multiphoton microscopy by optical parametric amplification**, Yi Sun, Haohua Tu, Sixian You, Chi Zhang, Yuan-Zhi Liu, Stephen A. Boppart, Univ. of Illinois (USA) . . . . . [11244-72]

**Multiphoton microscopy in assessment of heterogeneous tissue engineered grafts**, Daria Kuznetsova, Privolzhsky Research Medical Univ. (Russian Federation); Anastasia Koroleva, Laser Zentrum Hannover e.V. (Germany); Vadim V. Elagin, Privolzhsky Research Medical Univ. (Russian Federation); Boris Chichkov, Leibniz Univ. Hannover (Germany); Peter S. Timashev, Sechenov Univ. (Russian Federation); Elena V. Zagaynova, Privolzhsky Research Medical Univ. (Russian Federation) . . . . . [11244-73]

**In vivo time-series quantitative evaluation of skin burn healing using second-harmonic-generation microscopy**, Eiji Hase, Tokushima Univ. (Japan); Ryosuke Tanaka, Shuichiro Fukushima, Osaka Univ. (Japan); Takeshi Yasui, Tokushima Univ. (Japan) and Osaka Univ. (Japan) . . . [11244-74]

**Effect of wavelength on polarization-resolved second-harmonic-generation microscopy in thick tissues**, Eiji Hase, Kosuke Maeda, Takahiko Mizuno, Takeo Minamikawa, Takeshi Yasui, Tokushima Univ. (Japan) . . . . . [11244-75]

**Nonlinear imaging using a 35 fs 3.5 nJ all-PM fiber laser frequency doubled at 800 nm**, Charles-Henri Hage, Simon Boivinnet, Sébastien Vidal, Guillaume Machinet, Johan Bouillet, ALPhANOV (France) . . . . . [11244-76]

**Multiphoton imaging of precisely cut tumor slices for drug testing**, Hsu-Cheng Huang, Shu-Han Wen, Shu-Jen Chiang, National Taiwan Univ. (Taiwan); Pei-Jung Lee, Huei-Wen Chen, National Taiwan Univ. College of Medicine (Taiwan); Shih-Chi Chen, The Chinese Univ. of Hong Kong (Hong Kong, China); Chen-Yuan Dong, National Taiwan Univ. (Taiwan) . . . . [11244-77]

**Multiphoton imaging of dye penetration dynamics in tissue sections**, Paul Tseng, Shu-Jen Chiang, National Taiwan Univ. (Taiwan); Shean-Jen Chen, National Chia Tung Univ. (Taiwan); Chen-Yuan Dong, National Taiwan Univ. (Taiwan) . . . . . [11244-78]

**Two photon excitation in neurosciences using fiber lasers operating at 920nm and 1064nm**, Pascal Dupriez, Spark Lasers (France) . . . . . [11244-79]

**Automated Gleason grading of prostate cancers via deep learning in label-free multiphoton microscopic images**, Xiaoqin Zhu, Jianyong Cai, Qinqin Yang, Zhixin Xu, Fujian Normal Univ. (China); Hong Chen, Fujian Medical Univ. (China) . . . . . [11244-80]

**Multi-photon excited Fourier-transform fluorescence recovery after photobleaching (FT-FRAP) with patterned illumination**, Andreas C. Geiger, Purdue Univ. (USA) . . . . . [11244-81]

MONDAY 3 FEBRUARY

SESSION 5

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . MON 8:00 AM TO 10:15 AM

Metabolism/NADH/FAD/Tryptophan

Session Chairs: **Elena V. Zagaynova**,  
Privolzhsky Research Medical Univ. (Russian Federation);  
**Fu-Jen Kao**, National Yang-Ming Univ. (Taiwan)

8:00 am: **Metabolic imaging by simultaneous 2-photon FLIM of NAD(P)H and FAD** (*Invited Paper*), Wolfgang Becker, Becker & Hickl GmbH (Germany); Angelika C. Rueck, Univ. Ulm (Germany) . . . . . [11244-20]

8:20 am: **Metabolic FLIM and oxygen PLIM: Multiphoton luminescence lifetime imaging on the way to clinical diagnosis** (*Invited Paper*), Angelika C. Rueck, Univ. Ulm (Germany); P. Schäfer, The Children's Hospital of Philadelphia (USA); Bjorn von Einem, Christine A. F. von Arnim, Sviatlana Kalinina, Univ. Ulm (Germany) . . . . . [11244-21]

8:40 am: **Multiphoton imaging of liver pathology and regeneration** (*Invited Paper*), Elena V. Zagaynova, Privolzhsky Research Medical Univ. (Russian Federation); Svetlana A. Rodimova, Privolzhsky Research Medical Univ. (Russian Federation) and N.I. Lobachevsky State Univ. of Nizhni Novgorod (Russian Federation); Daria Kuznetsova, Privolzhsky Research Medical Univ. (Russian Federation); Dmitry Reunov, Privolzhsky Research Medical Univ. (Russian Federation) and N.I. Lobachevsky State Univ. of Nizhni Novgorod (Russian Federation); Alexander Gulin, N.N. Semenov Institute of Chemical Physics (Russian Federation); Varvara V. Dudenkova, Privolzhsky Research Medical Univ. (Russian Federation); Nikolay Bobrov, The Volga District Medical Ctr. of Federal Medical and Biological Agency (Russian Federation); Natalia Vdovina, Vladimir E. Zagaynov, Privolzhsky Research Medical Univ. (Russian Federation) . . . . . [11244-22]

9:00 am: **Probing tumor metabolism by FLIM of NAD(P)H** (*Invited Paper*), Marina V. Shirmanova, Maria M. Lukina, Liubov E. Shimolina, Irina N. Druzhkova, Nadezhda I. Ignatova, Privolzhsky Research Medical Univ. (Russian Federation); Vladimir E. Zagaynov, The Volga District Medical Ctr. (Russian Federation); Varvara V. Dudenkova, Privolzhsky Research Medical Univ. (Russian Federation); Vladislav I. Shcheslavskiy, Becker & Hickl GmbH (Germany); Elena V. Zagaynova, Privolzhsky Research Medical Univ. (Russian Federation) . . . . . [11244-23]

9:20 am: **Label free two photon microscopic imaging to assess tissue metabolic and biomechanical function** (*Invited Paper*), Irene Georgakoudi, Dimitra Poulis, Zhiyi Liu, Yang Zhang, Li Zeng, Lauren Black, Tufts Univ. (USA); Ana Soto, Carlos Sonnenschein, Tufts Univ. School of Medicine (USA); Hong-Thao Thieu, Elizabeth Genega, Tufts Medical Ctr. (USA) . . . . . [11244-24]

9:40 am: **NADH and FAD excitation with one excitation wavelength** (*Invited Paper*), Ruofan Cao, Horst K. Wallrabe, Ammasi Periasamy, Univ. of Virginia (USA) . . . . . [11244-25]

10:00 am: **The effects of T cell polarization and changes in microenvironment on cell autofluorescence**, Kelsey Tweed, Morgridge Institute for Research (USA) and Univ. of Wisconsin-Madison (USA); Isabel Jones, Morgridge Institute for Research (USA); Alex J. Walsh, Morgridge Institute for Research (USA) and Texas A&M Univ. (USA); Steven M. Trier, Morgridge Institute for Research (USA); Melissa C. Skala, Morgridge Institute for Research (USA) and Univ. of Wisconsin-Madison (USA) . . . . . [11244-26]

Coffee Break. . . . . Mon 10:15 am to 10:35 am

AWARD

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . . . 10:35 AM TO 11:15 AM

JenLab Young Investigator Award

Session Chair: **Ammasi Periasamy**, Univ. of Virginia (USA)

**Electric field imaging with vibrationally-resonant electric field-induced sum-frequency generation**, Evan P. Perillo, NanoString Technologies, Inc. (USA); Mary E. Phipps, Los Alamos National Lab. (USA); Jennifer Martinez, Northern Arizona Univ. (USA); Anatoly Efimov, Los Alamos National Lab. (USA) . . . . . [11244-82]

**Second-harmonic generation scattering from breast cancer core needle biopsies is associated with neoadjuvant chemotherapy response**, Danielle Desa, Monisha Bhanote, Univ. of Rochester (USA); Robert L. Hill, Harmonigenic™ Corp. (USA); Joseph B. Majeski, Univ. of Rochester (USA); Brandon Buscaglia, Marcus D'Aguiar, Rochester Institute of Technology (USA); Robert L. Strawderman, David G. Hicks, Bradley M. Turner, Edward B. Brown III, Univ. of Rochester (USA) . . . . . [11244-83]

**Study of the sarcomeric addition process in a tissue-like cell construct under mechanical overload via TPEF-SHG imaging system**, Ailin Wei, Zhonghai Wang, Zongming Yang, Shenghao Tan, Tong Ye, Clemson Univ. (USA); Yonghong Shao, Shenzhen Univ. (China); Thomas K. Borg, Medical Univ. of South Carolina (USA); Bruce Z. Gao, Clemson Univ. (USA) . . . . . [11244-85]

**Autofluorescence imaging of metabolic changes in human plasma-like medium vs standard culture medium**, Logan Florek, Morgridge Institute for Research (USA); Amani A. Gillette, Kimberly Huggler, Univ. of Wisconsin-Madison (USA); Jason Cantor, Melissa C. Skala, Univ. of Wisconsin-Madison (USA) and Morgridge Institute for Research (USA) . . . . . [11244-86]

**Confocal Mueller matrix imaging microscopy to study the corneal polarization anisotropies**, Ilyas Saytashev, Sudipta Saha, Joseph Chue-Sang, Jessica C. Ramella-Roman, Florida International Univ. (USA) . . . . . [11244-88]

**Monitoring drug induced changes in cardiomyocyte contractility with second harmonic generation (SHG) microscopy**, Che-Wei Chang, Yao-Hui Sun, Hillary K. Kao, Dalvir I. Pretto, Deborah K. Lieu, James W. Chan, Univ. of California, Davis (USA) . . . . . [11244-89]

**Inetic analysis of DNA and dox binding process using fluorescence lifetime imaging**, Liwei Liu, Shenzhen Univ. (China) . . . . . [11244-90]

**Multiphoton induced fluorescence and second harmonic imaging of drug-infused arterial walls for non-invasive photo-polymerizable stents**, Tochukwu Emeakaroha, Divya Kota, South Dakota School of Mines and Technology (USA); Sam Young, Alumend, LLC (USA); Steve J. Smith, South Dakota School of Mines and Technology (USA); Ron Utecht, Alumend, LLC (USA) . . . . . [11244-91]

**Label-free whole-colony imaging for metastatic and metabolic analysis by a flexible multimodal microscopy**, Binglin Shen, Shenzhen Univ. (China) . . . . . [11244-92]

**High-speed, large field-of-view and deep multiphoton imaging with an adaptive excitation source**, Bo Li, Chunyan Wu, Mengran Wang, Kriti Charan, Chris Xu, Cornell Univ. (USA) . . . . . [11244-93]

**Imaging plasma membrane microviscosity in cancer cells during chemotherapy**, Liubov E. Shimolina, Privolzhsky Research Medical Univ. (Russian Federation) and N.I. Lobachevsky State Univ. of Nizhni Novgorod (Russian Federation); Marina V. Shirmanova, Privolzhsky Research Medical Univ. (Russian Federation); Marina Kuimova, Imperial College London (United Kingdom); Maria M. Lukina, Nadezhda I. Ignatova, Elena V. Zagaynova, Privolzhsky Research Medical Univ. (Russian Federation) . . . . . [11244-94]

**Monitoring the role of palmitic acid in glioma cells using stimulated Raman scattering microscopy**, Yuhao Yuan, Niraj Shah, Fa-Ke Lu, Binghamton Univ. (USA) . . . . . [11244-84]

**Individual Leaflet Diffusion in Lipid Bilayers Resolved by Scanning FCS with sub 10 nm Axial Discrimination**, Mariano Gonzalez Pisfil, PicoQuant GmbH (Germany) and Humboldt-Universität zu Berlin (Germany); Marcelle König, Rhys Dowler, Benedikt Krämer, Sumeet Rohilla, Felix Koberling, Uwe Ortmann, Rainer Erdmann, PicoQuant GmbH (Germany) . . . . . [11244-651]

BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

Talk by 2014 Nobel Prize Winner in Physics:

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)



# CONFERENCE 11244

## SESSION 6

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . MON 11:15 AM TO 12:15 PM

### Technology and In Vivo Imaging I

Session Chair: **Michelle Digman**, Univ. of California, Irvine (USA)

11:15 am: **Multiphoton and FLIM imaging in quantifying ex vivo and in vivo body organ kinetics of solutes** (*Invited Paper*), Michael S. Roberts, Amy Holmes, Univ. of South Australia (Australia); Haolu Wang, Xiaowen Liang, Xin Liu, The Univ. of Queensland (Australia); Hauke Studier, Becker & Hickl GmbH (Germany); Michael Pastore, Genoskin (France); Deborah Barkauskas, Jeff E. Grice, Yousuf S. Mohammed, The Univ. of Queensland (Australia) . . . . . [11244-27]

11:35 am: **Quantification of blood-brain barrier permeability with multiphoton fluorescence imaging** (*Invited Paper*), Lingyan Shi, Univ. of California, San Diego (USA) . . . . . [11244-28]

11:55 am: **Ultracompact fiber-optic scanning platform for high-speed two-photon neural imaging on freely-walking mice** (*Invited Paper*), Xingde Li, Johns Hopkins Univ. (USA) . . . . . [11244-29]

Lunch Break . . . . . Mon 12:15 pm to 1:15 pm

## SESSION 7

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . MON 1:15 PM TO 2:50 PM

### Technology and In Vivo Imaging II

Session Chairs: **Alberto Diaspro**, Istituto Italiano di Tecnologia (Italy); **Paolo Bianchini**, Istituto Italiano di Tecnologia (Italy)

1:15 pm: **Approaching two-photon excitation microscopy from PCM2000 confocal to PRISM image scanning system.** (*Invited Paper*), Alberto Diaspro, Istituto Italiano di Tecnologia (Italy) and Univ. degli Studi di Genova (Italy) . . . . . [11244-30]

1:30 pm: **Large area functional and structural nonlinear brain imaging** (*Invited Paper*), Francesco Saverio Pavone, LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) . . . . . [11244-31]

1:50 pm: **Easy two-photon image-scanning microscopy with SPAD array and blind image reconstruction** (*Invited Paper*), Sami V. Koho, Eli Slenders, Giorgio Tortarolo, Marco Castello, Istituto Italiano di Tecnologia (Italy); Mauro Buttafava, Federica A. Villa, Politecnico di Milano (Italy); Elena Tcarenkova, Univ. of Turku (Finland); Marcel Ameloot, Univ. Hasselt (Belgium); Paolo Bianchini, Colin J. R. Sheppard, Alberto Diaspro, Istituto Italiano di Tecnologia (Italy); Alberto Tosi, Politecnico di Milano (Italy); Giuseppe Vicidomini, Istituto Italiano di Tecnologia (Italy) . . . . . [11244-32]

2:10 pm: **Improving the resolution in multiphoton microscopy** (*Invited Paper*), Paolo Bianchini, Istituto Italiano di Tecnologia (Italy); Behjat Kariman, Istituto Italiano di Tecnologia (Italy) and Univ. degli Studi di Genova (Italy); Francesco Garzella, Eleonora Uriati, Istituto Italiano di Tecnologia (Italy) and Univ. degli Studi di Parma (Italy); Giulia Zanini, Takahiro Deguchi, Istituto Italiano di Tecnologia (Italy); Alberto Diaspro, Istituto Italiano di Tecnologia (Italy) and Univ. degli Studi di Genova (Italy) . . . . . [11244-33]

2:30 pm: **Simultaneous dual-plane imaging with a multi-site mesoscope** (*Invited Paper*), Peter Saggau, Baylor College of Medicine (USA); Dmitri A. Tsybouski, Janelia Farm Research Campus, Howard Hughes Medical Institute (USA); Natalia Orlova, Allen Institute for Brain Science (USA) . . . . . [11244-34]

## AWARD PRESENTATION

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . . . 2:50 PM TO 3:10 PM

Coffee Break . . . . . Mon 3:10 pm to 3:30 pm

## SESSION 8

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . MON 3:30 PM TO 5:15 PM

### SHG/THG Microscopy

Session Chair: **Paul J. Campagnola**, Univ. of Wisconsin-Madison (USA)

3:30 pm: **Evaluation of newly synthesized potential NLO-phores for 2-photon and SHG imaging.** (*Invited Paper*), Alzbeta Marček Chorvátová, International Laser Ctr. (Slovakia), Univ. of SS. Cyril and Methodius (Slovakia); Peter Magdolen, Andrea Martinicka, Comenius Univ. in Bratislava (Slovakia); Martin Uherek, Dusan Chorvat, International Laser Ctr. (Slovakia); Ivica Sigmundova, Comenius Univ. in Bratislava (Slovakia) . . . . . [11244-37]

3:50 pm: **Studying intrinsic skin aging by slide-free in vivo harmonic generation microscopy** (*Invited Paper*), Chi-Kuang Sun, Kuan-Hung Lin, Ming-Liang Wei, National Taiwan Univ. (Taiwan); Yi-Hua Liao, National Taiwan Univ. Hospital (Taiwan) . . . . . [11244-36]

4:10 pm: **Multiscale SHG analysis of collagen architecture alterations in human idiopathic pulmonary fibrosis** (*Invited Paper*), Paul J. Campagnola, Darian S. James, Zachary Alden, Hsin-Yu Chang, Univ. of Wisconsin-Madison (USA); Mark Jones, Univ. of Southampton (United Kingdom); Nathan Sandbo, Univ. of Wisconsin-Madison (USA) . . . . . [11244-35]

4:30 pm: **Label-free characterization of attenuation lengths of cortical regions via three-photon microscopy in awake mice**, Murat Yildirim, Ming Hu, Peter T. C. So, Mriganka Sur, Massachusetts Institute of Technology (USA) . . . . . [11244-38]

4:45 pm: **Second harmonic generation imaging collagen structure modulation in embryonic chicken cornea.** Sheng-Lin Lee, Ming-Ye He, Yang-Fang Chen, Chen-Yuan Dong, National Taiwan Univ. (Taiwan) . [11244-39]

5:00 pm: **Bringing third and second harmonic generation microscopy into the clinic for the assessment of fresh lung (tumor) tissue.** Laura M. G. Van Huizen, Vrije Univ. Amsterdam (Netherlands); Daniëlle Seinstra, Chris Dickhoff, Teodora Radonic, Idris Bahce, Amsterdam UMC (Netherlands); Frank van Mourik, Tritos Diagnostics B.V. (Netherlands); Jouke T. Annema, Johannes M. A. Daniels, Wim-Jan P. van Boven, Amsterdam UMC (Netherlands); Marie Louise Groot, Vrije Univ. Amsterdam (Netherlands) . . . . . [11244-40]

## TUESDAY 4 FEBRUARY

## SESSION 9

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . TUE 8:00 AM TO 10:00 AM

### FLIM/FRET/FCS

Session Chair: **Kevin W. Eliceiri**, Univ. of Wisconsin-Madison (USA)

8:00 am: **Two-photon phosphorescence lifetime microscopy (2PLM) of oxygen** (*Invited Paper*), Sergei A. Vinogradov, Univ. of Pennsylvania (USA) . . . . . [11244-41]

8:20 am: **FLIM, FRET and high content analysis (HCA)** (*Invited Paper*), Paul M. W. French, Imperial College London (United Kingdom) . . . . . [11244-42]

8:40 am: **Multi-target immunofluorescence using spectral FLIM-FRET for separation of undesirable antibody cross-labeling and autofluorescence** (*Invited Paper*), Sumeet Rohilla, PicoQuant GmbH (Germany) and Charité Universitätsmedizin Berlin (Germany); Benedikt Krämer, Felix Koberling, Uwe Ortmann, PicoQuant GmbH (Germany); Ingo Gregor, Georg-August-Univ. Göttingen (Germany); Andreas C. Hocke, Charité Universitätsmedizin Berlin (Germany); Rainer Erdmann, PicoQuant GmbH (Germany) . . . . . [11244-43]

9:00 am: **Monitoring receptor-ligand interactions using fluorescence lifetime FRET imaging via deep learning** (*Invited Paper*), Margarida Barroso, Alena Rudkouskaya, Albany Medical College (USA); Jason T. Smith, Xavier Intes, Rensselaer Polytechnic Institute (USA) . . . . . [11244-44]

9:20 am: **High speed 2-photon fluorescence lifetime imaging of protein-protein interactions with a swept array microscope** (*Invited Paper*), Simon M. Ameer-Beg, Simon P. Poland, Thomas Kavanagh, James A. Levitt, King's College London (United Kingdom); Robert K. Henderson, Hanning Mai, The Univ. of Edinburgh (United Kingdom); Andrea Serio, Conor Treacy, Kelly O'Toole, King's College London (United Kingdom); Richard Walker, Photon Force Ltd. (United Kingdom) . . . . . [11244-45]

9:40 am: **Live cell metabolic imaging of cancer cell lines using multiphoton fluorescence polarization** (*Invited Paper*), Einstein Gnanatheepam, Anandh Sundaramoorthy, Durgalakshmi Dhinasekaran, Aruna Prakasa Rao, Ganesan Singaravelu, Anna Univ., Chennai (India) . . . . . [11244-46]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

**SESSION 10**

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . TUE 10:30 AM TO 12:15 PM

**Technology and In Vivo Imaging III**

Session Chair: **Margarida Barroso**, Albany Medical College (USA)

10:30 am: **Time-resolved mesoscopic imaging of a whole animal by FastFLIM** (*Invited Paper*), Yuansheng Sun, ISS, Inc. (USA); Chien Sing Poon, Wright State Univ. (USA); Hailin Qiu, Orient KOJI Scientific (China); Ulas C. Coskun, Shih-Chu J. Liao, Sunil Shah, Beniamino Barbieri, ISS, Inc. (USA); Ulas Sunar, Wright State Univ. (USA) . . . . . [11244-47]

10:50 am: **Real time imaging of the multiphoton excitation volume using a point detector** (*Invited Paper*), Sudipta Maiti, Tata Institute of Fundamental Research (India) . . . . . [11244-48]

11:10 am: **Synchronized subharmonic modulation in stimulated emission microscopy** (*Invited Paper*), Fu-Jen Kao, National Yang-Ming Univ. (Taiwan) . . . . . [11244-49]

11:30 am: **Multiplexed 3-photon microscopy for functional connectomics of mammalian cortex**, Kevin Takasaki, Allen Institute for Brain Science (USA); Dmitri A. Tsyboulski, Howard Hughes Medical Institute (USA); Jack Waters, Allen Institute for Brain Science (USA) . . . . . [11244-50]

11:45 am: **High speed resonant fiber-optic scanning nonlinear endomicroscopy for monitoring brain functional dynamics**, Hyeon-Cheol Park, Honghua Guan, Ang Li, Dawei Li, Johns Hopkins Univ. (USA); Yuanlei Yue, The George Washington Univ. (USA); Ming-Jun Li, Corning Incorporated (USA); Hui Lu, The George Washington Univ. (USA); Xingde Li, Johns Hopkins Univ. (USA) . . . . . [11244-51]

12:00 pm: **NAD(P)H FLIM for metabolic imaging: Fast acquisition, faster analysis, fastest decay detection**, Lukas Z. Braun, Axel Bergmann, Becker & Hickl GmbH (Germany); Rodrigo Suarez Ibarrola, Universitätsklinikum Freiburg (Germany); Hauke Studier, Becker & Hickl GmbH (Germany); Philippe F. Pohlmann, Universitätsklinikum Freiburg (Germany); Wolfgang Becker, Becker & Hickl GmbH (Germany) . . . . . [11244-52]

Lunch Break . . . . . Tue 12:15 pm to 1:30 pm

**SESSION 11**

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . TUE 1:30 PM TO 3:10 PM

**Technology and Raman Microscopy**

Session Chair: **Lingyan Shi**, Univ. of California, San Diego (USA)

1:30 pm: **From multi-photon absorption and stimulated emission to forbidden S0?T1 transition** (*Invited Paper*), Zygmunt K. Gryczynski, Texas Christian Univ. (USA); Ignacy Gryczynski, Univ. of North Texas Health Science Ctr. at Fort Worth (USA) . . . . . [11244-53]

1:50 pm: **Coherent Raman scattering imaging for pharmacokinetics and pharmacodynamics** (*Invited Paper*), Conor L. Evans, Wellman Ctr. for Photomedicine (USA) . . . . . [11244-54]

2:10 pm: **High-speed imaging during femtosecond-laser cell optoporation**, Ana Maria Gonçalves Batista, Hans Georg Breunig, Karsten König, Univ. des Saarlandes (Germany) . . . . . [11244-55]

2:25 pm: **Improving the sensitivity of coherent Raman scattering microscopy with 10 MHz solid-state light source**, Wenlong Yang, Gary R. Holtom, Harvard Univ. (USA); Yuanzhen Suo, Xiaoliang S. Xie, Peking Univ. (China) . . . . . [11244-56]

2:40 pm: **Frequency-tunable two-color ultrafast fiber laser for nonlinear excitation of NADH and FAD**, Axel Friedenaue, Konrad Birkmeier, Andreas Brodschelm, Christoph Skrobol, Patrick Leisching, TOPTICA Photonics AG (Germany) . . . . . [11244-57]

2:55 pm: **Time-lapse stimulated Raman scattering (SRS) microscopy**, Yuhao Yuan, Soumit Saha, Mohammad I. Almohaisin, Steven T. Blum, Fa-Ke Lu, Binghamton Univ. (USA) . . . . . [11244-58]

Coffee Break . . . . . Tue 3:00 pm to 3:20 pm

**SESSION 12**

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . TUE 3:30 PM TO 5:35 PM

**Technology and In Vivo Imaging IV**

Session Chairs: **Yuansheng Sun**, ISS, Inc. (USA); **Hauke Studier**, Becker & Hickl GmbH (Germany)

3:30 pm: **High-resolution tissue imaging using moxifloxacin as a clinically compatible cell labeling agent** (*Invited Paper*), Ki Hean Kim, Seunghun Lee, Bumju Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11244-59]

3:50 pm: **Multiphoton FLIM is gaining ground as a clinical tool**, Hauke Studier, Becker & Hickl GmbH (Germany); Yousuf S. Mohammed, Michael S. Roberts, The Univ. of Queensland (Australia); Amy Holmes, Michael Pastore, Univ. of South Australia (Australia); Wolfgang Becker, Becker & Hickl GmbH (Germany) . . . . . [11244-60]

4:05 pm: **Assessing functional and morphological properties of different adipose tissues in vivo by high-resolution, quantitative multi-photon imaging using endogenous contrast**, Zhiyi Liu, Dimitra Pouli, Yang Zhang, Irene Georgakoudi, Tufts Univ. (USA) . . . . . [11244-61]

4:20 pm: **Flexible multiphoton microscopy with femtosecond-pulse fiber delivery**, Hans Georg Breunig, Univ. des Saarlandes (Germany) and JenLab GmbH (Germany); Karsten König, Univ. des Saarlandes (Germany) . . [11244-62]

4:35 pm: **Optimization of analysis protocol and probe expression for monitoring intracellular oxygenation using fluorescence lifetime imaging of myoglobin-mCherry**, Rozhin Penjweini, Greg Alspaugh, Branden Roarke, Alexandra Chand, Jay R. Knutson, National Institutes of Health Clinical Ctr. (USA) . . . . . [11244-63]

4:50 pm: **Multimodal method for the identification of multiphoton cancer biomarkers using 3D tumor spheroids**, Björn-Ole Meyer, M. Pilar J. Stella, Dominik Marti, DTU Health Tech (Denmark); Bjørn Holst, Boye S. Nielsen, Kim Holmstrøm, Bioneer A/S (Denmark); Peter E. Andersen, DTU Health Tech (Denmark) . . . . . [11244-64]

5:05 pm: **Multiphoton autofluorescence imaging of advanced glycation end products glycated tissues**, Chih-Ju Lin, National Taiwan Univ. (Taiwan); Jeon Woong Kang, Peter T. C. So, Massachusetts Institute of Technology (USA); Chen-Yuan Dong, National Taiwan Univ. (Taiwan) . . . . . [11244-65]

5:20 pm: **Rapid volumetric multiphoton microscopy via dual resonant scanning with deep learning**, Chia Wei Hsu, Yu-Shin Hsu, Chun-Yu Lin, Shean-Jen Chen, National Chiao Tung Univ. (Taiwan) . . . . . [11244-66]

# CONFERENCE 11245

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH)

Monday-Wednesday 3-5 February 2020 • Proceedings of SPIE Vol. 11245

# Three-Dimensional and Multidimensional Microscopy: Image Acquisition and Processing XXVII

*Conference Chairs:* **Thomas G. Brown**, Univ. of Rochester (USA); **Tony Wilson**, Univ. of Oxford (United Kingdom); **Laura Waller**, Univ. of California, Berkeley (USA)

*Program Committee:* **Martin Booth**, Univ. of Oxford (United Kingdom); **Charles A. DiMarzio**, Northeastern Univ. (USA); **Jonathan T.C. Liu**, Univ. of Washington (USA); **Raimund J. Ober**, Texas A&M Univ. (USA); **Chrysanthe Preza**, The Univ. of Memphis (USA); **Monika Ritsch-Marte**, Medizinische Univ. Innsbruck (Austria); **Zachary J. Smith**, Univ. of Science and Technology of China (China)

## MONDAY 3 FEBRUARY

### POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Design and implementation of silicon photomultiplier-based confocal laser scanning microscope**, Dawei Fan, Tianyu Yan, Xinyu Wang, Kaitai Guo, Shouping Zhu, Xueli Chen, Xidian Univ. (China) . . . . . [11245-39]

**FPGA implementation of spectral fusing Gabor domain optical coherence microscopy**, Panomsak Meemon, Yutana Lenaphet, Jadsada Saetiew, Suranaree Univ. of Technology (Thailand) . . . . . [11245-40]

**Evaluation of a combined two-color phase plate forming three-dimensional dark holes in super resolution microscopy**, Koumei Nagai, Maruyama Takashi, Akira Kodaira, NTT Advanced Technology Corp. (Japan); Hiroshi Kumagai, Kitasato Univ. (Japan); Nandor Bokor, Budapest Univ. of Technology and Economics (Hungary); Yoshinori Iketaki, Olympus Corp. (Japan) and Kitasato Univ. (Japan) . . . . . [11245-41]

**Classification and quantification of cyanobacteria using an optical microscope and deep learning**, Yongeun Park, Konkuk Univ. (Korea, Republic of) . . . . . [11245-42]

**Stripe artifacts reduction in a light sheet microscope with multiple light sheets generated by microlens arrays**, Inkeon Ryu, Daekeun Kim, Dankook Univ. (Korea, Republic of) . . . . . [11245-43]

## TUESDAY 4 FEBRUARY

### SESSION 1

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . TUE 8:30 AM TO 10:10 AM

### Quantitative Phase and Holographic Imaging

Session Chair: **Thomas G. Brown**,  
The Institute of Optics, Univ. of Rochester (USA)

8:30 am: **Strategies for the retrieval of biophysical parameters from quantitative phase images of suspended cells**, Björn Kemper, Westfälische Wilhelms-Univ. Münster (Germany); Junwei Min, Baoli Yao, Chinese Academy of Science (China); Lena Tacke, Westfälische Wilhelms-Univ. Münster (Germany); Lilith Brandt, Klaus Brinker, Hochschule Hamm-Lippstadt (Germany); Jürgen Schnekenburger, Steffi Ketelhut, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [11245-1]

8:50 am: **3D refractive index tomography with quantitative oblique back-illumination microscopy**, Patrick B. Ledwig, Francisco E. Robles, Georgia Institute of Technology (USA) . . . . . [11245-2]

9:10 am: **High spatiotemporal resolution label-free imaging through Ultra-Oblique Quantitative Phase Microscopy (UO-QPM)**, Kaiqin Chu, Ying Ma, Siyue Guo, Zachary J. Smith, Univ. of Science and Technology of China (China) . . . . . [11245-3]

9:30 am: **Quantum limited digital holography and the limits of spatial heterodyne detection**, Thomas G. Brown, The Institute of Optics, Univ. of Rochester (USA) . . . . . [11245-4]

9:50 am: **Super-resolution reflection-mode holographic microscope for 3d imaging of semiconductor devices without optical lens**, Jaehyeon Son, Seung Beom Park, Kyungwon Yun, Taewan Kim, Jaehwang Jung, Myungjun Lee, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [11245-5]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . TUE 10:40 AM TO 12:20 PM

### Illumination and Optical Coherence

Session Chair: **Martin J. Booth**, Univ. of Oxford (United Kingdom)

10:40 am: **Three-dimensional partial coherent holography by a digital micro-mirror device**, Yi Xue, Univ. of California, Berkeley (USA) . . . . [11245-6]

11:00 am: **Structured illumination image processing with distorted patterns**, Leilei Peng, Dongli Xu, Wyant College of Optical Sciences (USA) . . . . . [11245-7]

11:20 am: **A hyperspectral microscope based on a birefringent ultrastable common-path interferometer**, Cristian Manzoni, Daniela Comelli, Alessia Candeo, Politecnico di Milano (Italy); Bárbara Elza Nogueira de Faria, Univ. Federal de Minas Gerais (Brazil); Gianluca Valentini, Andrea Bassi, Giulio N. Cerullo, Politecnico di Milano (Italy) . . . . . [11245-8]

11:40 am: **Flexible and uniform illumination for wide field microscopy from TIRF to epifluorescence excitation**, Adrien Mau, Institut des Sciences Moléculaires d'Orsay (France); Nicolas Bourg, Abbelight (France); Sandrine Leveque-Fort, Institut des Sciences Moléculaires d'Orsay (France) . . . . . [11245-9]

12:00 pm: **Four-dimensional formulation of image formation in optical coherence tomography**, Naoki Fukutake, Nikon Corp. (Japan); Yoshiaki Yasuno, Univ. of Tsukuba (Japan) . . . . . [11245-10]

Lunch Break . . . . . Tue 12:20 pm to 1:50 pm

### SESSION 3

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . TUE 1:50 PM TO 3:30 PM

### Multidimensional Image Reconstruction and Analysis

Session Chair: **Adam K. Glaser**, Univ. of Washington (USA)

1:50 pm: **A method for quantitative three-dimensional fiber tractography using optical coherence tomography**, James P. McLean, Shuyang Fang, Kristin M. Myers, Christine P. Hendon, Columbia Univ. (USA) . . . . . [11245-11]

2:10 pm: **Single-shot surface 3-D imaging by optical coherence factor**, Jian Xu, Ruizhi Cao, Changhui Yang, Caltech (USA) . . [11245-12]

2:30 pm: **Tomographic imaging of red blood cells using deep neural network**, Joowon Lim, Ahmed B. Ayoub, Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11245-13]

2:50 pm: **Advanced volumetric light field microscopy with temporal-focusing multiphoton selective excitation**, Feng-Chun Hsu, Yong Da Sie, National Chiao Tung Univ. (Taiwan); Chia-Yuan Chang, National Cheng Kung Univ. (Taiwan); Chun-Yu Lin, National Chiao Tung Univ. (Taiwan); Yvonne Y. Hu, National Cheng Kung Univ. (Taiwan); Shean-Jen Chen, National Chiao Tung Univ. (Taiwan) . . . . . [11245-14]  
 3:10 pm: **Demultiplexing multiview images from a single-shot speckle pattern with scattering media**, Xiangwen Zhu, Nanyang Technological Univ. (Singapore); Sujit Kumar Sahoo, Nanyang Technological Univ. (Singapore) and Indian Institute of Technology Goa (India); Dong Wang, Nanyang Technological Univ. (Singapore) and Taiyuan Univ. of Technology (China); Huy Quoc Lam, Cuong H. Dang, Nanyang Technological Univ. (Singapore) . . . . . [11245-15]  
 Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

**SESSION 4**

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . TUE 4:00 PM TO 5:30 PM

**Single Plane Illumination and Light Sheet Microscopy**

Session Chair: **Charles A. DiMarzio**, Northeastern Univ. (USA)

4:00 pm: **Multi-immersion open-top light-sheet microscopy (Invited Paper)**, Adam K. Glaser, Jonathan T. C. Liu, Univ. of Washington (USA) . . . . . [11245-16]  
 4:30 pm: **Imaging the airy way: Advanced beam shaping for light-sheet microscopy at depth**, Madhu Veetikazhy, Technical Univ. of Denmark (Denmark); Jonathan Nyk, Federico M. Gasparoli, Adrià Escobet-Montalbán, Univ. of St. Andrews (United Kingdom); Anders K. Hansen, Dominik Marti, Peter E. Andersen, Technical Univ. of Denmark (Denmark); Kishan Dholakia, Univ. of St. Andrews (United Kingdom) . . . . . [11245-17]  
 4:50 pm: **Towards an open access single objective lightsheet platform**, Manish Kumar, Yevgenia Kozorovitskiy, Northwestern Univ. (USA) . . . [11245-18]  
 5:10 pm: **Compact spectrograph and fast spectral deconvolution for hyperspectral imaging with overlapping fluorescent reporters**, Nathan A. Hart, Holly C. Gibbs, Alvin T. Yeh, Texas A&M Univ. (USA). [11245-19]

**WEDNESDAY 5 FEBRUARY**

**SESSION 5**

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . WED 8:30 AM TO 10:10 AM

**Computational Imaging**

Session Chair: **Zachary J. Smith**, Univ. of Science and Technology of China (China)

8:30 am: **3D fluorescence deconvolution with deep priors**, Kevin Zhang, Michael R. Kellman, Emrah Bostan, Laura Waller, Univ. of California, Berkeley (USA) . . . . . [11245-20]  
 8:50 am: **Computational super-resolution microscopy: leveraging noise models, regularization and sparsity to achieve highest resolution**, Jian Xing, Simeng Chen, Stephen Becker, Jiun-Yann Yu, Carol Cogswell, Univ. of Colorado Boulder (USA) . . . . . [11245-21]  
 9:10 am: **Deep-learning based three-dimensional virtual refocusing of fluorescence microscopy images**, Yichen Wu, Yair Rivenson, Hongda Wang, Yilin Luo, Eyal Ben-David, Laurent A. Bentolila, Univ. of California, Los Angeles (USA); Christian Pritz, The Hebrew Univ. of Jerusalem (Israel); Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11245-22]  
 9:30 am: **High-resolution 3D imaging using Fourier ptychographic tomography with a deep image prior**, Kevin C. Zhou, Roarke Horstmeyer, Duke Univ. (USA) . . . . . [11245-23]  
 9:50 am: **3D analysis of the spatial relationships of collagen and nerves in adipose tissue using the Metric Space Technique.**, Karissa Tilbury, Mitchell Harling, Kristy Townsend, Andre Khalil, Magdalena Blaszkiewicz, Jake Willow, Cory Johnson, The Univ. of Maine (USA) . . . . . [11245-24]  
 Coffee Break . . . . . Wed 10:10 am to 10:40 am

**SESSION 6**

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) .WED 10:40 AM TO 12:00 PM

**Extended Depth of Focus Microscopy**

Session Chair: **Raimund J. Ober**, Texas A&M Univ. (USA)

10:40 am: **Axial electrokinetic trapping of anisotropic particles**, Filip Strubbe, Bavo Robben, John P. George, Ingrid Amer Cid, Filip Beunis, Kristiaan Neyts, Univ. Gent (Belgium) . . . . . [11245-25]

11:00 am: **Multifocus imaging via polarization wavefront shaping**, Chen Li, Changqin Ding, Minghe Li, Jiayue Rong, James R. W. Ulcickas, Garth J. Simpson, Purdue Univ. (USA) . . . . . [11245-26]  
 11:20 am: **A study for accelerating the speed of all-in-focus image processing**, Lihui Wang, Guangdong Institute of Semiconductor Industrial Technology (China); Hirotochi Takeuchi, Satoshi Tabata, Masatoshi Ishikawa, The Univ. of Tokyo (Japan) . . . . . [11245-27]  
 11:40 am: **Volume focusing microscopy with a high Strehl ratio for fast imaging of thick samples**, Qi Meng, Zachary J. Smith, Kaiqin Chu, Univ. of Science and Technology of China (China) . . . . . [11245-28]  
 Lunch Break . . . . . Wed 12:00 pm to 1:30 pm

**SESSION 7**

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . WED 1:30 PM TO 3:20 PM

**Innovative Methods in Microscopy**

Session Chair: **Jonathan T. C. Liu**, Univ. of Washington (USA)

1:30 pm: **Deep tissue imaging and focusing for neuroscience (Invited Paper)**, Ke Si, Zhejiang Univ. (China); Wei Gong, Ctr. for Neuroscience, Zhejiang Univ. School of Medicine (China) . . . . . [11245-29]  
 2:00 pm: **Physics-based learning for measurement diversity in 3D refractive index microscopy**, Regina Eckert, Michael R. Kellman, Laura Waller, Univ. of California, Berkeley (USA) . . . . . [11245-30]  
 2:20 pm: **Excitation-scan hyperspectral mirror array system advancements to hyperspectral imaging applications**, Marina Parker, Craig M. Browning, Sam A. Mayes, Joshua Deal, Samantha Gunn Mayes, Thomas C. Rich, Silas J. Leavesley, Univ. of South Alabama (USA) . . [11245-31]  
 2:40 pm: **Video-rate 3-D programmable imaging based on a digital micromirror device**, Dihan Chen, Mindan Ren, Qiang Geng, Dapeng Zhang, Jialong Chen, Shih-Chi Chen, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11245-32]  
 3:00 pm: **Three-dimensional tomographic imaging and quantitative phase measurement using virtual phase conjugation**, Satoshi Kawashima, Atsushi Okamoto, Tomohiro Maeda, Kazuhisa Ogawa, Akihisa Tomita, Hokkaido Univ. (Japan); Ryusuke Osaki, Naoki Hayashi, FUJIFILM Corp. (Japan) . . . . . [11245-33]  
 Coffee Break . . . . . Wed 3:20 pm to 3:50 pm

**SESSION 8**

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . . . WED 3:50 PM TO 5:40 PM

**Fluorescence and Nonlinear Microscopy**

Session Chair: **Thomas G. Brown**, The Institute of Optics, Univ. of Rochester (USA)

3:50 pm: **Coherent anti-Stokes Raman Fourier ptychography (Invited Paper)**, Sandro Heuke, Aix-Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France); Kevin Unger, Samira Kadhir, Kamal Belkebir, Patrick Chaumet, Anne Sentenac, Hervé Rigneault, Aix-Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France) . . . . . [11245-34]  
 4:20 pm: **A multiplexing confocal FLIM microscope with 4-taps time-gated imager**, Morgan Richards, McMaster Univ. (Canada); Yuya Shirakawa, Shizuoka Univ. (Japan); Fares Badr, Jessica Kun, McMaster Univ. (Canada); Keiichiro Kagawa, Shoji Kawahito, Shizuoka Univ. (Japan); Qiyin Fang, McMaster Univ. (Canada) . . . . . [11245-35]  
 4:40 pm: **Electronically controllable multiple line-scanning confocal microscopy using digital micromirror device**, Chun-Hung Weng, Kyu Young Han, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11245-36]  
 5:00 pm: **3,3'-thiodipropanol as a refractive index-matching mounting medium for fluorescence microscopy**, Milvia Iris Alata Tejedó, Valeria Piazza, Juan Carlos Martínez Cervantes, Centro de Investigaciones en Óptica, A.C. (Mexico) . . . . . [11245-37]  
 5:20 pm: **Super-speed multiphoton microscopy for mesoscopic volume imaging with ultra-dense sampling beyond Nyquist Limit**, Bhaskar Jyoti Borah, Han-Hsiung Chi, Chen-Tung Yen, National Taiwan Univ. (Taiwan); Chi-Kuang Sun, National Taiwan Univ. (Taiwan) and Academia Sinica (Taiwan) . . . . . [11245-38]

# CONFERENCE 11246

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11246

## Single Molecule Spectroscopy and Superresolution Imaging XIII

Conference Chairs: **Ingo Gregor**, Georg-August-Univ. Göttingen (Germany); **Felix Koberling**, PicoQuant GmbH (Germany); **Rainer Erdmann**, PicoQuant GmbH Berlin (Germany)

Program Committee: **Andrea M. Armani**, The Univ. of Southern California (USA); **Michael Börsch**, Friedrich-Schiller-Univ. Jena (Germany); **Christian Eggeling**, Univ. of Oxford (United Kingdom), Friedrich-Schiller Univ. Jena (Germany); **Jörg Enderlein**, Georg-August-Univ. Göttingen (Germany); **Paul M. W. French**, Imperial College London (United Kingdom); **Ewa M. Goldys**, The Univ. of New South Wales (Australia); **Zygmunt Karol Gryczynski**, Univ. of North Texas Health Science Ctr. at Fort Worth (USA), Texas Christian Univ. at Fort Worth (USA); **Mike Heilemann**, Goethe-Univ. Frankfurt am Main (Germany); **Johan Hofkens**, KU Leuven (Belgium); **Zhen-Li Huang**, Huazhong Univ. of Science and Technology (China); **Markus Sauer**, Univ. Bielefeld (Germany); **Shimon Weiss**, Univ. of California, Los Angeles (USA); **Andong Xia**, Institute of Chemistry (China)

Conference Co-Sponsor:



### SATURDAY 1 FEBRUARY

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . . . 8:55 AM TO 9:00 AM

#### Welcome & Introduction

Rainer Erdmann gives welcome and introduction

#### SESSION 1

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . SAT 9:00 AM TO 10:20 AM

#### Biological or Multimodal Applications

Session Chair: **Rainer Erdmann**, PicoQuant GmbH (Germany)

9:00 am: **Novel semiconductor-laser-integrated AFM active optical probe with ultrashort pulses and nanoscale aperture**, Alexander A. Ukhanov, Fei-Hung Chu, Gennady A. Smolyakov, Kevin J. Malloy, Actoprobe LLC (USA) . . . . . [11246-1]

9:20 am: **ElastoTweezers: A novel platform for high-precision cell elasticity measurements**, Karsten Gall, Andy Sischka, Ionovation GmbH (Germany); Sebastian Knust, Univ. Bielefeld (Germany); Hendrik Milting, Herz- und Diabeteszentrum Nordrhein-Westfalen (Germany); Bastien Venzac, Séverine Le Gac, Univ. of Twente (Netherlands); Elwin Vrouwe, Micronit Microfluidics B.V. (Netherlands); Martina Viefhues, Dario Anselmetti, Univ. Bielefeld (Germany) . . . . . [11246-2]

9:40 am: **Feedback enabled pinpoint force fluorescence microscope**, Patrick Schmidt, Benjamin Reichert, John Lajoie, Iowa State Univ. of Science and Technology (USA); Sanjeevi Sivasankar, Univ. of California, Davis (USA) . . . . . [11246-3]

10:00 am: **Super-resolution imaging of pathological tissue reveals higher-order chromatin folding in cancer development**, Yang Liu, Univ. of Pittsburgh (USA) . . . . . [11246-4]

Coffee Break . . . . . Sat 10:20 am to 10:50 am

#### SESSION 2

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . SAT 10:50 AM TO 12:10 PM

#### FLIM, FRET & FCS I

Session Chair: **Mike Heilemann**, Goethe-Univ. Frankfurt am Main (Germany)

10:50 am: **Fluorescence lifetime image scanning microscopy**, Ingo Gregor, Niels Radmacher, Jörg Enderlein, Georg-August-Univ. Göttingen (Germany) . . . . . [11246-5]

11:10 am: **Scanning FCS and super-resolution microscopy on 2D lipid membranes**, Uwe Ortmann, PicoQuant GmbH (Germany); Mariano Gonzalez Pisfil, PicoQuant GmbH (Germany) and Humboldt-Univ. (Germany); Marcelle König, Rhys Dowler, Benedikt Krämer, Sumeet Rohilla, Felix Koberling, Rainer Erdmann, PicoQuant GmbH (Germany) . . . . . [11246-6]

11:30 am: **Fast and compact time-correlated single photon counting system for high-speed measurement with low distortion**, Giulia Acconcia, Serena Farina, Ivan G. Labanca, Massimo Ghioni, Ivan Rech, Politecnico di Milano (Italy) . . . . . [11246-7]

11:50 am: **Efficient wide-field FLIM and image modulation using Pockels cells**, Adam Bowman, Mark A. Kasevich, Stanford Univ. (USA) . . . . . [11246-8]

Lunch Break . . . . . Sat 12:10 pm to 1:40 pm

#### SESSION 3

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . SAT 1:40 PM TO 3:10 PM

#### FLIM, FRET & FCS II

Session Chair: **Felix Koberling**, PicoQuant GmbH (Germany)

1:40 pm: **Efficient light harvesting biotic-abiotic nanohybrid system incorporating atomically thin van Der Waals transition metal dichalcogenides (Invited Paper)**, Mircea Cotlet, Mingxing Li, Brookhaven National Lab. (USA) . . . . . [11246-9]

2:10 pm: **Dual-color super-resolution imaging for FRET measurements: Energy transfer among donor/acceptor pairs of quantum dots**, Duncan Ryan, Los Alamos National Lab. (USA); Megan K. Dunlap, Colorado State Univ. (USA); Somak Majumder, Chris J. Sheehan, James H. Werner, Jennifer A. Hollingsworth, Los Alamos National Lab. (USA); Martin P. Gelfand, Alan K. Van Orden, Colorado State Univ. (USA); Peter M. Goodwin, Los Alamos National Lab. (USA) . . . . . [11246-10]

2:30 pm: **Elucidation of the protein conformational changes occurring during assembly of P22 bacteriophage coat protein**, Sanchari Banerjee, Carolyn Teschke, Univ. of Connecticut (USA) . . . . . [11246-11]

2:50 pm: **Ultrafast fluorescence lifetime imaging microscopy by frequency-division multiplexing**, Hiroshi Kanno, The Univ. of Tokyo (Japan); Hideharu Mikami, The Univ. of Tokyo (Japan) and Japan Science and Technology Agency (Japan); Keisuke Goda, The Univ. of Tokyo (Japan) and Univ. of California (USA) and Wuhan Univ. (China) . . . . . [11246-12]

Coffee Break . . . . . Sat 3:10 pm to 3:40 pm

SESSION 4

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . SAT 3:40 PM TO 5:30 PM

**Nanoscopy and Superresolution Microscopy I**

Session Chair: **Ingo Gregor**, Georg-August-Univ. Göttingen (Germany)

3:40 pm: **The phasor FLIM analysis reveals metabolic modulation and cell migration through adhesion-mediated contractility** (*Invited Paper*), Michelle Digman, Austin Lefebvre, Emma Mah, Albert Yee, Univ. of California, Irvine (USA) . . . . . [11246-13]

4:10 pm: **Planar plasmonic antenna arrays resolve transient nanoscopic heterogeneities in biological membranes**, Pamina Winkler, ICFO - Institut de Ciències Fotòniques (Spain) . . . . . [11246-14]

4:30 pm: **Microsecond transient absorption spectroscopy at 77 K to inform cryogenic single-molecule active control microscopy**, Annina M. Sartor, Peter D. Dahlberg, William E. Moerner, Stanford Univ. (USA) . . . . . [11246-15]

4:50 pm: **Achieving spontaneous super-resolution in a confocal microscope by exploiting super-linear emitters**, Denitza Denkova, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia) and Institute for Bioengineering of Catalonia (Spain); Martin Ploschner, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia) and The Univ. of Queensland (Australia); Minakshi Das, Lindsay M. Parker, Xianlin Zheng, Yiqing Lu, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia); Antony Orth, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and RMIT Univ. (Australia); Nicole H. Packer, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Griffith Univ. (Australia); James A. Piper, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia) . . . . . [11246-16]

5:10 pm: **Combining 3D single molecule localization strategies and spectral demultiplexing for bioimaging**, Clément Cabriel, Nicolas Bourg, Pierre Jouchet, Guillaume Dupuis, Institut des Sciences Moléculaires d'Orsay (France); Cyndelia Guillaume, Abbelight (France); Aurélie Baron, Institut de Chimie des Substances Naturelles (France); Marie-Ange Badet-Denisot, Ctr. de Recherche de Gif-sur-Yvette (France); Boris Vauzeilles, Institut de chimie moléculaire et des matériaux d'Orsay (France); Christophe Leterrier, Aix-Marseille Univ. (Finland); Emmanuel Fort, Institut Langevin Ondes et Images (France); Sandrine Leveque-Fort, Institut des Sciences Moléculaires d'Orsay (France) . . . . . [11246-17]

BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

SESSION 5

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . SUN 8:50 AM TO 10:10 AM

**New Fundamental Single Molecule Techniques I**

Session Chair: **Felix Koberling**, PicoQuant GmbH (Germany)

8:50 am: **Highly inclined plane illumination microscopy with extended imaging depth**, Jinhan Ren, Kyu Young Han, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11246-18]

9:10 am: **Line-scanning confocal microscopy with multiple inclined beams**, Jialei Tang, Kyu Young Han, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11246-19]

9:30 am: **Correlating DNA-PAINT and single-molecule FRET for multiplexed super-resolution imaging**, Nina S. Deussner-Helfmann, Goethe-Univ. Frankfurt am Main (Germany); Alexander Auer, Maximilian T. Strauss, Max-Planck-Institut für Biochemie (Germany) and Ludwig-Maximilians-Univ. München (Germany); Paul Donlin-Asp, Max-Planck-Institut für Hirnforschung (Germany); Sebastian Malkusch, Marina S. Dietz, Hans-Dieter Barth, Goethe-Univ. Frankfurt am Main (Germany); Erin Schuman, Max-Planck-Institut für Hirnforschung (Germany); Ralf Jungmann, Max-Planck-Institut für Biochemie (Germany) and Ludwig-Maximilians-Univ. München (Germany); Mike Heilemann, Goethe-Univ. Frankfurt am Main (Germany) . . . . . [11246-20]

9:50 am: **Self-interference digital holography (SIDH) for far-field three-dimensional nanoscale localization of fluorescent nanoparticles**, Abhijit Marar, Peter Kner, Univ. of Georgia (USA) . . . . . [11246-21]

Coffee Break . . . . . Sun 10:10 am to 10:40 am

SESSION 6

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . SUN 10:40 AM TO 12:10 PM

**Nanoscopy and Superresolution Microscopy II**

Session Chair: **Ingo Gregor**, Georg-August-Univ. Göttingen (Germany)

10:40 am: **Quantitative single-molecule localization microscopy reports on protein numbers in signaling protein complexes** (*Invited Paper*), Mike Heilemann, Goethe-Univ. Frankfurt am Main (Germany) . . . . . [11246-22]

11:10 am: **Imaging the photoemission of CdSe/CdS quantum dot clusters with sub-nanosecond time resolution and nanometer scale spatial precision (LA-UR-19-27019)**, Megan K. Dunlap, Colorado State Univ. (USA); Duncan Ryan, Peter M. Goodwin, James H. Werner, Somak Majumder, Jennifer A. Hollingsworth, The Ctr. for Integrated Nanotechnologies (USA) and Los Alamos National Lab. (USA); Martin P. Gelfand, Alan K. Van Orden, Colorado State Univ. (USA) . . . . . [11246-23]

11:30 am: **Quantum imaging with SPAD arrays**, Gur Lubin, Ron Tenne, Weizmann Institute of Science (Israel); Ivan Michel Antolovic, Edoardo Charbon, Claudio Bruschini, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Dan Oron, Weizmann Institute of Science (Israel) . . . . . [11246-24]

11:50 am: **3D single molecule localization microscopy based on time modulated illumination.**, Pierre Jouchet, Clément Cabriel, Nicolas Bourg, Marion Bardou, Institut des Sciences Moléculaires d'Orsay (France); Christian Poüs, Institut Paris Saclay d'Innovation Thérapeutique (France); Emmanuel Fort, Institut Langevin Ondes et Images (France); Sandrine Leveque-Fort, Institut des Sciences Moléculaires d'Orsay (France) . . . . . [11246-25]

Lunch Break . . . . . Sun 12:10 pm to 1:40 pm

SESSION 7

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . SUN 1:40 PM TO 3:00 PM

**Nanoscopy and Superresolution Microscopy III**

Session Chair: **Mike Heilemann**, Goethe-Univ. Frankfurt am Main (Germany)

1:40 pm: **Towards easier, faster, super-resolved microscopy** (*Invited Paper*), Paul M. W. French, Imperial College London (United Kingdom) . . . . . [11246-26]

2:10 pm: **MINFLUX: Achieving the ultimate resolution limit in fluorescence microscopy** (*Invited Paper*), Francisco Balzarotti, Research Institute of Molecular Pathology (Austria); Jasmin K. Pape, Klaus C. Gwosch, Stefan W. Hell, Max-Planck-Institut für Biophysikalische Chemie (Germany) . . . . . [11246-27]

2:40 pm: **Two-color two-photon excitation STED (2C2P-STED) microscopy**, Christoph Polzer, Stefan Ness, Thomas Kellerer, Markus Hilleringmann, Hochschule für Angewandte Wissenschaften München (Germany); Joachim O. Raedler, Ludwig-Maximilians-Univ. München (Germany); Thomas Hellerer, Hochschule für Angewandte Wissenschaften München (Germany) . . [11246-28]

# CONFERENCE 11246

## YOUNG INVESTIGATOR AWARD

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . . . 3:00 PM TO 3:15 PM

Session Chair: **Ingo Gregor**, Georg-August-Univ. Göttingen (Germany)

Coffee Break. . . . . Sun 3:15 pm to 3:45 pm

## SESSION 8

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . SUN 3:45 PM TO 5:05 PM

### New Fundamental Single Molecule Techniques II

Session Chair: **Paul M. W. French**,  
Imperial College London (United Kingdom)

3:45 pm: **Super-resolution microscopy of / with luminescent carbon nanotubes for high-resolution brain imaging in the near-infrared**, Antoine Godin, Chiara Paviolo, Noémie Danné, Antony Lee, Joana Ferreira, Laurent Groc, Laurent Cognet, Univ. de Bordeaux, CNRS (France) . . [11246-29]

4:05 pm: **Imaging 3D orientation and wobbling of single fluorescent emitters by polarized super-resolved microscopy**, Valentina Curcio, Caio Vaz Rimoli, Institut Fresnel (France); Cesar Augusto Valades Cruz, Institut Curie (France); Pascal Verdier-Pinard, Ctr. de Recherche en Cancérologie de Marseille (France); Manos Mavrikakis, Sophie Brasselet, Institut Fresnel (France) . . . . . [11246-30]

4:25 pm: **Interferometric scattering for fluorescence-free electrokinetic trapping of single nanoparticles in free solution**, Abhijit A. Lavania, Stanford Univ. (USA); Allison H. Squires, Stanford Univ. (USA) and The Univ. of Chicago (USA); Peter D. Dahlberg, William E. Moerner, Stanford Univ. (USA) . . [11246-31]

4:45 pm: **Surface enhanced Raman spectroscopy applied for anti-retroviral drug screening**, Setumo Lebogang Thobakgale, Sello L. Manoto, Patience T. Mthunzi-Kufa, Rudzani Malabi, CSIR National Laser Ctr. (South Africa) . . . . . [11246-32]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Determining the ending time of super-resolution localization microscopy experiments**, Zhen-Li Huang, Wuhan National Lab. for Optoelectronics (China) . . . . . [11246-34]

**Measuring G-protein activation with spectrally resolved fluorescence fluctuation spectroscopy**, Daniel J. Foust, David W. Piston, Washington Univ. in St. Louis (USA) . . . . . [11246-37]

**An LED-based super resolution digital image scanning microscope**, Yigit Uysalli, Ekin Özgönül, Fatmanur Tiryaki, Elif Nur Firat Karalar, Alper Kiraz, Koç Univ. (Turkey) . . . . . [11246-38]

**Measuring localization confidence for quantifying accuracy and heterogeneity in single-molecule super-resolution microscopy**, Hesam Mazidi, Tianben Ding, Arye Nehorai, Matthew D. Lew, Washington Univ. in St. Louis (USA) . . . . . [11246-39]

**Quantification of labelled target molecules via dSTORM localization microscopy**, Dániel Varga, Hajnalka Majoros, Zsuzsanna Ujfaludi, Tibor Pankotai, Miklos Erdélyi, Univ. of Szeged (Hungary) . . . . . [11246-40]

**Super resolution infrared photothermal microscopy: operating principle and detection limits**, Iliia M. Pavlovec, Univ. of Notre Dame (USA); Eduard A. Podshivaylov, M.V. Lomonosov Moscow State Univ. (Russian Federation); Gregory V. Hartland, Univ. of Notre Dame (USA); Pavel A. Frantsuzov, M.V. Lomonosov Moscow State Univ. (Russian Federation); Masaru K. Kuno, Univ. of Notre Dame (USA) . . . . . [11246-41]

**Nano-resolution in vivo 3D orbital tracking system to study cellular dynamics and bio-molecular processes**, Ulas C. Coskun, ISS, Inc. (USA); Matthew L. Ferguson, Huynh Anh, Boise State Univ. (USA); Alexander V. Less, Univ. of California, Irvine (USA); Yuansheng Sun, Shih-Chu J. Liao, Sunil Shah, ISS, Inc. (USA); Enrico Gratton, Univ. of California, Irvine (USA); Beniamino Barbieri, ISS, Inc. (USA) . . . . . [11246-45]

**A single-molecule assay to measure protein binding affinity beyond photobleaching**, Thilini Perera, Ying S. Hu, Univ. of Illinois at Chicago (USA); Wendi Fu, Univ. of Illinois (USA) . . . . . [11246-46]

**A computationally-efficient bound for the variance of measuring the orientation of single molecules**, Tingting Wu, Tianben Ding, Hesam Mazidi, Matthew D. Lew, Washington Univ. in St. Louis (USA) . . . . . [11246-35]

**Line-scanning confocal fluorescence microscopy with improved spatial resolution**, Vahid Ebrahimi, Chun-Hung Weng, Kyu Young Han, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . [11246-42]

**Synthetic aperture localization nanoscopy**, Jeffrey J. Field, Randy A. Bartels, Colorado State Univ. (USA) . . . . . [11246-43]

**Activation and cross-interaction of receptor tyrosine kinases studied by single-molecule localization microscopy**, Marie-Lena I. E. Harwardt, Sebastian Malkusch, Mark S. Schröder, Petra Freund, Goethe-Univ. Frankfurt am Main (Germany); Sebastian Strauss, Ralf Jungmann, Ludwig-Maximilians-Univ. München (Germany) and Max-Planck-Institut für Biochemie (Germany); Marina S. Dietz, Mike Heilemann, Goethe-Univ. Frankfurt am Main (Germany) . . . . . [11246-48]

**Correlating DNA-PAINT and single-molecule FRET for multiplexed super-resolution imaging**, Nina S. Deussner-Helfmann, Goethe-Univ. Frankfurt am Main (Germany); Alexander Auer, Maximilian T. Strauss, Max-Planck-Institut für Biochemie (Germany) and Ludwig-Maximilians-Univ. München (Germany); Paul Donlin-Asp, Max-Planck-Institut für Hirnforschung (Germany); Sebastian Malkusch, Marina S. Dietz, Hans-Dieter Barth, Goethe-Univ. Frankfurt am Main (Germany); Erin Schuman, Max-Planck-Institut für Hirnforschung (Germany); Ralf Jungmann, Max-Planck-Institut für Biochemie (Germany) and Ludwig-Maximilians-Univ. München (Germany); Mike Heilemann, Goethe-Univ. Frankfurt am Main (Germany) . . . . . [11246-49]

**Study of conformation and mechanical property of RpoS mRNA inhibitory stem using optical tweezers**, Xuanling Li, University of Science and Technology of China (China) . . . . . [11246-274]

**Using Confocal Fluorescence Microscopy to Map Molecules Quantitatively**, Marcelle König, Caroline Berlage, Paja Reisch, Felix Koberling, Uwe Ortmann, Haisen Ta, Rainer Erdmann, PicoQuant GmbH (Germany) . . . . . [11246-350]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:  
Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

# CONFERENCE 11247

LOCATION: ROOM 214 (LEVEL 2 SOUTH)

Monday 3 February 2020 • Proceedings of SPIE Vol. 11247

## Optical Diagnostics and Sensing XX: Toward Point-of-Care Diagnostics

Conference Chair: **Gerard L. Coté**, Texas A&M Univ. (USA)

Program Committee: **Zane A. Arp**, U.S. Food and Drug Administration (USA); **Brent D. Cameron**, The Univ. of Toledo (USA); **Blaž Cugmas**, Univ. of Latvia (Latvia); **H. Michael Heise**, Fachhochschule Südwestfalen (Germany); **Kristen C. Maitland**, Texas A&M Univ. (USA); **Mike J. McShane**, Texas A&M Univ. (USA); **Kenith E. Meissner II**, Swansea Univ. (United Kingdom); **Timothy J. Muldoon**, Univ. of Arkansas (USA); **Aydogan Ozcan**, Univ. of California, Los Angeles (USA); **Babak Shadgan**, International Collaboration On Repair Discoveries (Canada)

### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... MON 9:00 AM TO 10:00 AM

#### Monte Carlo Modelling of Optical Properties for POC Applications

Session Chair: **Mike J. McShane**, Texas A&M Univ. (USA)

9:00 am: **Parallelized multi-layered Monte Carlo model for evaluation of a proximal phalanx photoplethysmograph**, Jesse Fine, Texas A&M Univ. (USA); Andres Rodriguez, Tananant Boonya-ananta, Jessica Ramella-Roman, Florida International Univ. (USA); Mike McShane, Gerard L. Coté, Texas A&M Univ. (USA) ..... [11247-1]

9:20 am: **Monte-Carlo simulation for design optimization of optical skin probe in near infrared spectroscopy**, June-Young Lee, Sungmo Ahn, Moonseong Park, Sung Hyun Nam, Samsung Advanced Institute of Technology (Korea, Republic of) ..... [11247-2]

9:40 am: **Quantification of relationship between noninvasive glucose prediction performance and collection efficiency of Raman spectrometer**, Yun Park, Sungmo Ahn, Hojun Chang, Woochang Lee, Sung Hyun Nam, Samsung Advanced Institute of Technology (Korea, Republic of) ..... [11247-3]

Coffee Break ..... Mon 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... MON 10:30 AM TO 11:50 AM

#### Raman and Surface Enhanced Raman for POC Applications

Session Chair: **Zane A. Arp**, U.S. Food and Drug Administration (USA)

10:30 am: **Toward point of care uropathogen detection using SERS-active filters**, Simon Dryden, Alexander Thompson, Salzitsa Anastasova, Daniel Leff, Ara Darzi, Imperial College London (United Kingdom) ..... [11247-4]

10:50 am: **Development of a paper microfluidic surface enhanced Raman scattering assay for cardiac troponin I**, Dandan Tu, John Dean, Allison Holderby, Monika Schechinger, Texas A&M Univ. (USA) and PATHS-UP ERC (USA); Gerard L. Coté, Texas A&M Univ. (USA) and Texas A&M Engineering Experiment Station (USA) and PATHS-UP ERC (USA) ..... [11247-5]

11:10 am: **Serum Raman spectroscopy: exploring delineation of oral premalignant disorders**, Snehal Dhupal, YMT Dental College (India); Arti Hole, Advanced Ctr. for Treatment, Research & Education in Cancer (India); Sheetal Korde, YMT Dental College (India); Sakshi Bubna, Aishwarya Naidu, C. Murali Krishna, Advanced Ctr. for Treatment, Research & Education in Cancer (India) ..... [11247-6]

11:30 am: **Detection of nervous system in gastrointestinal wall using Raman spectroscopy**, Katsuhiko Ogawa, Yusuke Oshima, Takahiro Hiratsuka, Tomonori Akagi, Kosuke Suzuki, Tomotaka Shibata, Yoshitake Ueda, Manabu Tojigamori, Hidefumi Shiroshita, Tsuyoshi Etoh, Masafumi Inomata, Oita Univ. (Japan) ..... [11247-7]

Lunch Break ..... Mon 11:50 am to 1:20 pm

#### SESSION 3

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... MON 1:20 PM TO 3:00 PM

#### Optical Analysis of Blood for Multiple Applications

Session Chairs: **Brent D. Cameron**, The Univ. of Toledo (USA); **Herbert Michael Heise**, Fachhochschule Südwestfalen (Germany)

1:20 pm: **Continuous optical monitoring of spinal cord hemodynamics during the first week post-injury in a porcine model of acute spinal cord injury**, Amanda Cheung, Lorna Tu, Neda Manouchehri, Kitty So, Megan Webster, Shera Fisk, Femke Streijger, Andrew Macnab, Brian K. Kwon, Babak Shadgan, The Univ. of British Columbia (Canada) ..... [11247-8]

1:40 pm: **Determination of hemoglobin derivatives in unaltered whole blood samples using Support Vector regression in the spectral range from 450 to 700 nm**, Benjamin Redmer, Technische Hochschule Lübeck (Germany) and Univ. zu Lübeck (Germany); Philip Schargus, Saidurga Karthikeyan, Bodo Nestler, Stefan Müller, Technische Hochschule Lübeck (Germany) ..... [11247-9]

2:00 pm: **Label-free hematology analysis using deep-ultraviolet microscopy**, Ashkan Ojaghi, Georgia Institute of Technology (USA); Francisco E. Robles, Georgia Institute of Technology & Emory Univ. School of Medicine (USA) ..... [11247-10]

2:20 pm: **Laser speckle decorrelation time analysis for red blood cell storage duration**, Hee-Jae Jeon, Muhammad Mohsin Qureshi, Gwangju Institute of Science and Technology (Korea, Republic of); Seung Yeon Lee, Chonnam National Univ. Hospital (Korea, Republic of); Euiheon Chung, Gwangju Institute of Science and Technology (Korea, Republic of) ..... [11247-11]

2:40 pm: **Anticoagulation and hemostasis monitoring at the bedside during cardiac surgical procedures**, Diane M. Tshikudi, Michael N. Andrawes, Seemantini K. Nadkarni, Massachusetts General Hospital (USA) ..... [11247-12]

Coffee Break ..... Mon 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... MON 3:30 PM TO 4:30 PM

#### Use of Mobile Phone for POC Analysis

Session Chair: **Babak Shadgan**, International Collaboration On Repair Discoveries (Canada)

3:30 pm: **Thermo-photonic detection and quantification of THC in oral fluid at unprecedented low concentrations**, Damber Thapa, Nakisa Samadi, Nisarg Patel, Artur Parkhimchyk, Nima Tabatabaei, York Univ. (Canada) ..... [11247-13]

3:50 pm: **Towards label-free point-of-care diagnosis of urinary schistosomiasis**, Temitope E. Agbana, Patrick Nijman, Max Hoerber, Jan-Carel Diehl, Angela van Diepen, Lisette van Lieshout, Maria Yazdanbakhsh, Michel Verhaegen, Gleb Vdovine, Technische Univ. Delft (Netherlands) ..... [11247-14]

4:10 pm: **A portable smartphone-linked optical sensor for rapid and chemical-free hemoglobin assay**, Joon Ho Lee, Yonsei Univ. (Korea, Republic of); Jaewoo Song, Yonsei Univ. College of Medicine (Korea, Republic of); Jun-Ho Choi, Socheol Kim, Ui-Han Kim, Van-Thuan Nguyen, Jong-Seok Lee, Chulmin Joo, Yonsei Univ. (Korea, Republic of) ..... [11247-15]

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# CONFERENCE 11247

## POSTERS-MONDAY

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**RGC imaging and fluorescence image comparison using reflection-type DIC microscopy**, Subeen Park, Korea Institute of Science and Technology (Korea, Republic of) and Kookmin Univ. (Korea, Republic of); Byeongho Park, Youngho Cho, Korea Institute of Science and Technology (Korea, Republic of); Hyung Min Kim, Kookmin Univ. (Korea, Republic of); Kyoung Min Lee, Da Young Song, Boramae Medical Ctr., Seoul National Univ. Hospital (Korea, Republic of); Robert J. Zawadzki, Univ. of California, Davis (USA); Dae Yu Kim, Inha Univ. (Korea, Republic of); Seok Hwan Kim, Seoul National Univ. Hospital (Korea, Republic of); Jae Hun Kim, Korea Institute of Science and Technology (Korea, Republic of). . . . . [11247-16]

**Lens-free holographic microscopy for complete blood analysis on a chip**, Yi-Chun Chen, National Central Univ. (Taiwan). . . . . [11247-17]

**Photoplethysmography for bovine heat detection: the preliminary results**, Blaž Cugmas, Univ. of Latvia (Latvia); Aleksandar Plavšić, VETS4SCIENCE d.o.o. (Slovenia); Eva Štruc, Vetamplify, SIA (Latvia); Janis Spigulis, Univ. of Latvia (Latvia). . . . . [11247-18]

**Detection of glucose by chitosan coated nanogold array on u-shaped optical sensor platform**, Begum Balkan, Cansu Canbek Ozdil, Murat Gülsoy, Bogaziçi Üniv. (Turkey). . . . . [11247-19]

# CONFERENCE 11248

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH)

Sunday–Thursday 2–6 February 2020 • Proceedings of SPIE Vol. 11248

# Adaptive Optics and Wavefront Control for Biological Systems VI

*Conference Chairs:* **Thomas G. Bifano**, Boston Univ. (USA); **Sylvain Gigan**, Lab. Kastler Brossel (France); **Na Ji**, Univ. of California, Berkeley (USA)

*Program Committee:* **Jacopo Bertolotti**, Univ. of Exeter (United Kingdom); **Martin J. Booth**, Univ. of Oxford (United Kingdom); **Wonshik Choi**, Korea Univ. (Korea, Republic of); **Tomá? ?i?már**, Univ. of Jena (Germany); **Meng Cui**, Purdue Univ. (USA); **John M. Girkin**, Durham Univ. (United Kingdom); **Benjamin Judkewitz**, Charité Universitätsmedizin Berlin (Germany); **Ori Katz**, The Hebrew Univ. of Jerusalem (Israel); **Peter A. Kner**, The Univ. of Georgia (USA); **Pablo Loza-Alvarez**, ICFO - Institut de Ciències Fotòniques (Spain); **Allard P. Mosk**, Utrecht Univ. (Netherlands); **Rafael Piestun**, Univ. of Colorado Boulder (USA); **Laura Waller**, Univ. of California, Berkeley (USA); **Monika Ritsch-Marte**, Medizinische Univ. Innsbruck (Austria); **Lei Tian**, Boston Univ. (USA)

## SUNDAY 2 FEBRUARY

### SESSION 1

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . SUN 8:50 AM TO 10:30 AM

#### AO Microscopy I

Session Chair: **Na Ji**, Univ. of California, Berkeley (USA)

8:50 am: **Adaptive optics enables fast widefield imaging of neuronal structure and function with optical sectioning in vivo**, Ziwei Li, Univ. of California, Berkeley (USA) and Tsinghua Univ. (China); Qinrong Zhang, Shih-Wei Chou, Zachary Newman, Univ. of California, Berkeley (USA); Raphael Turcotte, Univ. of California, Berkeley (USA); Ryan Natan, Univ. of California, Berkeley (USA); Qionghai Dai, Tsinghua Univ. (China); Ehud Y. Isacoff, Univ. of California, Berkeley (USA) and Helen Wills Neuroscience Institute, Univ. of California, Berkeley (USA) and Bioscience Division, Lawrence Berkeley National Lab. (USA); Na Ji, Univ. of California, Berkeley (USA) and Helen Wills Neuroscience Institute, Univ. of California, Berkeley (USA) . . . . . [11248-1]

9:10 am: **Volumetric imaging of synaptic activity at depth by adaptive optical Bessel focus scanning multiphoton microscopy**, Wei Chen, Univ. of California, Berkeley (USA) . . . . . [11248-2]

9:30 am: **Distortion matrix concept for deep imaging in optical coherence microscopy**, Alexandre Aubry, Amaury Badon, Victor Barolle, Institut Langevin Ondes et Images (France); Kristina Irsch, Institut de la Vision, (France) and UPMC-Sorbonne Universities (France); Albert C. Boccara, Mathias Fink, Institut Langevin Ondes et Images (France) . . . . . [11248-3]

9:50 am: **Lattice light-sheet and Fresnel incoherent coherence holography**, Mariana Potcoava, Shelagh Rodriguez, Zack Zurawski, Simon Alford, Univ. of Illinois at Chicago (USA) . . . . . [11248-4]

10:10 am: **Hybrid adaptive optics for light sheet microscopy using Scene base wave-front sensor**, Yang Liu, Keelan Lawrence, James Lauderdale, Peter Kner, The Univ. of Georgia (USA) . . . . . [11248-5]

Coffee Break . . . . . Sun 10:30 am to 11:00 am

### SESSION 2

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . SUN 11:00 AM TO 12:10 PM

#### AO Microscopy II

Session Chair: **Thomas G. Bifano**, Boston Univ. (USA)

11:00 am: **Fast wavefront modulation for microscopy through complex media** (*Invited Paper*), Sakshi Singh, Simon Labouesse, Omer Tzang, Eyal Niv, Rafael Piestun, Univ. of Colorado Boulder (USA) . . . . . [11248-6]

11:30 am: **Vectorial adaptive optics – correction of polarization and phase**, Chao He, Jingyu Wang, Qi Hu, Jacopo Antonello, Martin Booth, Univ. of Oxford (United Kingdom) . . . . . [11248-7]

11:50 am: **Closed-loop multiconjugate adaptive optics for microscopy**, Karen M. Hampson, Jiahe Cui, Matthew Wincott, Syed Hussain, Univ. of Oxford (United Kingdom); Kaustubh Banerjee, Pouya Rajaeipour, Çağlar Ataman, Hans Zappe, Univ. of Freiburg (Germany); Martin J. Booth, Univ. of Oxford (United Kingdom) . . . . . [11248-9]

Lunch Break . . . . . Sun 12:10 pm to 1:40 pm

### SESSION 3

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . SUN 1:40 PM TO 3:30 PM

#### Computational AO

Session Chair: **Sylvain Gigan**, Lab. Kastler Brossel (France)

1:40 pm: **Deep learning based computational microscopy in scattering media** (*Invited Paper*), Lei Tian, Boston Univ. (USA) . . . . . [11248-10]

2:10 pm: **Computational imaging with randomness**, Ryoichi Horisaki, Osaka Univ. (Japan) . . . . . [11248-11]

2:30 pm: **Computational confocal gating through multimode fiber without active wave-control**, Szu-Yu Lee, Brett E. Bouma, Martin Villiger, Wellman Ctr. for Photomedicine (USA) . . . . . [11248-12]

2:50 pm: **Full three-dimensional aberration-free super-resolution imaging through thick multicellular samples**, Ruizhe Lin, Peter Kner, The Univ. of Georgia (USA) . . . . . [11248-13]

3:10 pm: **Fast adaptive optics compensation via deep neural network**, Yuanlong Zhang, Qionghai Dai, Tsinghua Univ. (China) . . . . . [11248-14]

Coffee Break . . . . . Sun 3:30 pm to 4:00 pm

### SESSION 4

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . SUN 4:00 PM TO 5:40 PM

#### Imaging and Focusing through Scatter

Session Chair: **Rafael Piestun**, Univ. of Colorado Boulder (USA)

4:00 pm: **Image-guided wavefront-shaping**, Tomer Yeminy, Ori Katz, The Hebrew Univ. of Jerusalem (Israel) . . . . . [11248-15]

4:20 pm: **An angular-spectrum model for light focusing inside scattering media by optical phase conjugation**, Jiamiao Yang, Jingwei Li, Lihong V. Wang, Caltech (USA) . . . . . [11248-16]

4:40 pm: **Scattering assisted imaging**, Marco Leonetti, Alfonso Grimaldi, Silvia Ghirga, Giancarlo Ruocco, Istituto Italiano di Tecnologia (Italy); Giuseppe Antonacci, Univ. Gent (Belgium) and IMEC (Belgium) . . . . . [11248-17]

5:00 pm: **Optimal wave fields for micro-manipulation in complex scattering environments**, Michael Horodyski, Matthias Kühmayer, Andre Brandstötter, Kevin Pichler, Technische Univ. Wien (Austria); Yan V. Fyodorov, King's College London (United Kingdom); Ulrich Kuhl, Univ. de Nice Sophia Antipolis (France); Stefan Rotter, Technische Univ. Wien (Austria) . . . . . [11248-18]

5:20 pm: **Stochastic optical scattering localization for noninvasively imaging through scattering media at super-resolution**, Cuong H. Dang, Nanyang Technological Univ. (Singapore); Sujit K. Sahoo, Nanyang Technological Univ. (Singapore) and Indian Institute of Technology Goa (India); Dong Wang, Taiyuan Univ. of Technology (Singapore) . . . [11248-37]

# CONFERENCE 11248

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM

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Poster Setup: Sunday 10:00 AM – 4:30 PM

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**Using deflectometry to calibrate a remote focusing microscope,** Syed Asad Hussain, Karen Hampson, Matthew Wincott, Jacopo Antonello, Martin Booth, Univ. of Oxford (United Kingdom) . . . . . [11248-31]

**Wavefront shaping with feedback from linear fluorescence signal to non-invasively focus laser light inside scattering media,** Dayan Li, Vinh Tran, Nanyang Technological Univ. (Singapore); Sujit Sahoo, Nanyang Technological Univ. (Singapore) and Indian Institute of Technology Goa (India); Huy Lam, Nanyang Technological Univ. (Singapore); Dong Wang, Nanyang Technological Univ. (Singapore) and College of Physics and Optoelectronics, Taiyuan Univ. of Technology (China); Cuong Dang, Nanyang Technological Univ. (Singapore) . . . . . [11248-32]

**High-quality and fast two-photon volumetric imaging with adaptive optics,** Yu Wang, Britton Chance Ctr. for Biomedical Photonics, Wuhan National Lab. for Optoelectronics-Huazhong Univ. of Science and Technology (China) and MOE Key Lab. for Biomedical Photonics, Huazhong Univ. of Science and Technology (China); Huaming Li, Qinglei Hu, Xiaohua Lv, Shaohun Zeng, Huazhong Univ. of Science and Technology (China) . . . . . [11248-33]

**Sensorless wavefront correction for DMD-based fast 3-D imaging,** Mindan Ren, Qiang Geng, Shih-Chi Chen, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11248-34]

**Sampling effect on recovering hidden objects behind scattering media via deep learning,** Huanhao Li, Zhipeng Yu, The Hong Kong Polytechnic Univ. (Hong Kong, China); Yunqi Luo, Nanyang Technological Univ. (Singapore); Tianting Zhong, Shengfu Cheng, The Hong Kong Polytechnic Univ. (Hong Kong, China); Yuanjin Zheng, Nanyang Technological Univ. (Singapore); Puxiang Lai, The Hong Kong Polytechnic Univ. (Hong Kong, China) . . . . . [11248-35]

**Differential sensing technique for correlation-based adaptive optics,** Hayao Kikuchi, Yusuke Honma, Noriaki Miura, Takatoshi Shibuya, Kitami Institute of Technology (Japan); Yosuke Tamada, National Institute for Basic Biology (Japan); Atsushi Matsuda, National Institute of Information and Communications Technology (Japan); Masayuki Hattori, National Astronomical Observatory of Japan (Japan) . . . . . [11248-36]

**Wavefront shaping simulations based on Maxwell's equations: Focus intensity behavior while scanning inside randomly scattering media,** Felix Ott, Benjamin Krüger, Alwin Kienle, Institut für Lasertechnologien in der Medizin und Messtechnik (Germany) . . . . . [11248-38]

**Adaptive optics light-sheet microscopy for neuroimaging using direct wavefront sensing without guide star,** Fabrice Harms, Imagine Optic SA (France); Antoine Hubert, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (France) and Imagine Optic SA (France) and Lab. de Physique et d'Etude des Matériaux (France); Rémy Juvenal, Pauline Treimany, Cynthia Veilly, Guillaume Dovillaire, Xavier Levecq, Imagine Optic SA (France); Vincent Lorient, Alexandra Fragola, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (France) and Lab. de Physique et d'Etude des Matériaux (France) . . . . . [11248-39]

**Binary wavefront optimized multi-photon microscopy of mitochondria in the bone marrow cavity,** Kayvan ughesh Forouhesh Tehrani, Peter Kner, Luke Mortensen, The Univ. of Georgia (USA) . . . . . [11248-40]

**Optimization of wavefront aberration compensation in real-time sensorless adaptive-optics optical coherence tomography angiography,** Acner Camino Benech, Oregon Health & Science Univ. (USA); Ringo Ng, Joey Huang, Simon Fraser Univ. (Canada); Yali Jia, David Huang, Yifan Jian, Oregon Health & Sciences Univ. (USA) . . . . . [11248-41]

**Creating correct aberrations: why blur isn't always bad in the eye,** Gordon D. Love, Durham Univ. (United Kingdom); Martin S. Banks, Steven A. Cholewiak, Univ. of California, Berkeley (USA); Abigail P. Finch, Durham Univ. (United Kingdom) . . . . . [11248-44]

**Correction of aberration in a very compact setup using a deformable lens,** Stefano Bonora, Tommaso Furiere, Giulio Bursi, Davide Garoldini, Martino Quintavalla, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . . . [11248-42]

**Spherical aberration correction using multi actuator adaptive lens,** Stefano Bonora, Tommaso Furiere, Martino Quintavalla, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . . . [11248-43]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

John G. Greivenkamp, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam,**

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells

**Eric Betzig,** Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

## MONDAY 3 FEBRUARY

### SESSION 5

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . MON 8:30 AM TO 10:00 AM

### AO in Vision Science

Session Chair: **Peter Kner,** The Univ. of Georgia (USA)

8:30 am: **Computational ocular microscopy – quantitative assessment of corneal transparency** (*Invited Paper*), Kristina Irsch, Institut de la Vision (France) and Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France) and CNRS (France) . . . . . [11248-19]

9:00 am: **Adaptive optics two-photon microscopy for in vivo imaging of mouse retina,** Zhongya Qin, Sicong He, Congping Chen, Chao Yang, Hong Kong Univ. of Science and Technology (Hong Kong, China); Jasmine Yung, Christopher K.S. Leung, The Chinese Univ. of Hong Kong (Hong Kong, China); Kai Liu, Jianan Y. Qu, Hong Kong Univ. of Science and Technology (Hong Kong, China) . . . . . [11248-20]

9:20 am: **Matrix approach of Full-Field OCT for volumetric imaging of an opaque monkey cornea,** Paul Balondrade, Victor Barolle, Institut Langevin Ondes et Images (France); Kristina Irsch, Institut de la Vision (France); Claude Boccard, Mathias Fink, Alexandre Aubry, Institut Langevin Ondes et Images (France) . . . . . [11248-21]

9:40 am: **Image-based digital motion and aberration compensation in laser Doppler holography of the eye fundus,** Michael Atlan, Armand Tournin, Thomas Andal, Leo Puyo, Institut Langevin Ondes et Images (France); Michel Pâques, Ctr. Hospitalier National d'Ophthalmologie des Quinze-Vingts (France) . . . . . [11248-22]

Coffee Break. . . . . Mon 10:30 am to 11:00 am

### SESSION 6

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . MON 10:30 AM TO 12:10 PM

### Endoscopy and Multimode Fiber Imaging I

Session Chair: **Hervé Rigneault,** Institut Fresnel (France)

10:30 am: **Fast confocal fluorescence imaging in freely-behaving mice** (*Invited Paper*), Clara Dussaux, Ecole Normale Supérieure (France); Ombeline Hoa, Collège de France (France); Yan Chastagnier, Institut de Génétique Fonctionnelle (France); Jozsua Fodor, Ecole Normale Supérieure (France); Vivien Szabo, Institut de Génétique Fonctionnelle (France); Jean-François Léger, Laurent Bourdieu, Ecole Normale Supérieure (France); Michael Zugaro, Collège de France (France); Julie Perroy, Institut de Génétique Fonctionnelle (France); Cathie Ventalon, Ecole Normale Supérieure (France) . . . . . [11248-23]

11:00 am: **Flexible lensless endoscope with a conformationally invariant multi-core fiber,** Hervé Rigneault, Aix Marseille Univ. (France) and CNRS (France) and Ecole Centrale de Marseille (France); Viktor Tsvirkun, Aix Marseille Univ. (France) and CNRS (France) and Ecole Centrale de Marseille (France); Siddharth Sivankutty, Aix Marseille Univ. (France) and CNRS (France) and Ecole Centrale de Marseille (France); Geraud Bouwmans, Olivier Vanvincq, Univ. de Lille (France) and CNRS (France) and Lab. de Physique des Lasers, Atomes et Molécules (France); Esben Andresen, Univ. de Lille (France) and CNRS (France) and Univ. de Lille (France) . . . . . [11248-24]

11:20 am: **Light field modulation of laser beams passing through multi-core fiber** (*Invited Paper*), Jixiong Pu, Liqing Wu, Ziyang Chen, Huaqiao Univ. (China) . . . . . [11248-25]

11:50 am: **Image enhancement in multi-mode fiber-based endoscopy imaging**, Martin Šiler, Tereza Tučková, Petr Ják, Hana Uhlířová, Institute of Scientific Instruments of the CAS, v.v.i. (Czech Republic); Tomáš Čížmár, Institute of Scientific Instruments of the CAS, v.v.i. (Czech Republic), Leibniz-Institut für Photonische Technologien e.V. (Germany). . . . . [11248-26]  
 Lunch Break . . . . . Mon 12:10 pm to 1:30 pm

**SESSION 7**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . MON 1:30 PM TO 2:50 PM**

**Endoscopy and Multimode Fiber Imaging II**

Session Chair: **Martin J. Booth**, Univ. of Oxford (United Kingdom)

1:30 pm: **Super-resolution compressive endo-microscopy via a multimode fiber**, Liubov Amitonova, Johannes de Boer, Vrije Univ. Amsterdam (Netherlands) . . . . . [11248-27]

1:50 pm: **Robust 4D wavefront control through coherent fiber bundles for lensless endoscopy and optical tweezing**, Elias Scharf, Robert Kuszmierz, Jürgen Czarske, TU Dresden (Germany). . . . . [11248-28]

2:10 pm: **Numerical comparison of robustness of shaped beam delivery through multimode and multicore fibre against fibre bending**, Madhu Veettikazhy, Anders K. Hansen, Dominik Marti, Technical Univ. of Denmark (Denmark); Kishan Dholakia, Univ. of St. Andrews (United Kingdom); Peter E. Andersen, Technical Univ. of Denmark (Denmark) . . . . . [11248-29]

2:30 pm: **Hybrid photoacoustic and fluorescence endomicroscopy through a multimode fiber via transmission-matrix-based optical wavefront shaping**, Sylvain Mezil, Irène Wang, Philippe Moreau, Théodore Remark, Lab. Interdisciplinaire de Physique, Univ. Grenoble Alpes (France) and CNRS (France); Antonio M. Caravaca-Aguirre, Lab. Interdisciplinaire de Physique, Univ. Grenoble Alpes (France) and CNRS (France); Emmanuel Bossy, Lab. Interdisciplinaire de Physique, Univ. Grenoble Alpes (France) and CNRS (France) . . . . . [11248-30]

# CONFERENCE 11249

LOCATION: ROOM 314 (LEVEL 3 SOUTH)

Saturday–Tuesday 1–4 February 2020 • Proceedings of SPIE Vol. 11249

## Quantitative Phase Imaging VI

Conference Chairs: **Yang Liu**, Univ. of Pittsburgh (USA); **Gabriel Popescu**, Univ. of Illinois (USA); **YongKeun Park**, KAIST (Korea, Republic of)

Program Committee: **Tatiana Alieva**, Univ. Complutense de Madrid (Spain); **George Barbastathis**, Massachusetts Institute of Technology (USA); **Pietro Ferraro**, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); **Elena Holden**, Executive Strategic Advisory, Biotech and IVD (USA); **Björn Kemper**, Westfälische Wilhelms-Univ. Münster (Germany); **Myung K. Kim**, Univ. of South Florida (USA); **Jerome Mertz**, Boston Univ. (USA); **Aydogan Ozcan**, Univ. of California, Los Angeles (USA); **Demetri Psaltis**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Monika Ritsch-Marte**, Medizinische Univ. Innsbruck (Austria); **Peter T. C. So**, Massachusetts Institute of Technology (USA); **Laura Waller**, Univ. of California, Berkeley (USA); **Renjie Zhou**, The Chinese Univ. of Hong Kong (Hong Kong, China)

Conference Co-Sponsor:  Tomocube  OPTICS  
from image to knowledge

### SATURDAY 1 FEBRUARY

#### INTRODUCTION

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... 9:00 AM TO 9:15 AM

Session Chair: **Gabriel Popescu**, Univ. of Illinois (USA)

#### SESSION 1

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... SAT 9:15 AM TO 10:25 AM

#### QPI Methodologies I

Session Chair: **Gabriel Popescu**, Univ. of Illinois (USA)

9:15 am: **Single-shot full-field measurement with a multimode fiber** (*Invited Paper*), Hui Cao, Yale Univ. (USA) ..... [11249-1]

9:45 am: **Self-referenced interferometric method for SLM phase calibration based on two blazed gratings**, Liangcai Cao, Yunhui Gao, Rujia Li, Tsinghua Univ. (China) ..... [11249-2]

10:05 am: **Enhancing resolution in coherent microscopy using deep learning**, Kevin de Haan, Tairan Liu, Yair Rivenson, Zhensong Wei, Xin Zeng, Yibo Zhang, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . [11249-3]

Coffee Break. .... Sat 10:25 am to 10:55 am

#### SESSION 2

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... SAT 10:55 AM TO 12:05 PM

#### QPI Methodologies II

Session Chair: **Yang Liu**, Univ. of Pittsburgh (USA)

10:55 am: **Phase imaging with computational specificity** (*Invited Paper*), Gabriel Popescu, Univ. of Illinois (USA) ..... [11249-4]

11:25 am: **High-speed optical diffraction tomography (ODT) with deep learning approach**, Baoliang Ge, Mo Deng, George Barbastathis, Peter T. C. So, Massachusetts Institute of Technology (USA); Renjie Zhou, The Chinese University of Hong Kong (China); Zahid Yaqoob, Massachusetts Institute of Technology (USA) ..... [11249-5]

11:45 am: **Machine learning for optical pathlength demodulation in interferometric phase imaging**, Yizheng Zhu, Jacob A. Black, Shichao Chen, Virginia Polytechnic Institute and State Univ. (USA) ..... [11249-6]

Lunch Break ..... Sat 12:05 pm to 1:35 pm

#### SESSION 3

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... SAT 1:35 PM TO 3:05 PM

#### QPI Methodologies III

Session Chair: **YongKeun Park**, KAIST (Korea, Republic of)

1:35 pm: **3D super-resolution microscopy of fluorescently labelled molecules inside a biological tissue using phase analysis by SELFI** (*Invited Paper*), Laurent Cognet, Univ. de Bordeaux (France) and CNRS (France) ..... [11249-7]

2:05 pm: **Isotropic quantitative phase imaging in LED microscopy using azimuthally cosine-modulated illumination**, Sunwoong Hur, Chulmin Joo, Seungri Song, Yonsei Univ. (Korea, Republic of) ..... [11249-9]

2:25 pm: **Computational illumination for high-throughput intensity diffraction tomography of dynamic biological samples**, Alex C. Matlock, Boston Univ. (USA); Jiaji Li, Nanjing Univ. of Science and Technology (China); Lei Tian, Boston Univ. (USA) ..... [11249-11]

2:45 pm: **Reconstruction of three-dimensional refractive index tensor by solving an inverse scattering problem of vector fields diffracted from an optically anisotropic object**, Seungwoo Shin, YongKeun Park, KAIST (Korea, Republic of) ..... [11249-13]

Coffee Break. .... Sat 3:05 pm to 3:35 pm

#### SESSION 4

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... SAT 3:35 PM TO 5:05 PM

#### QPI Methodologies IV

3:35 pm: **High sensitivity SLIM imaging and deep learning to correlate sperm morphology and fertility outcomes**, Mikhail E. Kandel, Yuchen R. He, Marcello Rubessa, Matthew B. Wheeler, Gabriel Popescu, Univ. of Illinois (USA) ..... [11249-16]

3:55 pm: **Optimization-based optical diffraction tomography with spatially incoherent illumination**, Seth D. Smith-Dryden, Shengli Fan, Bahaa E. A. Saleh, Guifang Li, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) ..... [11249-17]

4:15 pm: **Optical diffraction tomography with deep-field match optimization**, Shengli Fan, Seth D. Smith-Dryden, Jian Zhao, Guifang Li, Bahaa E. A. Saleh, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) ..... [11249-18]

4:35 pm: **Metrology and standardization problems in 3D quantitative phase imaging** (*Invited Paper*), Malgorzata Kujawinska, Warsaw Univ. of Technology (Poland) ..... [11249-19]

**BIOS HOT TOPICS**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . SUN 9:00 AM TO 10:10 AM**

**QPI Methodologies V**

Session Chair: **Pietro Ferraro**, Istituto di Scienze Applicate e Sistemi Intelligenti "Eduardo Caianiello" (Italy)

- 9:00 am: **Interferometric Scattering Microscopy (iSCAT): seeing and tracking nanoparticles** (*Invited Paper*), **Vahid Sandoghdar**, Max-Planck-Institut für die Physik des Lichts (Germany) and Max-Planck-Zentrum für Physik und Medizin (Germany) . . . . . [11249-20]
- 9:30 am: **Harmonically-decoupled gradient light interference microscopy**, **Yi Wang**, Beckman Institute for Science and Technology, Univ. of Illinois (USA) . . . . . [11249-21]
- 9:50 am: **Quantitative imaging of anisotropic dynamics enabled by polarized shearing interferometric microscopy**, **Baoliang Ge, Qing Zhang**, Massachusetts Institute of Technology (USA); **Renjie Zhou**, The Chinese Univ. of Hong Kong (Hong Kong, China); **Zahid Yaqoob, Irmgard Bischofberger, Peter T. C. So**, Massachusetts Institute of Technology (USA) . . . . . [11249-22]
- Coffee Break . . . . . Sun 10:10 am to 10:40 am

**SESSION 6**

**LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . SUN 10:40 AM TO 12:10 PM**

**QPI Methodologies VI**

Session Chair: **Björn Kemper**, Westfälische Wilhelms-Universität Münster (Germany)

- 10:40 am: **Visualization of single unlabeled nanoparticles using depth scanning correlation interferometric microscopy** (*Invited Paper*), **Ugur Aygun, Koç Univ. (Turkey); Ayca Yalcin Ozkumur, Bahçesehir Univ. (Turkey); Hakan Ürey, Koç Univ. (Turkey)** . . . . . [11249-23]
- 11:10 am: **Complex diversity for multiple-wavelength single-shot phase retrieval**, **Thomas D. Milster, James C. Wyant** College of Optical Sciences (USA) . . . . . [11249-24]

11:30 am: **Structured illumination-based phase retrieval via GAN-based deep learning**, **Ziling Wu, Yunhui Zhu**, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [11249-25]

11:50 am: **Lens-free through-focus super resolution holographic microscopy with novel phase retrieval algorithm**, **Kyungwon Yun, Jaehyeon Son, Taewan Kim, Seung Beom Park, Jaehwang Jung, Daejun Park, Doyoung Kim, Myungjun Lee**, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [11249-26]

Lunch Break . . . . . Sun 12:10 pm to 1:40 pm

**SESSION 7**

**LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . SUN 1:40 PM TO 3:30 PM**

**QPI of Cells and Tissues I**

Session Chair: **Aydogan Ozcan**, Univ. of California, Los Angeles (USA)

- 1:40 pm: **On the use of machine learning for solving computational imaging problems** (*Invited Paper*), **George Barbastathis**, MIT (USA) . . [11249-8]
- 2:10 pm: **Correlative Brillouin microscopy and optical diffraction tomography for quantitative characterization of mechanical and biophysical properties of biological samples**, **Kyoohyun Kim**, Max-Planck-Institut für die Physik des Lichts (Germany) and TU Dresden (Germany) and Max-Planck-Zentrum für Physik und Medizin (Germany); **Raimund Schülöfner**, TU Dresden (Germany); **Timon Beck, Salvatore Girardo, Jochen R. Guck**, Max-Planck-Institut für die Physik des Lichts (Germany) and TU Dresden (Germany) and Max-Planck-Zentrum für Physik und Medizin (Germany) . . . . . [11249-10]
- 2:30 pm: **Quantitative polarized light spectroscopy of single gold nanorods and its dynamics**, **Yizheng Zhu, Zhixing He, Chengshuai Li, Hans D. Robinson**, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [11249-12]
- 2:50 pm: **Quantitative phase imaging utilized for retrieval of refractive index dispersion and glaucoma related tissue density alterations of the retina**, **Alvaro Barroso, Steffi Ketelhut, Peter Heiduschka, Gerburg Nettels-Hackert, Jürgen Schnekenbürger, Björn Kemper**, Westfälische Wilhelms-Universität Münster (Germany) . . . . . [11249-14]
- 3:10 pm: **Cross-modality deep learning brings bright-field image contrast to digital holographic microscopy**, **Yichen Wu, Yilin Luo, Gunvant Chaudhari, Yair Rivenson, Ayfer Calis, Kevin de Haan, Aydogan Ozcan**, Univ. of California, Los Angeles (USA) . . . . . [11249-15]
- Coffee Break . . . . . Sun 3:30 pm to 4:00 pm

**SESSION 8**

**LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . SUN 4:00 PM TO 5:20 PM**

**QPI of Cells and Tissues II**

Session Chair: **Yang Liu**, Univ. of Pittsburgh (USA)

- 4:00 pm: **Quantitative phase imaging of neuronal movement during action potential**, **Kevin C. Boyle, Tong Ling, Valentina Zuckerman, Thomas Flores, Daniel V. Palanker**, Stanford Univ. (USA) . . . . . [11249-27]
- 4:20 pm: **Quantifying myelination of single neurons using Spatial Light Interference Microscopy (SLIM)**, **Michael J. Fanous, Young Jae Lee, Catherine A. Best-Popescu**, Beckman Institute for Advanced Science and Technology (USA); **Allison Louie, Andrew Steelman, Megan P. Caputo, Laurie A. Rund, Rodney W. Johnson**, Univ. of Illinois (USA); **Tapas Das, Matthew J. Kuchan, Abbott Nutrition (USA); Gabriel Popescu**, Beckman Institute for Advanced Science and Technology (USA) . . . . . [11249-28]
- 4:40 pm: **Functional imaging of the retina with phase-sensitive full-field swept-source optical coherence tomography**, **Dierck Hillmann, Thorlabs GmbH (Germany) and Univ. zu Lübeck (Germany); Clara Pfäffle, Hendrik Spahr, Felix Hilge, Univ. zu Lübeck (Germany) and Medizinisches Laserzentrum Lübeck GmbH (Germany); Sazan Burhan, Katharina Gercke, Univ. zu Lübeck (Germany); Yoko Miura, Univ. zu Lübeck (Germany) and Medizinisches Laserzentrum Lübeck GmbH (Germany); Gereon M. Hüttmann, Univ. zu Lübeck (Germany) and Medizinisches Laserzentrum Lübeck GmbH (Germany) and Airway Research Ctr. North (ARCN), a Member of Deutsches Zentrum Für Lungenforschung (Germany) . . . . . [11249-29]**
- 5:00 pm: **Quantitative phase digital holographic microscopy combined with stem cell technology for identifying cell biomarkers of neurodevelopmental brain disorders including schizophrenia**, **Pierre P. Marquet, François Paquet-Mercier, Chloé Martel, Catherine Giroux, CERVO Brain Research Ctr. (Canada); Carine Ben Adiba, Joint International Research Unit in Child Psychiatry, Univ. de Lausanne (Switzerland) and Univ. Laval (Switzerland); Ana-Sofia Correia, Émile Rioux Pellerin, Jean-Xavier Giroux, Marie-Ève Crochetière, Erik Bélanger, CERVO Brain Research Ctr. (Canada); Pascal Jourdain, Joint International Research Unit in Child Psychiatry, Univ. de Lausanne (Switzerland) and Univ. Laval (Switzerland) . . . . . [11249-30]**

# CONFERENCE 11249

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

John G. Greivenkamp, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam,**

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells

Eric Betzig, Univ. of California, Berkeley and  
Howard Hughes Medical Institute (USA)

## MONDAY 3 FEBRUARY

### SESSION 9

LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . MON 9:00 AM TO 10:00 AM

### QPI of Cells and Tissues III

Session Chair: **YongKeun Park**, KAIST (Korea, Republic of)

9:00 am: **Non-invasive intracellular dynamics study using quadriwave lateral shearing interferometry**, Roman Zinchuk, PHASICS S.A. (France) and Aix Marseille Univ., CNRS (France) and Institut Fresnel (France); Julien Savatier, Aix Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France); Anaïs Saintoyant, Sherazade Aknoun, Antoine Federici, PHASICS S.A. (France); Serge Monneret, Aix Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France); Benoit Wattellier, PHASICS S.A. (France). . . . . [11249-31]

9:20 am: **Intelligent frequency-shifted optofluidic time-stretch quantitative phase imaging**, Yunzhao Wu, Yuqi Zhou, The Univ. of Tokyo (Japan); Chun-Jung Huang, National Chiao Tung Univ. (Taiwan); Hirofumi Kobayashi, Chan Zuckerberg Biohub (USA); Sheng Yan, Yasuyuki Ozeki, The Univ. of Tokyo (Japan); Chia-Wei M. Sun, National Chiao Tung Univ. (Taiwan); Cheng Lei, Wuhan Univ. (China); Keisuke Goda, The Univ. of Tokyo (Japan). . . . . [11249-32]

9:40 am: **Deep learning framework enables 3D label-free tracking of immunological synapse using optical diffraction tomography**, Moosung Lee, Young-Ho Lee, Jinyeop Song, Geon Kim, YoungJu Jo, KAIST (Korea, Republic of); Hyun-seok Min, Tomocube, Inc. (Korea, Republic of); Chan Hyuk Kim, YongKeun Park, KAIST (Korea, Republic of). . . . . [11249-33]

Coffee Break. . . . . Mon 10:00 am to 10:30 am

### SESSION 10

LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . MON 10:30 AM TO 12:10 PM

### QPI of Cells and Tissues IV

Session Chair: **Demetri Psaltis,**

Ecole Polytechnique Fédérale de Lausanne (Switzerland)

10:30 am: **Transcleral high resolution optical phase imaging of the retina** (*Invited Paper*), Christophe Moser, Timothé Laforest, Laura Kowalczyk, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Francine Behar-Cohen, Univ. Paris Descartes (France); Mathieu Künzi, EarlySight SA (Switzerland). . . . . [11249-34]

11:00 am: **Detection of HIV reactivation using Spatial Light Interference Microscopy**, Neha Goswami, Michael J. Fanous, Kathrin Bohn-Wippert, Erin N. Tevonian, Yiyang Lu, Roy D. Dar, Gabriel Popescu, Univ. of Illinois (USA). . . . . [11249-35]

11:20 am: **Wide-field label-free imaging of thick tissues using optical diffraction tomography**, Herve Hugonnet, Moosung Lee, Seungwoo Shin, Yongkeun Park, KAIST (Korea, Republic of). . . . . [11249-36]

11:40 am: **Towards scalable and reliable deep learning based phase microscopy using intensity-only measurements** (*Invited Paper*), Lei Tian, Boston Univ. (USA). . . . . [11249-37]

Lunch Break . . . . . Mon 12:10 pm to 1:40 pm

### SESSION 11

LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . MON 1:40 PM TO 3:00 PM

### QPI Algorithms I

Session Chair: **George Barbastathis,**  
Massachusetts Institute of Technology (USA)

1:40 pm: **Deep learning-based computational histology staining using spatial light interference microscopy (SLIM) Data**, Michael J. Fanous, Beckman Institute for Advanced Science and Technology (USA); Hassaan Majeed, Yuchen R. He, Nahil Sobh, Gabriel Popescu, Univ. of Illinois (USA). . . . . [11249-38]

2:00 pm: **Alternation of inverse problem and deep learning approaches for phase unwrapping in lens-free microscopy**, Cédric Allier, Lionel Hervé, Dorothee Kraemer, Olivier Cioni, Mathilde Menneteau, Ondrej Mandula, Sophie Morales, CEA-LETI (France). . . . . [11249-39]

2:20 pm: **PSTD simulation analysis of light transmission through cornea-like transparent scattering medium**, Pei-Lin Chou, Snow H. Tseng, National Taiwan Univ. (Taiwan). . . . . [11249-40]

2:40 pm: **Data-driven experimental design for computational imaging**, Michael R. Kellman, Emrah Bostan, Michael Lustig, Laura Waller, Univ. of California, Berkeley (USA). . . . . [11249-41]

Coffee Break. . . . . Mon 3:00 pm to 3:30 pm

### SESSION 12

LOCATION: ROOM 314 (LEVEL 3 SOUTH) . . . . . MON 3:30 PM TO 4:40 PM

### QPI Algorithms II

Session Chair: **Gabriel Popescu,** Univ. of Illinois (USA)

3:30 pm: **Imaging of in the presence of multiple scattering** (*Invited Paper*), Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland). . . . . [11249-42]

4:00 pm: **Digital staining with quantitative phase imaging for time-lapse studies of cellular growth and proliferation**, Mikhail E. Kandel, Young Jae Lee, Taylor H. Chen, Yuchen R. He, Nahil Sobh, Gabriel Popescu, Univ. of Illinois (USA). . . . . [11249-43]

4:20 pm: **Deep-learning-based noise reduction using unpaired dataset in optical diffraction tomography**, DongHun Ryu, KAIST (Korea, Republic of); Gunho Choi, Tomocube, Inc. (Korea, Republic of); YoungJu Jo, Stanford Univ. (USA); Young Seo Kim, WeiSun Park, KAIST (Korea, Republic of); Hyun-seok Min, Tomocube, Inc. (Korea, Republic of); YongKeun Park, KAIST (Korea, Republic of). . . . . [11249-44]

### POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at  
<http://spie.org/PWPosterGuidelines>

**Retrieval of red blood cell 3-D shape from single-shot quantitative phase image**, Yang-Hsien Lin, Kung-Bin Sung, National Taiwan Univ. (Taiwan). . . . . [11249-49]

**Compact dual-wavelength off-axis digital holography for quantitative phase imaging**, Mingguang Shan, Jixiang Lv, Zhi Zhong, Lei Liu, Bin Liu, Harbin Engineering Univ. (China). . . . . [11249-50]

**High-speed in vitro intensity diffraction tomography**, Jiaji Li, Nanjing Univ. of Science and Technology (China); Alex C. Matlock, Yunzhe Li, Boston Univ. (USA); Qian Chen, Nanjing Univ. of Science and Technology (China); Lei Tian, Boston Univ. (USA); Chao Zuo, Nanjing Univ. of Science and Technology (China). . . . . [11249-51]

**Real-time phase reconstruction of dual-wavelength off-axis digital holography based on Java and GPU**, Yunze Cao, Wanchen Li, Mingguang Shan, Zhi Zhong, Lei Liu, Bin Liu, Harbin Engineering Univ. (China). . . . . [11249-52]

**RGB speckle pattern interferometry for surface metrology**, Paul Kumar Upputuri, Praveenbalaji Rajendran, Manojit Pramanik, Nanyang Technological Univ. (Singapore). . . . . [11249-53]

- Simultaneous profiling of optically smooth and rough surfaces using dual-wavelength interferometry**, Paul Kumar Upputuri, Praveenbalaji Rajendran, Manojit Pramanik, Nanyang Technological Univ. (Singapore) . . . . . [11249-54]
- Quantitative phase imaging as a tool for apoptosis and necrosis detection and characterization.**, Tomas Vicar, Martina Raudenska, Jaromir Gumulec, Michal Masarik, Jan Balvan, Masaryk Univ. (Czech Republic) . . . . . [11249-55]
- Time-resolved high-sensitive thermal imaging system for the study of transient thermal phenomena by using quadriwave lateral shearing interferometry**, Antoine Federici, Benoit Wattellier, PHASICS S.A. (France) . . . . . [11249-56]
- Holotomographic investigation of an influence of PFA cell fixation process on refractive index of cellular organelles**, Maria Baczewska, Warsaw Univ. of Technology (Poland); Björn Kemper, Westfälische Wilhelms-Universität Münster (Germany); Malgorzata Kujawinska, Warsaw Univ. of Technology (Poland) . . . . . [11249-57]
- Digital suppression of system background and speckle in fourier transform light scattering**, Kaitlin J. Dunn, Robert L. Draham, The Institute of Optics, Univ. of Rochester (USA); Andrew J. Berger, The Institute of Optics, Univ. of Rochester (USA) and Univ. of Rochester (USA) . . . . . [11249-58]
- Differential phase contrast imaging on a gigapixel microscope**, Jaehee Park, Ramona Optics, Inc. (USA); Pavan Konda, Duke Univ. (USA); Mark Harfouche, Ramona Optics, Inc. (USA); Roarke Horstmeyer, Duke Univ. (USA) . . . . . [11249-59]
- Quantifying the performance of holographic tomography systems using the 3D-printed biological cell phantom**, Michal Ziemczonok, Arkadiusz T. Kuź, Warsaw Univ. of Technology (Poland); Chau-Jern Cheng, National Taiwan Normal Univ. (Taiwan); Malgorzata Kujawinska, Warsaw Univ. of Technology (Poland); Vinoth Balasubramani, National Taiwan Normal Univ. (Taiwan) . . . . . [11249-60]
- Characterization and compensation of wavelength dependent aberrations in hyperspectral quantitative phase imaging with digital holographic microscopy**, Nikolai Storm, Álvaro Barroso, Jürgen Schnekenbürger, Björn Kemper, Westfälische Wilhelms-Universität Münster (Germany) . . . . . [11249-61]
- Hologram compression in quantitative phase imaging**, Piotr Stępień, Warsaw Univ. of Technology (Poland); Raees K. M. Kizhakkumkara Muhamad, Vrije Univ. Brussel (Belgium); Malgorzata Kujawinska, Warsaw Univ. of Technology (Poland); Peter Schelkens, Vrije Univ. Brussel (Belgium) . [11249-62]
- Quantitative phase imaging provides mechanical phenotyping which aligns with atomic force microscopy**, Silvia Ceballos, Han Sang Park, Will J. Eldridge, Adam P. Wax, Duke Univ. (USA) . . . . . [11249-63]
- Fast imaging of cardiomyocyte dynamics alterations after drug reatment utilizing quantitative phase digital holographic microscopy**, Björn Kemper, Steffi Ketelhut, Westfälische Wilhelms-Universität Münster (Germany); Ivan Stojanovic, Martin L. Bennink, Peter Schön, Saxion Univ. of Applied Sciences (Netherlands); Jürgen Schnekenbürger, Westfälische Wilhelms-Universität Münster (Germany) . . . . . [11249-64]
- Quantitative phase imaging with epi-mode illumination for fiber-optic endoscopy**, Zhe Guang, Patrick B. Ledwig, Paloma Casteleiro Costa, Francisco E. Robles, Georgia Institute of Technology & Emory Univ. School of Medicine (USA) . . . . . [11249-65]
- Distributed computing pipeline for large-scale nonlinear optical diffraction tomography**, James Cimino, Univ. of California, Berkeley (USA) . . . . . [11249-66]
- Enhancement of depth selectivity in reflection phase microscopy by successive accumulation of interferograms**, Min Gyu Hyeon, Yong Guk Kang, Beop-Min Kim, Youngwoon Choi, Korea Univ. (Korea, Republic of) . . . . . [11249-67]
- Development of high sensitivity quantitative phase microscopy for label-free imaging of nanoscale dynamics**, Yujie Nie, Renjie Zhou, Yijin Wang, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11249-68]
- A portable multi-wavelength fiber-based quantitative phase microscope**, Mengxuan Niu, Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11249-69]
- An automated label-free cell classification system based on quantitative phase imaging and deep learning**, Xin Shu, Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11249-70]
- Non-invasive and facile observation of hierarchical and crystalline structure of silk materials with optical diffraction tomography**, Jianming Chen, Yanping He, Mengxuan Niu, Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11249-71]
- Enhancement of phase sensitivity in polarization holographic microscopy**, Kwanjun Park, Taeseok Daniel Yang, Taedong Kong, Beop-Min Kim, Korea Univ. (Korea, Republic of); Youngwoon Choi, Korea Univ. (Korea, Republic of) . . . . . [11249-72]
- Dynamic phase retrieval for fringe image processing in moiré tomography**, Zhenyan Guo, Nanjing Univ. of Science and Technology (China) . . . . [11249-73]
- Fundamental limits of phase conjugation**, Chenfei Hu, Univ. of Illinois (USA); Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China); Taewoo Kim, Jet Propulsion Lab. (USA) and Caltech (USA); Benny Chiang, Gabriel Popescu, Univ. of Illinois (USA) . . . . . [11249-74]
- 3D printed diffraction phase microscope with low-coherent radiation for quantitative phase imaging**, Alexandra O. Georgieva, Alexander P. Khurchak, Vladimir A. Kokljushkin, Sergei E. Putilin, Anton N. Tsyppkin, ITMO Univ. (Russian Federation); Boris V. Popov, Institute of Cytology (Russian Federation); Olga A. Smolyanskaya, Nikolay V. Petrov, ITMO Univ. (Russian Federation); Valery V. Tuchin, Saratov State Univ. (Russian Federation) and Institute of Precision Mechanics and Control (Russian Federation) and Tomsk State Univ. (Russian Federation) . . . . . [11249-75]
- Quantitative Phase Imaging (QPI) of platelets in prognosis of complications in patients with nephrolithiasis after surgical treatment**, Irina Vasilenko, Vladislav B. Metelin, A.N. Kosygin Russian State Univ. (Russian Federation) and M.F. Vladimirovsky Moscow Regional Research and Clinical Institute (Russian Federation); Elena Rusanova, Svetlana Buymistr, M.F. Vladimirovsky Moscow Regional Research and Clinical Institute (Russian Federation) . . . . . [11249-76]
- 3D visualization and quantitative densitometric evaluation of paracrine stem cell factors using QPI**, Irina Vasilenko, Vladislav B. Metelin, A.N. Kosygin Russian State Univ. (Russian Federation) and M.F. Vladimirovsky Moscow Regional Research and Clinical Institute (Russian Federation); Nataliya Kil'deeva, A.N. Kosygin Russian State Univ. (Russian Federation); Alexey Temnov, Institute of Biophysics of the Cell (Russian Federation); Pavel Ignatiev, Ural Optical & Mechanical Plant (Russian Federation); Nina Shikhina, A.N. Kosygin Russian State Univ. (Russian Federation) . . . . . [11249-77]
- Wolf phase tomography (WPT) using partially coherent light**, Xi Chen, Univ. of Illinois (USA); Mikhail Kandel, Chenfei Hu, Beckman institute (USA); Gabriel Popescu, Univ. of Illinois (USA) . . . . . [11249-78]
- Real-time Jones phase microscopy**, Yuheng Jiao, Beckman Institute for Advanced Science and Technology, Univ. of Illinois (USA) and Huazhong Univ. of Science and Technology (China); Mikhail E. Kandel, Beckman Institute for Advanced Science and Technology, Univ. of Illinois (USA); Xiaojun Liu, Wenlong Lu, Huazhong Univ. of Science and Technology (China); Gabriel Popescu, Beckman Institute for Advanced Science and Technology, Univ. of Illinois (USA) . . . . . [11249-79]
- Effects of substrate patterning on spheroid growth and dynamics studied by gradient light interference microscopy (GLIM)**, Michael J. Fanous, Beckman Institute for Advanced Science and Technology (USA); Yanfen Li, Univ. of Massachusetts Lowell (USA); Mikhail E. Kandel, Amr Abdeen, Univ. of Illinois (USA); Kristopher A. Kilian, The Univ. of Chicago (USA); Gabriel Popescu, Univ. of Illinois (USA) . . . . . [11249-80]
- Quantitative phase imaging with intelligent specificity for label-free identification of axons**, Young Jae Lee, Mikhail E. Kandel, Yuchen R. He, Eunjae Kim, Nahil Sohb, Gabriel Popescu, Univ. of Illinois (USA) . . . . [11249-81]
- Rapid antimicrobial susceptibility testing exploiting laser speckle formation by bacterial colonies**, SeungYun Han, YoonSeok Beak, KyeoReh Lee, KAIST (Korea, Republic of); YongKeun Park, KAIST (Korea, Republic of) and Tomocube, Inc. (Korea, Republic of) . . . . . [11249-82]
- Rapid label-free identification of individual bacterial pathogens using optical diffraction tomography and convolutional neural network**, Geon Kim, KAIST (Korea, Republic of); Daewoong Ahn, Tomocube, Inc. (Korea, Republic of); Minhee Kang, Sungkyunkwan Univ. School of Medicine (Korea, Republic of); YoungJu Jo, DongHun Ryu, KAIST (Korea, Republic of); HyunJung Kim, The Wave Talk (Korea, Republic of); Jinyeop Song, KAIST (Korea, Republic of); Jea Sung Ryu, KAIST (Honduras); Gunho Choi, Tomocube, Inc. (Korea, Republic of); Hyun Jung Chung, KAIST (Korea, Republic of); Kyuseok Kim, Seoul National Univ. (Korea, Republic of); Doo Ryeon Chung, In Young Yoo, Hee Jae Huh, Sungkyunkwan Univ. School of Medicine (Korea, Republic of); Hyun-seok Min, Tomocube, Inc. (Korea, Republic of); Nam Yong Lee, Sungkyunkwan Univ. School of Medicine (Korea, Republic of); YongKeun Park, KAIST (Korea, Democratic Peoples Republic of) . . . . . [11249-83]
- Robust three-dimensional quantitative phase imaging of intensively scattering objects using deep learning**, Geon Kim, Seungwoo Shin, DongHun Ryu, YongKeun Park, KAIST (Korea, Republic of) . . . . . [11249-84]

# CONFERENCE 11249

**Label-free three-dimensional imaging on the developmental process of primary neuron cells in collagen structure using optical diffraction tomography.** SeungYun Han, Dongjo Yoon, Moosung Lee, Yoonkey Nam, YongKeun Park, KAIST (Korea, Republic of). . . . . [11249-85]

**Prediction of arbitrary radiation forces on dielectric particles via permittivity gradient.** Moosung Lee, YongKeun Park, KAIST (Korea, Republic of). . . . . [11249-86]

**Utilizing optical diffraction tomography and artificial intelligence to identify white blood cells.** Young Seo Kim, KAIST (Korea, Republic of) and Tomocube, Inc. (Korea, Republic of); Daewoong Ahn, Tomocube, Inc. (Korea, Republic of); DongHun Ryu, Hayeon Cho, Khoi Dao, Kyunghwan Kim, Ji Yeon Park, YeongJin Yu, KAIST (Korea, Republic of); YoungJu Jo, KAIST (Korea, Republic of) and Stanford Univ. (USA); Hyun-seok Min, Suk-Jo Kang, Eui-Cheol Shin, KAIST (Korea, Republic of); YongKeun Park, KAIST (Korea, Republic of) and Tomocube, Inc. (Korea, Republic of) . . . . . [11249-87]

**Computational approach to dark-field optical diffraction tomography.** Tae-an Chang, Seungwoo Shin, Moosung Lee, YongKeun Park, KAIST (Korea, Republic of). . . . . [11249-88]

**Three-dimensional observations of the antibiotic responses of bacteria using optical diffraction tomography.** Jeonghun Oh, Moosung Lee, SeungYun Han, YongKeun Park, KAIST (Korea, Republic of) . . . . . [11249-89]

## TUESDAY 4 FEBRUARY

### SESSION 13

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . TUE 8:00 AM TO 9:40 AM

### Quantitative Phase Imaging and High-Speed Biomedical Imaging and Spectroscopy

Joint Session with 11249 and 11250

8:00 am: **Quantitative phase imaging and artificial intelligence: label-free 3D imaging, classification, and inference** (*Invited Paper*), YongKeun Park, KAIST (Korea, Republic of) . . . . . [11249-45]

8:30 am: **Deep single-cell biophysical phenotyping with high-throughput quantitative phase imaging** (*Invited Paper*), Kevin K. Tsia, The Univ. of Hong Kong (Hong Kong, China). . . . . [11249-46]

9:00 am: **Big-data reconstruction of 3D refractive index by multi-slice beam-propagation**, Shwetadwip Chowdhury, David Ren, James Cimino, Laura Waller, Univ. of California, Berkeley (USA) . . . . . [11249-47]

9:20 am: **Towards reliable deep learning based phase microscopy.** Yujia Xue, Shiyi Cheng, Yunzhe Li, Lei Tian, Boston Univ. (USA). . . . . [11250-39]

## Photonics West Industry Stage

Tuesday - Thursday • Hall DE

Keynotes and panels open to all attendees

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# CONFERENCE 11250

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY)

Saturday–Tuesday 1–4 February 2020 • Proceedings of SPIE Vol. 11250

## High-Speed Biomedical Imaging and Spectroscopy V

Conference Chairs: **Kevin K. Tsia**, The Univ. of Hong Kong (Hong Kong, China); **Keisuke Goda**, The Univ. of Tokyo (Japan)

Program Committee: **Steven G. Adie**, Cornell Univ. (USA); **Mohammad Hossein Asghari**, Loyola Marymount Univ. (USA); **Hongwei Chen**, Tsinghua Univ. (China); **Pei-Yu Eric Chiou**, Univ. of California, Los Angeles (USA); **Shi-Wei Chu**, National Taiwan Univ. (Taiwan); **Meng Cui**, Purdue Univ. (USA); **Qionghai Dai**, Tsinghua Univ. (China); **Mark Foster**, Johns Hopkins Univ. (USA); **Katsumasa Fujita**, Osaka Univ. (Japan); **Liang Gao**, Univ. of Illinois at Urbana-Champaign (USA); **Nobuyuki Hashimoto**, Citizen Watch Co., Ltd. (Japan); **Elena Holden**, Executive Strategic Advisory, Biotech and IVD (USA); **Bahram Jalali**, Univ. of California, Los Angeles (USA); **Chulhong Kim**, Pohang Univ. of Science and Technology (Korea, Republic of); **Thomas Klein**, Optores GmbH (Germany); **Edmund Y. Lam**, The Univ. of Hong Kong (Hong Kong, China); **Cheng Lei**, Wuhan Univ. (China); **Tzu-Ming Liu**, Univ. of Macau (Macao, China); **Yu-Hwa Lo**, Univ. of California, San Diego (USA); **Hideharu Mikami**, The Univ. of Tokyo (Japan); **Nao Nitta**, CYBO, Inc. (Japan); **Yasuyuki Ozeki**, The Univ. of Tokyo (Japan); **YongKeun Park**, KAIST (Korea, Republic of); **Adrian Podoleanu**, Univ. of Kent (United Kingdom); **Dario Polli**, Politecnico di Milano (Italy); **Eric O. Potma**, Univ. of California, Irvine (USA); **Peter T. C. So**, Massachusetts Institute of Technology (USA); **Lei Tian**, Boston Univ. (USA); **Laura Waller**, Univ. of California, Berkeley (USA); **Chao Wang**, Univ. of Kent (United Kingdom); **Lihong V. Wang**, Caltech (USA); **Kenneth Y. Wong**, The Univ. of Hong Kong (Hong Kong, China); **Takeshi Yasui**, Tokushima Univ. (Japan); **Tomokazu Yoshida**, Sysmex Corp. (Japan); **Zeev Zalevsky**, Bar-Ilan Univ. (Israel)

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### SATURDAY 1 FEBRUARY

#### OPENING REMARKS

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) ..... SAT 8:20 AM TO 8:30 AM

Opening remarks by **Kevin K. Tsia**,  
The Univ. of Hong Kong (Hong Kong, China)

#### SESSION 1

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) ..... SAT 8:30 AM TO 10:00 AM

#### High-Speed Volumetric Imaging

Session Chair: **Kevin K. Tsia**,  
The Univ. of Hong Kong (Hong Kong, China)

8:30 am: **Epi-illumination SPIM (eSPIM) for high-throughput volumetric imaging** (*Invited Paper*), Bo Huang, Univ. of California, San Francisco (USA) and Chan Zuckerberg Biohub (USA) ..... [11250-1]

9:00 am: **Visualizing dynamic biological processes using light-field microscopy** (*Invited Paper*), Robert Prevedel, European Molecular Biology Lab. (Germany) ..... [11250-2]

9:30 am: **Multiplexed line-scanning confocal microscopy for high-speed fluorescence imaging**, Jean-Marc Tsang, Jerome Mertz, Boston Univ. (USA) ..... [11250-3]

9:45 am: **Ultrafast contour imaging for time-domain diffuse optical tomography**, Xiaohua Feng, Liang Gao, Univ. of Illinois (USA) ..... [11250-4]

Coffee Break ..... Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) ..... SAT 10:30 AM TO 12:00 PM

#### High-Speed Fluorescence Imaging

Session Chair: **Adrian G. H. Podoleanu**,  
Univ. of Kent (United Kingdom)

10:30 am: **A compact device for ultra-fast whole-cell/tissue FLIM and hyper-spectral imaging** (*Invited Paper*), Michelle Digman, Univ. of California, Irvine (USA) ..... [11250-5]

11:00 am: **Simple chemical stains for feature-rich super-resolution and cleared-tissue microscopy** (*Invited Paper*), Joshua Vaughan, Univ. of Washington (USA) ..... [11250-6]

11:30 am: **Cell membrane poration by hydrodynamic stretching of live cells**, Abiral Tamang, Univ. of Leeds, Molecular and Nanoscale Physics Group (United Kingdom); Fern J Armistead, Andrew J Harvie, Sophie Meredith, Julia Pablo de Gala, Univ. of Leeds (United Kingdom); Hiroshi Kanno, Hideharu Mikami, The Univ. of Tokyo (Japan); Lars J.C. Leuken, Univ. of Leeds (United Kingdom); Keisuke Goda, The Univ. of Tokyo (Japan); Stephen D. Evans, Kevin Critchley, Univ. of Leeds (United Kingdom) ..... [11250-62]

11:45 am: **Optical gearbox for kHz frame rate imaging**, Meng Cui, Purdue Univ. (USA) ..... [11250-8]

Lunch Break ..... Sat 12:00 pm to 1:30 pm

#### SESSION 3

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) ..... SAT 1:30 PM TO 3:15 PM

#### High-Throughput Microscopy

Session Chair: **Meng Cui**, Purdue Univ. (USA)

1:30 pm: **Simultaneous multiplane imaging with reverberation multiphoton microscopy** (*Invited Paper*), Jerome Mertz, Devin Beaulieu, Ian Davison, Thomas Bifano, Boston Univ. (USA) ..... [11250-9]

2:00 pm: **High-speed super-resolution imaging of intracellular organelle interactions** (*Invited Paper*), Dong Li, Institute of Biophysics (China) [11250-10]

2:30 pm: **A widefield mid-infrared photothermal microscopy for chemical imaging at kHz frame rate and sub-micron spatial resolution**, Yeran Bai, Delong Zhang, Boston Univ. (USA); Ali Shakouri, Purdue Univ. (USA); Ji-Xin Cheng, Boston Univ. (USA) ..... [11250-11]

2:45 pm: **High-throughput and field-portable ptychographic lensless microscopy based on translated pattern modulation**, Guoan Zheng, Univ. of Connecticut (USA) ..... [11250-12]

3:00 pm: **Multi-megahertz spectrally encoded transmission microscopy based on dual-comb interferometry**, Xinglin Zeng, Yu-xuan Ren, Pingping Feng, Yuhua Duan, The Univ. of Hong Kong (Hong Kong, China); Chi Zhang, Huazhong Univ. of Science and Technology (China); Kevin K. Tsia, Kenneth Kin-Yip Wong, The Univ. of Hong Kong (Hong Kong, China). [11250-13]

Coffee Break ..... Sat 3:15 pm to 3:45 pm

# CONFERENCE 11250

## SESSION 4

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . SAT 3:45 PM TO 5:45 PM

### Imaging Flow Cytometry

Session Chair: **Keisuke Goda**, The Univ. of Tokyo (Japan)

3:45 pm: **High-throughput analysis of cell physical properties** (*Invited Paper*), Dino Di Carlo, Univ. of California, Los Angeles (USA). [11250-14]

4:15 pm: **Image guided FACS and 3D imaging flow cytometer** (*Invited Paper*), Yu-Hwa Lo, Univ. of California, San Diego (USA) . . . . [11250-15]

4:45 pm: **High-speed single-cell quantitative phase imaging integrated with real-time deformability cytometry**, Evelyn H. Y. Cheung, Rashmi Sreeramachandramurthy, Dickson M. D. Siu, Kelvin C. M. Lee, The Univ. of Hong Kong (Hong Kong, China); Martin Kraeter, Max-Planck-Institut für die Physik des Lichts (Germany); Felix Reichel, TU Dresden (Germany); Jochen Guck, Max-Planck-Institut für die Physik des Lichts (Germany); Kevin K. Tsia, The Univ. of Hong Kong (Hong Kong, China) . . . . . [11250-16]

5:00 pm: **Image-based cell sorting using artificial intelligence classification**, Maik Herbig, Ahmad Ahsan Nawaz, Martin Nötzel, Marta Urbanska, Martin Kräter, Philipp Rosendahl, Angela Jacobi, TU Dresden (Germany); Oliver Otto, TU Dresden (Germany) and Ernst Moritz Arndt Univ. Greifswald (Germany) and Zellmechanik Dresden GmbH (Germany); Christoph Herold, Zellmechanik Dresden GmbH (Germany); Jochen Guck, TU Dresden (Germany) . . . . . [11250-17]

5:15 pm: **Compressed ultrafast imaging flow cytometry**, Jongchan Park, Liang Gao, Univ. of Illinois (USA) . . . . . [11250-18]

5:30 pm: **FluorATOM: high-throughput imaging flow cytometry for synchronized biophysical and biomolecular phenotyping**, Kelvin C. M. Lee, Maolin Wang, Isabella Cheuk, Vivian Shine, Ava Kwong, Kenneth Kin-Yip Wong, Hayden So, Kevin K. Tsia, The Univ. of Hong Kong (Hong Kong, China) . . . . . [11250-19]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 5

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 8:30 AM TO 10:00 AM

### High-Throughput Biology

Session Chair: **Liang Gao**, Univ. of Illinois (USA)

8:30 am: **Adaptive optics for diffraction limited two-photon imaging of neuronal function throughout the full depth of mouse cortex** (*Invited Paper*), David Kleinfeld, Rui Liu, Univ. of California, San Diego (USA) . . . . . [11250-20]

9:00 am: **Probing the spatiotemporal dynamics of Ras-associated membrane nanodomains with high-throughput single particle tracking via photoactivated localization microscopy (spt-PALM)** (*Invited Paper*), Yerim Lee, Carey Phelps, Tao Huang, Barmak Mostofian, Daniel Zuckerman, Xiaolin Nan, Oregon Health & Science Univ. (USA) . . . . . [11250-21]

9:30 am: **Visualization of membrane potential changes induced by oscillating electric fields**, Allen Kiestler, Zach Coker, Bennett Ibey, Joel Bixler, Air Force Research Lab. (USA) . . . . . [11250-22]

9:45 am: **High-speed label-free photoacoustic histopathology**, Jin Woo Baik, Jin Young Kim, Hyojin Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Myeongjoo Son, Kyunghee Byun, Gachon Univ. of Medicine and Science (Korea, Republic of); Hae Young Choi, Daegu-Gyeongbuk Medical Innovation Foundation (Korea, Republic of); Seon Young Ryu, Panovision Co., Ltd. (Korea, Republic of); Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11250-23]

Coffee Break. . . . . Sun 10:00 am to 10:30 am

### SESSION 6

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 10:30 AM TO 12:00 PM

### High-Speed Raman Technologies

Session Chair: **Eric O. Potma**, Univ. of California, Irvine (USA)

10:30 am: **Compressive Raman imaging** (*Invited Paper*), Hervé Rigneault, Aix-Marseille Univ. (France) and Ecole Centrale de Marseille (France) and CNRS (France); Camille Scotte, Siddharth Sivankutty, Aix-Marseille Univ. (France); Randy Bartels, Colorado State Univ. (USA) . . . . . [11250-24]

11:00 am: **High-sensitivity stimulated Raman imaging with chemical tags** (*Invited Paper*), Lu Wei, Caltech (USA) . . . . . [11250-25]

11:30 am: **High-throughput multimodal Raman-fluorescence flow cytometry**, Matthew Lindley, The Univ. of Tokyo (Japan); Kotaro Hiramatsu, The Univ. of Tokyo (Japan) and PRESTO, Japan Science and Technology Agency (Japan); Fukashi Shibata, Tsuyoshi Takeshita, Algal Bio Co., Ltd. (Japan); Shigeyuki Kawano, The Univ. of Tokyo (Japan); Keisuke Goda, The Univ. of Tokyo (Japan) and Univ. of California, Los Angeles (USA) and The Institute of Technological Sciences, Wuhan Univ. (China) . . . . . [11250-26]

11:45 am: **Rapid monitoring of pharmacokinetics of mitochondria-targeting molecules in live cells with bioorthogonal hyperspectral stimulated Raman scattering microscopy**, Kideog Bae, Wei Zheng, Zhiwei Huang, Optical Bioimaging Lab. (Singapore) . . . . . [11250-27]

Lunch Break . . . . . Sun 12:00 pm to 1:30 pm

### SESSION 7

LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 1:30 PM TO 3:15 PM

### Machine Learning

Session Chair: **Kotaro Hiramatsu**, The Univ. of Tokyo (Japan)

1:30 pm: **Computational augmentations of single molecule super-resolution microscopy** (*Invited Paper*), Christophe Zimmer, Institut Pasteur (France) . . . . . [11250-28]

2:00 pm: **Pushing the limits of fluorescence microscopy with adaptive imaging and machine learning** (*Invited Paper*), Loic Royer, Chan Zuckerberg Biohub (USA) . . . . . [11250-29]

2:30 pm: **Classification of platelet aggregates by intelligent imaging flow cytometry**, Yuqi Zhou, Atsushi Yasumoto, The Univ. of Tokyo (Japan); Cheng Lei, Wuhan Univ. (China); Chun-Jung Huang, National Chiao Tung Univ. (Taiwan); Hirofumi Kobayashi, Chan Zuckerberg Biohub (USA); Yunzhao Wu, Sheng Yan, The Univ. of Tokyo (Japan); Chia-Wei Sun, National Chiao Tung Univ. (Taiwan); Yutaka Yatomi, Keisuke Goda, The Univ. of Tokyo (Japan) . . . . . [11250-30]

2:45 pm: **High throughput label-free optical hemogram of granulocytes enhanced by artificial neural networks**, Roopam K. Gupta, Mingzhou Chen, Univ. of St. Andrews (United Kingdom); Graeme P. A. Malcolm, Nils Hempler, M Squared Lasers Ltd. (United Kingdom); Kishan Dholakia, Simon Powis, Univ. of St. Andrews (United Kingdom) . . . . . [11250-31]

3:00 pm: **Simple, rapid and cost-effective drug-susceptibility testing of leukemia by intelligent whole-blood imaging flow cytometry**, Hirofumi Kobayashi, The Univ. of Tokyo (Japan) and Chan Zuckerberg Biohub (USA); Cheng Lei, The Univ. of Tokyo (Japan) and Wuhan Univ. (China); Yi Wu, The Univ. of Tokyo (Japan) and Univ. of Toronto (Canada); Chun-Jung Huang, The Univ. of Tokyo (Japan) and National Chiao Tung Univ. (Taiwan); Atsushi Yasumoto, Masahiro Jona, The Univ. of Tokyo (Japan); Wenxuan Li, Carnegie Mellon Univ. (USA); Yaxiaer Yalikun, Ctr. for Biosystems Dynamics Research, RIKEN (Japan); Baoshan Guo, The Univ. of Tokyo (Japan); Chia-Wei Sun, National Chiao Tung Univ. (Taiwan); Yo Tanaka, Ctr. for Biosystems Dynamics Research, RIKEN (Japan); Makoto Yamada, Ctr. for Advanced Intelligence Project, RIKEN (Japan); Yutaka Yatomi, The Univ. of Tokyo (Japan); Keisuke Goda, The Univ. of Tokyo (Japan) and Wuhan Univ. (China) and Univ. of California, Los Angeles (USA) . . . . . [11250-32]

Coffee Break . . . . . Sun 3:15 pm to 3:45 pm

**SESSION 8**

**LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 3:45 PM TO 5:45 PM**

**High-Throughput Technologies**

Session Chair: **Guoan Zheng**, Univ. of Connecticut (USA)

3:45 pm: **Acquiring fluorescence decay kinetic measurements with on-chip acoustic focusing cytometry** (*Invited Paper*), Jessica P. Houston, Jesus Sambrano Jr., Kevin D. Houston, Saptasree Bose, Concepcion Sanchez, New Mexico State Univ. (USA) . . . . . [11250-33]

4:15 pm: **High-speed tracking of proteins on a live cell membrane via iSCAT** (*Invited Paper*), Vahid Sandoghdar, Max-Planck-Institut für die Physik des Lichts (Germany) . . . . . [11250-34]

4:45 pm: **Single-shot compressed ultrafast holography**, RuiBo Shang, Geoffrey Luke, Thayer School of Engineering at Dartmouth (USA) . . . [11250-35]

5:00 pm: **Continuous high-resolution observation system using high-speed gaze and focus control with wide-angle triangulation**, Tomohiro Sueishi, The Univ. of Tokyo (Japan); Takuya Ogawa, Shoji Yachida, NEC Corp. (Japan); Masatoshi Ishikawa, The Univ. of Tokyo (Japan) . . . . . [11250-36]

5:15 pm: **Rapid, robust, and low-cost whole slide imaging system based on LED-array illumination and color-multiplexed single-shot autofocus**, Shaowei Jiang, Zichao Bian, Chengfei Guo, Guoan Zheng, Univ. of Connecticut (USA) . . . . . [11250-37]

5:30 pm: **Towards high-speed fourier ptychographic imaging using binary measurements on a SPAD camera**, Xi Yang, Pavan Chandra Konda, Roarke Horstmeyer, Duke Univ. (USA) . . . . . [11250-38]

**CLOSING REMARKS**

**LOCATION: ROOM 101 (LEVEL 1 SOUTH LOBBY) . . . . . 5:45 PM TO 5:55 PM**

Closing remarks by Conference Chair Keisuke Goda

**POSTERS-SUNDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Ultrahigh-throughput rendering of digital holograms for real-time laser Doppler ophthalmoscopy and Gabor microscopy**, Michael Atlan, Leo Puyo, Louis Pallegoix, Julie Rivet, Institut Langevin Ondes et Images (France) . . . . . [11250-40]

**Application of post optical amplification for scan-less confocal amplitude and phase imaging with dual-comb microscopy**, Takahiko Mizuno, Takuya Tsuda, Eiji Hase, Takeo Minamikawa, Institute of Post-LED Photonics, Tokushima Univ. (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan); Hirotsugu Yamamoto, Utsunomiya Univ. (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan); Takeshi Yasui, Institute of Post-LED Photonics, Tokushima Univ. (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan) . . . . . [11250-41]

**Full-field dual-comb fluorescence lifetime microscopy**, Takahiko Mizuno, Eiji Hase, Takeo Minamikawa, Institute of Post-LED Photonics, Tokushima Univ. (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan); Hirotsugu Yamamoto, Utsunomiya Univ. (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan); Takeshi Yasui, Institute of Post-LED Photonics, Tokushima Univ. (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan) . . . . . [11250-42]

**BIOS SUNDAY PLENARY**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

**Welcome and Award Presentation**

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

**Presentation of 2020 SPIE Biophotonics Technology Innovator Award**

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics:**

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

**TUESDAY 4 FEBRUARY**

**SESSION 9**

**LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . TUE 8:00 AM TO 9:40 AM**

**Quantitative Phase Imaging and High-Speed Biomedical Imaging and Spectroscopy**

Joint Session with 11249 and 11250

8:00 am: **Quantitative phase imaging and artificial intelligence: label-free 3D imaging, classification, and inference** (*Invited Paper*), YongKeun Park, KAIST (Korea, Republic of) . . . . . [11249-45]

8:30 am: **Deep single-cell biophysical phenotyping with high-throughput quantitative phase imaging** (*Invited Paper*), Kevin K. Tsia, The Univ. of Hong Kong (Hong Kong, China) . . . . . [11249-46]

9:00 am: **Big-data reconstruction of 3D refractive index by multi-slice beam-propagation**, Shwetadwip Chowdhury, David Ren, James Cimino, Laura Waller, Univ. of California, Berkeley (USA) . . . . . [11249-47]

9:20 am: **Towards reliable deep learning based phase microscopy**, Yujia Xue, Shiyi Cheng, Yunzhe Li, Lei Tian, Boston Univ. (USA) . . . . . [11250-39]

# CONFERENCE 11251

LOCATION: ROOM 305 (LEVEL 3 SOUTH)

Saturday–Tuesday 1–4 February 2020 • Proceedings of SPIE Vol. 11251

# Label-free Biomedical Imaging and Sensing (LBIS) 2020

Conference Chairs: **Natan T. Shaked**, Tel Aviv Univ. (Israel); **Oliver Hayden**, Technische Univ. München (Germany)

Program Committee: **Shi-Wei Chu**, National Taiwan Univ. (Taiwan); **Adam de la Zerda**, Stanford Univ. School of Medicine (USA); **Pietro Ferraro**, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); **Jochen R. Guck**, TU Dresden (Germany); **Bahram Jalali**, Univ. of California, Los Angeles (USA); **Ori Katz**, The Hebrew Univ. of Jerusalem (Israel); **Alexander T. Khmaladze**, Univ. at Albany (USA); **Pierre P. Marquet**, Ctr. de Recherche de l’Univ. Laval Robert-Giffard (Canada); **Aydogan Ozcan**, Univ. of California, Los Angeles (USA); **Jürgen Popp**, Friedrich-Schiller-Univ. Jena (Germany); **Francisco E. Robles**, Georgia Institute of Technology & Emory Univ. School of Medicine (USA); **Melissa C. Skala**, Univ. of Wisconsin-Madison (USA); **Valery V. Tuchin**, Saratov State Univ. (Russian Federation), Tomsk State Univ. (Russian Federation), Institute of Precision Mechanics and Control of the RAS (Russian Federation); **Yihui Wu**, Changchun Institute of Optics, Fine Mechanics and Physics (China); **Yizheng Zhu**, Virginia Polytechnic Institute and State Univ. (USA)

## SATURDAY 1 FEBRUARY

### OPENING REMARKS

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... SAT 8:00 AM TO 8:30 AM

Opening remarks by Conference Chairs:  
**Natan T. Shaked**, Tel Aviv Univ. (Israel);  
**Oliver Hayden**, Technische Univ. München (Germany)

### SESSION 1

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... SAT 8:30 AM TO 10:00 AM

#### Spontaneous Raman I

Session Chairs: **Natan T. Shaked**, Tel Aviv Univ. (Israel);  
**Oliver Hayden**, Technische Univ. München (Germany)

8:30 am: **Rapid theranostics by multicontast spectroscopy/imaging** (Keynote Presentation), Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany) ..... [11251-1]

9:15 am: **Detection of the differentiation state of salivary gland organoids for tissue engineering by Raman spectroscopy**, Ting Chean Khoo, Nicholas Moskwa, Georgios A. Athanassiadis, Anna V. Sharikova, Melinda Larsen, Alexander Khmaladze, Univ. at Albany (USA) ..... [11251-2]

9:30 am: **1064 nm Raman microscopy using a multifocal excitation pattern**, Haojie Ji, Marcos A. Soares de Oliveira, Che-Wei Chang, James W. Chan, Univ. of California, Davis (USA) ..... [11251-3]

9:45 am: **Quantitative monitoring of live cell engineered bone in 3D printed resorbable calcium-phosphate implant in vitro using fiber-optic Raman spectroscopy**, Anders R. Walther, Morten Ø. Andersen, Martin A. B. Hedegaard, Univ. of Southern Denmark (Denmark) ..... [11251-4]

Coffee Break ..... Sat 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... SAT 10:30 AM TO 12:30 PM

#### Spectroscopy and Scattering I

Session Chair: **Oliver Hayden**, Technische Univ. München (Germany)

10:30 am: **Intracellular Doppler spectroscopy for label-free functional imaging of living tissue** (Invited Paper), David D. Nolte, Purdue Univ. (USA) ..... [11251-5]

11:00 am: **Highly sensitive low-frequency Raman spectroscopy enabled by Sagnac-enhanced impulsive stimulated Raman scattering**, Walker Peterson, The Univ. of Tokyo (Japan); Kotaro Hiramatsu, The Univ. of Tokyo (Japan) and Japan Science and Technology Agency (Japan); Keisuke Goda, The Univ. of Tokyo (Japan) and Japan Science and Technology Agency (Japan) and Univ. of California, Los Angeles (USA) ..... [11251-6]

11:15 am: **Towards intracellular phase transitions in ALS disease by noncontact Brillouin microscopy**, Giuseppe Antonacci, IMEC (Belgium); Valeria de Turris, Istituto Italiano di Tecnologia (Italy); Alessandro Rosa, Giancarlo Ruocco, Sapienza Univ. di Roma (Italy) ..... [11251-7]

11:30 am: **High resolution spectral measurements of the numerical aperture induced effects in Brillouin imaging**, Roni Shaashoua, Alberto Bilencia, Ben-Gurion Univ. of the Negev (Israel) ..... [11251-8]

11:45 am: **Label-free classification of acute myeloid Leukemia by Raman with microsphere assisted imaging** (Invited Paper), Yihui Wu, Mingbo Chi, Changchun Institute of Optics, Fine Mechanics and Physics (China); Huaming Xing, Wenchao Zhou, Changchun Institute of Optics, Fine Mechanics, and Physics (China) ..... [11251-9]

12:15 pm: **Spectral phasor analysis of autofluorescence responses from cells embedded in turbid media containing collagen**, Max Kreider, Andrew I. Rodriguez, Karthik Vishwanath, Paul Urayama, Miami Univ. (USA) ..... [11251-10]

Lunch Break ..... Sat 12:30 pm to 2:15 pm

### SESSION 3

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... SAT 2:15 PM TO 5:00 PM

#### Autofluorescence, Nonlinear, and Multiphoton Imaging

Session Chair: **Melissa C. Skala**, Morgridge Institute for Research (USA)

2:15 pm: **Quantitative melanin imaging using label-free third-harmonic-generation enhancement-ratio microscopy** (Invited Paper), Chi-Kuang Sun, National Taiwan Univ. (Taiwan); Yi-Hua Liao, National Taiwan Univ. Hospital (Taiwan) ..... [11251-11]

2:45 pm: **Assessment of neuropathology of Alzheimer’s disease brain with high-resolution, label-free multi-harmonic generation microscopy**, Sandeep Chakraborty, Pei-Che Wu, Sheng-Tse Chen, National Taiwan Univ. (Taiwan); Ming-Jang Chiu, National Taiwan Univ. Hospital (Taiwan); Chi-Kuang Sun, National Taiwan Univ. (Taiwan) ..... [11251-13]

3:00 pm: **Real-time intraoperative diagnosis by deep neural network driven multiphoton virtual histology**, Sixian You, Yi Sun, Jaena Park, Haohua Tu, Marina Marjanovic, Stephen A. Boppart, Beckman Institute for Advanced Science and Technology (USA) ..... [11251-14]

3:15 pm: **Multispectral characterisation of mesenchymal stem cells: Age, cell cycle, senescence and pluripotency**, Jared M. Campbell, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and The Univ. of New South Wales (Australia); Abbas Habibalahi, Saabah B. Mahbub, The Univ. of New South Wales (Australia); Martin E. Gosnell, Quantitative Pty Ltd. (Australia) and The Univ. of New South Wales (Australia); Ayad G. Anwer, The Univ. of New South Wales (Australia); Sharon Paton, The Univ. of Adelaide (Australia); Stan Gronthos, Mesenchymal Stem Cell Lab. (Australia); Ewa M. Goldys, The Univ. of New South Wales (Australia) ..... [11251-15]

Coffee Break ..... Sat 3:30 pm to 4:00 pm

4:00 pm: **Label-free investigation of human collagen morpho-mechanics by correlative SHG, Brillouin and Raman microscopy**, Raffaella Mercatelli, Sara Mattana, Istituto Nazionale di Ottica (Italy); Laura Capozzoli, Istituto di Chimica dei Composti Organometallici (Italy); Fulvio Ratto, Francesca Rossi, Roberto Pini, Istituto di Fisica Applicata “Nello Carrara” (Italy); Daniele Fioretto, Univ. degli Studi di Perugia (Italy); Francesco S. Pavone, Univ. degli Studi di Firenze (Italy) and LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy); Silvia Caponi, Istituto dei Materiali, Consiglio Nazionale delle Ricerche (Italy); Riccardo Cicchi, Istituto Nazionale di Ottica (Italy) and LENS - Lab. Europeo di Spettroscopie Non-Lineari (Italy) ..... [11251-17]

SUNDAY 2 FEBRUARY

SESSION 4

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... SUN 8:00 AM TO 10:15 AM

OCT and Interferometry

Session Chair: **Natan T. Shaked**, Tel Aviv Univ. (Israel)

8:00 am: **Label free optical cell and tissue characterization for veterinary pathology and teratology** (*Invited Paper*), Jürgen Schnekenburger, Alvaro Barroso Pena, Björn Kemper, Westfälische Wilhelms-Univ. Münster (Germany) ..... [11251-21]

8:30 am: **Digital focusing and image registration for resolution-preserving angular compounding in optical coherence tomography (OCT)**, Jingjing Zhao, Yonatan Winetraub, Edwin Yuan, Orr Zohar, Adam de la Zerda, Stanford Univ. (USA) ..... [11251-22]

8:45 am: **Wide-field intraoperative polarization sensitive and angiographic optical coherence tomography of in vivo non-human primate peripheral nerve**, Mohsen Erfanzadeh, Massachusetts General Hospital (USA) and Harvard Medical School (USA); Ahhyun S. Nam, Marek Hansdorfer, Kasey Kwong, Mark A. Randolph, Robert W. Redmond, Massachusetts General Hospital (USA); Benjamin J. Vakoc, Massachusetts General Hospital (USA) and Harvard Medical School (USA) ..... [11251-23]

9:00 am: **Laguerre Gauss modes for speckle reduction while extending depth of focus of optical coherence tomography**, Yonatan Winetraub, Edwin Yuan, Adam de la Zerda, Stanford Univ. (USA) ..... [11251-24]

9:15 am: **Label-free imaging of a novel zebrafish cancer model**, Ryan Sentosa, Medizinische Univ. Wien (Austria); Caterina Sturtzel, Martin Distel, St. Anna Kinderkrebsforschung e.V. (Austria); Wolfgang Drexler, Rainer A. Leitgeb, Angelika Unterhuber, Marco Andreana, Medizinische Univ. Wien (Austria) ..... [11251-25]

9:30 am: **Seeing the unseen in patients: Advancing disease prevention and treatment through microimaging** (*Keynote Presentation*), Guillermo J. Tearney, Massachusetts General Hospital (USA) ..... [11251-26]

Coffee Break. .... Sun 10:15 am to 10:40 am

PANEL DISCUSSION

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... 10:40 AM TO 12:20 PM

SPECIAL PANEL:

**New Horizons in Clinical Applications of Label-Free Imaging and Sensing**

Lunch Break ..... Sun 12:20 pm to 1:50 pm

SESSION 5

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... SUN 1:50 PM TO 3:35 PM

Plasmonics and Biosensors

Session Chair: **Yihui Wu**, Changchun Institute of Optics, Fine Mechanics and Physics (China)

1:50 pm: **Label-free imaging of exosomes using depth scanning correlation interferometric microscopy** (*Invited Paper*), Ugur Aygun, Koç Univ. (Turkey); Ayca Yalcin Ozkumur, Bahçesehir Univ. (Turkey); Naside Gozde Durmus, Utkan Demirci, Stanford Univ. (USA); Hakan Ürey, Koç Univ. (Turkey) ..... [11251-27]

2:20 pm: **Optical biosensing of mycobacterium tuberculosis for point-of-care diagnosis**, Charles Maphanga, Sello L. Manoto, Saturnin S. Ombinda-Lembomba, Council for Scientific and Industrial Research (South Africa); Patience T. Mthunzi-Kufa, Council for Scientific and Industrial Research (South Africa) and Univ. of South Africa (South Africa) and Univ. of KwaZulu-Natal (South Africa) ..... [11251-28]

2:35 pm: **Semi-supervised deep machine learning for rapid antimicrobial susceptibility testing from vibrational spectroscopy data**, Regina Ragan, Univ. of California, Irvine (USA) ..... [11251-29]

2:50 pm: **Highly sensitive & selective detection of organophosphate nerve agent and pesticide based on a reusable liquid-crystal optical sensor**, Fengjie He, Univ. of Nevada, Las Vegas (USA); Xingliang Xiong, Chongqing Medical Univ. (China); Hui Zhao, Shengjie Zhai, Univ. of Nevada, Las Vegas (USA) ..... [11251-30]

3:05 pm: **Plasmonic imaging - from parallel acquisition to actual structural imaging, how to overcome the propagation effect limit?** (*Invited Paper*), Michael T. Canva, CNRS (France) and Univ. de Sherbrooke (Canada) [11251-31]

Coffee Break. .... Sun 3:35 pm to 4:00 pm

4:15 pm: **Label-free multispectral monitoring of functional state: from embryos to human articular cartilage tissue**, Saabah B. Mahbub, Jared M. Campbell, The Univ. of New South Wales (Australia) and ARC Ctr. of Excellence for Nanoscale Biophotonics (Australia); Tiffany C. Y. Tan, Kylie R. Dunning, The Univ. of Adelaide (Australia) and ARC Ctr. of Excellence for Nanoscale Biophotonics (Australia); Abbas Habibalahi, Michael Bertoldo, Dale Goss, Lindsay Wu, The Univ. of New South Wales (Australia); Ewa M. Goldys, The Univ. of New South Wales (Australia) and ARC Ctr. of Excellence for Nanoscale Biophotonics (Australia) ..... [11251-18]

4:30 pm: **Probing the metabolic interaction of pancreatic tumor and stroma by label-free optical redox imaging**, Rupsa Datta, Morgridge Institute for Research (USA); Allison Lau, Sharanya Sivananda, Matthew Vander Heiden, The David H. Koch Institute for Integrative Cancer Research (USA); Melissa C. Skala, Morgridge Institute for Research (USA) and Univ. of Wisconsin-Madison (USA) ..... [11251-12]

4:45 pm: **Ex vivo assessment of the optical characteristics of human brain and tumour tissue**, Jonathan Shapey, Univ. College London (United Kingdom); Yijing Xie, Elham Nabavi, King's College London (United Kingdom); Efthymios Maneas, Univ. College London (United Kingdom); Shakeel R. Saeed, Ear Institute, Univ. College London (United Kingdom); Neil Dorward, Neil Kitchen, National Hospital for Neurology & Neurosurgery (United Kingdom); Adrien E. Desjardins, Univ. College London (United Kingdom); Sébastien Ourselin, King's College London (United Kingdom); Zane Jaunmuktane, Sebastian Brandner, Univ. College London (United Kingdom); Robert Bradford, National Hospital for Neurology & Neurosurgery (United Kingdom); Tom Vercauteren, King's College London (United Kingdom) ..... [11251-19]

BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)

7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**

7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**

7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)

7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)

7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)

7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)

8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)

8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*

8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)

8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)

8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)

8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

# CONFERENCE 11251

## SESSION 6

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... SUN 4:00 PM TO 5:15 PM

### Photoacoustics and Acousto-optics

Session Chair: **Yihui Wu**, Changchun Institute of Optics, Fine Mechanics and Physics (China)

4:00 pm: **Broadband photoacoustic microscopy based on surface plasmonic sensing** (*Invited Paper*), Xiao-Cong Yuan, Shenzhen Univ. (China) ..... [11251-32]

4:30 pm: **Label-free photothermal phase microscopy of live cells** (*Invited Paper*), Yizheng Zhu, Joseph G. Thomas, Shichao Chen, Virginia Polytechnic Institute and State Univ. (USA) ..... [11251-33]

5:00 pm: **Observational study of label-free image-guided hyperspectral imaging of Necrotising Enterocolitis (NEC) in neonates**, Elham Nabavi, King's College London (United Kingdom); Iain Yardley, Evelina Children's Hospital (United Kingdom); Michael Ebner, King's College London (United Kingdom); Jonathan Shapey, Univ. College London (United Kingdom); David Edwards, Tom Vercauteren, King's College London (United Kingdom) ..... [11251-34]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

**Talk by 2014 Nobel Prize Winner in Physics: Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

## MONDAY 3 FEBRUARY

### SESSION 7

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... MON 8:00 AM TO 9:30 AM

### Polarization and Dark-Field

Session Chair: **Yihui Wu**, Changchun Institute of Optics, Fine Mechanics and Physics (China)

8:00 am: **Instant polarized light microscopy for real-time wide-field visualization of collagen architecture**, Po-Yi Lee, Bin Yang, Ziyi Zhu, Fengting Ji, Yi Hua, Bryn Brazile, Ian A. Sigal, Univ. of Pittsburgh (USA) ..... [11251-35]

8:15 am: **GRIN lens based polarization endoscope – from conception to application**, Chao He, Univ. of Oxford (United Kingdom); Jintao Chang, Tsinghua Univ. (China); Honghui He, Shenzhen Key Lab. for Minimal Invasive Medical Technologies (China); Shaoxiong Liu, Shenzhen Sixth People's Hospital (China); Daniel S. Elson, Imperial College London (United Kingdom); Hui Ma, Tsinghua Univ. (China); Martin J. Booth, Univ. of Oxford (United Kingdom) ..... [11251-36]

8:30 am: **How to choose and optimize a classifier for your polarimetric imaging data?**, Jean Reh binder, Christian Heinrich, Univ. de Strasbourg (France); Angelo Pierangelo, Lab. de Physique des Interfaces et des Couches Minces (France) and Ecole Polytechnique (France) and Univ. Paris Saclay (France); Jihad Zallat, Univ. de Strasbourg (France) ..... [11251-37]

8:45 am: **Digital histology of tissue with Mueller polarimetric microscopy**, Hee Ryung Lee, Lab. de Physique des Interfaces et des Couches Minces (France) and CNRS (France); Pengcheng Li, Hui Ma, Tsinghua Univ. (China); Christian Lotz, Florian Kai Groeber-Becker, Sofia Dembski, Universitätsklinikum Würzburg (Germany) and Fraunhofer-Institut für Silicatforschung ISC (Germany); Razvigor Ossikovski, Tatiana Novikova, Lab. de Physique des Interfaces et des Couches Minces (France) and CNRS (France) ..... [11251-38]

9:00 am: **Label-free super-resolution microsphere-assisted microscopy of biological samples**, Sylvain Lecler, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) and Institut National des Sciences Appliquées de Strasbourg (France); Stéphane Perrin, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) and CNRS (France); Giorgio Quaranta, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) and Ecole Polytechnique Fédérale de Lausanne (Switzerland); Nadia Messaddeq, Nicolas Lemercier, Jean-Luc Vonesch, Institut de génétique et de biologie moléculaire et cellulaire (France) and Univ. de Strasbourg (France) and Institut National de la Santé et de la Recherche Médicale (France); Paul Montgomery, Lab. des sciences de l'Ingénieur, de l'Informatique et de l'Imagerie (France) and Univ. de Strasbourg (France) and CNRS (France) ..... [11251-39]

9:15 am: **Scalable analysis of architecture of brain tissue with label-free imaging and deep learning**, Syuan-Ming Guo, Chan Zuckerberg Biohub (USA); Matt Keefe, David Shin, Univ. of California, San Francisco (USA); Jenny Folkesson, Anitha Krishnan, Chan Zuckerberg Biohub (USA); Tomasz Nowakowski, Univ. of California, San Francisco (USA) and Chan Zuckerberg Biohub (USA); Shalin B. Mehta, Chan Zuckerberg Biohub (USA) ..... [11251-40]

### SESSION 8

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... MON 9:30 AM TO 10:30 AM

### Spectroscopy and Scattering II

Session Chair: **Oliver Hayden**, Technische Univ. München (Germany)

9:30 am: **Multiplexed spatial-spectral imaging** (*Invited Paper*), Yuan Luo, National Taiwan Univ. (Taiwan) ..... [11251-41]

10:00 am: **Label free morphochemical characterization of tissues**, Francesco S. Pavone, LENS - Lab. Europeo di Spettroscopia Non-Lineari (Italy) ..... [11251-42]

10:15 am: **Clinical stratification of peripheral edema using Short Wave Infrared (SWIR) molecular chemical imaging**, Aaron Smith, Shona D. Stewart, ChemImage Corp. (USA); Arash Samiei, Allegheny General Hospital (USA); Arjun S. Bangalore, Heather Gomer, Marlena Darr, Robert C. Schweitzer, Christopher Post, Patrick J. Treado, ChemImage Corp. (USA); Jeffrey Cohen, Allegheny General Hospital (USA) ..... [11251-43]

Coffee Break ..... Mon 10:30 am to 11:00 am

### SESSION 9

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... MON 11:00 AM TO 1:00 PM

### Coherent Raman

Session Chair: **Francisco E. Robles**, Georgia Institute of Technology & Emory Univ. School of Medicine (USA)

11:00 am: **Label-free chemical microscopy for Life science and translational medicine** (*Keynote Presentation*), Ji-Xin Cheng, Boston Univ. (USA) ..... [11251-44]

11:45 am: **Rapid switching between various wavelength regions for coherent Raman imaging with a robust all-fiber source**, Tim Hellwig, Maximilian Brinkmann, Westfälische Wilhelms-Universität Münster (Germany) and Refined Laser Systems UG (Germany); Carsten Fallnich, Westfälische Wilhelms-Universität Münster (Germany) and Cells-in-Motion Cluster of Excellence (Germany) ..... [11251-45]

12:00 pm: **Why nonlinear Raman microspectroscopy is more than just a gimmick?**, Vladislav V. Yakovlev, Texas A&M Univ. (USA) ..... [11251-46]

12:15 pm: **Two new approaches to broadband stimulated Raman scattering microscopy**, Alejandro De La Cadena Perez Gallardo, Carlo Michele Valensise, Daniele Viola, Giulio N. Cerullo, Dario Polli, Politecnico di Milano (Italy) ..... [11251-47]

12:30 pm: **Fingerprint-to-CH stretch region high spectral resolution Stimulated Raman Scattering microscopy with an Acousto Optical Tunable Filter**, Sergey P. Laptinok, Luca Genchi, Vijayakumar P. Rajamanickam, Andrea Bertoncini, Alessandro Giammona, Carlo Liberale, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11251-49]

12:45 pm: **High-resolution multimodal flexible coherent Raman endoscope**, Hervé Rigneault, Viktor Tsvirkun, Vasyli Mytskaniuk, Aix-Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France); Marc Fabert, Frédéric Louradour, Univ. de Limoges (France) and XLIM (France); Alexandre Kudlinski, Lab. de Physique des Lasers, Atomes et Molécules (France) and Univ. de Lille (France) ..... [11251-50]

Lunch Break ..... Mon 1:00 pm to 2:45 pm

**SESSION 10**

**LOCATION: ROOM 305 (LEVEL 3 SOUTH) . . . . . MON 2:45 PM TO 4:15 PM**

**Spontaneous Raman II**

Session Chair: **Alexander Khmaladze**, Univ. at Albany (USA)

2:45 pm: **Sensitivity analysis of wavefront shaping based Raman endoscopy**, Liubov Amitonova, Johannes F. de Boer, Vrije Univ. Amsterdam (Netherlands) . . . . . [11251-51]

3:00 pm: **Raman hyperspectral imaging of transferrin-bound iron in T47D and MDA-MB-231 breast cancer cells**, Ting Chean Khoo, Univ. at Albany (USA); Kate Tubbesing, Alena Rudkouskaya, Albany Medical College (USA); Georgios A. Athanassiadis, Anna V. Sharikova, Univ. at Albany (USA); Margarida Barroso, Albany Medical College (USA); Alexander Khmaladze, Univ. at Albany (USA) . . . . . [11251-52]

Coffee Break . . . . . Mon 3:15 pm to 3:45 pm

3:45 pm: **Multimodal, label-free histopathology for improving the diagnosis of Hirschsprung disease**, Marcos A. Soares de Oliveira, Laura A. Galganski, Che-Wei Chang, Christopher D. Pivetti, Karen E. Matsukuma, Bo Zhang, Alexandro Lopez, Payam Saadai, James W. Chan, Univ. of California, Davis (USA) . . . . . [11251-53]

4:00 pm: **Molecular imaging of extracellular vesicles in vitro via Raman metabolic labelling**, Conor C. Horgan, Anika Nagelkerke, Thomas E. Whittaker, Valeria Nele, Lucia Massi, Ulrike Kauscher, Jelle Penders, Mads S. Bergholt, Imperial College London (United Kingdom); Steve R. Hood, GlaxoSmithKline (United Kingdom); Molly M. Stevens, Imperial College London (United Kingdom) . . . . . [11251-54]

**POSTERS-MONDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Scanning Offset-Emission Hyperspectral Microscopy (SOHM) of waveguiding in single ZnO nanorod**, Bonghwan Chon, National Institute of Standards and Technology (USA) and Georgetown Univ. (USA); Johnson T. Truong, Matthew Hansen, Jong-in Hahm, Georgetown Univ. (USA); Young Jong Lee, National Institute of Standards and Technology (USA) . . . . . [11251-76]

**Study of the red blood cell aggregation by coherent anti-Stokes Raman spectroscopy**, Martín A. Toderi, Gustavo E. Galizzi, Bibiana D. Riquelme, Instituto de Física Rosario (Argentina) and Univ. Nacional de Rosario (Argentina); Dominique Dumas, Univ. de Lorraine (France) and CNRS (France) and Institut National de la Santé et de la Recherche Médicale (France) . . . . . [11251-77]

**A label-free study of focal adhesions using deep learning in interference reflection microscopy**, Lisa Sophie Kölln, Univ. of Strathclyde (United Kingdom); Carsten G. Hansen, The Univ. of Edinburgh (United Kingdom); Gail McConnell, Univ. of Strathclyde (United Kingdom) . . . . . [11251-78]

**Epithelial mesenchymal transition of prostate cancer cells monitored with a photonic crystal biosensor**, Melissa Cadena, Frank De Luna, The Univ. of Texas at San Antonio (USA); Lu-Zhe Sun, The Univ. of Texas Health Science Ctr. at San Antonio (USA); Jing Yong Ye, The Univ. of Texas at San Antonio (USA) . . . . . [11251-79]

**High-speed digital holography for monitoring the Daphnia heart rate in environmental toxicity test**, Sang-Won Lee, Ik Hwan Kwon, Tae Geol Lee, Korea Research Institute of Standards and Science (Korea, Republic of) . . . . . [11251-80]

**Line scan Raman microspectroscopy for label-free diagnosis of ex vivo pituitary adenoma biopsies**, Daniela Bovenkamp, Jeremias Püls, Fabian Placzek, Alexander Micko, Stefan Wolfsberger, Romana Höftberger, Greisa Vila, Rainer A. Leitgeb, Wolfgang Drexler, Marco Andreana, Angelika Unterhuber, Medizinische Univ. Wien (Austria) . . . . . [11251-81]

**In vivo optical coherence tomography of cerebral microvessels in medaka**, Takashi Suzuki, Tomohiro Ueno, Naoya Oishi, Kyoto Univ. Graduate School of Medicine (Japan); Hidenao Fukuyama, Beijing Institute of Technology Human Brain Research Lab. and Intelligent Robotics Institute (China) and Nagoya City Univ. Graduate School of Medical Sciences and Medical School (Japan) . . . . . [11251-82]

**Snapshot polarization microscopy for imaging of brain tissue**, Marco Augustin, Antonia Lichtenegger, Johanna Gesperger, Pablo Eugui, Adelheid Wöhner, Bernhard Baumann, Medizinische Univ. Wien (Austria) . . . . . [11251-83]

**Label-free ultrasensitive detection of Amyloid- $\beta$  using microtoroid resonators for early detection of Alzheimer's disease**, Adley Gin, Phuong-Diem Nguyen, Judith Su, The Univ. of Arizona (USA) . . . . . [11251-84]

**Birefringence microscopy for imaging the structural integrity of myelin**, Nathan Blanke, Irving J. Bigio, Boston Univ. (USA) . . . . . [11251-85]

**Volumetric visualization of spinal cord using optical coherence tomography and tissue clearing technique**, Woohee Shin, Ga Hyang Lee, Yujin Ahn, Kibeom Park, Hyunmo Yang, Woonggyu Jung, Ulsan National Institute of Science and Technology (Korea, Republic of) . . . . . [11251-86]

**Real-time measurement of hemoglobin concentration in continuous-wave diffusion optical spectroscopy using the least-squares method**, Yikeun Kim, Pukyong National Univ. (Korea, Republic of); Chang Su Kim, Hyung Hwan Moon, Kosin Univ. (Korea, Republic of); HyunSeo Park, Pukyong National Univ. (Korea, Republic of); Eun-Kee Park, Kosin Univ. (Korea, Republic of); Yeh-Chan Ahn, Pukyong National Univ. (Korea, Republic of) . . . . . [11251-87]

**Quantitative analysis of the microvasculature flow speed using optical coherence tomography angiography technique and variable interscan time algorithm**, Ting-Hao Chen, Ting-Yen Tsai, Yin-Peng Huang, Chuan-Bor Chueh, Meng-Shan Wu, Yi-Chun Wu, Ching-Yu Wang, Yi-Ping Hung, National Taiwan Univ. (Taiwan); Meng-Tsan Tsai, Chang Gung Univ. (Taiwan); Hsiang-Chieh Lee, National Taiwan Univ. (Taiwan) . . . . . [11251-88]

**A sub-sampling image acquisition strategy for single pixel imaging with low signal-to-noise ratio**, Fangyuan Sha, Nanyang Technological Univ. (Singapore); Sujit K. Sahoo, Nanyang Technological Univ. (Singapore) and Indian Institute of Technology Goa (India); Cuong H. Dang, Nanyang Technological Univ. (Singapore) . . . . . [11251-89]

**Incorrect submission due to confusing. We want to cancel this paper.**, Yikeun Kim, Pukyong National University (Korea, Republic of) . . . . . [11251-90]

**Computer-aided label-free fluorescence lifetime skin cancer screening**, Renan A. Romano, Ramon G. T. Rosa, Instituto de Física de São Carlos (Brazil); Ana Gabriela Salvio, Hospital Amaral Carvalho (Brazil); Javier A. Jo, Texas A&M Univ. (USA) and The Univ. of Oklahoma (USA); Cristina Kurachi, Instituto de Física de São Carlos (Brazil) . . . . . [11251-91]

**Enhancement of label-free biosensing of cardiac troponin I**, Chase Christenson, Kwaku Baryeh, The Univ. of Texas at San Antonio (USA); Samad Ahadian, Rohollah Nasiri, Mehmet R. Dokmeci, Marcus Goudie, Ali Khademhosseini, Univ. of California, Los Angeles (USA); Jing Yong Ye, The Univ. of Texas at San Antonio (USA) . . . . . [11251-93]

**Deep learning algorithms enable the automated chondrocyte viability assessment of cartilage with autofluorescence and second harmonic generation imaging**, Tong Ye, Xun Chen, Yang Li, Nicole Wyman, Clemson Univ. (USA) . . . . . [11251-94]

**Polarization recovery in full thickness bone allows for discrimination of diseased state**, Emily G. Pendleton, Ruth P. Barrow, Ana D. Maslesa, Kayvan F. Tehrani, Luke J. Mortensen, The Univ. of Georgia (USA) . . . . . [11251-95]

**3D printed portable holographic microscope for biomedical particle ensemble investigations**, Nikolay V. Petrov, Alexandra O. Georgieva, Dmitriy V. Ladaniy, Alexander P. Khurchak, ITMO Univ. (Russian Federation) . . . . . [11251-97]

**Label-free ex-vivo intravital 3D imaging of human hair follicles with optical coherence tomography**, Janin Lehmann, Monasterium Lab. Skin & Hair Research Solutions GmbH (Germany); Alvaro Barroso Pena, Björn Kemper, Jürgen Schneckener, Westfälische Wilhelms-Universität Münster (Germany); Ralf Paus, Monasterium Lab. Skin & Hair Research Solutions GmbH (Germany) and Univ. of Manchester (United Kingdom); Marta Bertolini, Monasterium Lab. Skin & Hair Research Solutions GmbH (Germany); Jeremy Chéret, Univ. of Miami (USA) and Monasterium Lab. Skin & Hair Research Solutions GmbH (Germany) . . . . . [11251-98]

**Ultrafast plasmonic and real-time label-free polymerase chain reaction**, Padideh Mohammadyousef, McGill Univ. (Canada); Miltiadis Paliouras, Mark Trifiro, Lady Davis Institute for Medical Research, Jewish General Hospital (Canada); Andrew G. Kirk, McGill Univ. (Canada) . . . . . [11251-99]

**Label-free characterization of mitochondria assembly in oocyte of Caenorhabditis elegans by two-photon excited autofluorescence**, Tao Chen, Yi-tang Lee, Dinghuan Deng, Meng C. Wang, Baylor College of Medicine (USA) . . . . . [11251-100]

**Raman spectroscopy and gold thin film for biosensing and detection**, Saturnin S. Ombinda-Lemboumba, Lebogang Thobakgale, Sello L. Manoto, Masixole Y. Lugongolo, CSIR National Laser Ctr. (South Africa); Patience T. Mthunzi-Kufa, CSIR National Laser Ctr. (South Africa) and Univ. of South Africa (South Africa) and Univ. of KwaZulu-Natal (South Africa) . . . . . [11251-92]

# CONFERENCE 11251

## TUESDAY 4 FEBRUARY

### SESSION 11

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... TUE 8:00 AM TO 10:15 AM

#### Holography and Phase Microscopy I

Session Chair: **Oliver Hayden**, Technische Univ. München (Germany)

8:00 am: **Low latency deep cytometry with realtime inference** (*Invited Paper*), Bahram Jalali, Yueqin Li, Ata Mahjoubfar, Univ. of California, Los Angeles (USA); Kayvan R. Niazi, NantWorks, LLC (USA) ..... [11251-55]

8:30 am: **Holographic analysis of sperm for in vitro fertilization**, Simcha K. Mirsky, Pinkie J. Eravuchira, Itay Barnea, Lidor Karako, Mattan Levi, Michal Balberg, Hayit Greenspan, Natan T. Shaked, Tel Aviv Univ. (Israel) ..... [11251-56]

8:45 am: **Cell biophysical properties measured with multimodal quantitative-phase digital holographic microscopy**, Erik Bélanger, Emile Rioux-Péllierin, Sara Mattar, François Paquet-Mercier, Marie-Eve Crochetière, Jean-Xavier Giroux, Pierre P. Marquet, CERVO Brain Research Ctr. (Canada) and Univ. Laval (Canada) ..... [11251-57]

9:00 am: **Towards a robust low cost Fourier Ptychographic device**, Alexander Heemels, Temitope E. Agbana, Silvania F. Pereira, Jan-Carel Diehl, Michel Verhaegen, Gleb Vdovin, Technische Univ. Delft (Netherlands) ..... [11251-58]

9:15 am: **Six-pack holography and dynamic synthetic aperture superresolution**, Simcha K. Mirsky, Natan T. Shaked, Tel Aviv Univ. (Israel) ..... [11251-59]

9:30 am: **Deep learning-enabled holography** (*Keynote Presentation*), Aydogan Ozcan, Univ. of California, Los Angeles (USA) ..... [11251-60]

Coffee Break ..... Tue 10:15 am to 10:45 am

### SESSION 12

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... TUE 10:45 AM TO 12:15 PM

#### Holography and Phase Microscopy II

Session Chair: **Natan T. Shaked**, Tel Aviv Univ. (Israel)

10:45 am: **Utilizing digital holographic microscopy for label-free monitoring of blood cell differentiation** (*Invited Paper*), Björn Kemper, Angelika Vollmer, Andreas Bauwens, Westfälische Wilhelms-Universität Münster (Germany) ..... [11251-61]

11:15 am: **Label-free 3D refractive index interferometric tomography of live cancer cells with full angular coverage**, Matan Dudaie, Tel Aviv Univ. (Israel) ..... [11251-62]

11:30 am: **Experimental digital Gabor hologram rendering of C. elegans worms by a model-trained convolutional neural network**, Michael Atlan, Julie Rivet, Antoine Taliencio, Institut Langevin Ondes et Images (France); Nicolas Boutry, Guillaume Tochon, EPITA (France); Jean-Pierre Huignard, Institut Langevin Ondes et Images (France) ..... [11251-63]

11:45 am: **Full-field interferometric imaging of neuron deformation during action potential**, Tong Ling, Kevin C. Boyle, Valentina Zuckerman, Thomas Flores, Daniel V. Palanker, Stanford Univ. (USA) ..... [11251-64]

12:00 pm: **Neural-network based classification of non-adherent cancer cells using Label free Quantitative Phase Imaging data**, Silvia Ceballos, Han Sang Park, Will J. Eldridge, Adam P. Wax, Duke Univ. (USA) ..... [11251-65]

Lunch Break ..... Tue 12:15 pm to 1:30 pm

### SESSION 13

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... TUE 1:30 PM TO 3:15 PM

#### Holography and Phase Microscopy II

Session Chair: **Yizheng Zhu**, Virginia Polytechnic Institute and State Univ. (USA)

1:30 pm: **3D computational phase microscopy with multiple-scattering samples** (*Invited Paper*), Laura Waller, Univ. of California, Berkeley (USA) ..... [11251-66]

2:00 pm: **Probing live cell T cell in label-free manner using morpho molecular microscopy**, Rishikesh Pandey, CytoVeris Inc. (USA); Ishan Barman, Johns Hopkins University (USA) ..... [11251-67]

2:15 pm: **Label free discrimination and selection of cancer cells during flow**, Matan Dudaie, Tel Aviv Univ. (Israel) ..... [11251-68]

2:30 pm: **Speckle-free quantitative phase microscopy using pseudo-thermal light source for label-free imaging of biological cells and tissues with high temporal phase stability and spatial phase sensitivity**, Dalip S. Mehta, Indian Institute of Technology Delhi (India) ..... [11251-69]

2:45 pm: **Differential detection at extended pupil plane for label-free phase contrast imaging**, Hari P. Paudel, Clemens Alt, Judith M. Runnels, Charles P. Lin, Massachusetts General Hospital (USA) and Harvard Medical School (USA) ..... [11251-70]

3:00 pm: **Highly Sensitive and Label-free Digital Detection of Whole Cell E. coli with Interferometric Reflectance Imaging**, Negin Zараee, Fulya Ekiz Kanik, Boston Univ. (USA); Abdul Mueyed Bhuiya, Univ. of California, Berkeley (USA); Emily S. Gong, Physical Sciences Inc. (USA); Matthew T. Geib, Nese Lortlar Ünlü, Ayca Yalcin Ozkumur, Boston Univ. (USA); Julia R. Dupuis, Physical Sciences Inc. (USA); M. Selim Ünlü, Boston Univ. (USA) ..... [11251-323]

Coffee Break ..... Tue 3:15 pm to 3:45 pm

### SESSION 14

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... TUE 3:45 PM TO 5:15 PM

#### Holography and Phase Microscopy IV

Session Chair: **Natan T. Shaked**, Tel Aviv Univ. (Israel)

3:45 pm: **Epi-mode tomographic quantitative phase imaging in thick scattering samples** (*Invited Paper*), Francisco E. Robles, Georgia Institute of Technology & Emory Univ. School of Medicine (USA) ..... [11251-71]

4:15 pm: **Label-free cell analysis and classification with lens-less computational imaging**, Duofang Chen, Xixin Luo, Zhaohui Wang, Jimin Liang, Xueli Chen, Xidian Univ. (China) ..... [11251-72]

4:30 pm: **Ultraviolet hyperspectral microscopy using chromatic aberration based iterative phase-recovery**, Nischita Kaza, Ashkan Ojaghi, Georgia Institute of Technology (USA); Francisco E. Robles, Georgia Institute of Technology & Emory Univ. School of Medicine (USA) ..... [11251-73]

4:45 pm: **High throughput screening of cancer cells using holographic cytometry**, Han Sang Park, Will J. Eldridge, Silvia Ceballos, Adam P. Wax, Duke Univ. (USA) ..... [11251-74]

5:00 pm: **Digital holographic microscopy (DHM) and transport of intensity (TIE) phase imaging of live cells**, Shane Carney, Ting Chean Khoo, Jeremy Wittkopp, Kai Pisila, Georgios A. Athanassiadis, Anna V. Sharikova, Alexander Khmaladze, Jonathan C. Petrucci, Univ. at Albany (USA) ..... [11251-75]

### CONCLUDING REMARKS

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... 5:15 PM TO 5:35 PM

Concluding Remarks by Conference Chairs

# CONFERENCE 11252

LOCATION: ROOM 313 (LEVEL 3 SOUTH)

Saturday–Monday 1–3 February 2020 • Proceedings of SPIE Vol. 11252

## Advanced Chemical Microscopy for Life Science and Translational Medicine

Conference Chairs: **Ji-Xin Cheng**, Boston Univ. (USA); **Wei Min**, Columbia Univ. (USA); **Garth J. Simpson**, Purdue Univ. (USA)

Program Committee: **Rohit Bhargava**, Univ. of Illinois (USA); **Stephen A. Boppart**, Univ. of Illinois (USA); **Sophie Brasselet**, Institut Fresnel (France); **Minhaeng Cho**, Korea Univ. (Korea, Republic of); **Marcus T. Cicerone**, Georgia Institute of Technology (USA); **Hilton B. de Aguiar**, Ecole Normale Supérieure (France); **Conor L. Evans**, Wellman Ctr. for Photomedicine (USA); **Hanieh Fattahi**, Max-Planck-Institut für Quantenoptik (Germany); **Dan Fu**, Univ. of Washington (USA); **Katsumasa Fujita**, Osaka Univ. (Japan); **Zhiwei Huang**, National Univ. of Singapore (Singapore); **Minbiao Ji**, Fudan Univ. (China); **Anita Mahadevan-Jansen**, Vanderbilt Univ. (USA); **Julian Moger**, Univ. of Exeter (United Kingdom); **Yasuyuki Ozeki**, The Univ. of Tokyo (Japan); **Sapun H. Parekh**, The Univ. of Texas at Austin (USA); **Ammasi Periasamy**, Univ. of Virginia (USA); **Dario Polli**, Politecnico di Milano (Italy); **Jürgen Popp**, Leibniz-Institut für Photonische Technologien e.V. (Germany); **Eric O. Potma**, Univ. of California, Irvine (USA); **Hervé Rigneault**, Institut Fresnel (France); **Lingyan Shi**, Univ. of California, San Diego (USA); **Chi-Kuang Sun**, National Taiwan Univ. (Taiwan); **Meng Wang**, Baylor College of Medicine (USA); **Warren S. Warren**, Duke Univ. (USA); **Jesse W. Wilson**, Colorado State Univ. (USA); **Xiaoliang Sunney Xie**, Peking Univ. (China); **Xiaoji G. Xu**, Lehigh Univ. (Canada); **Shuhua Yue**, Beihang Univ. (China)

Conference Cosponsors:



9:35 am: **Imaging Amphotericin B orientation in Candida spp. through polarization stimulated Raman scattering microscopy**, Pu-Ting Dong, Yuewei Zhan, Boston Univ. (USA); Zeina Dagher, Massachusetts General Hospital (USA); Jie Hui, Kai-Chih Huang, Boston Univ. (USA); Michael K. Mansour, Massachusetts General Hospital (USA); Ji-Xin Cheng, Boston Univ. (USA) . . . . . [11252-6]

9:50 am: **In vivo quantification of mean corpuscular hemoglobin concentration by transient absorption microscopy and stimulated Raman scattering microscopy**, Andrew Francis, Univ. of Washington (USA) . [11252-7]

Coffee Break . . . . . Sat 10:05 am to 10:35 am

### SESSION 2

LOCATION: ROOM 313 (LEVEL 3 SOUTH) . . . . . SAT 10:35 AM TO 12:00 PM

#### Superresolution Chemical Microscopy

Session Chair: **Dan Fu**, Univ. of Washington (USA)

10:35 am: **Super-resolution microscopy via translated speckle illumination and ptychographic structured modulation (Invited Paper)**, Guoan Zheng, Univ. of Connecticut (USA) . . . . . [11252-8]

11:00 am: **Towards deep super-resolution coherent Raman scattering microscopy in scattering media**, Julien Guilbert, Awoke A. Negash, Lab. Kastler Brossel (France); Simon Labouesse, Univ. of Colorado Boulder (USA); Sylvain Gigan, Lab. Kastler Brossel (France); Hilton Barbosa de Aguiar, Ecole Normale Supérieure (France) and PSL Research Univ. (France); Anne Sentenac, Aix Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France) . . . . . [11252-9]

11:15 am: **Near-resonance enhanced label-free stimulated Raman scattering microscopy with spatial resolution beyond 130 nm**, Chi Yang, Ping Wang, Huazhong Univ. of Science and Technology (China) . . . . [11252-11]

11:30 am: **Super-resolution pump probe microscopy**, Guang Yang, Ping Wang, Huazhong Univ. of Science and Technology (China) . . . . [11252-12]

11:45 am: **Super resolution correlative far-field submicron simultaneous IR and raman microscopy: a new paradigm in vibrational spectroscopy**, Mustafa Kansiz, Craig B. Prater, Photothermal Spectroscopy Corp. (USA) . . . . . [11252-78]

Lunch Break . . . . . Sat 12:00 pm to 1:30 pm

### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 313 (LEVEL 3 SOUTH) . . . . . SAT 8:00 AM TO 10:05 AM

#### CARS, SRS, Raman Innovation and Applications I

Session Chair: **Ji-Xin Cheng**, Boston Univ. (USA)

8:00 am: **Raman microscopy using a multi-slit spectrophotometer for high throughput cell analysis. (Invited Paper)**, Katsumasa Fujita, Osaka Univ. (Japan) . . . . . [11252-1]

8:25 am: **Spatial frequency projection imaging of coherent anti-Stokes Raman scattering (SPIFI-CARS) (Invited Paper)**, Sandro Heuke, Aix-Marseille Univ. (France) and Institut Fresnel (France) and CNRS (France); Siddharth Sivankutty, Camille Scotte, Aix-Marseille Univ. (France); Patrick A. Stockton, Randy A. Bartels, Colorado State Univ. (USA); Anne Sentenac, Hervé Rigneault, Aix-Marseille Univ. (France) . . . . . [11252-2]

8:50 am: **Probing the mechanisms of infrared neural stimulation with stimulated Raman scattering microscopy**, Wilson R. Adams, Rekha Gautam, Graham A. Throckmorton, Laura E. Masson, Jeremy B. Ford, John Logan Jenkins, E. Duco Jansen, Anita Mahadevan-Jansen, Vanderbilt Univ. (USA) . . . . . [11252-3]

9:05 am: **Application of stimulated Raman scattering microscopy in the chemical detection of atmospheric aerosols**, Jianpeng Ao, Fudan Univ. (China) . . . . . [11252-4]

9:20 am: **In vivo chemical alteration profiling Caenorhabditis elegans during development and aging by hyperspectral stimulated Raman scattering microscopy**, Tao Chen, Dinghuan Deng, Ayse Sena Mutlu, Yong Yu, Baylor College of Medicine (USA); Meng C. Wang, Baylor College of Medicine (USA) and Howard Hughes Medical Institute (USA) . . . . . [11252-5]

# CONFERENCE 11252

## SESSION 3

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... SAT 1:30 PM TO 3:05 PM

### New Methods for Chemical Imaging

Session Chair: **Warren S. Warren**, Duke Univ. (USA)

1:30 pm: **Brillouin microscopy for tissue and cell biomechanics** (*Invited Paper*), Giuliano Scarcelli, Univ. of Maryland, College Park (USA) ..... [11252-13]

1:55 pm: **Multiscale photoacoustic tomography from MIR to UV** (*Invited Paper*), Lihong V. Wang, Caltech (USA) ..... [11252-14]

2:20 pm: **Thermo-elastic optical coherence microscopy**, Aaron Doug Deen, Erasmus MC (Netherlands); Tom Pfeiffer, Institut für Biomedizinische Optik (Germany); Heleen M. M. van Beusekom, Jeroen Essers, Erasmus MC (Netherlands); Robert A. Huber, Institut für Biomedizinische Optik (Germany); Antonius F. W. van der Steen, Erasmus MC (Netherlands) and Shenzhen Institute of Advanced Technology (China) and Technische Univ. Delft (Netherlands); Gijs van Soest, Tianshi Wang, Erasmus MC (Netherlands) ..... [11252-15]

2:35 pm: **Stimulated Raman scattering imaging by an achromatic water-immersion metalens**, Peng Lin, Boston Univ. (USA); Wei Ting Chen, Harvard Univ. (USA); Kerolos M. A. Yousef, College of Biotechnology, MISR Univ. for Science and Technology (Egypt); Jason C. Qian, Johns Hopkins Univ. (USA); Federico Capasso, Harvard Univ. (USA); Ji-Xin Cheng, Boston Univ. (USA) ..... [11252-16]

2:50 pm: **Imaging the molecular composition-specific tissue biomechanics at high frequency with Brillouin-Raman microscopy**, Francesca Palombo, Univ. of Exeter (United Kingdom) ..... [11252-17]

Coffee Break. .... Sat 3:05 pm to 3:35 pm

## SESSION 4

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... SAT 3:35 PM TO 5:15 PM

### Transient Absorption and Harmonic Microscopy

Session Chair: **Rohith K. Reddy**, Univ. of Houston (USA)

3:35 pm: **Simulating heme protein transient absorption fingerprints with time-correlator theory**. (*Invited Paper*), Jesse W. Wilson, Colorado State Univ. (USA) ..... [11252-18]

4:00 pm: **Far-field imaging of defects in graphene with spatial resolution near 100 nm**, Yali Bi, Ping Wang, Huazhong Univ. of Science and Technology (China) ..... [11252-19]

4:15 pm: **In vitro quantification of single red blood cell oxygen saturation by femtosecond transient absorption microscopy**, Andrew Francis, Univ. of Washington (USA) ..... [11252-20]

4:30 pm: **Chemical imaging with vibrationally resonant third-order sum frequency generation microscopy**, David Knez, Eric O. Potma, Adam M. Hanninen, Richard C. Prince, Univ. of California, Irvine (USA) ..... [11252-21]

4:45 pm: **Polarization dependent second harmonic generation microscopy in turbid media**, James R. W. Ulcickas, Garth J. Simpson, Purdue Univ. (USA) ..... [11252-22]

5:00 pm: **In vivo high-resolution multimodal nonlinear optical microscopy of spinal cord in mice**, Wanjie Wu, Zhongya Qin, Junqiang Wu, Congping Chen, Weitao Chen, Jianan Y. Qu, Kai Liu, Hong Kong Univ. of Science and Technology (Hong Kong, China) ..... [11252-23]

## BIOS HOT TOPICS

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SAT 7:00 PM TO 9:30 PM

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### SESSION 5

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... SUN 8:15 AM TO 10:05 AM

### CARS, SRS, Raman Innovation and Applications II

Session Chair: **Eric O. Potma**, Univ. of California, Irvine (USA)

- 8:15 am: **High-throughput vibrational flow cytometry** (*Invited Paper*), Kotaro Hiramatsu, Keisuke Goda, The Univ. of Tokyo (Japan) ..... [11252-24]
- 8:40 am: **Super-multiplexed vibrational imaging for complex biomedicine** (*Invited Paper*), Wei Min, Columbia Univ. (USA) ..... [11252-25]
- 9:05 am: **Robust all-fiber light source for hyperspectral, coherent Raman microscopy in translational research**, Tim Hellwig, Maximilian Brinkmann, Westfälische Wilhelms-Universität Münster (Germany) and Refined Laser Systems UG (Germany); Carsten Fallnich, Westfälische Wilhelms-Universität Münster (Germany) and Cells in Motion Cluster of Excellence (Germany) ..... [11252-26]
- 9:20 am: **Alignment-free frequency modulation stimulated Raman scattering microscopy**, Andrew Hill, Univ. of Washington (USA) ..... [11252-27]
- 9:35 am: **Forbidden transitions: the hyper-Raman spectra of biologically important molecules**, Christopher B. Marble, Texas A&M Univ. (USA); Xingqi Xu, Texas A&M Univ. (USA) and Zhejiang Univ. (China); Georgi I. Petrov, Texas A&M Univ. (USA); Dawei Wang, Zhejiang Univ. (China); Vladislav V. Yakovlev, Texas A&M Univ. (USA) ..... [11252-28]
- 9:50 am: **High speed imaging of B-cells by stimulated Raman scattering**, Robert Oda, The Univ. of Tokyo (Japan) and Univ. of Hawai'i at Manoa (USA) and John A. Burns School of Medicine (USA); Jingwen Shou, The Univ. of Tokyo (Japan); Bruce Shiramizu, Univ. of Hawai'i at Manoa (USA) and John A. Burns School of Medicine (USA); Yasuyuki Ozeki, The Univ. of Tokyo (Japan) ..... [11252-29]
- Coffee Break. .... Sun 10:05 am to 10:35 am

## SESSION 6

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... SUN 10:35 AM TO 12:00 PM

### Infrared Chemical Imaging I

Session Chair: **Jesse W. Wilson**, Colorado State Univ. (USA)

10:35 am: **Submicrometer resolution vibrational spectroscopic imaging by mid-infrared photothermal microscopy** (*Invited Paper*), Yeran Bai, Ji-Xin Cheng, Boston Univ. (USA) ..... [11252-31]

11:00 am: **Mid-infrared optical photothermal imaging for cancer diagnosis**, Chalapathi Gajjela, Licheng Zhang, Shihao Ran, David Mayerich, Rohith K. Reddy, Univ. of Houston (USA) ..... [11252-32]

11:15 am: **Cytoplasmic protein imaging with mid-infrared photothermal microscopy**, Jong Min Lim, Institute for Basic Science (Korea, Republic of); Chanjong Park, Minhaeng Cho, Institute for Basic Science (Korea, Republic of) and Korea Univ. (Korea, Republic of) ..... [11252-33]

11:30 am: **Infrared polarimetric spectroscopic imaging using quantum cascade lasers**, Yamuna Phal, Kevin L. Yeh, Rohit Bhargava, Univ. of Illinois (USA) ..... [11252-34]

11:45 am: **Light sources for coherent Raman and infrared microscopy**, Ingo Rimke, APE Angewandte Physik & Elektronik GmbH (Germany) ..... [11252-35]

Lunch Break ..... Sun 12:00 pm to 1:30 pm

## SESSION 7

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... SUN 1:30 PM TO 3:05 PM

### Data Science in Chemical Microscopy

Session Chair: **Lu Wei**, Caltech (USA)

1:30 pm: **Quantifying pharmacokinetics and pharmacodynamics with coherent Raman imaging and deep learning** (*Invited Paper*), Conor L. Evans, Wellman Ctr. for Photomedicine (USA) ..... [11252-36]

1:55 pm: **Rapid diagnosis of endoscopic biopsies with deep-learning based SRS histology** (*Invited Paper*), Minbiao Ji, Fudan Univ. (China) [11252-37]

2:20 pm: **Spectroscopic fingerprint stimulated Raman scattering imaging of living cells and large area tissues by ultrafast delay-line tuning and deep learning**, Haonan Lin, Boston Univ. (USA) ..... [11252-38]

2:35 pm: **Denoising of stimulated Raman scattering microscopy images via deep learning**, Bryce Manifold, Univ. of Washington (USA) ..... [11252-39]

2:50 pm: **Incorporating machine learning with Raman spectroscopy to differentiate bone types**, Michael Sieverts, Kendall Stauffer, Caroline Garrett, Pratima Labroo, Nikolai Sopko, PolarityTE, Inc. (USA) ..... [11252-40]

Coffee Break ..... Sun 3:05 pm to 3:35 pm

## SESSION 8

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... SUN 3:35 PM TO 5:25 PM

### CARS, SRS, Raman Innovation and Applications III

Session Chair: **Wei Min**, Columbia Univ. (USA)

3:35 pm: **Chemical imaging in-planta with stimulated Raman scattering microscopy: Shedding new light on agrochemical formulation** (*Invited Paper*), Julian Moger, Univ. of Exeter (United Kingdom) ..... [11252-41]

4:00 pm: **Broadband stimulated Raman scattering microscopy** (*Invited Paper*), Dario Polli, Alejandro De La Cadena, Carlo Valensise, Daniele Viola, Giulio N. Cerullo, Politecnico di Milano (Italy) ..... [11252-42]

4:25 pm: **Novel narrow linewidth 785 nm diode laser with enhanced spectral purity facilitates low-frequency Raman spectroscopy.**, Magnus Rådmark, Gunnar Elgcróna, Håkan Karlsson, Cobolt AB (Sweden) ..... [11252-43]

4:40 pm: **Vibrational imaging of glucose metabolism in animals**, Lingyan Shi, Univ. of California, San Diego (USA); Wei Min, Columbia Univ. (USA) ..... [11252-44]

4:55 pm: **High-speed super-multiplex organelle imaging**, Jingwen Shou, The Univ. of Tokyo (Japan); Fanghao Hu, Columbia Univ. (USA); Robert Oda, The Univ. of Tokyo (Japan); Wei Min, Columbia Univ. (USA); Yasuyuki Ozeki, The Univ. of Tokyo (Japan) ..... [11252-45]

5:10 pm: **Feasibility study of Bessel beam based Raman spectroscopy**, Feng Ren, Haoyu Wang, Nan Wang, Yonghua Zhan, Yichao Liu, Xueli Chen, Xidian Univ. (China) ..... [11252-46]

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

Poster Setup: Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Generative adversarial network based sparse reconstruction for stimulated Raman projection tomography**, Huiyuan Wang, Nan Wang, Shouping Zhu, Jimin Liang, Xueli Chen, Xidian Univ. (China) ..... [11252-47]

**Label-free characterization of mitochondria assembly in oocyte of *Caenorhabditis elegans* by Two-photon excited autofluorescence**, Tao Chen, Yi-tang Lee, Dinghuan Deng, Meng C. Wang, Baylor College of Medicine (USA) ..... [11252-48]

**Coherent Raman micro-spectrometry**, Vasyil V. Shynkar, HORIBA FRANCE SAS (France); Alberto Lombardini, Institut Fresnel (France); Sébastien Legendre, HORIBA FRANCE SAS (France); Hervé Rigneault, Institut Fresnel (France); Philippe De Bettignies, HORIBA FRANCE SAS (France) ... [11252-308]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SUN 7:15 PM TO 8:00 PM

Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

Talk by 2014 Nobel Prize Winner in Physics:

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

## MONDAY 3 FEBRUARY

### SESSION 9

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... MON 8:00 AM TO 10:05 AM

### Translation into Clinic

Session Chair: **Shuhua Yue**, Beihang Univ. (China)

8:00 am: **Rapid cell screening via Raman microscopy** (*Invited Paper*), Jürgen Popp, Leibniz-Institut für Photonische Technologien e.V. (Germany) ..... [11252-49]

8:25 am: **Rapid fiber-optic Raman spectroscopy: immediate medical diagnosis in gastrointestinal tracts** (*Invited Paper*), Zhiwei Huang, National Univ. of Singapore (Singapore) ..... [11252-50]

8:50 am: **Quasi-simultaneous coherent Raman imaging of components in the fingerprint, silent and high-wavenumber region with a portable all-fiber light source**, Maximilian Brinkmann, Tim Hellwig, Westfälische Wilhelms- Univ. Münster (Germany); Isaac J. Pence, Conor L. Evans, Wellman Ctr. for Photomedicine (USA); Carsten Fallnich, Westfälische Wilhelms- Univ. Münster (Germany) ..... [11252-51]

9:05 am: **Grading metastatic potential of early-stage melanomas using pump-probe microscopy**, David Grass, Xiaomeng Jia, Martin C. Fischer, Warren S. Warren, Duke Univ. (USA) ..... [11252-52]

9:20 am: **Cholesteryl ester-rich lipid droplet is a prognostic marker and therapeutic target for human metastatic melanoma**, Hyeon Jeong Lee, Zhicong Chen, The Boston Univ. Photonics Ctr. (USA); Muzhou Wu, Rhoda M. Alani, School of Medicine, Boston Univ. (USA); Ji-Xin Cheng, The Boston Univ. Photonics Ctr. (USA) ..... [11252-53]

9:35 am: **Stimulated Raman scattering - vibrational imaging in cells, tissues and model organisms**, Volker Schweikhard, Leica Microsystems CMS GmbH (Germany) ..... [11252-54]

9:50 am: **CARSA: Fast & accurate antibiotic susceptibility testing tool by coherent anti-stokes Raman scattering imaging of D2O metabolism**, Pu Wang, Vibronix, Inc. (USA); Weili Hong, Beihang Univ. (China) ... [11252-55]

Coffee Break ..... Mon 10:05 am to 10:35 am

# CONFERENCE 11252

## SESSION 10

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... MON 10:35 AM TO 12:00 PM

### Infrared Chemical Imaging II

Session Chair: **Meng C. Wang**, Baylor College of Medicine (USA)

10:35 am: **Peakforce infrared microscopy for label-free chemical imaging at sub 10 nm spatial resolution** (*Invited Paper*), Xiaoji Xu, Lehigh Univ. (USA) ..... [11252-56]

11:00 am: **Label free mid-infrared photothermal imaging of fibroblast cells**, Panagis Samolis, Michelle Y Sander, Boston Univ (USA). ..... [11252-57]

11:15 am: **Bioimaging by molecular-vibration-sensitive quantitative phase microscopy based on wide-field mid-infrared photothermal excitation**, Miu Tamamitsu, Keiichiro Toda, Yu Nagashima, The Univ. of Tokyo (Japan); Ryoichi Horisaki, Osaka Univ. (Japan); Takuro Ideguchi, The Univ. of Tokyo (Japan). ..... [11252-58]

11:30 am: **Design of quantum cascade laser microscopy systems for infrared chemical imaging**, Kevin L. Yeh, Yamuna Phal, Ishaan Sharma, Rohit Bhargava, Univ. of Illinois (USA). ..... [11252-59]

11:45 am: **Fingerprinting individual bio-nanoparticles by interferometric photothermal microscopy**, Celalettin Yurdakul, Haonan Zong, Yeran Bai, M. Selim Unlü, Ji-Xin Cheng, Boston Univ. (USA). ..... [11252-60]

Lunch Break ..... Mon 12:00 pm to 1:30 pm

## SESSION 11

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... MON 1:30 PM TO 3:05 PM

### CARS, SRS, Raman Innovation and Applications IV

Session Chair: **Hilton Barbosa de Aguiar**, Ecole Normale Supérieure (France)

1:30 pm: **Label-free coherent Raman imaging of ultrafast chemical reactions** (*Invited Paper*), Ping Wang, Yali Bi, Haozheng Li, Huazhong Univ. of Science and Technology (China) ..... [11252-61]

1:55 pm: **Stimulated Raman imaging with chemical probes for subcellular bioanalysis** (*Invited Paper*), Lu Wei, Kun Miao, Jiajun Du, Caltech (USA) ..... [11252-62]

2:20 pm: **Hyper-Raman spectroscopic analysis of molecular interactions between dimethyl sulfoxide and water**, Xingqi Xu, Texas A&M Univ. (USA) and Zhejiang Univ. (China); Christopher B. Marble, Georgi I. Petrov, Texas A&M Univ. (USA); Dawei Wang, Zhejiang Univ. (China); Vladislav V. Yakovlev, Texas A&M Univ. (USA). ..... [11252-63]

2:35 pm: **Applications of single-cell Raman microspectroscopy in cancer cell**, Tong Yu, Wei E. Huang, Adrian L. Harris, Univ. of Oxford (United Kingdom). ..... [11252-64]

2:50 pm: **Tracing the formation and degradation of fatty-acid-rich mitochondria using label-free chemical imaging**, Chi Zhang, Stephen A. Boppart, Univ. of Illinois (USA) ..... [11252-65]

Coffee Break ..... Mon 3:05 pm to 3:35 pm

## SESSION 12

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... MON 3:35 PM TO 5:25 PM

### CARS, SRS, Raman Innovation and Applications V

Session Chair: **Garth J. Simpson**, Purdue Univ. (USA)

3:35 pm: **Stimulated Raman imaging in the high and low frequency ranges** (*Invited Paper*), Hervé Rigneault, Aix Marseille Univ. (France) and CNRS (France) and Centrale Marseille (France). ..... [11252-66]

4:00 pm: **Lipid metabolic imaging opens new avenue for human cancer diagnosis** (*Invited Paper*), Shuhua Yue, Shuo Zhang, Beihang Univ. (China); Lin Yao, Liqun Zhou, Peking Univ. First Hospital (China) ..... [11252-67]

4:25 pm: **High-sensitivity impulsive Raman spectroscopy with Doppler Raman spectroscopy**, David R. Smith, Jeff J. Field, David G. Winters, Scott R. Domingue, Colorado State Univ. (USA); Frauke Rininsland, Daniel J. Kane, Mesa Photonics, LLC (USA); Jesse W. Wilson, Randy A. Bartels, Colorado State Univ. (USA) ..... [11252-68]

4:40 pm: **In vivo longitudinal label-free tracking of intracellular lipid in a zebrafish cancer model**, Angelika Unterhuber, Medizinische Univ. Wien (Austria); Caterina Sturtzel, St. Anna Kinderkrebsforschung e.V. (Austria); Wolfgang Drexler, Medizinische Univ. Wien (Austria); Martin Distel, St. Anna Kinderkrebsforschung e.V. (Austria); Marco Andreana, Medizinische Univ. Wien (Austria) ..... [11252-69]

4:55 pm: **The status of instrumentation for Raman imaging for bioclinical screening and biopharmaceutical development**, Andrew Whitley, Fran Adar, Li Yan, Bridget A. O'Donnell, HORIBA Scientific (USA) ..... [11252-70]

5:10 pm: **Super-resolution Raman Microscopy by selective suppression of stimulated Raman scattering**, Sang-Hee Shim, Korea Univ. (Korea, Republic of). ..... [11252-10]

# CONFERENCE 11253

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH)

Saturday–Sunday 1–2 February 2020 • Proceedings of SPIE Vol. 11253

# Biomedical Applications of Light Scattering X

Conference Chairs: **Adam Wax**, Duke Univ. (USA); **Vadim Backman**, Northwestern Univ. (USA)

Program Committee: **Irving J. Bigio**, Boston Univ. (USA); **Stephen A. Boppart**, Univ. of Illinois (USA); **Dirk J. Faber**, Academisch Medisch Ctr. (Netherlands); **Steven L. Jacques**, Tufts Univ. (USA); **Ofer Levi**, Univ. of Toronto (Canada); **Lev T. Perelman**, Harvard Univ. (USA); **Brian W. Pogue**, Thayer School of Engineering at Dartmouth (USA); **Bruce J. Tromberg**, National Institute of Biomedical Imaging and Bioengineering (USA)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . SAT 8:00 AM TO 10:40 AM

#### Cancer Detection and Characterization

Session Chair: **Adam P. Wax**, Duke Univ. (USA)

8:00 am: **Progress in angle-resolved low-coherence interferometry for real-time detection of epithelial dysplasia** (*Invited Paper*), Zachary A. Steelman, Derek Ho, Yang Zhao, Haoran Zhang, Evan Jelly, Ge Song, Wesley Y. Kendall, Michael Crose, Brian Cox, Kengyeh K. Chu, Adam P. Wax, Duke Univ. (USA) . . . . . [11253-1]

8:30 am: **Subdiffuse model to extract tissue optical properties with single fiber reflectance spectroscopy, applied to esophageal cancer**, Anouk L. Post, The Netherlands Cancer Institute (Netherlands) and Amsterdam UMC (Netherlands); Dirk J. Faber, Amsterdam UMC (Netherlands); Dick J. C. M. Sterenborg, The Netherlands Cancer Institute (Netherlands) and Amsterdam UMC (Netherlands); Ton G. van Leeuwen, Amsterdam UMC (Netherlands) . . . . . [11253-2]

8:50 am: **In situ molecular characterization and brain cancer detection using macroscopic spontaneous Raman spectroscopy imaging** (*Invited Paper*), Frédéric Leblond, Polytechnique Montréal (Canada) . . [11253-3]

9:20 am: **Scatter orientation index and texture analysis of human breast tissues using multi-spectral, multi-spatial frequency structured light imaging**, Samuel S. Streever, Thayer School of Engineering at Dartmouth (USA); Elizabeth J. Rizzo, Wendy A. Wells, Dartmouth-Hitchcock Medical Ctr. (USA); Keith D. Paulsen, Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA) . . . . . [11253-4]

9:40 am: **Determination of the optical properties in normal and diseased tissues by novel goniometry and by 3D second harmonic generation microscopy** (*Invited Paper*), Paul J. Campagnola, Alexander Jambor, Kirby Campbell, Univ. of Wisconsin-Madison (USA) . . . . . [11253-5]

10:10 am: **Optical scattering signatures of normal and malignant colorectal and ovarian tissues revealed by OCT** (*Invited Paper*), Quing Zhu, Yifeng Zeng, Washington Univ. in St. Louis (USA) . . . . . [11253-6]

Coffee Break. . . . . Sat 10:40 am to 11:10 am

### SESSION 2

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . .SAT 11:10 AM TO 12:10 PM

#### Neural Activity

Session Chair: **Paul J. Campagnola**, Univ. of Wisconsin-Madison (USA)

11:10 am: **Cerebral hemodynamics measured with diffuse optical spectroscopies to elucidate mechanisms of cognitive dysfunction after mild traumatic brain injury** (*Invited Paper*), Erin M. Buckley, Emory Univ. (USA) . . . . . [11253-7]

11:40 am: **Interferometric imaging of neural activity** (*Invited Paper*), Daniel V. Palanker, Stanford Univ. (USA) . . . . . [11253-8]

Lunch Break . . . . . Sat 12:10 pm to 1:15 pm

### SESSION 3

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . SAT 1:15 PM TO 2:55 PM

#### OCT and Brillouin

Session Chair: **Vadim Backman**, Northwestern Univ. (USA)

1:15 pm: **Inverse spectroscopic optical coherence tomography to measure tissue ultrastructures and functions** (*Invited Paper*), Ji Yi, Boston Univ. (USA) . . . . . [11253-9]

1:45 pm: **Observations on the heterogeneity of 3D breast organoids to toxicant exposures via OCT speckle fluctuation spectroscopy**, Lin Yang, The Univ. of North Carolina at Chapel Hill (USA); Alexander Sobel, Richard L. Blackmon, Elon Univ. (USA); Amy L. Oldenburg, The Univ. of North Carolina at Chapel Hill (USA) . . . . . [11253-10]

2:05 pm: **Single axis multipass VIPA spectroscopy**, Antonio Fiore, Giuliano Scarcelli, Univ. of Maryland, College Park (USA) . . . . . [11253-11]

2:25 pm: **In vivo mechanical analysis of the cornea using Brillouin light scattering and optical coherence elastography** (*Invited Paper*), Seok-Hyun Yun, Wellman Ctr. for Photomedicine (USA) . . . . . [11253-12]

Coffee Break. . . . . Sat 2:55 pm to 3:25 pm

### SESSION 4

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . SAT 3:25 PM TO 4:35 PM

#### Cell Diagnostics

Session Chair: **Dirk J. Faber**, Amsterdam UMC (Netherlands)

3:25 pm: **On-chip refractive index cytometry for whole-cell deformability discrimination** (*Invited Paper*), Antoine Leblanc-Hotte, Polytechnique Montréal (Canada); Nadine Sen Nkwe, Univ. de Montréal (Canada); Geneviève Chabot-Roy, Hôpital Maisonneuve-Rosemont (Canada); El Bachir Affar, Sylvie Lesage, Jean-Sébastien Delisle, Univ. de Montréal (Canada); Yves-Alain Peter, Polytechnique Montréal (Canada) . . . . . [11253-13]

3:55 pm: **Using quantitative phase imaging to acquire angular scattering information from single macrophages**, Robert L. Draham, Kaitlin J. Dunn, The Institute of Optics, Univ. of Rochester (USA); Elizabeth A. M. Lister, Carnegie Mellon Univ. (USA) and The Institute of Optics, Univ. of Rochester (USA); Jonathan J. Pinney, Michael R. Elliott, Univ. of Rochester (USA); Andrew J. Berger, The Institute of Optics, Univ. of Rochester (USA) and Univ. of Rochester (USA) . . . . . [11253-14]

4:15 pm: **Characterizing the refractive index auto-correlation function from whole cells using interferometric microscopy**, Aya Eid, Vadim Backman, Allen Taflove, Adam Eshein, Yue Li, Ranya Virk, Northwestern Univ. (USA) . . . . . [11253-15]

### SESSION 5

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . SAT 4:35 PM TO 5:55 PM

#### Dynamic Scattering

Session Chair: **Ji Yi**, Boston Univ. (USA)

4:35 pm: **Fast measurement of reflection matrix for deep imaging in highly scattering media based on optical coherence tomography**, Jing Cao, Qiang Yang, Yusi Miao, Tiancheng Huo, Yan Li, Youmin He, Jiang Zhu, Zhongping Chen, Univ. of California, Irvine (USA) . . . . . [11253-16]

4:55 pm: **Multi-element interferometric diffuse correlation spectroscopy at 1064 nm**, Mitchell B. Robinson, Harvard-MIT Health Sciences and Technology (USA) and Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Davide Tamborini, Adriano Peruch, Stefan A. Carp, Maria Angela Franceschini, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) . . . . . [11253-17]

# CONFERENCE 11253

5:15 pm: **Comparison of wide-field scatter methods for surface weighted imaging: active illumination versus high spatial frequency imaging**, Benjamin W. Maloney, Samuel S. Streeter, Mindy Wu, Brian W. Pogue, Keith D. Paulsen, Dartmouth College (USA) . . . . . [11253-18]

5:35 pm: **Scatter signatures in SFDI data enable breast surgical margin delineation via ensemble learning**, Arturo Pardo, Univ. de Cantabria (Spain) and Instituto de Investigación Valdecilla (Spain); Samuel S. Streeter, Thayer School of Engineering at Dartmouth (USA); José M. López-Higuera, Univ. de Cantabria (Spain) and Instituto de Investigación Valdecilla (Spain) and CIBER-BBN (Spain); Brian W. Pogue, Thayer School of Engineering at Dartmouth (USA); Olga M. Conde, Univ. de Cantabria (Spain) and Instituto de Investigación Valdecilla (Spain) and CIBER-BBN (Spain) . . . . . [11253-19]

**Extracting optical transport coefficients of a turbid medium using time-resolved diffuse reflectance at multiple source-detector separations: a Monte Carlo study**, Michael C. Helton, Mary-Ann Mycek, Univ. of Michigan (USA); Karthik Vishwanath, Miami Univ. (USA) . . . . . [11253-23]

**Development of a beam propagation method to simulate the point spread function degradation in scattering media**, Xiaojun Cheng, Yunzhe Li, Jerome Mertz, Boston Univ. (USA); Sava Sakadzic, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Anna Devor, David A. Boas, Lei Tian, Boston Univ. (USA) . . . . . [11253-24]

**Assessment of cell death using dynamic light scattering with M-mode optical coherence tomography imaging**, Sehar Rijja, Michael C. Kolios, Ryerson Univ. (Canada) . . . . . [11253-25]

**A cross-validation study of several Monte Carlo (MC) models for simulation of polarized light propagation in turbid tissue-like scattering media**, Alexander Doronin, Victoria Univ. of Wellington (New Zealand); Hee Ryung Lee, Ecole Polytechnique (France) and Institut Polytechnique de Paris (France); Igor V. Meglinski, Univ. of Oulu (Finland) and Aston Univ. (United Kingdom); Alexander V. Bykov, Univ. of Oulu (Finland); Tatiana Novikova, Ecole Polytechnique (France) and Institut Polytechnique de Paris (France) . [11253-27]

**Building and validating a complete data processing pipeline for extracting the central venous oxygen saturation**, Shih-Cheng Tu, Che-Hao Yeh, Yin-Fu Chen, Wen-Wei Su, Kung-Bin Sung, National Taiwan Univ. (Taiwan) . . . . . [11253-28]

**Automated optical attenuation coefficient extraction in glaucomatous eyes for clinical translation**, Shuang Chang, Vanderbilt Univ. (USA); Theodore Leng, Stanford Univ. School of Medicine (USA); Sylvia Groth, Vanderbilt Univ. Medical Ctr. (USA); Audrey K. Bowden, Vanderbilt Univ. (USA) . . . . . [11253-29]

**Design of a portable multiwavelength and multidistance diffuse correlation spectroscopy system**, Adriano Peruch, Davide Tamborini, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Mitchell B. Robinson, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) and Harvard-MIT Health Sciences and Technology (USA); Kuan-Cheng Wu, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) and Boston Univ. (USA); Zachary Starkweather, Parya Farzam, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA); Felipe Orihuela-Espina, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) and Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Maria Angela Franceschini, Athinoula A. Martinos Ctr. for Biomedical Imaging (USA) . . . . . [11253-30]

**Multi-layer modeling of intracranial hematoma using Monte Carlo simulations and frequency domain diffuse near infrared spectroscopy**, Ian A. Robinson, Alec Lafontant, Drexel Univ. (USA); Vladimir L. Kuzmin, Saint-Petersburg State Polytechnical Univ. (Russian Federation); Baruch Ben Dor, InfraScan, Inc. (USA); Michael Neidrauer, Leonid Zubkov, Drexel Univ. (USA) . . . . . [11253-31]

**Fast, compact measurement of deep tissue blood flow with integrated diffuse correlation spectroscopy**, Arindam Biswas, Ashwin B. Parthasarathy, Univ. of South Florida (USA) . . . . . [11253-32]

**High-speed, high-sensitivity diffuse correlation spectroscopy using a single-photon avalanche diode array**, Wenhui Liu, Duke Univ. (USA) and Tsinghua Univ. (China); Ruobing Qian, Shiqi Xu, Pavan Konda, Duke Univ. (USA); Haoqian Wang, Tsinghua Univ. (China); Roarke Horstmeyer, Duke Univ. (USA) . . . . . [11253-33]

**Diagnosis of oral cancer through multifractal detrended fluctuation analysis of interference spectra**, Asima Pradhan, Gyana Ranjan Sahoo, Dipti Bharti, Indian Institute of Technology Kanpur (India) . . . . . [11253-35]

## BIOS HOT TOPICS

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
*BIOS 2020 Symposium Chair*  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

## SUNDAY 2 FEBRUARY

### POSTERS-SUNDAY

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . SUN 5:30 PM TO 7:00 PM**

*Conference attendees are invited to attend the BIOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Sunday 10:00 AM – 4:30 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Optical parameter scans of scattering media using multispectral spatial frequency domain imaging under a curvilinear coordinates system**, Jose E. Calderon, David Serrano, Frederick A. Just, Mariel Nieves, Univ. de Puerto Rico Mayagüez (USA) . . . . . [11253-20]

**Dependent scattering in bi-disperse discrete random media**, Dirk J. Faber, Roosje M. Ruis, Ton G. van Leeuwen, Amsterdam UMC (Netherlands)[11253-21]

**Application of laser speckle contrast imaging in laparoscopic surgery**, Wido Heeman, Univ. of Groningen (Netherlands); Klaas Dijkstra, NHL Hogeschool (Netherlands); Christiaan Hoff, Sietze Koopal, Jean-Pierre Pierie, Medisch Ctr. Leeuwarden B.V. (Netherlands); Hessel Bouma, LIMIS Development B.V. (Netherlands); E. Christiaan Boerma, Medisch Ctr. Leeuwarden B.V. (Netherlands) . . . . . [11253-22]

### BIOS SUNDAY PLENARY

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM**

#### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

#### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

#### Talk by 2014 Nobel Prize Winner in Physics:

**Spying on the Secret Lives of Cells**

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

# CONFERENCE 11254

LOCATION: ROOM 210 (LEVEL 2 SOUTH)

Sunday–Monday 2–3 February 2020 • Proceedings of SPIE Vol. 11254

# Nanoscale Imaging, Sensing, and Actuation for Biomedical Applications XVII

Conference Chairs: **Dror Fixler**, Bar-Ilan Univ. (Israel); **Ewa M. Goldys**, The Univ. of New South Wales (Australia)

Conference Co-Chair: **Sebastian Wachsmann-Hogiu**, Univ. of California, Davis (USA)

Program Committee: **Vasily N. Astratov**, The Univ. of North Carolina at Charlotte (USA); **Lorena Betancor**, Univ. ORT Uruguay (Uruguay); **Henry Hess**, Columbia Univ. (USA); **Malgorzata J?drzejewska-Szczerska**, Gdansk Univ. of Technology (Poland); **Sung Jin Kim**, Univ. of Miami (USA); **James F. Leary**, Purdue Univ. (USA); **Brian D. MacCraith**, Dublin City Univ. (Ireland); **Alzbeta Marcek Chorvatova**, International Laser Ctr. (Slovakia); **Paras N. Prasad**, Univ. at Buffalo (USA); **Sharon M. Weiss**, Vanderbilt Univ. (USA)

Conference Co-Sponsor: **Prizmatix**

## SUNDAY 2 FEBRUARY

### SESSION 1

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... SUN 8:30 AM TO 12:20 PM

#### Multifunctional Nanoparticles

Session Chair: **Ewa M. Goldys**,  
The Univ. of New South Wales (Australia)

8:30 am: **Biosensing the presence of nanoparticles using endogenous fluorescence in live algae**, Alzbeta Mar?ek Chorvátová, International Laser Ctr. (Slovakia) and Univ. of SS. Cyril and Methodius (Slovakia); Dusan Chorvat, International Laser Ctr. (Slovakia); Tibor Teplicky, Faculty of Medicine at Comenius Univ. in Bratislava (Slovakia); Anton Mateasik, International Laser Ctr. (Slovakia); Martin Valica, Ss. Cyril and Methodius Univ. (Slovakia) ..... [11254-1]

8:50 am: **Neuron photostimulation using quantum funnels**, Houman Bahmani Jalali, Onuralp Karatum, Rustamzhon Melikov, Ugur Meric Dikbas, Sadra Sadeghi, Erdost Yildiz, Itir Bakis Dogru, Guncem Ozgun Eren, Cagla Ergun, Afsun Sahin, Ibrahim Halil Kavakli, Sedat Nizamoglu, Koç Univ. (Turkey) ..... [11254-2]

9:10 am: **Particle shape analysis using whispering gallery mode polarization sensing**, Cheng Li, Jiang Qiu, Adley Gin, Phuong-Diem Nguyen, Judith Su, The Univ. of Arizona (USA) ..... [11254-3]

9:30 am: **Interaction-free quantum imaging**, Eliahu Cohen, Bar-Ilan Univ. (Israel) ..... [11254-4]

9:50 am: **Nanoplasmonic imaging biosensor for digital detection of disease biomarkers**, Alexander Belushkin, Filiz Yesilkoy, Hatice Altug, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11254-5]

10:10 am: **Sharper and dipper laser beam shaping for super-resolved imaging in silicon**, Moshe Sinvani, Nadav Shabairou, Maor Tiferet, Zeev Zalevsky, Bar-Ilan Univ. (Israel) ..... [11254-6]

Coffee Break ..... Sun 10:30 am to 11:00 am

11:00 am: **High signal-to-noise, nonbleaching subdiffraction nanoscale imaging**, Yunbo Liu, Somn Eunice Lee, Univ. of Michigan (USA) ..... [11254-7]

11:20 am: **Spatially resolving mucus concentration for respiratory disease via translational and rotational diffusion rates of plasmonic gold nanorods using Diffusion-Sensitive OCT**, Richard L. Blackmon, Elon Univ. (USA); Kelsey Oeler, The Univ. of North Carolina at Chapel Hill (USA); Brittany Barton, Elon Univ. (USA); Brian Lynch, Joseph Tracy, North Carolina State Univ. (USA); David B. Hill, Amy Oldenburg, The Univ. of North Carolina at Chapel Hill (USA) ..... [11254-8]

11:40 am: **Photoacoustic monitoring of drug release from PLGA nanocarriers for tumor treatment**, Jeanne Lemaster, Univ. of California, San Diego (USA) ..... [11254-9]

12:00 pm: **Nitrogen vacancy based detection of ultra-low para-magnetic particle concentrations in tissues**, Mark A. Keppeler, Philip R. Hemmer, Vladislav V. Yakovlev, Texas A&M Univ. (USA) ..... [11254-10]

Lunch Break ..... Sun 12:20 pm to 2:00 pm

### SESSION 2

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... SUN 2:00 PM TO 6:00 PM

#### Nanoscale Imaging I

Session Chair: **Dror Fixler**, Bar-Ilan Univ. (Israel)

2:00 pm: **Interferometric spectrally encoded endoscopy – nanometric imaging of tissue vibrations in vivo** (*Invited Paper*), Dvir Yelin, Technion-Israel Institute of Technology (Israel) ..... [11254-11]

2:30 pm: **Label-free super-resolution imaging with hyperbolic materials** (*Invited Paper*), Evgenii E. Narimanov, Purdue Univ. (USA) ..... [11254-12]

3:00 pm: **A practical theoretical framework for optimizing spontaneous super-resolution on confocal microscopes**, Martin Ploschner, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia) and The Univ. of Queensland (Australia); Denitza Denkova, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia) and Institute for Bioengineering of Catalonia (Spain); Minakshi Das, Lindsay M. Parker, Xianlin Zheng, Yiqing Lu, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia); Antony Orth, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and RMIT Univ. (Australia); Nicolle H. Packer, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia) and Institute for Glycomics, Griffith Univ. (Australia); James A. Piper, ARC Ctr. of Excellence for Nanoscale BioPhotonics (Australia) and Macquarie Univ. (Australia) . [11254-13]

3:20 pm: **Wide-field dual-probe imaging approach validated using QDs and skin mimicking phantoms**, Alexander Saeboe, Keyi Han, Joshua Kays, Reyhaneh Toufanian, Allison Dennis, Boston Univ. (USA) ..... [11254-14]

Coffee Break ..... Sun 3:40 pm to 4:10 pm

4:10 pm: **NIR-II fluorescence in vivo functional bioimaging** (*Invited Paper*), Jun Qian, Zhejiang Univ. (China) ..... [11254-15]

4:40 pm: **Internalization by PMMA nanoparticle-mediated endocytosis of a survivin molecular beacon as theranostic agent in human cancer cells.**, Barbara Adinolfi, Sara Tombelli, Cosimo Trono, Ambra Giannetti, Mario Pellegrino, Giovanna Sotgiu, Greta Varchi, Marco Ballestri, Francesco Baldini, Consiglio Nazionale delle Ricerche (Italy) ..... [11254-16]

5:00 pm: **Remote optical sensing of neuronal tissue vibrations during regeneration**, Nisan Ozana, Sharon Cohen, Ariel Halevi, Roy Rozenman, Orit Shefi, Zeev Zalevsky, Bar-Ilan Univ. (Israel) ..... [11254-17]

5:20 pm: **AgNP-decorated 3D nano-bowl structures for SERS detection of urea and exosomes**, Juanjuan Liu, Meruyert Imanbekova, Sebastian Wachsmann-Hogiu, McGill Univ. (Canada) ..... [11254-18]

# CONFERENCE 11254

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

John G. Greivenkamp, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

#### Nirmala Ramanujam,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

#### Spying on the Secret Lives of Cells

Eric Betzig, Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

## MONDAY 3 FEBRUARY

### SESSION 3

LOCATION: ROOM 210 (LEVEL 2 SOUTH) . . . . . MON 8:40 AM TO 11:50 AM

### Nanoscale Imaging II

Session Chair: **Sebastian Wachsmann-Hogiu**, McGill Univ. (Canada)

8:40 am: **Protein-modified CuS nanotriangles for dual-modal photoacoustic and magnetic resonance imaging**, Zhen Yuan, Duyang Gao, Univ. of Macau (Macao, China) . . . . . [11254-19]

9:00 am: **Single silica microparticle sensors with dark-field polarization-dependent microscopy**, Pritam Khan, Grace Brennan, Matthew Gleeson, Daragh Rice, S. A. M. Tofail, Ning Liu, Christophe Sillien, Univ. of Limerick (Ireland) . . . . . [11254-20]

9:20 am: **Optical coherence tomography and fluorescence microscopy dual-modality imaging for single cell tracking with nanowire lasers**, Xuzhou Li, Wei Zhang, William Y. Wang, Xiaoqin Wu, Xiaotian Tan, Brendon Baker, Xueding Wang, Xudong Fan, Univ. of Michigan (USA) [11254-21]

9:40 am: **Differential uptake of Gold-nanorods promotes identification of M1/M2 subtype of macrophage by flow cytometry**, Ruchira Chakraborty, Bar-Ilan Univ. (Israel); Dorit Leshem-Lev, Rabin Medical Ctr. (Israel); Dror Fixler, Bar-Ilan Univ. (Israel) . . . . . [11254-22]

10:00 am: **Nanofluidic label-free single biomolecule detection**, Barbora Spackova, Johan Tenghamn, Joachim Fritzsche, Christoph Langhammer, Chalmers Univ. of Technology (Sweden) . . . [11254-23]

Coffee Break. . . . . Mon 10:20 am to 10:50 am

10:50 am: **Super-resolution imaging using saturated absorption combined with spatial frequency modulated Imaging**, Patrick A. Stockton, Keith Wernsing, Jeff Field, Colorado State Univ. (USA); Jeff Squier, Colorado School of Mines (USA) . . . . . [11254-24]

11:10 am: **Multifunctional intracellular nanodisk lasers**, Marcel Schubert, Alasdair H. Fikouras, Soraya C. Caixeiro, Markus Karl, Jothi D. Kumar, Simon J. Powis, Andrea Di Falco, Malte C. Gather, Univ. of St. Andrews (United Kingdom) . . . . . [11254-25]

11:30 am: **Highly sensitive and reliable plasmonic nanoparticle-based digital cytometry for quantification of MUC16 binding on the surface of leukocytes**, Sinyoung Jeong, Massachusetts General Hospital (USA); Germán González, Nicholas Nowell, PNP Research Corp. LLC (USA); Lauren A. Austin, Massachusetts General Hospital (USA); Jawad Hoballah, PNP Research Corp. LLC (USA); Fatima Mubarak, Massachusetts General Hospital (USA); Arvinder Kapur, Manish S. Patankar, Univ. of Wisconsin-Madison (USA); Daniel W. Cramer, Brigham and Women's Hospital (USA); Petra Krauledat, W. Peter Hansen, PNP Research Corp. LLC (USA); Conor L. Evans, Massachusetts General Hospital (USA) . . . . . [11254-26]

Lunch Break . . . . . Mon 11:50 am to 2:00 pm

### SESSION 4

LOCATION: ROOM 210 (LEVEL 2 SOUTH) . . . . . MON 2:00 PM TO 3:30 PM

### Nanostructures for Biomedical Sensors I

Session Chair: **Dror Fixler**, Bar-Ilan Univ. (Israel)

2:00 pm: **Enhanced non-contact and continuous sensing of periodic bio-signs: Laser encoded illumination for extending sensor's temporal bandwidth** (*Invited Paper*), Zeev Zalevsky, Bar-Ilan Univ. (Israel) . . . [11254-27]

2:30 pm: **Magnetic hyperthermia dosimetry of in vivo murine melanoma based on stiffness sensing with magnetomotive optical coherence elastography**, Pin-Chieh Huang, Eric J. Chaney, Ronit Barkalifa, Rishyashring R. Iyer, Yuanzhi Liu, Darold R. Spillman Jr., Stephen A. Boppart, Univ. of Illinois (USA) . . . . . [11254-28]

2:50 pm: **Multi-color high-speed imaging of single biomolecules with metallic nanoparticles**, Jun Ando, Akihiko Nakamura, Mayuko Yamamoto, Ryota Iino, Institute for Molecular Science (Japan) . . . . . [11254-29]

3:10 pm: **Multiplexed biomarker detection using plasmon field effect transistor**, Mark Ciappesoni, Jieyuan Tian, Mohammad Arif Iftekhar, Sung Jin Kim, Univ. of Miami (USA) . . . . . [11254-30]

Coffee Break. . . . . Mon 3:30 pm to 4:00 pm

### SESSION 5

LOCATION: ROOM 210 (LEVEL 2 SOUTH) . . . . . MON 4:00 PM TO 5:10 PM

### Nanostructures for Biomedical Sensors II

Session Chair: **Alzbeta Marček Chorvátová**, International Laser Ctr. (Slovakia)

4:00 pm: **Label free depth resolved visualization of the sub-micron structure with nano-sensitivity** (*Invited Paper*), Sergey A. Alexandrov, National Univ. of Ireland, Galway (Ireland); Paul M. McNamara, Compact Imaging Ireland Ltd. (Ireland); Nandan Das, Yi Zhou, National Univ. of Ireland, Galway (Ireland); Josh Hogan, Compact Imaging, Inc. (USA); Martin Leahy, National Univ. of Ireland, Galway (Ireland) . . . . . [11254-31]

4:30 pm: **Plasmonic meta-electrodes for intracellular recordings on high-density CMOS-MEAs**, Francesco Tantussi, Michele Dipalo, Giovanni Melle, Laura Lovato, Andrea Jacassi, Valeria Caprettini, Denis Garoli, Giulia Bruno, Istituto Italiano di Tecnologia (Italy); Andrea Schirato, Alessandro Alabastri, Rice Univ. (USA); Francesco De Angelis, Francesca Santoro, Istituto Italiano di Tecnologia (Italy) . . . . . [11254-32]

4:50 pm: **Direct on-sensor imaging for shadow-based microparticle characterization and bioluminescence imaging**, Meruyert Imanbekova, Ayyappa Sudalaiyadum Perumal, Sara Kheireddine, Sebastian Wachsmann-Hogiu, McGill Univ. (Canada) . . . . . [11254-33]

### POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BIOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Array-based sensing of metastatic cells using DNA-templated silver nanoclusters**, Soonwoo Hong, Yu-An Kuo, Trung D. Nguyen, Yuan-I Chen, Yen-Liang Liu, Prathyush B. Shankar, Hsin-Chih Yeh, The Univ. of Texas at Austin (USA) . . . . . [11254-34]

**Investigation of the effect of pH on lyotropic liquid crystal using Raman spectroscopy**, Vahideh Abdolazimi, Joshua Hanneman, Sarah Scanlin, Adam K. Fontecchjo, Drexel Univ. (USA) . . . . . [11254-35]

**STED super-resolution imaging of mitochondrial cristae in live cells**, Zhigang Yang, Junle Qu, Liwei Liu, Shenzhen Univ. (China) . . . . . [11254-37]

**Temporal measurement of the entire electric field of ultrafast signals**, Moti Fridman, Bar-Ilan Univ. (Israel) . . . . . [11254-38]

**Overlapping time-lens array**, Moti Fridman, Bar-Ilan Univ. (Israel) . . [11254-39]

**Near-infrared scattering measurements of the iso-path-length point for endoscopic applications**, Hamootal Duadi, Bar-Ilan Univ. (Israel); Daqing Piao, Oklahoma State Univ. (USA); Dror Fixler, Bar-Ilan Univ. (Israel) . . . . . [11254-40]

- In vivo fluorescent imaging of size-dependent bioaccumulation of polystyrene nanoplastics in zebrafish embryo**, Jinyoung Jeong, Korea Research Institute of Bioscience and Biotechnology (Korea, Republic of) . . . . . [11254-41]
- Extraction of the absorption coefficient of cylindrical tissue from a single wavelength based on the full scattering profile**, Idit Feder, Hamootal Duadi, Dror Fixler, Bar-Ilan Univ. (Israel) . . . . . [11254-42]
- Tip-based angular characterization of thermo-plasmonic effect in gold thin films**, Hongki Lee, Seongmin Im, Donghyun Kim, Yonsei Univ. (Korea, Republic of) . . . . . [11254-43]
- Spectroscopy measurements of opaque material by nanophotonics iterative multi-plane technique**, Inbar Yariv, Dror Fixler, Hamootal Duadi, Channa Shapira, Bar-Ilan Univ. (Israel) . . . . . [11254-44]
- Localized fluorescence enhancement of fluorescently labelled DNA strands over gold nanovoids**, Huaiyang Zeng, Optoelectronics Research Ctr. (United Kingdom) . . . . . [11254-45]
- Nanoscope study of the effect of synthesized carbon nanoparticles on prostate cancer cells by atomic-force microscopy**, Ayan Nurkesh, Nazarbayev Univ. (Kazakhstan); Qinglei Sun, Qilu Univ. of Technology (China); Haiyan Fan, Akerke Altaikyzy, Yingqiu Xie, Kanat Dukenbayev, Nazarbayev Univ. (Kazakhstan) . . . . . [11254-46]
- A compact integrated optical biosensor based on silicon nitride platform**, Mohamed El-Rayany, Mohamed Swillam, The American Univ. in Cairo (Egypt) . . . . . [11254-47]
- Low-cost glucose biosensor fabricated by a photosensitive resin that features nanoparticles**, José V. Guzmán-Gonzalez, Univ. Autónoma de Nuevo León (Mexico); Aleksandr Polokhin, Univ. Autónoma de Nuevo León (Mexico) and National Research Univ. of Electronic Technology (Russian Federation); Arturo A. Castillo-Guzmán, Valentin Guzmán-Ramos, Univ. Autónoma de Nuevo León (Mexico); Mario A. Garcia-Ramirez, Univ. de Guadalajara (Mexico) . . . . . [11254-48]
- Detection of multi-molecule fluorescence with plasmonic nanoantenna arrays in two polarized directions**, Taeyeon Kim, Heesang Ahn, Hyerin Song, Kyujung Kim, Pusan National Univ. (Korea, Republic of) . . . . . [11254-49]
- Robust biosensing platform using a plasmon field effect transistor with a Si-based active channel**, Mark Ciappesoni, Mohammad Arif Iftekhar, Jieyuan Tian, Sung Jin Kim, Univ. of Miami (USA) . . . . . [11254-50]
- Radiolabeled core/shell iron oxide@gold nanoparticles for multi modal CT/MRI imaging**, Oshra Betzer, Menachem Motiei, Tamar Dreifuss, Tamar Sadan, Bar-Ilan Univ. (Israel); Noam Omer, Noam Omer, Tamar Blumenfeld-Katzir, Tamar Blumenfeld-Katzir, Noam Ben-Eliezer, Tel Aviv Univ. (Israel); Rachela Popovtzer, Bar-Ilan Univ. (Israel) . . . . . [11254-51]
- Multimodal high-resolution imaging of photoreceptor cells using gold nanoparticles**, Oshra Betzer, Yoav Chemla, Tamar Sadan, Amos Markus, Menachem Motiei, Yossi Mandel, Rachela Popovtzer, Bar-Ilan Univ. (Israel) . . . . . [11254-52]
- Tracking bacteria clearance using gold nanoparticles for wound therapy applications**, Menachem Motiei, Oshra Betzer, Tamar Sadan, Neta Zilony, Bar-Ilan Univ. (Israel); Guy Topaz, Meir Medical Ctr. (Israel) and Sackler Faculty of Medicine, Tel Aviv Univ. (Israel); Rachela Popovtzer, Bar-Ilan Univ. (Israel); Moris Topaz, Meir Medical Ctr. (Israel) and Sackler Faculty of Medicine, Tel Aviv Univ. (Israel) . . . . . [11254-53]
- Investigation on reducing the band gap in nano composite polymers by doping.**, Sharvare Palwai, Padmaja Guggilla, Ashok Batra, Alabama A&M Univ. (USA) . . . . . [11254-54]
- Optical flow of vesicles: computer vision approach for endocytosis of nanoparticles in a living cell**, Seohyun Lee, Hyuno Kim, Hideo Higuchi, Masatoshi Ishikawa, The Univ. of Tokyo (Japan) . . . . . [11254-36]

**BIOS Expo Industry Stage**

Saturday - Sunday • Hall DE  
 Keynotes and panels on the latest developments, open to all attendees.  
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# CONFERENCE 11255

LOCATION: ROOM 304 (LEVEL 3 SOUTH)

Saturday–Monday 1–3 February 2020 • Proceedings of SPIE Vol. 11255

## Colloidal Nanoparticles for Biomedical Applications XV

Conference Chairs: **Marek Osiński**, The Univ. of New Mexico (USA); **Antonios G. Kanaras**, Univ. of Southampton (United Kingdom)

Program Committee: **Ramón Alvarez-Puebla**, Univ. de Vigo (Spain); **Jacob M. Berlin**, City of Hope Beckman Research Institute (USA); **James B. Delehanty**, U.S. Naval Research Lab. (USA); **Allison M. Dennis**, Boston Univ. (USA); **Laura Fabris**, Rutgers, The State Univ. of New Jersey (USA); **Hedi Mattoussi**, Florida State Univ. (USA); **Igor Medintz**, U.S. Naval Research Lab. (USA); **Jay L. Nadeau**, McGill Univ. (Canada); **Kelly L. Nash**, The Univ. of Texas at San Antonio (USA); **Wolfgang J. Parak**, Univ. Hamburg (Germany); **Francisco Raymo**, Univ. of Miami (USA); **Ute Resch-Genger**, Bundesanstalt für Materialforschung und -prüfung (Germany); **Konstantin V. Sokolov**, The Univ. of Texas M. D. Anderson Cancer Ctr. (USA); **Claudia Tortiglione**, Istituto di Scienze Applicate e Sistemi Intelligenti “Eduardo Caianiello” (Italy); **Chih-Chung Yang**, National Taiwan Univ. (Taiwan); **Junjie Zhu**, Nanjing Univ. (China)

Conference Co-Sponsor:



### SATURDAY 1 FEBRUARY

#### WELCOME REMARKS

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... 8:45 AM TO 8:50 AM

Welcome remarks given by

**Marek Osiński**, The Univ. of New Mexico (USA);  
**Antonios G. Kanaras**, Univ. of Southampton (United Kingdom)

#### SESSION 1

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... SAT 8:50 AM TO 10:00 AM

#### Biomedical Applications of Plasmonic Nanoparticles I

Session Chair: **Jun Chen**, Huashan Worldwide Medical Ctr. (China)

8:50 am: **Bio-nano interface engineering towards the clinical translation of plasmonic nanotechnologies** (*Invited Paper*), Swarnapali De Silva Indrasekara, The Univ. of North Carolina at Charlotte (USA) ..... [11255-1]

9:20 am: **STARSTEM - NanoSTARs imaging for STEM cell therapy for arthritic joints**, Vijay Raghavan, National Univ. of Ireland, Galway (Ireland) ..... [11255-2]

9:40 am: **VNB-mediated endosomal escape triggers robust gene silencing in human cell lines**, Juan Fraire, Gaëlle Houthaev, Jing Liu, Laurens Raes, Stephan Stremersch, Toon Brans, Univ. Gent (Belgium); Gerardo García-Díaz Barriga, Koen Raemdonck, Winnok H. De Vos, Univ. Antwerpen (Belgium); Stefaan De Smedt, Kevin Braeckmans, Univ. Gent (Belgium) ..... [11255-3]

Coffee Break. .... Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... SAT 10:30 AM TO 12:00 PM

#### Synthesis and Characterization of Nanoparticles

10:30 am: **Protein-capped Lead Sulfide Quantum Dots For In vivo Imaging in the NIR-II window** (*Invited Paper*), Jun Chen, Huashan Hospital, Fudan Univ. (China) ..... [11255-4]

11:00 am: **Synthesis and characterization of colloidal CdSeS/ZnS quantum dots**, Mark V. Reymatias, Arjun Senthil, Dominic Bosomtwi, Shruti I. Gharde, Alexis Garnica, Nhi Nguyen, Karen Hernandez, Nathan J. Withers, The Univ. of New Mexico (USA); Sergei A. Ivanov, Los Alamos National Lab. (USA); Dale L. Huber, Sandia National Labs. (USA); Marek Osiński, The Univ. of New Mexico (USA) ..... [11255-5]

11:20 am: **Development of a biodegradable and non-toxic near infrared optically active quantum dot**, Joshua Kays, Allison M. Dennis, Boston Univ. (USA) ..... [11255-6]

11:40 am: **Synthesis and characterization of near-infrared PbSe/SnS colloidal core-shell quantum dots**, Arjun Senthil, Mark V. Reymatias, Nathan J. Withers, Dominic Bosomtwi, Gema J. Alas, Rafael Castro, Shruti I. Gharde, Nikita A. Dougan, DeYannah J. Walker, Nhi Nguyen, Karen Hernandez, Alexis Garnica, Gennady A. Smolyakov, The Univ. of New Mexico (USA); Dale L. Huber, Sandia National Labs. (USA); Sergei A. Ivanov, Los Alamos National Lab. (USA); Marek Osiński, The Univ. of New Mexico (USA) .. [11255-7]

Lunch Break. .... Sat 12:00 pm to 2:00 pm

#### SESSION 3

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... SAT 2:00 PM TO 3:10 PM

#### Nano-Bio Complexes and Assemblies

Session Chair: **Swarnapali De Silva Indrasekara**, The Univ. of North Carolina at Charlotte (USA)

2:00 pm: **Enzyme-controlled release of quantum dot in a DNA icosahedron** (*Invited Paper*), Divita Mathur, U.S. Naval Research Lab. (USA); Ashley A. Chapin, Univ. of Maryland, College Park (USA); Matthew Chiriboga, Kimihiro Susumu, U.S. Naval Research Lab. (USA); Luz Merlyn Vargas Restrepo, Remi Veneziano, George Mason Univ. (USA); Ellen R. Goldman, Igor L. Medintz, U.S. Naval Research Lab. (USA) ..... [11255-8]

2:30 pm: **Role of surface coating in the promotion or prevention of protein corona around nanocolloids**, Hedi Mattoussi, Florida State Univ (USA); Woody Perng, Goutam Palui, Florida State Univ. (USA); Wentao Wang, Ocean NanoTech (USA) ..... [11255-10]

2:50 pm: **Artificial repeat proteins evolved as habit modifiers and protein origami templates for the morphosynthesis of (111)-terminated gold nanocrystals**, Janak Prasad, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France) and CNRS (France); Sébastien Viollet, Institut de biologie intégrative de la cellule, Univ. Paris-Sud (France) and CEA (France) and CNRS (France); Laureen Moreaud, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France) and CNRS (France); Agathe Urvoas, Marie Valerio-Lepiniec, Agnès Mesneau, Philippe Minard, Institut de Biologie Intégrative de la Cellule (France); Erik Dujardin, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France) and CNRS (France) ..... [11255-11]

Coffee Break. .... Sat 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... SAT 3:40 PM TO 5:00 PM

#### Biomedical Applications of Plasmonic Nanoparticles II

Session Chair: **Divita Mathur**, U.S. Naval Research Lab. (USA)

3:40 pm: **Confined heat generation using gold nanoparticles for the activation and control of biological processes**, David A. Hastman Jr., U.S. Naval Research Lab. (USA) and Univ. of Maryland, College Park (USA); Eunkeu Oh, U.S. Naval Research Lab. (USA) and KeyW Corp. (USA); Joseph Melinger, U.S. Naval Research Lab. (USA); Guillermo Lasarte-Aragones, Univ. de Córdoba (Spain); Paul Cunningham, U.S. Naval Research Lab. (USA); Matthew Chiriboga, U.S. Naval Research Lab. (USA) and George Mason Univ. (USA); Zach Salvato, Tommy Salvato, Sebastián Díaz, Igor L. Medintz, U.S. Naval Research Lab. (USA) ..... [11255-12]

4:00 pm: **A single particle sensing platform based on 2D gold nanocrystals coated with designable artificial repeat proteins**, Laureen Moreaud, Janak Prasad, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France) and CNRS (France); Sirin Celiksoy, Johannes Gutenberg Univ. Mainz (Germany); Sébastien Viollet, Agathe Urvoas, Marie Valerio-Lepiniec, Philippe Minard, Institut de biologie intégrative de la cellule, Univ. Paris-Sud (France); Carsten Soennichsen, Johannes Gutenberg Univ. Mainz (Germany); Erik Dujardin, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France) and CNRS (France) ..... [11255-13]

4:20 pm: **Porous AuAg nanoparticles synthesis and their theranostic application**, Lu Wang, Sergiy Patskovsky, Morteza H. Kafshgari, Michel Meunier, Polytechnique Montréal (Canada) . . . . . [11255-14]

4:40 pm: **Strategies to improve the photostability of plasmonic nanoparticles**, Lucia Cavigli, Sonia Centi, Istituto di Fisica Applicata “Nello Carrara” (Italy); Boris Khebtsov, Institute of Biochemistry and Physiology of Plants and Microorganisms (Russian Federation); Alessio Milanesi, Claudia Borri, Istituto di Fisica Applicata “Nello Carrara” (Italy); Patrizia Bogani, Univ. degli Studi di Firenze (Italy); Nikolai Khebtsov, Institute of Biochemistry and Physiology of Plants and Microorganisms (Russian Federation); Roberto Pini, Fulvio Ratto, Istituto di Fisica Applicata “Nello Carrara” (Italy) . . . . . [11255-15]

**BIOS HOT TOPICS**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SAT 7:00 PM TO 9:30 PM**

- 7:00 PM: **Welcome and Opening Remarks**  
*BIOS 2020 Symposium Chair*  
**Jennifer Barton**, The Univ. of Arizona (USA)  
BIOS 2020 Symposium Chair  
**Wolfgang Drexler**, Medical Univ. of Vienna (Austria)
- 7:05 PM: **Presentation of 2019 Britton Chance Biomedical Optics Award by SPIE President**
- 7:10 PM: **Presentation by Steven Jacques, Univ. of Washington (USA); 2020 Britton Chance Biomedical Optics Award Winner**
- 7:30 PM: **Hot Topics Facilitator Remarks**  
**Sergio Fantini**, Tufts Univ. (USA)
- 7:35 PM: **Optical Coherence Tomography from Research to Clinical Practice**  
**James Fujimoto**, Massachusetts Institute of Technology (USA)
- 7:45 PM: **Computational Microscopy**  
**Laura Waller**, Univ. of California, Berkeley (USA)
- 7:55 PM: **Seeing Early Cancer in a New Light**  
**Sarah Bohndiek**, Univ. of Cambridge (United Kingdom)
- 8:05 PM: **Multiscale QPI**  
**Gabriel Popescu**, Univ. of Illinois at Urbana-Champaign (USA)
- 8:15 PM: **Photoacoustic Imaging Assistants for Minimally Invasive Surgeries and Procedures**  
**Muyinatu A. Lediju Bell**, Johns Hopkins Univ. (USA) *Journal of Biomedical Optics Speaker*
- 8:25 PM: **Interface of Radiation-Optical Interactions and Nanotechnology: Future Clinical Perspectives**  
**Ewa Goldys**, Univ. of New South Wales (Australia)
- 8:35 PM: **Imaging the Proteome in Living Cells**  
**Bo Huang**, Univ. of California, San Francisco (USA)
- 8:45 PM: **X-Induced Photodynamic Therapy**  
**Shawn Chen**, NIH/NBIB (USA)
- 8:55 PM: **AI Cell Sorting**  
**Keisuke Goda**, Univ. of Tokyo (Japan)

**SUNDAY 2 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 304 (LEVEL 3 SOUTH) . . . . . SUN 9:10 AM TO 10:00 AM**

**Nanoparticle Characterization Techniques**

Session Chair: **Thomas Pons**, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (France)

9:10 am: **Brownian diffusion of nanocolloids: Diffusion ordered NMR spectroscopy versus dynamic light scattering** (*Invited Paper*), Hedi Mattoussi, Chengqi Zhang, Zhicheng Jin, Florida State Univ. (USA); Birong Zeng, Florida State Univ. (USA) and Xiamen Univ. (China) . . . . . [11255-16]

9:40 am: **Universal and quantitative measure of colloidal stability of plasmonic nanoparticles via comprehensive stability parameter method**, Wei-Kuan Lin, Somin Eunice Lee, Univ. of Michigan (USA) . . . . . [11255-17]

Coffee Break. . . . . Sun 10:00 am to 10:30 am

**SESSION 6**

**LOCATION: ROOM 304 (LEVEL 3 SOUTH) . . . . . SUN 10:30 AM TO 11:50 AM**

**NP Applications in Biosensing and Bioimaging I**

Session Chair: **Emmanuel Stratakis**, Foundation for Research and Technology-Hellas (Greece)

10:30 am: **DNA origami nanotools for biosensing** (*Invited Paper*), Guillermo Acuna, Univ. de Fribourg (Switzerland); Philip Tinnefeld, Ludwig-Maximilians-Univ. München (Germany); Qingshan Wei, North Carolina State Univ. (USA); Aydogan Ozcan, Univ. of California, Los Angeles (USA); Mauricio Pilo-Pais, Univ. de Fribourg (Switzerland); Kateryna Trofymchuk, Viktorija Glembockyte, Sarah Ochmann, Ludwig-Maximilians-Univ. München (Germany); Mathias Lakatos, Univ. de Fribourg (Switzerland) . . . . . [11255-18]

11:00 am: **Single-particle electrocatalysis and single-cell analysis by electrochemiluminescence microscopy** (*Invited Paper*), Junjie Zhu, Nanjing Univ. (China) . . . . . [11255-19]

11:30 am: **Engineering functional nanoparticles for delivery in cells**, Konstantina Alexaki, Maria-Eleni Kyriazi, Univ. of Southampton (United Kingdom); Afaf El-Sagheer, Tom Brown, University of Oxford (United Kingdom); Antonios G. Kanaras, Univ. of Southampton (United Kingdom) . . . . . [11255-20]

Lunch Break . . . . . Sun 11:50 am to 1:50 pm

**SESSION 7**

**LOCATION: ROOM 304 (LEVEL 3 SOUTH) . . . . . SUN 1:50 PM TO 3:00 PM**

**Biofouling and Applications in Neuroscience**

Session Chair: **Hedi Mattoussi**, Florida State Univ. (USA)

1:50 pm: **Nanoparticle zwitterionic coatings: evading protein corona in serum and cytoplasm** (*Invited Paper*), Thomas Pons, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (France) . . . . . [11255-21]

2:20 pm: **InP quantum dot based optoelectronic biointerfaces for high level control of photostimulation of neurons**, Onuralp Karatum, Mohammad Mohammadi Aria, Guncem Ozgun Eren, Rustamzhon Melikov, Ugur Meric Dikbas, Shashi Bhushan Srivastava, Itir Bakis Dogru, Hourman Bahmani Jalali, Ibrahim Halil Kavakli, Sedat Nizamoglu, Koç Univ. (Turkey) . . . . . [11255-22]

2:40 pm: **The control of light-activated capacitive and faradaic charge-transfer mechanisms in optoelectronic biointerfaces**, Rustamzhon Melikov, Shashi Bhushan Srivastava, Mohammad Mohammadi Aria, Ugur Meric Dikbas, Ibrahim Halil Kavakli, Sedat Nizamoglu, Koç Univ. (Turkey) . . . . . [11255-23]

Coffee Break. . . . . Sun 3:00 pm to 3:30 pm

**NEUROTECHNOLOGIES PLENARY SESSION**

**LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 3:30 PM TO 5:30 PM**

This session will highlight the breadth of exciting advances occurring in the field of neurophotonics and provide a unique forum for communication and networking for leaders and innovators in the neurophotonics community.

**Welcome and Opening Remarks**

**David Boas**, Boston Univ. (USA) and **Elizabeth Hillman**, Columbia Univ. (USA)

**PRESENTATIONS:**

**New tools for optical recording of neuronal function**  
**Robert Prevedel**, European Molecular Biology Lab. (Germany)

**Volitional control of neuromodulators as a novel form of neural interface**  
**David Kleinfeld**, Univ. of California, San Diego (USA)

**Wearable functional near infrared spectroscopy**  
**Audrey Bowden**, Vanderbilt Univ. (USA)

**Noninvasive monitoring of intracerebral pressure**  
**Jana Kainerstorfer**, Carnegie Mellon Univ. (USA)

**The role of NIBIB in neuro-technology development**  
**Bruce Tromberg**, National Institutes of Health (USA)

# CONFERENCE 11255

## POSTERS-SUNDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... SUN 5:30 PM TO 7:00 PM

Conference attendees are invited to attend the BiOS poster session on Sunday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Sunday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Near infrared-emitting silicon quantum dot micelles interaction with blood plasma proteins**, Shanmugavel Chinnathambi, National Institute for Materials Science (Japan) ..... [11255-35]

**Spectral engineering of UV luminescence of upconverting nanoparticles**, Vina Nguyen, Peter Dawson, Marek Romanowski, The Univ. of Arizona (USA) ..... [11255-36]

**Synthesis of alloy of the Cerium Oxide [Ce(Mn:Fe)O<sub>2</sub>] nanoparticles: Its structural and magnetic properties**, Nasir Amin, Government College Univ. Faisalabad (Pakistan) ..... [11255-37]

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) ..... SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

John G. Greivenkamp, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

**Spying on the Secret Lives of Cells**

Eric Betzig, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

## MONDAY 3 FEBRUARY

### SESSION 8

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... MON 9:00 AM TO 10:00 AM

### NP Applications in Biosensing and Bioimaging II

Session Chair: Halima F. Alem, Univ. de Lorraine (France)

9:00 am: **Antibody-free small molecule sensing with a cell phone-enabled fluorescent bead assay** (Invited Paper), Allison M. Dennis, Boston Univ (USA) ..... [11255-24]

9:30 am: **Pulsed laser assisted generation of novel materials and related applications** (Invited Paper), Emmanuel Stratakis, Foundation for Research and Technology-Hellas (Greece) ..... [11255-25]

Coffee Break ..... Mon 10:00 am to 10:30 am

### SESSION 9

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... MON 10:30 AM TO 12:00 PM

### NP Applications in Biosensing and Bioimaging III

Session Chair: Gianluca M. Farinola, Univ. degli Studi di Bari Aldo Moro (Italy)

10:30 am: **Enzyme mimicking metal oxide nanoparticles for bacterial sensing** (Invited Paper), Shazia Mumtaz, Lahore Univ. of Management Sciences (Pakistan); Akash Gupta, Vincent M. Rotello, Univ. of Massachusetts Amherst (USA); Irshad Hussain, Lahore Univ. of Management Sciences (Pakistan) ..... [11255-26]

11:00 am: **Brightness-equalized quantum shells for biosensing and imaging**, Reyhaneh Toufanian, Allison M. Dennis, Boston Univ. (USA) ..... [11255-27]

11:20 am: **Lipoic acid as anchoring groups and reactive sites on nanoparticles coated with multi-coordinating polymers**, Zhicheng Jin, Florida State Univ. (USA); Anshika Kapur, Department of Surgery, University of Maryland School of Medicine (USA); Wentao Wang, Xen Biofluidx, Inc. (USA); Hedi Mattoussi, Florida State Univ. (USA) ..... [11255-28]

11:40 am: **Measurement of electron transfer at single-molecule level with graphene-based electrochemical microscopy**, Qing Xia, Zixuan Chen, Junjie Zhu, Nanjing Univ. (China) ..... [11255-29]

Lunch Break ..... Mon 12:00 pm to 1:50 pm

### SESSION 10

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... MON 1:50 PM TO 3:00 PM

### Applications of Nanoparticles in Cancer Theranostics

Session Chair: Allison M. Dennis, Boston Univ. (USA)

1:50 pm: **Functional nano-carrier for cancer therapy** (Invited Paper), Halima F. Alem, Univ. de Lorraine (France) ..... [11255-30]

2:20 pm: **Dual-drug loaded phase-changing nanodroplets for image-guided tumor therapy**, Catalina-Paula Spatarelu, Sidhartha Jandhyala, Geoffrey P. Luke, Dartmouth College (USA) ..... [11255-31]

2:40 pm: **Quantitative detection and imaging of multiple biological molecules in living cells**, Shan Huang, Junjie Zhu, Nanjing Univ. (China) ..... [11255-32]

Coffee Break ..... Mon 3:00 pm to 3:30 pm

### SESSION 11

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... MON 3:30 PM TO 4:20 PM

### Multifunctional Nanoparticles for Biomedical Applications

Session Chair: Allison M. Dennis, Boston Univ. (USA)

3:30 pm: **Multifunctional biosilica micro/nanostructures for biomedical applications from diatoms microalgae** (Invited Paper), Gianluca M. Farinola, Univ. degli Studi di Bari Aldo Moro (Italy) ..... [11255-33]

4:00 pm: **Optical and structural study of Co ions incorporated with CdSe /ZnS core / Shell nanocrystals**, Nadeem Sabir, Government College Univ. Faisalabad (Pakistan) ..... [11255-34]

### Award Ceremony

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... 4:20 PM TO 4:35 PM

### Ocean Optics Young Investigator Award Ceremony

### CLOSING REMARKS

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... 4:35 PM TO 4:40 PM

Closing remarks by Conference Chairs  
Marek Osipiński and Antonios G. Kanaras

# CONFERENCE 11256

LOCATION: ROOM 304 (LEVEL 3 SOUTH)

Monday–Tuesday 3–4 February 2020 • Proceedings of SPIE Vol. 11256

# Reporters, Markers, Dyes, Nanoparticles, and Molecular Probes for Biomedical Applications XII

*Conference Chairs:* **Samuel Achilefu**, Washington Univ. School of Medicine in St. Louis (USA); **Ramesh Raghavachari**, U.S. Food and Drug Administration (USA)

*Program Committee:* **Mingfeng Bai**, Vanderbilt Univ. Medical Ctr. (USA); **Mikhail Y. Berezin**, Washington Univ. School of Medicine in St. Louis (USA); **Richard B. Dorshow**, MediBeacon Inc. (USA); **Jelena M. Janjic**, Duquesne Univ. (USA); **Hisataka Kobayashi**, National Cancer Institute (USA); **Dolonchampa Maji**, Washington Univ. School of Medicine in St. Louis (USA); **Ashok Kumar Mishra**, Indian Institute of Technology Madras (India); **Gabor Patonay**, Georgia State Univ. (USA); **Attila Tarnok**, Univ. Leipzig (Germany); **Deepa Venkitesh**, Indian Institute of Technology Madras (India)

## MONDAY 3 FEBRUARY

### POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Wikipedia to identify popular compounds of photochemical interest and expand the PhotochemCAD database**, Yuru Cao, Univ. of North Carolina at Chapel Hill (USA); Masahiko Taniguchi, North Carolina State Univ. (USA); Hely Mehta, Univ. of North Carolina at Chapel Hill (USA); Ibrahim Bayer, Ann E. Norcross, Jonathan S. Lindsey, North Carolina State Univ. (USA) . . . [11256-17]

**Challenges in searching the scientific literature – photophysical data as a case study**, Masahiko Taniguchi, Jonathan S. Lindsey, North Carolina State Univ. (USA) . . . . . [11256-18]

**Electron Properties of porous carbon nanostructures doped by atoms cesium**, Anna S. Kolesnikova, Saratov State Univ. (Russian Federation) . . . . . [11256-19]

**Modification of the molecular-mechanics method for the study of the mechanical properties of porous carbon nanostructures with potassium**, Anna S. Kolesnikova, Kristina Prihodchenko, Saratov State Univ. (Russian Federation) . . . . . [11256-20]

**The penetration and movement of nanoparticles on membrane**, Lianxin Xin, Zachary B. Tylor, Hacene Boukari, Jun Ren, Delaware State Univ. (USA) . . . . . [11256-21]

**Water desalination using zigzag pillared graphene**, Margarita M. Mazepa, Anna S. Kolesnikova, Irina V. Kirillova, Leonid Yu. Kossovich, Saratov State Univ. (Russian Federation) . . . . . [11256-22]

**Electron-energy properties of pillared graphene modified with potassium**, Dmitry Shmygin, Michael M. Slepchenkov, Saratov State Univ. (Russian Federation) . . . . . [11256-23]

**2D monocrystalline nanostructures of cobalt oxide Co3O4 for sensing individual molecules**, Olga E. Glukhova, Dmitriy A. Kolosov, Michael M. Slepchenkov, Saratov State Univ. (Russian Federation) . . [11256-24]

**Patterns of interaction of the cell membrane with a matrix of natural polymers and carbon nanotubes**, Olga E. Glukhova, Michael M. Slepchenkov, Saratov State Univ. (Russian Federation) . . . . . [11256-25]

## TUESDAY 4 FEBRUARY

### SESSION 1

LOCATION: ROOM 304 (LEVEL 3 SOUTH) . . . . . TUE 8:10 AM TO 10:00 AM

### Phototherapeutic Applications using NIR and other Probes

Session Chair: **Samuel Achilefu**, Washington Univ. in St. Louis (USA)

8:10 am: **Near infrared photoimmunotherapy for cancer; Immunoactivation regimens and applications of imaging technologies** (*Invited Paper*), Hisataka Kobayashi, National Cancer Institute (USA) . . . . . [11256-1]

8:40 am: **Optical imaging of immune response following synergistic immune photothermal therapy (SYMPHONY)** (*Invited Paper*), Gregory M. Palmer, Antoine Mansourati, Yuxiang Wang, Stefan Stryker, Wei Phin Tan, Yang Liu, Etienne Wiguins, Paolo Maccarini, Brant A. Inman, Tuan Vo-Dinh, Duke Univ. (USA) . . . . . [11256-2]

9:10 am: **Functional quantum dots for diagnostics and phototherapies of cancer cells** (*Invited Paper*), Jinhua Li, International Joint Research Ctr. for Nanophotonics and Biophotonics, Changchun Univ. of Science and Technology (China) . . . . . [11256-3]

9:40 am: **Non-invasive membrane potential measurements using endogenous markers**, Vladislav V. Yakovlev, Texas A&M Univ. (USA) [11256-4]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

### NANO/BIOPHOTONICS PLENARY SESSION

LOCATION: ROOM 207 (SOUTH LEVEL TWO) . . . . . TUE 10:30 AM TO 11:30 AM

Session Chairs: **Ewa M. Goldys**, The Univ. of New South Wales (Australia); **Paras N. Prasad**, Univ. at Buffalo (USA)

10:30 am: **Plasmonics nanoparticles for use in theranostics** (*Plenary*), Michel Meunier, Polytechnique Montréal (Canada)

Lunch Break . . . . . Tue 11:30 am to 1:00 pm

# CONFERENCE 11256

## SESSION 2

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... TUE 1:00 PM TO 3:00 PM

### Nanomaterials as Probes and in Imaging Applications I

Session Chair: **Mikhail Y. Berezin**, Washington Univ. in St. Louis (USA)

1:00 pm: **pH-sensitive shortwave infrared quantum dots for In vivo pH mapping**, Manon Debayle, Xiangzhen Xu, Nicolas Lequeux, Thomas Pons, Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris (France) ..... [11256-5]

1:20 pm: **Self-assembled poly(aryl ether)-based dendritic systems as in vitro drug carriers, metal ion sensors and antibacterial agents** (*Invited Paper*), Prasad Edamana, Ramay Kannan, Indian Institute of Technology Madras (India); Vignesh Muthuvijayan, Indian Institute of Technology Madras (India) ..... [11256-6]

1:50 pm: **Nonequilibrium plasma aerotaxy of freestanding III-V semiconductor nanocrystals with controlled photonic properties** (*Invited Paper*), Necip B. Uner, Elijah J. Thimsen, Washington Univ. in St. Louis (USA) ..... [11256-7]

2:20 pm: **Gold nanorods with size-controlled polydopamine coating for spectral imaging**, Jeanne Lemaster, Univ. of California, San Diego (USA) ..... [11256-8]

2:40 pm: **The toxicity and clearance of copper indium sulfide quantum dots in vivo**, Joshua Kays, Alexander M. Saeboe, Reyhaneh Toufanian, Allison M. Dennis, Boston Univ. (USA) ..... [11256-9]

Coffee Break. .... Tue 3:00 pm to 3:30 pm

## SESSION 3

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... TUE 3:30 PM TO 4:40 PM

### Nanomaterials as Probes and in Imaging Applications II

Session Chair: **Mikhail Y. Berezin**, Washington Univ. in St. Louis (USA)

3:30 pm: **Preparations and applications of modulated covalent multidye silica nanoparticles** (*Invited Paper*), Gabor Patonay, Eman Alsolmy, Gala Chapman, Walid Abdelwahab, Georgia State Univ. (USA) ..... [11256-10]

4:00 pm: **Gold nanostars as a contrast agent for tracking stem cell therapy using multispectral photoacoustic tomography.**, Soorya James, National Univ. of Ireland, Galway (Ireland) ..... [11256-11]

4:20 pm: **Red blood cell membranes-camouflaged gold nanostars for enhanced photoacoustic diagnosis and photothermal treatment of liver cancer**, Xiazi Huang, Puxiang Lai, The Hong Kong Polytechnic Univ. (Hong Kong, China) ..... [11256-12]

## SESSION 4

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... TUE 4:40 PM TO 6:20 PM

### Fluorescent and Luminescent Probes

4:40 pm: **Chemical probes for optical bio-imaging** (*Invited Paper*), Lu Wei, Caltech (USA) ..... [11256-13]

5:10 pm: **A luminescent oxygen-sensing hydrogel for mapping tissue oxygenation**, Haley L. Marks, Juan Pedro Cascales Sandoval, Joshua Glahn, Massachusetts General Hospital (USA); Katherine Cook, Boston Univ. (USA); Emmanuel Roussakis, Massachusetts General Hospital (USA); Mark W. Grinstaff, Boston Univ. (USA); Dieter Manstein, Conor L. Evans, Massachusetts General Hospital (USA) ..... [11256-14]

5:30 pm: **An orange-fluorescent dye with long-lasting blinking for single molecule localization microscopy**, Daiki Hara, Yuji Okamoto, Shingo Fujiyama, Youichi Nishikawa, Sysmex Corp. (Japan); Yoshihiko Norimine, Yuji Kazuta, Takafumi Motoki, Hiroyuki Amino, Eisai Co., Ltd. (Japan); Shigeki Iwanaga, Sysmex Corp. (Japan) ..... [11256-15]

5:50 pm: **Aggregation induced enhanced emission in Dimethyl-2,5-bis(4-methoxyphenylamino)terephthalate** (*Invited Paper*), Anasuya Mishra, Anshu Kumar, Anil Kumar, Anindya Dutta, Indian Institute of Technology Bombay (India) ..... [11256-16]

# CONFERENCE 11257

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH)

Sunday–Monday 2–3 February 2020 • Proceedings of SPIE Vol. 11257

## Plasmonics in Biology and Medicine XVII

Conference Chairs: **Tuan Vo-Dinh**, Duke Univ. (USA); **Ho-Pui A. Ho**, The Chinese Univ. of Hong Kong (Hong Kong, China); **Krishanu Ray**, Univ. of Maryland School of Medicine (USA)

Program Committee: **Hatice Altug**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **A. Claude Boccara**, Ecole Supérieure de Physique et de Chimie Industrielles (France); **Michael T. Canva**, Lab. Charles Fabry (France); **Andrew M. Fales**, U.S. Food and Drug Administration (USA); **Dror Fixler**, Bar-Ilan Univ. (Israel); **Christopher D. Geddes**, Univ. of Maryland, Baltimore (USA); **Zygmunt Karol Gryczynski**, Univ. of North Texas Health Science Ctr. at Fort Worth (USA); **Naomi J. Halas**, Rice Univ. (USA); **Jiri Homola**, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); **Joseph R. Lakowicz**, Univ. of Maryland School of Medicine (USA); **Laura Maria Lechuga**, Institut Català de Nanociència i Nanotecnologia (ICN2) (Spain); **Martin Maiwald**, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany); **Shuming Nie**, Emory Univ. (USA); **Sang-Hyun Oh**, Univ. of Minnesota, Twin Cities (USA); **Jürgen Popp**, Leibniz-Institut für Photonische Technologien e.V. (Germany); **Wei-Chuan Shih**, Univ. of Houston (USA); **P. James Schuck**, Columbia Univ. (USA); **Bernd Sumpf**, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany); **Richard P. Van Duyne**, Northwestern Univ. (USA)

### SUNDAY 2 FEBRUARY

#### SESSION 1

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . SUN 1:30 PM TO 3:10 PM

#### Plasmonics and SERS Systems

Session Chair: **Tuan Vo-Dinh**, Duke Univ. (USA)

1:30 pm: **Plasmonic nanoparticles in agarose gel and filter paper-integrated microfluidic devices for SERS detection of molecules**, Li-An Wu, Yun-Chu Chen, Wen-Chi Pai, Yun-Hsian Hsu, Yih-Fan Chen, National Yang-Ming Univ. (Taiwan). . . . . [11257-1]

1:50 pm: **Surface plasmon resonance imaging enhanced by active mass transport**, Marion Costella, Univ. de Sherbrooke (Canada) and Ecole Centrale de Lyon (France); Marie Frénéa-Robin, Univ. de Lyon (France); Julien Marchalot, Institut National des Sciences Appliquées de Lyon (France); Julien Moreau, Institut d'Optique Graduate School (France); Oleh Andreiev, Paul G. Charette, Michael T. Canva, Univ. de Sherbrooke (Canada). . . . . [11257-2]

2:10 pm: **Nanoplasmonic-enhanced cellular imaging**, Frederic A. Banville, Lab. Nanotechnologies Nanosystemes (Canada) and Univ. de Sherbrooke (Canada) and CNRS (France); Julien Moreau, Institut d'Optique Graduate School (France); Jean-François Bryche, Michel Grandbois, Michael T. Canva, Paul G. Charette, Lab. Nanotechnologies Nanosystemes (Canada) and Univ. de Sherbrooke (Canada) and CNRS (France). . . . . [11257-3]

2:30 pm: **Nanoprecision placement of biomolecules on plasmonic hotspots for MEF-based biosensors**, Tiago Ramos-Leite-da-Silva, Kevin M. McPeak, Louisiana State Univ. (USA). . . . . [11257-4]

2:50 pm: **Aluminum plasmonics for self cleaning surfaces: Complete inactivation of multidrug-resistant bacteria with low-intensity visible light**, Xiangchao Zhu, Mingran Liu, Michael Trebino, Jin Hwan Park, Fitnat Yildiz, Ahmet A. Yanik, Univ. of California, Santa Cruz (USA) . . . [11257-5]

Coffee Break. . . . . Sun 3:10 pm to 3:40 pm

#### SESSION 2

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . SUN 3:40 PM TO 5:40 PM

#### Advanced Raman and SERS Systems

Session Chairs: **Bernd Sumpf**, Ferdinand-Braun-Institut (Germany); **Martin Maiwald**, Ferdinand-Braun-Institut (Germany)

3:40 pm: **A diode laser based clinical diagnostic system using shifted excitation resonance Raman difference spectroscopy for the in vivo detection of  $\beta$ -carotene in human skin** (Invited Paper), Bernd Sumpf, Marcel Braune, Martin Maiwald, Ferdinand-Braun-Institut (Germany); Maxim E. Darvin, Jürgen Lademann, Charité Universitätsmedizin Berlin (Germany); Günther Tränkle, Ferdinand-Braun-Institut (Germany) . . . [11257-6]

4:10 pm: **Improving Raman spectroscopy using diode lasers at 785 nm for shifted excitation Raman difference spectroscopy** (Invited Paper), Martin Maiwald, Bernd Sumpf, Ferdinand-Braun-Institut (Germany) . . [11257-7]

4:40 pm: **Design and modeling of SERS-based sensor chips for applications in nanomedicine**, Akanksha Ninawe, Kaleem Ahmed, Anuj Dhawan, Indian Institute of Technology Delhi (India) . . . . . [11257-8]

5:00 pm: **Characterization of SERS nanoparticle detectability using 3D-printed optical phantoms**, Andrew M. Fales, Ilko K. Ilev, Joshua Pfefer, U.S. Food and Drug Administration (USA) . . . . . [11257-9]

5:20 pm: **Plasmon-enhanced Raman sensing of single biomolecular recognition**, Taka-aki Yano, Takuo Tanaka, Tokushima Univ. (Japan) and RIKEN (Japan). . . . . [11257-10]

### BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

#### Welcome and Award Presentation

**John G. Greivenkamp**, Univ. of Arizona (United States), 2020 SPIE President

#### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam**,

Duke University, Durham, North Carolina, USA

#### Talk by 2014 Nobel Prize Winner in Physics:

#### Spying on the Secret Lives of Cells

**Eric Betzig**, Univ. of California, Berkeley and Howard Hughes Medical Institute (USA)

### MONDAY 3 FEBRUARY

#### SESSION 3

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . MON 9:00 AM TO 11:50 AM

#### Plasmonic Nanostructures

Session Chair: **Krishanu Ray**, Univ. of Maryland School of Medicine (USA)

9:00 am: **Ultrafast VCSEL-based plasmonic polymerase chain reaction with real-time label-free amplicon detection for point-of-care diagnostics**, Padideh Mohammadyousef, Gideon Uchehara, McGill Univ. (Canada); Miltiadis Paliouras, Mark Trifiro, Lady Davis Institute for Medical Research, Jewish General Hospital (Canada); Andrew G. Kirk, McGill Univ. (Canada) . . . . . [11257-11]

9:20 am: **Enhanced quantum emission and molecular detection in Epsilon-near-zero Meta-structures**, Howard Lee, Baylor Univ. (USA) . . . . . [11257-12]

9:40 am: **Bloch long-range surface plasmons on waveguide arrays integrated with electrochemical electrodes as multichannel multimodal biosensors**, Maryam Khodami, Zohreh Hirbodvash, Oleksiy Krupin, Pierre Berini, Univ. of Ottawa (Canada) . . . . . [11257-13]

10:00 am: **Single-point detection strategy for probing 2D SPR sensor array**, Dongping Wang, Jacky Fong Chuen Loo, Yeung Yam, Shih-Chi Chen, Aaron Ho-Pui Ho, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11257-14]

Coffee Break. . . . . Mon 10:20 am to 10:50 am

10:50 am: **Gold nanostar-enhanced multimodal photoacoustic microscopy and optical coherence tomography for the visualization of laser-induced choroidal neovascularization in living rabbits.**, Van Phuc Nguyen, Yanxiu Li, Jessica Henry, Michael Aaberg, Sydney Jones, Thomas Qian, Wei Zhang, Univ. of Michigan-Kellogg Eye Ctr. (USA); Xueding Wang, Univ. of Michigan (USA); Yannis M. Paulus, Univ. of Michigan-Kellogg Eye Ctr. (USA) . . . . . [11257-15]

11:10 am: **Design of calorimetric sensor based on plasmonic metamaterials for low cost point of care diagnostic application**, Gurukaelaiarasu Tamilarasi Mani, Renilkumar Mudachathi, SRM Institute of Science and Technology (India) . . . . . [11257-16]

11:30 am: **Functional metasurfaces for rapid, colorimetric cancer tissue diagnostics**, Lisa V. Poulikakos, Mark Lawrence, David R. Barton III, Jennifer A. Dionne, Stanford Univ. (USA) . . . . . [11257-17]

Lunch Break . . . . . Mon 11:50 am to 1:20 pm

# CONFERENCE 11257

## SESSION 4

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . MON 1:20 PM TO 3:00 PM

### Plasmonic Detection

Session Chair: **Ho-Pui Ho**,

The Chinese Univ. of Hong Kong (Hong Kong, China)

1:20 pm: **In-vitro detection of polypeptide conformations at attomolar concentration using an ultrafast laser and surface-enhanced infrared absorption spectroscopy on a single resonant nanoantenna**, Florian Mörz, Rostyslav Semenyshyn, Tobias R. J. Steinle, Monica Ubl, Mario Hentschel, Univ. Stuttgart (Germany); Frank F. Neubrech, Ruprecht-Karls-Univ. Heidelberg (Germany); Harald Giessen, Univ. Stuttgart (Germany) . . . . . [11257-18]

1:40 pm: **Quantitative super-resolution of time-resolved dynamics of actin via plasmonics**, Xintao Zhao, Somn Eunice Lee, Univ. of Michigan (USA) . . . . . [11257-19]

2:00 pm: **Development of collinear transmission plasmonic biosensor for detection of HIV-1.**, Saturnin S. Ombinda-Lemboumba, Sello L. Manoto, Rudzani Malabi, CSIR National Laser Ctr. (South Africa); Patience T. Mthunzi-Kufa, CSIR National Laser Ctr. (South Africa) and Univ. of South Africa (South Africa) and Univ. of Kwazulu Natal (South Africa) . . . . . [11257-20]

2:20 pm: **Plasmonic subdiffraction imaging of single actin filament and actin network structures**, Guangjie Cui, Somn Eunice Lee, Univ. of Michigan (USA) . . . . . [11257-21]

Coffee Break. . . . . Mon 2:40 pm to 3:10 pm

## SESSION 5

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . MON 3:10 PM TO 4:50 PM

### Plasmonic Detection and Sensing

Session Chairs: **Andrew M. Fales**, U.S. Food and Drug Administration (USA); **Anuj Dhawan**, Indian Institute of Technology Delhi (India)

3:10 pm: **Deep learning allows enhanced detection of surface plasmon scattering**, Gwiyeong Moon, Yonsei Univ. (Korea, Republic of); Taehwang Son, Massachusetts General Hospital (USA); Hongki Lee, Donghyun Kim, Yonsei Univ. (Korea, Republic of) . . . . . [11257-23]

3:30 pm: **Fiber-optic SERS sensors using plasmonic nanostar probes for detection of molecular biotargets**, Vanessa Cupil-Garcia, Pietro Strobbia, Fitzpatrick Institute for Photonics, Duke Univ. (USA); Yang Ran, Fitzpatrick Institute for Photonics (USA) and Jinan Univ. (China); Bridget M. Crawford, Hsin-Neng Wang, Fitzpatrick Institute for Photonics, Duke Univ. (USA); Rodolfo Zentella, Tai-Ping Sun, Duke Univ. (USA); Tuan Vo-Dinh, Fitzpatrick Institute for Photonics, Duke Univ. (USA) . . . . . [11257-24]

3:50 pm: **Particle sensing with confined optical field enhanced fluorescence emission**, Shamsul Abedin, Christian Vargas, Eric O. Potma, Univ. of California, Irvine (USA) . . . . . [11257-25]

4:10 pm: **Label-free neurophotonics: electro-plasmonic biosensors for ultrasensitive detection of electrogenic activity of cells**, Ahsan Habib, Xiangchao Zhu, Univ. of California, Santa Cruz (USA); Isik Uryan Can, Univ. of Notre Dame (USA); Maverick McLanahan, Univ. of California, Santa Cruz (USA); Pinar Zorlutuna, Univ. of Notre Dame (USA); Ahmet A. Yanik, Univ. of California, Santa Cruz (USA) . . . . . [11257-26]

4:30 pm: **The ZnO nanoflower based SPR biosensor for enhancing sensitivity**, Heesang Ahn, Hyerin Song, Soojung Kim, Kyujung Kim, Pusan National Univ. (Korea, Republic of) . . . . . [11257-27]

## POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

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Poster Setup: Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Application of label-free SERS and EC-SERS for detection of traces of drugs in biological fluids**, Martynas Velička, Sonata Adomavičiūtė, Edvinas Zacharovas, Valdas Šablinskas, Vilnius Univ. (Lithuania) . . . . . [11257-28]

**Fiber based SERS studies of cancerous tissues – toward clinical trials**, Sonata Adomavičiūtė, Martynas Velička, Valdas Šablinskas, Vilnius Univ. (Lithuania) . . . . . [11257-29]

**Sensitivity-enhanced surface resonance plasmonic sensor using a multilayer structure with functionalized microgel**, Hyerin Song, Heesang Ahn, Taeyeon Kim, Soojung Kim, Junha Choi, Pusan National Univ. (Korea, Republic of); Mohammad Mojahedi, Univ. of Toronto (Canada); Kyujung Kim, Pusan National Univ. (Korea, Republic of) . . . . . [11257-30]

**Manipulation of hot-spot densities inside Ag bundle patterns by controlling the Ag nanostructure size for reliable and sensitive SERS substrates**, Taeksu Lee, Korea Institute of Machinery & Materials (Korea, Republic of) and Yonsei Univ. (Korea, Republic of); Soongeun Kwon, Hyungjun Lim, Jae-Jong Lee, Korea Institute of Machinery & Materials (Korea, Republic of) . . . . . [11257-31]

**Opto-thermal response of plasmonic nanostructures based on metallic nanowire arrays**, Seongmin Im, Hongki Lee, Eunji Sim, Donghyun Kim, Yonsei Univ. (Korea, Republic of) . . . . . [11257-32]

**Inkjet dispense SERS (ID-SERS) for highly accurate quantitative analysis**, Fausto D'Apuzzo, Raghuvir Sengupta, Jason S. Aronoff, Milo Overbay, Anita Rogacs, Steven J. Barcelo, HP, Inc. (USA) . . . . . [11257-33]

**Development of surface plasmon resonance biosensor through light matter colocalization on gold nanogap**, Changhun Lee, Eunji Sim, Donghyun Kim, Yonsei Univ. (Korea, Republic of) . . . . . [11257-34]

**Enhanced capacitive photostimulation of neurons by hot-electron injection in optoelectronic biointerfaces**, Rustamzhan Melikov, Shashi Bhushan Srivastava, Onuralp Karatim, Itir Bakis Dogru, Houman Bahmani Jalali, Sadra Sadeghi, Ugur Meric Dikbas, Ibrahim Halil Kavakli, Sedat Nizamoglu, Koç Univ. (Turkey) . . . . . [11257-35]

**A framework for quantifying actin networks formed by different bundling techniques**, John Gregg, Somn Eunice Lee, Univ. of Michigan (USA) . . . . . [11257-36]

**Characterization of bacteria on a plasmonic diatom-AgNP nanocomposite strip using SERS**, Mehmet Kahraman, Gaziantep Üniv. (Turkey); Ayse Mine Saridag, Gaziantep Üniv. (Turkey); Aysun Korkmaz, Gaziantep Üniv. (Turkey); Maya Kenton, McGill Univ. (Canada); Gulsen Aksin, Ibrahim Halil Kilic, Gaziantep Üniv. (Turkey); Sebastian Wachsmann-Hogiu, McGill Univ. (Canada) . . . . . [11257-37]

**Sensitivity enhancement of a surface plasmon resonance biosensor by adding Pb<sub>5</sub>Ge<sub>3</sub>O<sub>11</sub> layer to diagnose the hypothyroidism**, Alireza Keshavarz, Soraya Zangeneh Zadeh, Shiraz Univ. of Technology (Iran, Islamic Republic of); Ali Hatfeh, Nipissing Univ. (Canada) . . . . . [11257-38]

**Gold nanoparticles as enhanced SHG contrast agents for biological imaging**, Kenzo Yamaguchi, Eiji Hase, Toshihiro Okamoto, Masanobu Haraguchi, Takeshi Yasui, Tokushima Univ. (Japan) . . . . . [11257-39]

**Nanostar probes: A golden platform for Synergistic Immuno Photothermal Nanotherapy (SYMTHONY) for the treatment of metastatic cancer**, Vanessa Cupil-Garcia, Fitzpatrick Institute for Photonics (USA); Bridget M. Crawford, Yang Liu, Fitzpatrick Institute for Photonics, Duke Univ. (USA); Gregory Palmer, Duke Univ. Medical Ctr. (USA); Paolo Maccarini, Duke Univ. (USA); Brant Inman, Duke Univ. Medical Ctr. (USA); Tuan Vo-Dinh, Fitzpatrick Institute for Photonics, Duke Univ. (USA) . . . . . [11257-41]

**Applications of plasmonic nanoparticles for in vivo biosensing of plants**, Vanessa Cupil-Garcia, Pietro Strobbia, Fitzpatrick Institute for Photonics (USA) and Duke Univ. (USA); Bridget M. Crawford, Hsin-Neng Wang, Fitzpatrick Institute for Photonics, Duke Univ. (USA); Rodolfo Zentella, Tai-Ping Sun, Duke Univ. (USA); Tuan Vo-Dinh, Fitzpatrick Institute for Photonics, Duke Univ. (USA) . . . . . [11257-42]

**Super-high enhancement of surface enhanced Raman scattering substrate via resonance coupling**, Wenxue Li, Lin Pang, Zhisen Jiang, Sichuan Univ. (China) . . . . . [11257-40]

**Self-similarity in azimuthal Walsh filters and corresponding far-field diffraction characteristics : a unique study to control tightly focused fields and coupling of light into metamaterials, plasmonic structure, and waveguides**, Indrani Bhattacharya, Univ of Eastern Finland (Finland) . . . . . [11257-337]

**Optimization of suspended core PCF parameters and anchoring of nanostructures for highly sensitive and reproducible SERS sensing**, Flavien Boffara, Jayakumar Perumal, Agency for Science, Technology and Research (A\*STAR) (Singapore); Georges J. Humbert, Jean-Louis Auguste, XLIM (France); Sylvain Vedraïne, Univ. de Limoges (France); Dinis U.S. Malini C. Olivo, Agency for Science, Technology and Research (A\*STAR) (Singapore) . . . . . [11257-263]

**Modelling of plasmon generation of gold nanostars and interactions in tissue for use in optical acoustic imaging**, Aaron Croke, National Univ. of Ireland, Galway (Ireland) . . . . . [11257-22]

# CONFERENCE 11258

LOCATION: ROOM 301 (LEVEL 3 SOUTH)

Sunday–Monday 2–3 February 2020 • Proceedings of SPIE Vol. 11258

## Frontiers in Biological Detection: From Nanosensors to Systems XII

Conference Chairs: **Amos Danielli**, Bar-Ilan Univ. (Israel); **Benjamin L. Miller**, Univ. of Rochester Medical Ctr. (USA); **Sharon M. Weiss**, Vanderbilt Univ. (USA)

Program Committee: **Andrea M. Armani**, The Univ. of Southern California (USA); **Nathaniel C. Cady**, SUNY Polytechnic Institute (USA); **Xudong Fan**, Univ. of Michigan (USA); **Jason A. Guicheteau**, U.S. Army Edgewood Chemical Biological Ctr. (USA); **Laura Maria Lechuga**, Institut Català de Nanociència i Nanotecnologia (ICN2) (Spain); **Francesco Michelotti**, Sapienza Univ. di Roma (Italy); **Michael J. Sailor**, Univ. of California, San Diego (USA); **Christopher C. Striemer**, Adarza BioSystems, Inc. (USA); **Yuze Alice Sun**, The Univ. of Texas at Arlington (USA)

Conference Co-Sponsor:



### SUNDAY 2 FEBRUARY

#### SESSION 1

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SUN 9:00 AM TO 10:00 AM

#### Magnetism

Session Chair: **Sharon M. Weiss**, Vanderbilt Univ. (USA)

9:00 am: **Rapid and sensitive detection of repetitive nucleic acid sequences using magnetically modulated biosensors**, Michael Margulis, Amos Danielli, Bar-Ilan Univ. (Israel) ..... [11258-1]

9:20 am: **Magnetically aggregated biosensors for sensitive detection of biomarkers at low concentrations**, Shmuel Burg, Meir Cohen, Michael Margulis, Shira Roth, Amos Danielli, Bar-Ilan Univ. (Israel) ..... [11258-2]

9:40 am: **A rapid biosensing method for identification of protein-DNA interactions**, Shira Roth, Diana Ideses, Tamar Juven-Gershon, Amos Danielli, Bar-Ilan Univ. (Israel) ..... [11258-3]

Coffee Break. .... Sun 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SUN 10:30 AM TO 11:50 AM

#### New Sensing Methods

Session Chair: **Amos Danielli**, Bar-Ilan Univ. (Israel)

10:30 am: **Optical polarimetric elastography for biomechanical analysis** (*Invited Paper*), Andrea M. Armani, Kylie Trettner, Haijie Zuo, Katie Barajas, Raymond Yu, Alexa Hudnut, The Univ. of Southern California (USA) .. [11258-4]

11:00 am: **Optimization of a plasmonic fluorescence biosensor platform to detect serum antibodies with high sensitivity and consistency** (*Invited Paper*), Eunice Chou, SUNY Polytechnic Institute (USA); Arturo Pilar, Ernest Guignon, William Page, Ciencia, Inc. (USA); George Gibson, Univ. of Connecticut (USA); Yi-Pin Lin, Wadsworth Ctr. (USA); Nathaniel C. Cady, SUNY Polytechnic Institute (USA) ..... [11258-5]

11:30 am: **High-Q dielectric metasurfaces for ultrasensitive and high-throughput biomolecule detection**, Filiz Yesilkoy, Univ. of Wisconsin (USA); Eduardo R. Arvelo, Yasaman Jahani, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Mingkai Liu, The Australian National Univ. (Australia); Andreas Tittl, Volkan Cevher, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Yuri S. Kivshar, The Australian National Univ. (Australia); Hatice Altug, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11258-6]

Lunch Break. .... Sun 11:50 am to 1:20 pm

#### SESSION 3

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SUN 1:20 PM TO 3:20 PM

#### Resonators and Integrated Photonics I

Session Chair: **Benjamin L. Miller**, Univ. of Rochester Medical Ctr. (USA)

1:20 pm: **Ultra-sensitive and selective detection of protein biomarkers using frequency-locked microtoroid optical resonators** (*Invited Paper*), Tsu-Te Judith Su, Wyant College of Optical Sciences (USA) ..... [11258-7]

1:50 pm: **Integrated optical microring resonators for absorption spectroscopy**, Pauline Girault, Guillaume Beaudin, Univ. de Sherbrooke (Canada); Miguel Diez, Simon Joly, Laurent Oyhenart, Lab. d'Intégration du Matériau au Système (France); Chi Thanh Nguyen, Isabelle Ledoux-Rak, Lab. de Photonique Quantique et Moléculaire (France); Michael T. Canva, Paul G. Charette, Univ. de Sherbrooke (Canada); Laurent Béchou, Lab. d'Intégration du Matériau au Système (France) ..... [11258-8]

2:10 pm: **Label-free ultrasensitive detection of Amyloid- $\beta$  using microtoroid resonators with lipid surface functionalization**, Adley Gin, Phuong-Diem Nguyen, Tsu-Te Judith Su, The Univ. of Arizona (USA) .. [11258-9]

2:30 pm: **Sensor platform based on packaged whispering-gallery-resonators**, Alethea V. Zamora Gomez, Jonas Herter, Tiet Nyugen, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Valentin Wunderlich, Technische Univ. Berlin (Germany); Christian Janeczka, Henning Schröder, Martin Schneider-Ramelow, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany) ..... [11258-10]

2:50 pm: **Silicon nitride ring resonator biosensors fabricated at AIM Photonics: detection of cytokines** (*Invited Paper*), Benjamin L. Miller, Michael R. Bryan, John S. Coggiotti, Daniel J. Steiner, Univ. of Rochester Medical Ctr. (USA) ..... [11258-11]

Coffee Break. .... Sun 3:20 pm to 3:50 pm

#### SESSION 4

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... SUN 3:50 PM TO 5:20 PM

#### Resonators and Integrated Photonics II

Session Chair: **Sharon M. Weiss**, Vanderbilt Univ. (USA)

3:50 pm: **Fiber-integrated fabric for non-tight contact bio-sensing of vital signs** (*Invited Paper*), Rotem Hendel, Barak Straussman, Yafim Beiderman, Sergey Agdarov, Zeev Zalevsky, Bar-Ilan Univ. (Israel) ..... [11258-12]

4:20 pm: **Microsecond single molecule enzymology using plasmonically enhanced optical resonators**, Sivaraman Subramanian, Simona Frustaci, Frank Vollmer, Univ. of Exeter (United Kingdom) ..... [11258-287]

4:40 pm: **Fabry-Perot etalon with three fiber Bragg gratings as a digital sensor**, Ubaid Ullah, M. Imran Cheema, Lahore Univ. of Management Sciences (Pakistan) ..... [11258-13]

5:00 pm: **Amplified phase shift – fiber cavity ring down spectroscopy for biosensing applications at 1550nm**, M. Imran Cheema, Ubaid Ullah, M. Daniyal Ghauri, Lahore Univ. of Management Sciences (Pakistan); Rana Muhammad Armaghan Ayaz, Yigit Uysalli, Berna Morova, Alper Kiraz, Koç Univ. (Turkey) ..... [11258-14]

# CONFERENCE 11258

## BIOS SUNDAY PLENARY

LOCATION: ROOM 206/214 (SOUTH LEVEL TWO) . . . . . SUN 7:15 PM TO 8:00 PM

### Welcome and Award Presentation

John G. Greivenkamp, Univ. of Arizona (United States), 2020 SPIE President

### Presentation of 2020 SPIE Biophotonics Technology Innovator Award

THE 2020 RECIPIENT

**Nirmala Ramanujam,**

Duke University, Durham, North Carolina, USA

### Talk by 2014 Nobel Prize Winner in Physics:

#### Spying on the Secret Lives of Cells

**Eric Betzig,** Univ. of California, Berkeley and

Howard Hughes Medical Institute (USA)

## MONDAY 3 FEBRUARY

### SESSION 5

LOCATION: ROOM 301 (LEVEL 3 SOUTH) . . . . . MON 9:20 AM TO 10:50 AM

### Microscopy and New Sensing Methods

Session Chair: **Amos Danielli,** Bar-Ilan Univ. (Israel)

9:20 am: **High-throughput and label-free imaging of individual biological nanoparticles at high-resolution,** Celalettin Yurdakul, Oguzhan Avci, Alex C. Matlock, Lei Tian, Selim Ünlü, Boston Univ. (USA) . . . . . [11258-15]

9:40 am: **Bioluminescent bacterial biosensor for large scale field deployment,** Aharon J. Agranat, Yossi Kabessa, Etai Shpigel, Benjamin Shemer, The Hebrew Univ. of Jerusalem (Israel); Offer Schwartzglass, Shenkar College of Engineering and Design (Israel); Loay Atamneh, Yossi Mizrahi, Mauro Ejzenberg, Shimshon Belkin, The Hebrew Univ. of Jerusalem (Israel) . . . . . [11258-16]

10:00 am: **Smartphone biosensing for point of care diagnostics,** Sello L. Manoto, Chemist M. Mabena, Rudzani Malabi, Saturnin S. Ombinda-Lemboumba, Patience T. Mthunzi-Kufa, CSIR National Laser Ctr. (South Africa) . . . . . [11258-18]

10:20 am: **Deep learning-enabled computational microscopy and sensing (Invited Paper),** Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11258-19]

Coffee Break. . . . . Mon 10:50 am to 11:20 am

### SESSION 6

LOCATION: ROOM 301 (LEVEL 3 SOUTH) . . . . . MON 11:20 AM TO 12:20 PM

### Porous Silicon

Session Chair: **Benjamin L. Miller,** Univ. of Rochester Medical Ctr. (USA)

11:20 am: **Label-free high-sensitivity (bio)sensing with silicon structures and systems at the micro and nanoscale (Invited Paper),** Giuseppe Barillaro, Univ. di Pisa (Italy) . . . . . [11258-20]

11:50 am: **Use of peptide capture agents in porous silicon biosensors (Invited Paper),** Sharon M. Weiss, Rabeb Layouni, Tengfei Cao, Vanderbilt Univ. (USA); Matthew B. Coppock, U.S. Army Combat Capabilities Development Command (USA); Paul E. Laibinis, Vanderbilt Univ. (USA) . . . . . [11258-21]

### BEST STUDENT TALK AWARDS

LOCATION: ROOM 301 (LEVEL 3 SOUTH) . . . . . 12:20 PM TO 12:35 PM

## POSTERS-MONDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

Conference attendees are invited to attend the BiOS poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Monday 10:00 AM – 4:30 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Optical microring resonator for low-cost integrated sensor,** Pauline Girault, Guillaume Beaudin, Univ. de Sherbrooke (Canada); Miguel Díez, Simon Joly, Laurent Oyhenart, Lab. d'Intégration du Matériau au Système (France); Chi Thanh Nguyen, Isabelle Ledoux-Rak, Lab. de Photonique Quantique et Moléculaire (France); Michael T. Canva, Paul G. Charette, Univ. de Sherbrooke (Canada); Laurent Béchou, Lab. d'Intégration du Matériau au Système (France) . . . . . [11258-22]

**Immobilization of HIV GP41 antibodies on glass substrates for HIV biosensing,** Sello L. Manoto, CSIR National Laser Ctr. (South Africa); Ahmed El-Husseini, Cairo Univ. (Egypt); Rudzani Malabi, Lebogang Thobakgale, Saturnin S. Ombinda-Lemboumba, Patience T. Mthunzi-Kufa, CSIR National Laser Ctr. (South Africa) . . . . . [11258-23]

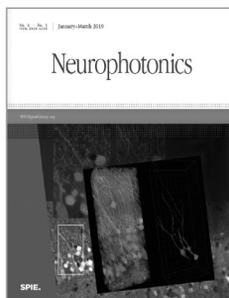
**High sensitivity biosensor chips based on VCSEL and gold nanoslit array integrated with microfluidics,** Yiyang Xie, Beijing Univ. of Technology (China); Qiang Kan, Chinese Academy of Sciences (China) . . . . . [11258-24]



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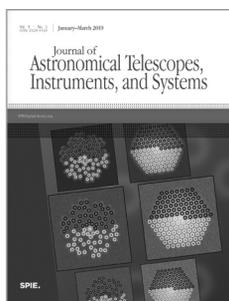
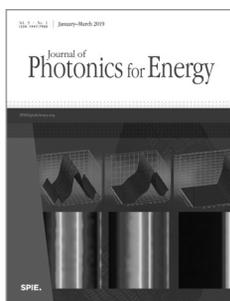


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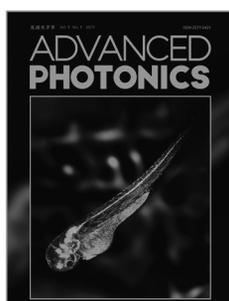
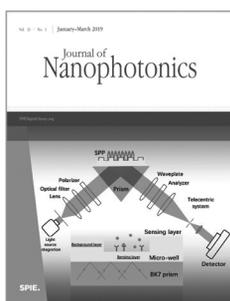
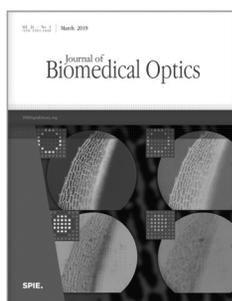
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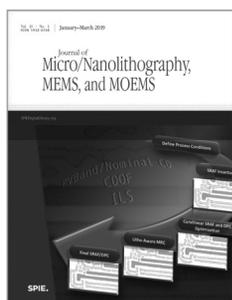
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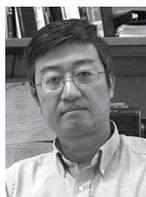
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- 11259 **Solid State Lasers XXIX: Technology and Devices** (Clarkson, Shori) . . . . . 285
- 11260 **Fiber Lasers XVII: Technology and Systems** (Dong, Zervas) . . . . . 289
- 11261 **Components and Packaging for Laser Systems VI** (Glebov, Leisher) . . . . . 294
- 11262 **High-Power Diode Laser Technology XVIII** (Zediker) . . . . . 297
- 11263 **Vertical External Cavity Surface Emitting Lasers (VECSELs) X** (Hastie) . . . . . 299

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Program Track Chairs: **Vladimir Ilchenko**, GM Cruise LLC (USA); **Paul O. Leisher**, Lawrence Livermore National Lab. (USA)

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Program Track Chairs: **Henry Helvajian**, The Aerospace Corp. (USA); **Guido Hennig**, Daetwyler Graphics AG (Switzerland)

- 11267 **Laser Applications in Microelectronic and Optoelectronic Manufacturing (LAMOM) XXV** (Račiukaitis, Molpeceres, Qiao, Narazaki) . . . . . 311
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- 11271 **Laser 3D Manufacturing VII** (Gu, Chen, Helvajian) . . . . . 324

**MACRO APPLICATIONS**

Program Track Chairs: **Bo Gu**, Bos Photonics (USA); **Stefan Kaierle**, Laser Zentrum Hannover e.V. (Germany)

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- 11272 **Free-Space Laser Communications XXXII** (Hemmati, Boroson) . . . . . 327
- 11273 **High-Power Laser Materials Processing: Applications, Diagnostics, and Systems IX** (Kaierle, Heinemann) . . . . . 330
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- Kunihiko Washio**, Paradigm Laser Research Ltd. (Japan)
- Mark S. Zediker**, NUBURU, Inc. (USA)



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## Frontiers in Ultrafast Optics Best Student Paper Competition

### FRONTIERS IN ULTRAFAST OPTICS: BIOMEDICAL, SCIENTIFIC, AND INDUSTRIAL APPLICATIONS (CONF. 11270)

Monday 3 February 2020

Location: Room 104 (Level 1 South Lobby)

**COMPETITION . . . . . 10:30 AM - 11:30 AM**  
**JUDGING & AWARD CEREMONY . 11:30 AM - 11:50 AM**

For Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications, we are pleased to announce that cash prizes and plaques will be awarded to the best student presentations in this conference (1st, 2nd, and 3rd place; both poster and oral papers considered).

Papers submitted by graduate and undergraduate students are eligible. In order to ensure a fair evaluation, the conference chairs and the program committee will judge the students during a special student competition session held during the conference. Here the students present a brief 5-minute summary of their original talk or poster presented at the conference.

Following the student competition, the judges will meet and decide on the top three students. Winners will be announced during the award ceremony.

AWARD SPONSORS:



## VECSELS Best Student Paper Competition

### VERTICAL EXTERNAL CAVITY SURFACE EMITTING LASERS (VECSELS) (CONF. 11263)

Wednesday 5 February 2020 • 11:40 AM - 11:50 AM

Location: Room 208 (Level 2 South)

The committee is pleased to announce that this year a cash prize of \$500, donated by Coherent Inc., will be awarded for the best student presentation in this conference; judged by the committee, on the basis of scientific content, impact, and clarity.

Qualifying manuscripts will be reviewed prior to the conference. Throughout the conference, qualifying student oral presentations will be evaluated. Student presentations will be judged based on scientific merit, impact, clarity of the presentation, and manuscript. While the award is not judged by the manuscript, a manuscript must be submitted.

AWARD SPONSOR:



## LAMOM Best Student Paper Competition (Oral and Poster)

### LASER APPLICATIONS IN MICROELECTRONIC AND OPTOELECTRONIC MANUFACTURING (LAMOM) (CONF. 11267)

Wednesday 5 February 2020 • 3:50 PM - 4:00 PM

Location: Room 154 (Upper Mezzanine South)

A cash prize will be awarded to the best student oral and poster presentation in this conference.

Throughout the conference, qualifying student presentations will be evaluated by the conference committee, and the results will be announced during the award ceremony. Student presentations (both oral and poster) will be judged based on scientific merit of the work, and clarity of the presentation. While the award is not judged by the manuscript, a manuscript must be submitted.

AWARD SPONSORS:



## Fiber Lasers Best Student Oral Paper Competition

### FIBER LASERS: TECHNOLOGY AND SYSTEMS (CONF. 11260)

Thursday 6 February 2020 • 5:30 PM - 5:40 PM

Location: Room 205 (Level 2 South)

For Fiber Lasers: Technology and Systems, we are pleased to announce that a cash prize will be awarded to the best student oral presentation in the conference.

Throughout the conference, qualifying student oral presentations will be evaluated by the conference committee, and the results will be announced in this session. Student presentations will be judged based on scientific merit of the work, and clarity of the presentation. While the award is not judged by the manuscript, a manuscript must be submitted.

To be eligible for consideration, the student must be the first author on an accepted paper, and must make the oral presentation.

AWARD SPONSORS:



# CONFERENCE DAILY SCHEDULE

SATURDAY 1 February	SUNDAY 2 February	MONDAY 3 February	TUESDAY 4 February	WEDNESDAY 5 February	THURSDAY 6 February
		LASE Plenary Session, 3:30 PM - 5:20 PM	Laser Communications Technical Event, 7:30 PM - 9:00 PM		
			LASE & BiOS Poster Session 6:00 PM - 8:00 PM		
<b>LASER SOURCES</b>					
Program Track Chairs: <b>Kunihiko Washio</b> , Paradigm Laser Research Ltd. (Japan); <b>John Ballato</b> , Clemson Univ. (USA)					
			11259 <b>Solid State Lasers XXIX: Technology and Devices</b> (Clarkson, Shori) p. 285		
		11260 <b>Fiber Lasers XVII: Technology and Systems</b> (Dong, Zervas) p. 289			
		11261 <b>Components and Packaging for Laser Systems VI</b> (Glebov, Leisher) p. 294			
	11262 <b>High-Power Diode Laser Technology XVIII</b> (Zediker) p. 297	11263 <b>Vertical External Cavity Surface Emitting Lasers (VECSELs) X</b> (Hastie) p. 299			
<b>NONLINEAR OPTICS AND BEAM GUIDING</b>					
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# CONFERENCE 11259

LOCATION: ROOM 203 (LEVEL 2 SOUTH)

Tuesday–Thursday 4–6 February 2020 • Proceedings of SPIE Vol. 11259

# Solid State Lasers XXIX: Technology and Devices

Conference Chairs: **W. Andrew Clarkson**, Univ. of Southampton (United Kingdom); **Ramesh K. Shori**, SPAWAR Systems Ctr. (USA)

Program Committee: **Gary Cook**, Air Force Research Lab. (USA); **Dennis G. Harris**, Dennis Harris Associates (USA); **Helena Jelínková**, Czech Technical Univ. in Prague (Czech Republic); **Christian Kränkel**, Leibniz-Institut für Kristallzüchtung (Germany); **Jacob I. Mackenzie**, Univ. of Southampton (United Kingdom); **Markus Pollnau**, Univ. of Surrey (United Kingdom); **Narasimha S. Prasad**, NASA Langley Research Ctr. (USA); **Bojan Resan**, Fachhochschule NordWestschweiz (Switzerland); **Nikolay E. Ter-Gabrielyan**, U.S. Army Research Lab. (USA)

## TUESDAY 4 FEBRUARY

### SESSION 1

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... TUE 8:00 AM TO 10:00 AM

### Eye Safe and Mid-IR Lasers I

Session Chair: **Ramesh K. Shori**,  
Naval Information Warfare Ctr. Pacific (USA)

8:00 am: **1.34  $\mu\text{m}$  Nd:YVO<sub>4</sub> laser passively Q-switched by V:YAG and optimized for lidar**, Thomas J. Kane, Kane OE (USA) ..... [11259-1]

8:20 am: **Transparent ceramics for eye-safe solid state laser**, Woohong Kim, Guillermo Villalobos, Brandon Shaw, Colin Baker, Jesse Frantz, Michael Hunt, U.S. Naval Research Lab. (USA); Bryan Sadowski, KeyW Corp. (USA); Jasbinder Sanghera, U.S. Naval Research Lab. (USA) ..... [11259-2]

8:40 am: **Parametric testing of a 2-micron Tm:Lu<sub>2</sub>O<sub>3</sub> laser**, John Vetrovec, David M. Filgas, Drew A. Copeland, Carey A. Smith, Aqwest, LLC (USA); Eldridge Briscoe, General Atomics Aeronautical Systems, Inc. (USA) ..... [11259-3]

9:00 am: **Tm:GGAG and Tm, Ho:GGAG lasing under 1.7  $\mu\text{m}$  diode pumping**, Jan Kratochvíl, Czech Technical Univ. in Prague (Czech Republic); Pavel Boháček, Institute of Physics of the CAS, v.v.i. (Czech Republic); Jan Šulc, Michal Nemeč, Martin Fibrich, Helena Jelínková, Czech Technical Univ. in Prague (Czech Republic); Bohumil Trunda, Lubomír Havlík, Karel Jurek, Martin Nikl, Institute of Physics of the CAS, v.v.i. (Czech Republic) ..... [11259-4]

9:20 am: **Passively Q-switched 10 mJ Tm:YLF laser with efficient OPO conversion to mid-IR**, Lew Goldberg, Vernon King, Alan D. Hays, Brian J. Cole, U.S. Army Combat Capabilities Development Command C5ISR (USA) ..... [11259-5]

9:40 am: **Compact 12mJ mid-IR pulsed source using an intracavity KTA OPO followed by a CSP OPA**, Brian J. Cole, Lew Goldberg, John Nettleton, U.S. Army Combat Capabilities Development Command C5ISR (USA); Leonard Pomeranz, Kevin Zawilski, Peter Schunemann, John C. McCarthy, BAE Systems (USA) ..... [11259-6]

Coffee Break ..... Tue 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... TUE 10:30 AM TO 12:30 PM

### Eye Safe and Mid-IR Lasers II

Session Chair: **Ramesh K. Shori**,  
Naval Information Warfare Ctr. Pacific (USA)

10:30 am: **High power Ho:Y<sub>2</sub>O<sub>3</sub> ceramic laser with 104 W of output power at 2117 nm**, Jinwen Tang, Jiangsu Normal Univ. (China); Enhao Li, Fudan Univ. (China); Fei Wang, Jiangsu Normal Univ. (China); Weichao Yao, Fudan Univ. (China); Yajie Shen, Jun Wang, Dingyuan Tang, Jiangsu Normal Univ. (China); Deyuan Shen, Fudan Univ. (China) ..... [11259-7]

10:50 am: **Diode end-pumped high power Er:Y<sub>2</sub>O<sub>3</sub> ceramic laser at ~3  $\mu\text{m}$** , Enhao Li, Fudan Univ. (China); Jinwen Tang, Fei Wang, Yajie Shen, Jiangsu Normal Univ. (China); Weichao Yao, Deyuan Shen, Fudan Univ. (China); Jun Wang, Dingyuan Tang, Jiangsu Normal Univ. (China) ..... [11259-8]

11:10 am: **Efficiency optimization of 3- $\mu\text{m}$  Q-switched lasers based on Er-doped crystalline materials**, Nikolay E. Ter-Gabrielyan, Viktor Fromzel, U.S. Army Combat Capabilities Development Command (USA) ..... [11259-9]

11:30 am: **Challenges of power scaling flashlamp pumped 3  $\mu\text{m}$  Er:YAG lasers**, Scott J. Hamlin, MegaWatt Lasers, Inc. (USA); Ramesh Shori, Univ. of California, Los Angeles (USA) ..... [11259-10]

11:50 am: **Crystal host engineering for transition metal lasers**, Jonathan W. Evans, Ronald W. Stites, Sean A. McDaniel, Patrick A. Berry, Gary Cook, Air Force Research Lab. (USA); Thomas R. Harris, Azimuth Corp. (USA); Kenneth L. Schepler, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) ..... [11259-11]

12:10 pm: **Picosecond laser source at 3.4 microns for laser material processing of polymers**, Sebastian Nyga, Fraunhofer-Institut für Lasertechnik ILT (Germany) ..... [11259-12]

Lunch/Exhibition Break ..... Tue 12:30 pm to 2:00 pm

### SESSION 3

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... TUE 2:00 PM TO 3:20 PM

### Structured Beams

Session Chair: **Dennis G. Harris**, Dennis Harris Associates (USA)

2:00 pm: **Q-switched vortex laser using a Sagnac interferometer as an output coupler**, Jan Willem T. Geberbauer, William Kerridge-Johns, Michael J. Damzen, Imperial College London (United Kingdom) ..... [11259-13]

2:20 pm: **Control and stabilization of spatial mode quality in a radially polarized solid-state laser using machine learning**, Thomas L. Jefferson-Brain, Matthew J. Barber, Optoelectronics Research Ctr. (United Kingdom); Azaria D. Coupe, Univ. of Southampton (United Kingdom); William A. Clarkson, Peter C. Shardlow, Optoelectronics Research Ctr. (United Kingdom) ..... [11259-14]

2:40 pm: **Diode-pumped Yb:CALGO laser with conical refraction output**, Anisur R. Reza, Reza Akbari, Univ. of Manitoba (Canada); Ksenia Fedorova, Philipps-Univ. Marburg (Germany); Grigori Sokolovskii, Ioffe Institute (Russian Federation); Edik Rafailov, Aston Univ. (United Kingdom); Arkady Major, Univ. of Manitoba (Canada) ..... [11259-15]

3:00 pm: **High purity twisted light from a metasurface solid state resonator**, Heng Sroor, Univ. of Shanghai for Science and Technology (China); Yao-Wei Huang, Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard Univ. (USA) and National Univ. of Singapore (Singapore); Bereneice Sephton, Univ. of the Witwatersrand, Johannesburg (South Africa); Darryl Naidoo, CSIR National Laser Ctr. (South Africa) and Univ. of the Witwatersrand, Johannesburg (South Africa); Adam Valles, Univ. of the Witwatersrand, Johannesburg (South Africa); Cheng-Wei Qiu, National Univ. of Singapore (Singapore); Qiwen Zhan, Univ. of Shanghai for Science and Technology (China); Antonio Ambrosio, Ctr. for Nanoscale Systems, Harvard Univ. (USA); Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard Univ. (USA); Andrew Forbes, Univ. of the Witwatersrand Johannesburg (South Africa) ..... [11259-16]

Coffee Break ..... Tue 3:20 pm to 3:50 pm

# CONFERENCE 11259

## SESSION 4

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... TUE 3:50 PM TO 5:30 PM

### Novel Laser Concepts

Session Chair: **Narasimha S. Prasad**,  
NASA Langley Research Ctr. (USA)

3:50 pm: **Diode pumped, single-mode, narrow linewidth tunable vertical surface emitting organic laser (VECSOL) controlled by a chirped volume Bragg grating**, Oussama Mhikib, Univ. of Central Florida (USA) and Univ. Paris 13 (France) and CNRS (France); Ivan Divliansky, Univ. of Central Florida (USA); Vadim Smirnov, OptiGrate Corp. (USA); Sebastien Forget, Sebastien Chenais, Univ. Paris 13 (France) and CNRS (France); Leonid Glebov, Univ. of Central Florida (USA) ..... [11259-17]

4:10 pm: **Narrow linewidth tunable and dual wavelength compact Alexandrite laser**, Goronwy Tawy, Michael J. Damzen, Imperial College London (United Kingdom) ..... [11259-18]

4:30 pm: **Nd:YLF/KGW intracavity Raman laser in DBMC configuration emitting at 1147 and 1163 nm**, Niklaus U. Wetter, Marilyn S. Ferreira, Instituto de Pesquisas Energéticas e Nucleares (Brazil); Helen M. Pask, Macquarie Univ. (Australia) ..... [11259-19]

4:50 pm: **Highly stable, high power hybrid fiber and Innoslab amplifier for narrow linewidth signals**, Pelin Cebeci, Jhon Vera Mosquera, Martin Giesberts, Benjamin Erben, Oliver Fitzau, Marco Höfer, Hans-Dieter Hoffmann, Fraunhofer-Institut für Lasertechnik ILT (Germany) ..... [11259-20]

5:10 pm: **High-power ultrafast lasers based on InnoSlab technology**, Claus Schnitzler, Torsten Mans, Jan Dolkemeyer, Arvid Hage, Marco Swantusch, Phillip Dittmann, AMPHOS GmbH (Germany) ..... [11259-21]

## POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Tuesday 10:00 AM– 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Temperature influence on Er:GAG crystal: Spectroscopic properties and lasing at 3  $\mu$ m**, Richard Vojtkar, Jan Sulc, Czech Technical Univ. in Prague (Czech Republic); Pavel Boháček, Institute of Physics of the CAS, v.v.i. (Czech Republic); Michal Nemeč, Jan Kratochvíl, Helena Jelínková, Czech Technical Univ. in Prague (Czech Republic); Bohumil Trunda, Lubomír Havlík, Martin Nikl, Karel Jurek, Institute of Physics of the CAS, v.v.i. (Czech Republic) . . [11259-60]

**Efficient composite Nd:YVO/Nd:GVO laser with in-band pumping**, Mohammad Nadimi, Chinedu Onyeneke, Arkady Major, Univ. of Manitoba (Canada) ..... [11259-61]

**Dual-wavelength Yb:CALGO laser with wavelength spacing tunability**, Anisur R. Reza, Reza Akbari, Arkady Major, Univ. of Manitoba (Canada) ..... [11259-62]

**Performance of diode-pumped Yb:YAP lasers with different crystal orientations**, Reza Akbari, Univ. of Manitoba (Canada); Pavel Loiko, ITMO Univ. (Russian Federation); Jun Xu, Tongji Univ. (China); Xiaodong Xu, Jiangsu Normal Univ. (China); Arkady Major, Univ. of Manitoba (Canada) ..... [11259-63]

**Generation of THz frequency offset with dual-wavelength Yb:KGW laser**, Reza Akbari, Arkady Major, Univ. of Manitoba (Canada) ..... [11259-64]

**Simplified cavity design for KLM Ti:sapphire oscillators**, Reza Akbari, Arkady Major, Univ. of Manitoba (Canada) ..... [11259-65]

**Thermal lensing in diode-pumped Yb:CALGO and Yb:KGW lasers**, Reza Akbari, Univ. of Manitoba (Canada); Pavel Loiko, ITMO Univ. (Russian Federation); Arkady Major, Univ. of Manitoba (Canada) ..... [11259-66]

**Programmable, pulse shaped diode laser**, Thomas Schönau, Paul Fey, Kristian Lauritsen, Rainer Erdmann, PicoQuant GmbH (Germany) . . [11259-67]

**Ultra-broadband picosecond OPCPA FrontEnd for a PW class laser facility**, Pedro Oliveira, Mario Galletti, Giedre Archipovaite, Marco Galimberti, Waseem Shaikh, Ian Musgrave, Cristina Hernandez-Gomez, Munadi Ahmad, STFC Rutherford Appleton Lab. (United Kingdom) ..... [11259-68]

**Super-octave Cr:ZnS middle-IR laser with intrinsic nonlinear interferometry**, Sergey Vasilyev, Igor Moskalev, Viktor Smolski, Jeremy Peppers, Mike Mirov, IPG Photonics Corp. (USA); Vladimir V. Fedorov, Dmitry Martyshkin, The Univ. of Alabama at Birmingham (USA); Sergey Mirov, IPG Photonics Corp. (USA) and The Univ. of Alabama at Birmingham (USA); Valentin Gapontsev, IPG Photonics Corp. (USA) ..... [11259-69]

**>27 MW peak power doughnut mode Nd:YAG microchip laser**, Hwan Hong Lim, Institute for Molecular Science (Japan); Takunori Taira, RIKEN Spring-8 Ctr. (Japan) and Institute for Molecular Science (Japan) ..... [11259-70]

**Samarium-doping concentration influence on spectroscopic parameters of Sm:YAG crystal**, Michal Nemeč, Jan Sulc, Helena Jelínková, Alena Zavadilova, Czech Technical Univ. in Prague (Czech Republic); Karel Nejezchleb, Nick Kapitch, Crytur Ltd. (Czech Republic) ..... [11259-71]

**Passive mode-locking of a fs-laser-written Yb:KLuW channel waveguide laser with carbon nanotubes**, Ji Eun Bae, Tae Gwan Park, KAIST (Korea, Republic of); Esrom Kifle, Xavier Mateos, Magdalena Aguiló, Francesc Díaz, Univ. Rovira i Virgili (Spain); Carolina Romero, Javier Rodríguez Vázquez de Aldana, Univ. of Salamanca (Spain); Fabian Rotermund, KAIST (Korea, Republic of) ..... [11259-72]

**Fe:ZnMnTe laser generating around 5  $\mu$ m at 78 K**, Helena Jelínková, Czech Technical Univ. in Prague (Czech Republic); Maxim E. Doroshenko, A. M. Prokhorov General Physics Institute (Russian Federation); Michal Jelínek, Jan Sulc, David Vyhldal, Adam Riha, Czech Technical Univ. in Prague (Czech Republic); Nazar O. Kovalenko, Andrey S. Gerasimenko, Institute for Single Crystals of the NASU (Ukraine) ..... [11259-73]

**High-repetition-rate passively Q-switched Nd:GdTaO<sub>4</sub>/Cr<sup>4+</sup>:YAG 1066 nm laser**, Rengpeng Yan, Yang Liu, Wentao Wu, Xudong Li, Harbin Institute of Technology (China); Fang Peng, Qingli Zhang, Renqin Dou, Anhui Institute of Optics and Fine Mechanics (China) ..... [11259-74]

**Generation of 40 W, 400 fs pulses at 1 MHz repetition rate from efficient, room temperature Yb:YAG double-pass amplifier seeded by fiber CPA system**, Laurynas Veselis, Tadas Bartulevicius, Karolis Madeikis, Andrejus Michailovas, EKSPLA (Lithuania) and Ctr. for Physical Sciences and Technology (Lithuania) ..... [11259-75]

**Efficient nonlinear compression of ultrafast high-power amplifier**, Florent Guichard, Axel Chambinaud, Julien Pouysegur, Alice Odier, Martin Cormier, Yoann Zaouter, Quentin Mocaer, Clemens Hönninger, Eric Mottay, Amplitude Laser Group (France) ..... [11259-76]

**Multi-watt continuous-wave and passively Q-switched Tm:CaYAlO<sub>4</sub> micro-lasers**, Xavier Mateos Ferré, Univ. Rovira i Virgili (Spain); Mengting Chen, Jinan Univ. (China) and Univ. Rovira i Virgili (Spain); Pavel Loiko, ITMO Univ. (Russian Federation); Fangxin Yue, Venkatesan Jambunathan, Antonio Lucianetti, Tomas Mocek, HiLASE Ctr., Institute of Physics (Czech Republic); Josep M. Serres, Francesc Díaz, Magdalena Aguiló, Univ. Rovira i Virgili (Spain); Tae Gwan Park, Ji Eun Bae, Fabian Rotermund, KAIST (Korea, Republic of); Xiaodong Xu, Jiangsu Normal Univ. (China); Jun Xu, Tongji Univ. (China); Shibo Day, Zhenqiang Chen, Jinan Univ. (China); Uwe Griebner, Valentin Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Arkady Major, Univ. of Manitoba (Canada) ..... [11259-77]

**4- $\mu$ m room temperature Fe:ZnSe laser pumped by radiation of mechanically Q-switched Er:YAG**, Krishna Karki, Shova D. Subedi, Dmitry Martyshkin, Vladimir V. Fedorov, Sergey Mirov, The Univ. of Alabama at Birmingham (USA) ..... [11259-78]

**Laser spectroscopic and saturation properties of GR1 centers in synthetic diamond**, Shova D. Subedi, Vladimir V. Fedorov, Sergey Mirov, The Univ. of Alabama at Birmingham (USA); Matthew Markham, Element Six (UK) Ltd. (United Kingdom) ..... [11259-79]

**73-fs SESAM mode-locked Tm,Ho:CNGG laser at 2061 nm**, Yicheng Wang, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Yongguang Zhao, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) and Jiangsu Normal Univ. (China); Zhongben Pan, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) and Institute of Chemical Materials (China); Soile Suomalainen, Antti Härkönen, Mircea Guina, Tampere Univ. (Finland); Uwe Griebner, Valentin Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) ..... [11259-80]

**High power coherent beam combination laser system using solid-medium stimulated Brillouin scattering phase conjugate mirrors**, Seongwoo Cha, Hong Jin Kong, KAIST (Korea, Republic of) ..... [11259-81]

**Compensation of thermal lensing in flashlamp pump Er:YAG lasers**, Scott J. Hamlin, MegaWatt Lasers, Inc. (USA); Ramesh Shori, Univ. of California, Los Angeles (USA) ..... [11259-82]

**High-energy, high-average-power 1-kHz burst-mode picosecond laser system**, Ning Ma, Ce Yang, Meng Chen, Beijing Univ. of Technology (China) ..... [11259-83]

**Spectral density contrast in DPSS and ECD lasers for quantum and other narrow-linewidth applications**, Bence Szutor, Fedor Karpushko, UniKLasers Ltd. (United Kingdom) ..... [11259-84]

WEDNESDAY 5 FEBRUARY

SESSION 5

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... WED 8:00 AM TO 10:00 AM

Pulsed Lasers I

Session Chair: **W. Andrew Clarkson**, Optoelectronics Research Ctr. (United Kingdom)

- 8:00 am: **An Yb<sup>3+</sup>: YAG slab-based design for the amplification of pulses in the range of 20mJ with gains up to more than 20dB**, Alain Jolly, ALPhANOV (France) and CEA-CESTA (France); Johan Bouillet, Guillaume Machinet, ALPhANOV (France) ..... [11259-22]
- 8:20 am: **Sub-ns pulse shaping of microchip laser under amplification**, Taisuke Kawasaki, RIKEN (Japan); Vincent Yahia, Institute for Molecular Science (Japan); Takunori Taira, RIKEN (Japan) ..... [11259-23]
- 8:40 am: **Passively Q-switched Nd:YVO4 laser operating at 914 nm**, Marco Nägele, Univ. Stuttgart (Germany) and Robert Bosch GmbH (Germany); Klaus Stoppel, Robert Bosch GmbH (Germany); Thomas Dekorsy, Univ. Stuttgart (Germany) ..... [11259-24]
- 9:00 am: **Ultra-compact >100kHz Q-switched Alexandrite lasers**, Goronwy Tawy, Michael J. Damzen, Imperial College London (United Kingdom) ..... [11259-25]
- 9:20 am: **Control of the temporal shape of nanosecond long lasers using feedback loops**, Pedro Oliveira, Laurence Bradley, Marco Galimberti, Ian Musgrave, STFC Rutherford Appleton Lab. (United Kingdom) ... [11259-26]
- 9:40 am: **Optically synchronized stable sub-nanosecond Nd:YAG pump laser for low-jitter optical parametric chirped pulse amplification**, Yasuhiro Miyasaka, Hiromitsu Kiriya, Maki Kishimoto, Michiaki Mori, Kotaro Kondo, Kando Masaki, Kiminori Kondo, National Institutes for Quantum and Radiological Science and Technology (Japan) ..... [11259-27]
- Coffee Break ..... Wed 10:00 am to 10:30 am

SESSION 6

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 12:30 PM

Pulsed Lasers II

Session Chair: **W. Andrew Clarkson**, Optoelectronics Research Ctr. (United Kingdom)

- 10:30 am: **Fiber-coupled high-power diode-pumped solid-state lasers for laser cleaning**, Yong Wang, Dewang Yang, Yuan Ren, Qilu Univ. of Technology (China) ..... [11259-28]
- 10:50 am: **A fiber/solid-state hybrid laser system for hydrogen ion beam neutralization at the spallation neutron source**, Yun Liu, Abdurahim Rakhman, Oak Ridge National Lab. (USA) ..... [11259-29]
- 11:10 am: **Compact, multi-wavelength, passively Q-switched laser by means of volume Bragg gratings**, Lam H. Mach, Evan R. Hale, Oussama Mhibik, Ivan Divliansky, Leonid Glebov, Univ. of Central Florida (USA) [11259-30]
- 11:30 am: **High average power passively Q-switched Yb:YAG micro-laser**, Chris McIntosh, Alan D. Hays, U.S. Army Combat Capabilities Development Command C5ISR (USA); Stephen R. Chinn, Fibertek, Inc. (USA); Lew Goldberg, U.S. Army Combat Capabilities Development Command C5ISR (USA) [11259-31]
- 11:50 am: **Active Q-switch Tm:YLF based on electro-optic KLTN**, Salman Noach, Rotem Nahear, Jerusalem College of Technology (Israel); Yehuda Vidal, Aharon Agranat, The Hebrew Univ. of Jerusalem (Israel) ..... [11259-32]
- 12:10 pm: **Active pulse underwater vision system**, Mariia Khodakovskaia, Vitalii Khodakovskii, Bauman Moscow State Technical Univ. (Russian Federation) ..... [11259-33]
- Lunch/Exhibition Break ..... Wed 12:30 pm to 2:00 pm

SESSION 7

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... WED 2:00 PM TO 3:00 PM

Laser Material Characterization I

Session Chair: **Nikolay E. Ter-Gabrielyan**, U.S. Army Combat Capabilities Development Command (USA)

- 2:00 pm: **Yb concentration influence of on thermal lensing in YbLuAG and YbYAG lasers at cryogenic temperatures: Modeling and experimental study**, Karel Veselský, Jan Šulc, Helena Jelínková, Czech Technical Univ. in Prague (Czech Republic); Karel Nejezchleb, Crytur Ltd. (Czech Republic) ..... [11259-34]
- 2:20 pm: **Efficient laser operation of Yb:Lu3Al5O12 transparent ceramics fabricated from laser ablated nanopowders**, Liza Basyrova, Univ. Rovira i Virgili (Spain) and ITMO Univ. (Russian Federation); Pavel Loiko, ITMO Univ. (Russian Federation); Roman Maksimov, Ural Federal Univ. (Russian Federation) and Institute of Electrophysics (Russian Federation); Vladislav Shitov, Institute of Electrophysics (Russian Federation); Josep M. Serres, Magdalena Aguiló, Francesc Diaz, Univ. Rovira i Virgili (Spain); Uwe Griebner, Valentin Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Xavier Mateos, Univ. Rovira i Virgili (Spain) ..... [11259-35]
- 2:40 pm: **Growth, spectroscopy and laser operation of Yb3+,Na+/Li+-codoped CNGG-type garnets promising for ultrafast lasers**, Zhongben Pan, Institute of Chemical Materials (China) and Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Pavel Loiko, Univ. de Caen Basse-Normandie (France); Josep M. Serres, Univ. Rovira i Virgili (Spain); Hualei Yuan, Xiaojun Dai, Huaqiang Cai, Institute of Chemical Materials (China); Magdalena Aguiló, Francesc Diaz, Univ. Rovira i Virgili (Spain); Patrice Camy, Univ. de Caen Basse-Normandie (France); Yicheng Wang, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) and Ruhr-Univ. Bochum (Germany); Uwe Griebner, Valentin Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Xavier Mateos, Univ. Rovira i Virgili (Spain) ..... [11259-36]
- Coffee Break ..... Wed 3:00 pm to 3:30 pm

SESSION 8

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... WED 3:30 PM TO 6:10 PM

Laser Material Characterization II

Session Chair: **Nikolay E. Ter-Gabrielyan**, U.S. Army Combat Capabilities Development Command (USA)

- 3:30 pm: **Watt level performance of ductile diced PPLN waveguides**, Lewis G. Carpenter, Sam A. Berry, Peter G. R. Smith, Corin B. E. Gawith, Univ. of Southampton (United Kingdom) ..... [11259-37]
- 3:50 pm: **Testing of the 5-cm aperture ceramic Yb:YAG edge-pumped disk laser amplifier**, John Vetrovec, David M. Filgas, Drew A. Copeland, Roger R. Thibault, Suraj J. Thiagarajan, Aqwest, LLC (USA); Eldridge Briscoe, General Atomics Aeronautical Systems, Inc. (USA) ..... [11259-38]
- 4:10 pm: **Time-gated measurements of fusion-class laser beam profiles**, Thomas E. Lanier, Simon J. Cohen, Jean-Michel G. Di Nicola, Michael A. Erickson, James A. Folta, Abraham D. Handler, Emily R. Hurd, Brian L. Olejniczak, Tyler H. Tate, Clifford C. Widmayer, Steven T. Yang, Paul J. Wegner, Lawrence Livermore National Lab. (USA) ..... [11259-39]
- 4:30 pm: **Thermal lensing in diamond at 1 kW Raman laser power**, Robert J. Williams, Sergei Antipov, Ondrej Kitzler, David J. Spence, Rich P. Mildren, Macquarie Univ. (Australia) ..... [11259-40]
- 4:50 pm: **Spatially resolved B-integral measurements on the NIF laser**, Michael A. Erickson, Simon J. Cohen, Jean-Michel G. Di Nicola, James A. Folta, Abraham D. Handler, Thomas E. Lanier, Brian L. Olejniczak, Clifford C. Widmayer, Wade Williams, Steven T. Yang, Paul J. Wegner, Lawrence Livermore National Lab. (USA) ..... [11259-41]
- 5:10 pm: **Precision diagnostic system enhancements and recommissioning for advanced laser beam characterization at the National Ignition Facility**, Abe Handler, Simon J. Cohen, Jean-Michel G. Di Nicola, Jim Folta, Steven Yang, Paul J. Wegner, Lawrence Livermore National Lab. (USA) ..... [11259-42]
- 5:30 pm: **Tunable 4.35-4.67 μm Zn<sub>(1-x)</sub>Mn<sub>(x)</sub>Se:Fe<sup>2+</sup>,Cr<sup>2+</sup> (x=0.3) laser at 78 K pumped by a 1.94 μm Tm fiber laser through Cr<sup>2+</sup> -> Fe<sup>2+</sup> energy transfer**, Adam Riha, Czech Technical Univ. in Prague (Czech Republic); Maxim E. Doroshenko, A. M. Prokhorov General Physics Institute (Russian Federation); Helena Jelínková, Michal Jelínek, Michal Nemeč, Václav Kubeček, Miroslav Cech, Czech Technical Univ. in Prague (Czech Republic); Nazar O. Kovalenko, Andrey S. Gerasimenko, Institute for Single Crystals of the NASU (Ukraine) ..... [11259-43]

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5:50 pm: **Spectroscopic characterization of Fe:MgAl<sub>2</sub>O<sub>4</sub>, Fe:ZnAl<sub>2</sub>O<sub>4</sub> and Fe:InP crystals for mid-IR laser applications**, Bryce Coyne, Krishna Karki, The Univ. of Alabama at Birmingham (USA); Stanislav Balabanov, Alexander Belyaev, G. G. Devyatkykh Institute of Chemistry of High-Purity Substances (Russian Federation); Viktor Smolski, IPG Photonics Corp. (USA); Vladimir V. Fedorov, The Univ. of Alabama at Birmingham (USA) and IPG Photonics Corp. (USA); Sergey Mirov, The Univ. of Alabama at Birmingham (USA) and IPG Photonics Corp. (USA) . . . . . [11259-44]

## THURSDAY 6 FEBRUARY

### SESSION 9

LOCATION: ROOM 203 (LEVEL 2 SOUTH) . . . . . THU 8:00 AM TO 10:00 AM

#### Ultrafast Lasers I

Session Chair: **W. Andrew Clarkson**,  
Optoelectronics Research Ctr. (United Kingdom)

8:00 am: **Towards kW average power ultrafast thin-disk amplifiers**, Knut Michel, Christian Grebing, Clemens Herkommer, Robert Jung, Sandro Klingebiel, Peter Krötz, Stephan Prinz, Catherine Y. Teisset, Christoph Wandt, Thomas Metzger, TRUMPF Scientific Lasers GmbH + Co., KG (Germany) . . . . . [11259-45]

8:20 am: **Next generation of high-power industrial ultrafast lasers based on InnoSlab technology**, Dirk H. Sutter, TRUMPF Laser GmbH (Germany); Ulf Quentin, Florian Kanal, TRUMPF Laser- und Systemtechnik GmbH (Germany); Hans-Jürgen Otto, TRUMPF Laser GmbH (Germany); Jan Dolkemeyer, AMPHOS GmbH (Germany); Raphael Gebbs, Marc Sailer, TRUMPF Laser GmbH (Germany); Jonas Kleiner, TRUMPF Laser- und Systemtechnik GmbH (Germany); Aleksander Budnicki, TRUMPF Laser GmbH (Germany); Claus Schnitzler, Torsten Mans, AMPHOS GmbH (Germany); Alexander Killi, TRUMPF Laser GmbH (Germany) . . . . . [11259-46]

8:40 am: **Influence of pump beam shaping and noise on performance of direct diode-pumped Ti:sapphire laser**, Muhammad Tahir Jamal, Anders Kragh Hansen, Peter Eskil Andersen, Ole Bjarlin Jensen, Technical Univ. of Denmark (Denmark) . . . . . [11259-47]

9:00 am: **New Vulcan PetaWatt beamline: PW class fully OPCPA laser system for betatron imaging**, Pedro Oliveira, Mario Galletti, Giedre Archipovaite, Marco Galimberti, Munadi Ahmad, Waseem Shaikh, Ian Musgrave, Cristina Hernandez-Gomez, STFC Rutherford Appleton Lab. (United Kingdom) . . . . . [11259-48]

9:20 am: **Femtosecond 100 W-level OPCPAs from near-IR to short-wave-IR wavelengths**, Robert Riedel, Michael Schulz, Ivanka Grguras, Torsten Golz, Jan H. Buss, Mark J. Prandolini, Class 5 Photonics GmbH (Germany) . . . . . [11259-49]

9:40 am: **Robust ultrafast laser with fiber amplification and pulse recompression**, Florian Emaury, Menhir Photonics AG (Switzerland); Fabian Luetolf, Guillaume Basset, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland); Benjamin Rudin, Menhir Photonics AG (Switzerland); Bojan Resan, Fachhochschule Nordwestschweiz (Switzerland) . . . . . [11259-50]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

### SESSION 10

LOCATION: ROOM 203 (LEVEL 2 SOUTH) . . . . . THU 10:30 AM TO 12:10 PM

#### Ultrafast Lasers II

Session Chair: **Helena Jelínková**, Czech  
Technical Univ. in Prague (Czech Republic)

10:30 am: **Operation of a novel, dual function thin slab ultrafast amplifier at 1030nm, 515nm and 343nm**, Jason R. Lee, Rolf B. Birch, Benjamin Fulford, David Birkin, Luxinar Ltd. (United Kingdom) . . . . . [11259-51]

10:50 am: **0.5 terawatt laser based on a hybrid architecture for high energy diode-pumped lasers delivering sub-500 fs pulses**, Magali Durand, Jean-Gabriel Brisset, Pierre Sevilano, Abdelhak Saci, Bastien Gavory, Antoine Courjaud, Emilien Gontier, Amplitude Systèmes (France) . . . . . [11259-52]

11:10 am: **10 petawatt lasers for extreme light applications**, Francois Lureau, Guillaume Matras, Sebastien Laux, Christophe Radier, Olivier Chalus, Olivier Casagrande, Christophe Derycke, Sandrine Ricaud, Laurent Boudjemaa, Christophe Simon-Boisson, Thales LAS France SAS (France); Ioan Dancus, Daniel Ursescu, Institutul National de Cercetare-Dezvoltare pentru Fizica si Inginerie Nucleara Horia Hulubei (Romania) . . . . . [11259-53]

11:30 am: **High temporal contrast, diode pumped, femtosecond laser providing 200fs, 1053nm pulses for seeding large scale Nd:glass laser systems**, Gabor Kulcsar, Erdal Schranz, Daniel Kopf, MONTFORT Laser GmbH (Austria) . . . . . [11259-54]

11:50 am: **High-power OPCPA at 800 nm**, Torsten Golz, Ivanka Grguras, Jan H. Buss, Robert Riedel, Michael Schulz, Class 5 Photonics GmbH (Germany) . . . . . [11259-55]

Lunch/Exhibition Break . . . . . Thu 12:10 pm to 1:40 pm

### SESSION 11

LOCATION: ROOM 203 (LEVEL 2 SOUTH) . . . . . THU 1:40 PM TO 3:10 PM

#### UV-VIS Lasers

Session Chair: **Helena Jelínková**,  
Czech Technical Univ. in Prague (Czech Republic)

1:40 pm: **2 kW cw laser in the green wavelength regime for copper welding (Invited Paper)**, Sebastian Pricking, Eva-Maria Dold, Elke Kaiser, Alexander Killi, TRUMPF Laser GmbH (Germany); Stefanie Bisch, Sebastian Zaske, Frank Baumann, Rüdiger Brockmann, TRUMPF Laser- und Systemtechnik GmbH (Germany) . . . . . [11259-56]

2:10 pm: **A promising approach for sodium guide star laser: Diamond Raman and intracavity second harmonic generation**, Xuezhong Yang, Ondrej Kitzler, Macquarie Univ. (Australia); Rich P. Mildren, David J. Spence, Macquarie Univ. (Australia); Yan Feng, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [11259-57]

2:30 pm: **Multiple and selectable wavelength green laser generation based on coaxial diode-end-pumping**, Yang Liu, Kai Zhong, Quan Sheng, Kefei Liu, Hongzhan Qiao, Jian-Quan Yao, Tianjin Univ. (China) . . . . . [11259-58]

2:50 pm: **High efficiency gallium nitride laser diode pumped CW ruby laser**, Bill F. Krupke, WFK Lasers, LLC (USA); Jason Zweiback, Triangulum Technologies, LLC (USA) . . . . . [11259-59]

# CONFERENCE 11260

LOCATION: ROOM 205 (LEVEL 2 SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11260

## Fiber Lasers XVII: Technology and Systems

Conference Chair: **Liang Dong**, Clemson Univ. (USA)

Conference Co-Chair: **Michalis N. Zervas**, Optoelectronics Research Ctr. (United Kingdom)

Program Committee: **Adrian L. Carter**, Coherent | Nufern (Australia); **Fabio Di Teodoro**, Raytheon Co. (USA); **Mark Dubinskii**, U.S. Army Research Lab. (USA); **Heike Ebendorff-Heidepriem**, The Univ. of Adelaide (Australia); **Gregory D. Goodno**, Northrop Grumman Aerospace Systems (USA); **Ingmar Hartl**, Deutsches Elektronen-Synchrotron (Germany); **Clifford Headley III**, OFS Fitel LLC (USA); **Stuart D. Jackson**, Macquarie Univ. (Australia); **Cesar Jauregui-Misas**, Friedrich-Schiller-Univ. Jena (Germany); **Clémence Jollivet**, Coherent | Nufern (USA); **Manoj Kanskar**, nLIGHT, Inc. (USA); **Martin Dybendal Maack**, NKT Photonics A/S (Denmark); **Peter F. Moulton**, MIT Lincoln Lab. (USA); **Martin H. Muendel**, Lumentum (USA); **Craig A. Robin**, U.S. Army Space and Missile Defense Command (USA); **Bryce Samson**, IPG Photonics Corp. (USA); **Lawrence Shah**, Luminar Technologies, Inc. (USA); **L. Brandon Shaw**, U.S. Naval Research Lab. (USA); **Wei Shi**, Tianjin Univ. (China); **Akira Shirakawa**, The Univ. of Electro-Communications (Japan); **Paul Steinvurzel**, The Aerospace Corp. (USA); **V. R. Supradeepa**, Ctr. for Nano Science and Engineering (CeNSE) (India); **Pu Wang**, Beijing Univ. of Technology (China); **Yoann Zaouter**, Amplitude Systèmes (France); **Pu Zhou**, National Univ. of Defense Technology (China)

Conference Co-Sponsors:



### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... MON 8:00 AM TO 10:30 AM

#### kW-Class Fiber Lasers and Amplifiers I

Session Chair: **Adrian L. Carter**, Coherent | Nufern (USA)

8:00 am: **One decade of fiber-lasers in industrial applications: sheet-metal cutting** (*Invited Paper*), Eckard Deichsel, Bystronic Laser AG (Switzerland) ..... [11260-1]

8:30 am: **High-efficient kW-level single-mode Yb fiber lasers in all-fiber format with diffraction-limited beam at wavelengths in 1000 nm to 1030 nm range** (*Invited Paper*), Nikolai Platonov, Oleg Shkurikhin, IPG Photonics Corp. (USA); Valentin Fomin, IPG Laser GmbH (Germany); Daniil Myasnikov, IRE-Polus Co. (Russian Federation); Roman Yagodkin, IPG Photonics Corp. (USA); Anton Ferin, Alexey Doronkin, IPG Laser GmbH (Germany); Ivan Ulyanov, IRE-Polus Co. (Russian Federation); Valentin Gapontsev, IPG Photonics Corp. (USA) ..... [11260-2]

9:00 am: **Spectral brightness scaling of kW fiber amplifiers via nonlinear linewidth narrowing** (*Invited Paper*), Gregory D. Goodno, Joshua Rothenberg, Northrop Grumman Aerospace Systems (USA) ..... [11260-3]

9:30 am: **High power narrow-linewidth Raman amplifier and its limitation**, Victor Distler, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Friedrich Möller, Gonzalo Palma-Vega, Thomas Schreiber, Ramona Eberhardt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Maximilian Strecker, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-4]

9:50 am: **Wavelength flexible, kW-level narrow linewidth fibre laser based on 7GHz PRBS phase modulation**, Wei Ying Lim, Kai Wen Seah, Yong'En Joash Ye, Beng Sing Tan, Chu Perng Seah, DSO National Labs. (Singapore) ..... [11260-5]

10:10 am: **Novel active DC fiber designs mitigating SRS and TMI in industrial lasers operating above 2 kW**, Joshua Bradford, Coherent | Nufern (USA) ..... [11260-6]

Coffee Break. .... Mon 10:30 am to 11:00 am

#### SESSION 2

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... MON 11:00 AM TO 12:00 PM

#### Ultrafast Fiber Lasers and Amplifiers I

Session Chair: **Bryce N. Samson**, IPG Photonics Corp. (USA)

11:00 am: **Compact ultrafast fiber lasers enabling new applications** (*Invited Paper*), David Clark, IPG Photonics Corp. (USA) ..... [11260-7]

11:30 am: **500W, 5mJ, 6fs, CEP-stable few-cycle pulses: An update on the ELI-ALPS HR2 beamline** (*Invited Paper*), Steffen Haedrich, Nico Walther, Marco Kienel, Active Fiber Systems GmbH (Germany); Peter Simon, Laser-Lab. Göttingen e.V. (Germany); Tamás Nagy, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Andreas Blumenstein, Laser-Lab. Göttingen e.V. (Germany); Evgeny Shestae, Robert Klas, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Joachim Buldt, Henning Stark, Friedrich-Schiller-Univ. Jena (Germany); Sven Breikopf, Active Fiber Systems GmbH (Germany); Péter Jójárt, Zoltán Várallyay, Károly Osvay, ELI-ALPS Research Institute (Hungary); Tino Eidam, Active Fiber Systems GmbH (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Helmholtz Institute Jena (Germany) ..... [11260-8]

Lunch Break ..... Mon 12:00 pm to 1:00 pm

#### SESSION 3

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... MON 1:00 PM TO 3:00 PM

#### Coherent Combination of Fiber Lasers

Session Chair: **Fabio Di Teodoro**, Raytheon Co. (USA)

1:00 pm: **Laser development at MIT Lincoln Laboratory** (*Invited Paper*), Tso Yee Fan, MIT Lincoln Lab. (USA) ..... [11260-9]

1:30 pm: **7.2-kW ultrafast fiber laser based on coherent combination** (*Invited Paper*), Michael Müller, Christopher Aleshire, Henning Stark, Joachim Buldt, Albrecht Steinkopff, Friedrich-Schiller-Univ. Jena (Germany); Arno Klenke, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Elissa Haddad, François Légaré, Institut National de la Recherche Scientifique (Canada); Andreas Tünnermann, Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-10]

2:00 pm: **Reinforcement learning for tiled aperture beam combining**, Henrik Tünnermann, Akira Shirakawa, The Univ. of Electro-Communications (Japan) ..... [11260-11]

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2:20 pm: **Investigation of the thermo-optical behavior of multicore fibers used in coherently combined fiber laser systems**, Albrecht Steinkopff, Cesar Jauregui-Misas, Friedrich-Schiller-Univ. Jena (Germany); Arno Klenke, Helmholtz Institute Jena (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Christopher Aleshire, Friedrich-Schiller-Univ. Jena (Germany); Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Helmholtz Institute Jena (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) . . . . [11260-12]

2:40 pm: **Simplification strategies for segmented-mirror splitters in multicore fiber CBC systems**, Arno Klenke, Helmholtz Institute Jena (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Michael Müller, Henning Stark, Friedrich-Schiller-Univ. Jena (Germany); Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11260-13]  
Coffee Break. . . . . Mon 3:00 pm to 3:30 pm

## LASE PLENARY SESSION

**LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . . MON 3:30 PM TO 5:40 PM**

- 3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)
- 3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)
- 3:40 pm: **VCSEL: Born Small and Grown Big (Plenary)**  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)
- 4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources (Plenary)**  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)
- 5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science (Plenary)**  
**Robert L. Byer**, Stanford Univ. (USA)

## TUESDAY 4 FEBRUARY

### SESSION 4

**LOCATION: ROOM 205 (LEVEL 2 SOUTH) . . . . . TUE 8:00 AM TO 10:00 AM**

#### Thulium Doped Fiber Lasers and Amplifiers I

Session Chair: **Stuart D. Jackson**, Macquarie Univ. (Australia)

- 8:00 am: **Cladding-pumped nested-ring Tm fiber laser with 131 W single-mode output at 1907 nm**, Matthew J. Barber, Peter C. Shardlow, Pranabesh Barua, Jayanta K Sahu, Andy Clarkson, Univ. of Southampton (United Kingdom) . . . . . [11260-14]
- 8:20 am: **47-W 1726-nm operation of a thulium fiber laser pumped in-band by an erbium-only fiber laser**, Mark D. Burns, Peter C. Shardlow, Pranabesh Barua, Thomas L. Jefferson-Brain, Jayanta K. Sahu, William A. Clarkson, Optoelectronics Research Ctr. (United Kingdom) and Univ. of Southampton (United Kingdom) . . . . . [11260-15]
- 8:40 am: **Efficient cladding pump Tm:Ho co-doped fiber laser for operation in the 2.1 microns region**, Norberto J. Ramirez Martínez, Miguel M. A. Núñez Velázquez, Jayanta K. Sahu, Optoelectronics Research Ctr. (United Kingdom) . . . . . [11260-16]
- 9:00 am: **Watt-class optical parametric amplification driven by a thulium-doped fiber laser in the molecular fingerprint region**, Tobias Heuermann, Martin Gebhardt, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Ziyao Wang, Friedrich-Schiller-Univ. Jena (Germany); Christian Gaida, Active Fiber Systems GmbH (Germany); Frédéric Maes, Univ. Laval (Canada); Cesar Jauregui, Friedrich-Schiller-Univ. Jena (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) . . . . . [11260-17]
- 9:20 am: **Cavity requirements for optimizing Tm/Ho-doped coaxial fiber laser systems**, Krysta A. Boccuzzi, The Institute of Optics, Univ. of Rochester (USA); G. Alex Newburgh, U.S. Army Research Lab. (USA); John R. Marcante, The Institute of Optics, Univ. of Rochester (USA) . . . . . [11260-18]

9:40 am: **108-W average power ultrashort pulses with GW-level peak power from a Tm-doped fiber CPA system**, Ziyao Wang, Friedrich-Schiller-Univ. Jena (Germany); Tobias Heuermann, Martin Gebhardt, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Christian Gaida, Friedrich-Schiller-Univ. Jena (Germany) and Active Fiber Systems GmbH (Germany); Cesar Jauregui, Friedrich-Schiller-Univ. Jena (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz-Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) . . . . . [11260-19]

Coffee Break. . . . . Tue 10:00 am to 10:30 am

### SESSION 5

**LOCATION: ROOM 205 (LEVEL 2 SOUTH) . . . . . TUE 10:30 AM TO 12:00 PM**

#### Ultrafast Fiber Lasers and Amplifiers II

Session Chair: **Ingmar Hartl**, Deutsches Elektronen-Synchrotron (Germany)

- 10:30 am: **Coherent beam combining of 60 femtosecond fiber amplifiers (Invited Paper)**, Ihsan Fsaifes, Louis Daniault, Séverine Bellanger, Matthieu Veinhard, Ecole Polytechnique (France); Jérôme Bourderionnet, Christian Larat, Eric Lallier, Thales Research & Technology (France); Eric Durand, Thales LAS France SAS (France); Arnaud Brignon, Thales Research & Technology (France); Jean-Christophe Chanteloup, Ecole Polytechnique (France) . . . . . [11260-20]
- 11:00 am: **Energetic ultrafast source tunable between 940 to 1250 nm for multi-photon microscopy**, Yang Yu, Xidian Univ. (China) and Institute of Physics (China); Shaobo Fang, Hao Teng, Institute of Physics (China); Jiangfeng Zhu, Jun-Li Wang, Xidian Univ. (China); Guoqing Chang, Institute of Physics (China); Zhiyi Wei, Institute of Physics (China) and Xidian Univ. (China)[11260-21]
- 11:20 am: **Generation of megawatt-class soliton at 1680 nm in a flexible Bragg fiber**, Hugo Delahaye, Geoffroy Granger, XLIM (France); Dmitry Gaponov, Laure Lavoute, Mathieu Jossent, NOVAE (France); Svetlana S. Aleshkina, Mikhail Salganskii, Mikhail E. Likhachev, Fiber Optics Research Ctr. (Russian Federation); Denis S. Lipatov, G. G. Devyatikh Institute of Chemistry of High-Purity Substances (Russian Federation); Sebastien Février, XLIM (France) . . . . . [11260-22]
- 11:40 am: **Ytterbium doped multicore fiber saturable absorber for high energy ultrafast fiber lasers**, Stefan Gausmann, Md. Selim Habib, Jose Enrique Antonio-Lopez, Rodrigo Amezcua-Correa, Axel Schülzgen, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . [11260-23]
- Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:20 pm

### SESSION 6

**LOCATION: ROOM 205 (LEVEL 2 SOUTH) . . . . . TUE 1:20 PM TO 3:00 PM**

#### Ultrafast Fiber Lasers and Amplifiers III

Session Chair: **Yoann Zaouter**, Amplitude Systèmes (France)

- 1:20 pm: **Amplification of ultrafast pulses in an extended Mamyshev regenerator**, Paul Reppen, Dieter Wandt, Laser Zentrum Hannover e.V. (Germany); Uwe Morgner, Leibniz Univ. Hannover (Germany); Jörg Neumann, Dietmar Kracht, Laser Zentrum Hannover e.V. (Germany) . . . . . [11260-24]
- 1:40 pm: **Bidirectional mode-locked all-normal dispersion fiber laser**, Bowen Li, Shu-Wei Huang, Univ. of Colorado Boulder (USA) . . . . . [11260-25]
- 2:00 pm: **Compact all-fiber supercontinuum source with high stability**, Philip G. Westergaard, OFS Fitel Denmark ApS (Denmark) . . . . . [11260-26]
- 2:20 pm: **Self-similar spatiotemporal mode-locked fiber laser**, Ugur Tegin, Eirini Kakkava, Babak Rahmani, Demetri Psaltis, Christophe Moser, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11260-27]
- 2:40 pm: **1020-1064 nm wavelength-tunable all polarization maintaining mode-locked fiber laser with a programmable optical filter**, Masanori Nishiura, Saitama Univ. (Japan) and Sevansix Inc. (Japan); Tatsutoshi Shioda, Saitama Univ. (Japan) . . . . . [11260-28]
- Coffee Break. . . . . Tue 3:00 pm to 3:30 pm

SESSION 7

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... TUE 3:30 PM TO 5:40 PM

**Thulium Doped Fiber Lasers and Amplifiers II**

Session Chair: **Clémence Jollivet**, Coherent | Nufern (USA)

3:30 pm: **Soft x-ray high order harmonic generation driven by high repetition rate ultrafast thulium-doped fiber lasers** (*Invited Paper*), Martin Gebhardt, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Christian Gaida, Friedrich-Schiller-Univ. Jena (Germany); Tobias Heuermann, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Ziyao Wang, Friedrich-Schiller-Univ. Jena (Germany); Robert Klas, Alexander Kirsche, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Steffen Hädrich, Friedrich-Schiller-Univ. Jena (Germany) and Active Fiber Systems GmbH (Germany); Cesar Jauregui, Friedrich-Schiller-Univ. Jena (Germany); Jan Rothhardt, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-29]

4:00 pm: **1720-nm narrow-linewidth all-fiber ring laser based on thulium-doped fiber**, Junxiang Zhang, Quan Sheng, Shuai Sun, Chaodu Shi, Tianjin Univ. (China); Shijie Fu, Wyant College of Optical Sciences (USA); Wei Shi, Jianquan Yao, Tianjin Univ. (China) ..... [11260-30]

4:20 pm: **Single-frequency hybrid Brillouin-thulium fiber laser with kilohertz linewidth**, Chaodu Shi, Quan Sheng, Tianjin Univ. (China); Shijie Fu, The Univ. of Arizona (USA); Shuai Sun, Junxiang Zhang, Wei Shi, Jianquan Yao, Tianjin Univ. (China) ..... [11260-31]

4:40 pm: **High power, beam combinable thulium-doped all-fiber amplifier at 2.11 μm**, Joel M. Solomon, Air Force Research Lab. (USA) and The Univ. of North Carolina at Charlotte (USA); Brian Anderson, Angel Flores, Air Force Research Lab. (USA) ..... [11260-32]

5:00 pm: **Novel 2-μm broadband polarization-maintaining single clad Tm-doped fiber amplifier**, Robert E. Tench, Jean-Marc Delavaux, Cybel LLC (USA); Thierry Robin, Beniot Cadier, William Renaud, iXblue SAS (France) ..... [11260-33]

5:20 pm: **Toward high peak power ultrashort pulses using normal dispersion thulium fiber in all-fiber amplifier**, Yuhao Chen, ShaoXiang Chen, Kun Liu, Sidharthan Raghuraman, Qi Jie Wang, Dingyuan Tang, Seongwoo Yoo, Nanyang Technological Univ. (Singapore) ..... [11260-35]

POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

Poster Setup: Tuesday 10:00 AM–5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWVPosterGuidelines>

**Eigenvalue management in dispersion oscillating fibers**, Alexey A. Sysoliatin, Konstantin Gochelashvili, Andrew Konukhov, Leonid Melnikov, A. M. Prokhorov General Physics Institute (Russian Federation) ..... [11260-79]

**Comprehensive study on the parameters affecting the line-width and stability of SOA-based SLM random fiber laser**, Heba A. Shawk, Hussein E. Kotb, National Telecommunication Institute (Egypt); Diaa Khalil, Ain Shams Univ. (Egypt) ..... [11260-80]

**A novel pulsewidth adjustable high energy fiber laser for industrial laser cleaning**, Jianwu Ding, Jinhui Liu, Xi Wei, Xianming Zhang, GW Laser Technology LLC (China) ..... [11260-81]

**Sub 500-kHz single soliton generation in a ring cavity Er-fiber laser**, Luis A. Rodríguez-Morales, Iván Armas-Rivera, Baldemar Ibarra-Escamilla, Manuel Durán Sánchez, Evgeny Kuzin, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) ..... [11260-82]

**Over 10 W 532 nm generation by utilizing PP-Mg:SLT and PM-CW fiber laser based on FBGs**, Kazuma Dobashi, Masayuki Hoshi, Koichi Imai, Junji Hirohashi, Satoshi Makio, Oxide Corp. (Japan) ..... [11260-83]

**Research on picosecond pulsed all-fiber Yb-doped laser with 1.2-GHz repetition rate**, Xiaole Wei, Tianjin Univ. (China); Huai Wei, Beijing Jiaotong Univ. (China); Quan Sheng, Wei Shi, Jianquan Yao, Tianjin Univ. (China) ..... [11260-84]

**Reduction of photodarkening in tandem-pumped Yb-doped silica fibers**, Jongseon Park, Taehyoung Kim, Korea Institute of Industrial Technology (Korea, Republic of); Ji Won Kim, Hanyang Univ. (Korea, Republic of); Hoon Jeong, Korea Institute of Industrial Technology (Korea, Republic of) ..... [11260-85]

**Linear Er-doped fiber Mamyshhev regenerator with high pulse energy generation**, Lou Xing, Toyota Technological Institute (Japan) ..... [11260-86]

**Compact high-power GHz intra-burst repetition rate all-in-fiber CPA system with LMA fiber power amplifier**, Tadas Bartulevicius, Karolis Madeikis, Laurynas Veselis, Andrejus Michailovas, EKSPLA (Lithuania) and Ctr. for Physical Sciences and Technology (Lithuania) ..... [11260-87]

**Multi-gigahertz harmonic mode-locking in all-polarization maintaining fiber laser enabled by Sb<sub>2</sub>Te<sub>3</sub> saturable absorber**, Jakub Boguslawski, Institute of Physical Chemistry (Poland) and Wroclaw Univ. of Science and Technology (Poland); Grzegorz Sobó?, Wroclaw Univ. of Science and Technology (Poland); Rafal Zybała, Warsaw Univ. of Technology (Poland); Jaroslaw Sotor, Wroclaw Univ. of Science and Technology (Poland) . [11260-88]

**Stable harmonic mode locking in all PM-fiber Mamyshhev oscillator**, Bernard Piechal, Institute of Physical Chemistry (Poland); Tomasz Michal Kardas, Fluence sp. z o. o. (Poland); Mateusz Pielach, Institute of Physical Chemistry PAS (Poland); Yuriy Stepanenko, Institute of Physical Chemistry (Poland) ..... [11260-89]

WEDNESDAY 5 FEBRUARY

SESSION 8

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... WED 8:00 AM TO 10:00 AM

**Novel Design and Materials I**

Session Chair: **L. Brandon Shaw**, U.S. Naval Research Lab. (USA)

8:00 am: **All-fibre bandwidth tunable filter for high power fibre lasers**, Jaclyn Chan, Optoelectronics Research Ctr. (United Kingdom); Christophe A. Codemard, SPI Lasers UK Ltd. (United Kingdom); Natasha T. Vukovic, Michalis N. Zervas, Optoelectronics Research Ctr. (United Kingdom) [11260-36]

8:20 am: **Talbot fiber: A poorman’s approach to coherent combining**, Cesar Jauregui-Misas, Albrecht Steinkopff, Friedrich-Schiller-Univ. Jena (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-37]

8:40 am: **Bend insensitivity of large-mode-area CLING fibers**, Krysta A. Boccuzzi, John R. Marcianti, The Institute of Optics, Univ. of Rochester (USA) ..... [11260-38]

9:00 am: **Low-noise, single-frequency 200W fiber amplifier**, Felix Wellmann, Michael Steinke, Laser Zentrum Hannover e.V. (Germany); Nina Bode, Benno Willeke, Max-Planck-Institut für Gravitationsphysik (Germany); Ludger Overmeyer, Leibniz Univ. Hannover (Germany); Peter Wessels, Jörg Neumann, Dietmar Kracht, Laser Zentrum Hannover e.V. (Germany) ..... [11260-39]

9:20 am: **Beating of two FDML lasers in real time**, Christin Grill, Simon Lotz, Torben Blömker, Dominic Kastner, Sebastian Karpf, Wolfgang Draxinger, Univ. zu Lübeck (Germany); Mark Schmidt, Christian Jirauschek, Technische Univ. München (Germany); Robert Huber, Univ. zu Lübeck (Germany) . . . . [11260-40]

9:40 am: **Short-range supercontinuum Lidar for combustion diagnostics**, Abba Saleh, Valmet Technologies Oy (Finland) and Tampere Univ. (Finland); Piotr Ryczkowski, Goery Genty, Juha Toivonen, Tampere Univ. (Finland) ..... [11260-41]

Coffee Break.....Wed 10:00 am to 10:30 am

# CONFERENCE 11260

## SESSION 9

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 12:10 PM

### Mode Instability/Stimulated Thermal Rayleigh Scattering

Session Chair: **Michalis N. Zervas**,  
Optoelectronics Research Ctr. (United Kingdom)

10:30 am: **Mode Instability in coiled fiber amplifiers**, Benjamin G. Ward, Defense Threat Reduction Agency (USA) ..... [11260-42]

10:50 am: **Novel high-speed camera analysis of transverse mode instabilities in rod fiber amplifiers**, Simon L. Christensen, Technical Univ. of Denmark (Denmark) and NKT Photonics A/S (Denmark); Mette M. Johansen, Mattia Michieletto, Marco Triches, Laurent Huot, Martin D. Maack, NKT Photonics A/S (Denmark); Jesper Lægsgaard, Technical Univ. of Denmark (Denmark) ..... [11260-43]

11:10 am: **The sensitivity of the mode instability threshold to different types of intensity noise**, Christoph Stihler, Friedrich-Schiller-Universität Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Cesar Jauregui-Misas, Friedrich-Schiller-Universität Jena (Germany); Sobhy E. Kholaf, Friedrich-Schiller-Universität Jena (Germany) and Helmholtz Institute Jena (Germany); Jens Limpert, Friedrich-Schiller-Universität Jena (Germany) and Helmholtz Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-44]

11:30 am: **Manipulating the heat load distribution by laser gain competition in TMI-limited fiber amplifiers**, Friedrich Möller, Victor Distler, Thomas Schreiber, Ramona Eberhardt, Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-45]

11:50 am: **Mitigation of transverse mode instability with travelling waves in high-power fiber amplifiers**, Cesar Jauregui-Misas, Christoph Stihler, Yiming Tu, Sobhy E. Kholaf, Friedrich-Schiller-Universität Jena (Germany); Jens Limpert, Friedrich-Schiller-Universität Jena (Germany) and Helmholtz Institute Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-46]

Lunch/Exhibition Break ..... Wed 12:10 pm to 1:40 pm

## SESSION 10

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... WED 1:40 PM TO 3:40 PM

### Novel Design and Materials II

Session Chair: **Peter F. Moulton**, MIT Lincoln Lab. (USA)

1:40 pm: **Visible and UV femtosecond pulse light delivery in anti-resonant hollow core fibers**, Mattia Michieletto, Christian Jakobsen, Jens K. Lyngso, Dmitri Oulianov, Marco Triches, Anders S. Olesen, Mette M. Johansen, Rajesh S. Patel, Tara Murphy, Martin D. Maack, NKT Photonics A/S (Denmark) ..... [11260-47]

2:00 pm: **Single-frequency chirally-coupled-core all-fiber amplifier with 100W in a linearly-polarized TEM<sub>00</sub>-mode**, Sven Hochheim, Michael Steinke, Peter Wessels, Omar de Varona Ortega, Laser Zentrum Hannover e.V. (Germany); Joonas Koponen, nLIGHT, Inc., Lohja (Finland); Tyson Lowder, nLIGHT, Inc. (USA); Steffen Novotny, nLIGHT, Inc., Lohja (Finland); Jörg Neumann, Dietmar Kracht, Laser Zentrum Hannover e.V. (Germany) ..... [11260-48]

2:20 pm: **All-fiber mode-locked laser at 0.98  $\mu\text{m}$** , Svetlana S. Aleshkina, Fiber Optics Research Ctr. (Russian Federation); Denis S. Lipatov, G. G. Devyatkykh Institute of Chemistry of High-Purity Substances (Russian Federation); Vladimir V. Velmiskin, Tatiana A. Kochergina, Fiber Optics Research Ctr. (Russian Federation); Andrei Fedotov, Regina Gumenyuk, Tampere Univ. (Finland); Leonid Kotov, Valery Temyanko, Wyant College of Optical Sciences (USA); Mikhail M. Bubnov, Fiber Optics Research Ctr. (Russian Federation); Aleksey N. Guryanov, G. G. Devyatkykh Institute of Chemistry of High-Purity Substances (Russian Federation); Mikhail E. Likhachev, Fiber Optics Research Ctr. (Russian Federation) ..... [11260-49]

2:40 pm: **Power scaling of Ce co-doped, highly doped Yb fiber lasers**, Volker Reichel, Sonja Unger, Jens Kobelke, Jörg Bierlich, Anka Schwuchow, Tina Eschrich, Martin Leich, Matthias Jäger, Katrin Wondraczek, Leibniz-Institut für Photonische Technologien e.V. (Germany); Friedrich Möller, Johannes Nold, Victor Distler, Stefan Kuhn, Nicoletta Haarlammert, Thomas Schreiber, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-50]

3:00 pm: **New microstructured optical fibers for innovative lasers**, Eric Audouard, Eric Mottay, Amplitude Systèmes (France) ..... [11260-51]

3:20 pm: **Design and analysis on optically pumped THz fiber laser based on hollow-core anti-resonant fiber**, Guo Zhang, Shuai Sun, Yao Zhang, Quan Sheng, Wei Shi, Jianquan Yao, Tianjin Univ. (China) ..... [11260-52]

Coffee Break ..... Wed 3:40 pm to 4:10 pm

## SESSION 11

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... WED 4:10 PM TO 5:50 PM

### Novel Design and Materials III

Session Chair: **Wei Shi**, Tianjin Univ. (China)

4:10 pm: **Milliwatt power nonlinearities in polarization maintaining fibers with microsecond response time**, Hanieh Afkhami Radkani, Jean-Claude Diels, The Univ. of New Mexico (USA) ..... [11260-53]

4:30 pm: **High pulse energy, all-fiber supercontinuum source using tapered photonic crystal fibers**, Oyewole Benjamin Efunbajo, NKT Photonics A/S (Denmark) and Technical Univ. of Denmark (Denmark); Patrick Bowen, Peter M. Moselund, NKT Photonics A/S (Denmark); Peter E. Andersen, Ole Bang, Technical Univ. of Denmark (Denmark) ..... [11260-54]

4:50 pm: **ROGUE-based, random distributed feedback lasers**, Frédéric Monet, Victor Lambin-Iezzi, Jean-Sébastien Boisvert, Billie Maubois, Raman Kashyap, Polytechnique Montréal (Canada) ..... [11260-55]

5:10 pm: **Yellow emission from dysprosium-doped ZBLAN fibre laser**, Md Ziaul Amin, Matthew Majewski, Stuart D. Jackson, Macquarie Univ. (Australia) ..... [11260-56]

5:30 pm: **Coherent light source with 106-nm broadband spectrum generated directly from Yb-doped fiber oscillator**, Lei Jin, Shoko Yokokawa, Sze Yun Set, Shinji Yamashita, The Univ. of Tokyo (Japan) ..... [11260-57]

## THURSDAY 6 FEBRUARY

## SESSION 12

LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... THU 8:00 AM TO 10:00 AM

### Mid Infrared Fiber Lasers and Amplifiers

Session Chair: **Heike Ebendorff-Heidepriem**,  
The Univ. of Adelaide (Australia)

8:00 am: **Sub-150-fs all-fiber polarization maintaining tunable laser in the mid-infrared**, Philippe Morin, Simon Boivin, Jean-Paul Yehouessi, ALPhANOV (France); Tiphaine Berberian, Lab. Charles Fabry (France) and Amplitude Laser Group (France); Frédéric Druon, Lab. Charles Fabry (France); Sébastien Vidal, Guillaume Machinet, ALPhANOV (France); Florent Guichard, Yoann Zaouter, Amplitude Laser Group (France); Johan Boulet, ALPhANOV (France) ..... [11260-58]

8:20 am: **All-fiber 600nm amplified spontaneous emission (ASE) source covering the spectral range of 2.75  $\mu\text{m}$  to 3.35  $\mu\text{m}$** , Pin Long, O/E Land Inc. (Canada) and North Photonics Inc. (USA); M. R. K. Soltanian, Institut National de la Recherche Scientifique (Canada) and O/E Land Inc. (Canada); Maria Iulia Comanici, McGill Univ. (Canada); Qammar Goher, O/E Land Inc. (Canada); François Légaré, Institut National de la Recherche Scientifique (Canada) ..... [11260-59]

8:40 am: **Suppressing fiber tip failure: On the road to 100 W-level 3- $\mu\text{m}$  fiber lasers**, Frédéric Maes, Yigit Ozan Aydin, Thomas Poulin, Souleymane Toubou Bah, Vincent Fortin, Réal Vallée, Martin Bernier, Univ. Laval (Canada) ..... [11260-60]

9:00 am: **Diode pumped dysprosium fiber laser**, Matthew R. Majewski, Md Ziaul Amin, Macquarie Univ. (Australia); Thibaud Berthelot, Le Verre Fluoré (France); Stuart D. Jackson, Macquarie Univ. (Australia) ..... [11260-61]

9:20 am: **Mid-IR supercontinuum based vibrational overtone combination spectroscopy**, Kyei Kwarkye, Technical Univ. of Denmark (Denmark); Manoj Kumar Dasa, DTU Fotonik (Denmark); Abubakar I. Adamu, Getinet Woyessa, Christian R. Petersen, Technical Univ. of Denmark (Denmark); Søren B. Engelsen, Univ. of Copenhagen (Denmark); Ole Bang, Technical Univ. of Denmark (Denmark) ..... [11260-62]

9:40 am: **New excitation wavelengths for dysprosium-doped mid-infrared fiber lasers**, Md Ziaul Amin, Stuart D. Jackson, Matthew Majewski, Alex Fuerbach, Robert Woodward, Macquarie Univ. (Australia) ..... [11260-63]

Coffee Break ..... Thu 10:00 am to 10:30 am

**SESSION 13**

**LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... THU 10:30 AM TO 11:30 AM**

**Eye-Safe Fiber Lasers and Amplifiers**

Session Chair: **Mark Dubinskii**,

U.S. Army Combat Capabilities Development Command (USA)

10:30 am: **Hundred-watt CW and Joule level pulsed output from Raman fiber laser in 1.7- $\mu$ m band**, Andrew Grimes, OFS Fitel, LLC (USA); Anand Hariharan, OFS (USA); Simona Ovtar, Poul Kristensen, Philip G. Westergaard, OFS Fitel Denmark ApS (Denmark); Steven Rako, Cory Baumgarten, Robert C. Stoneman, Arete Associates (USA); Jeffrey W. Nicholson, OFS Fitel, LLC (USA) ..... [11260-64]

10:50 am: **High power single frequency 2090-nm Ho<sup>3+</sup> doped MOPA**, Mateusz Wyszomolek, Peter Wessels, Jörg Neumann, Laser Zentrum Hannover e.V. (Germany); Uwe Morgner, Laser Zentrum Hannover e.V. (Germany) and Leibniz Univ. Hannover (Germany); Dietmar Kracht, Laser Zentrum Hannover e.V. (Germany)..... [11260-65]

11:10 am: **Investigation of gamma radiation influence on active Er<sup>3+</sup>-doped optical fiber amplifiers**, Mateusz Wyszomolek, Laser Zentrum Hannover e.V. (Germany); Bogusz Stepak, Wroclaw Univ. of Science and Technology (Poland); Piotr Wilk, Wroclawski Park Technologiczny S.A. (Poland); Adam Wasilewski, Slawomir Wronka, National Ctr. for Nuclear Research (Poland); Michael Steinke, Omar de Varona Ortega, Peter Wessels, Dietmar Kracht, Jörg Neumann, Laser Zentrum Hannover e.V. (Germany); Jacek Glowinkowski, Wroclawski Park Technologiczny S.A. (Poland); Kate Tuck, Mark Hill, Fibercore Ltd. (United Kingdom); Uwe Morgner, Leibniz Univ. Hannover (Germany) ..... [11260-66]

Lunch/Exhibition Break ..... Thu 11:30 am to 1:00 pm

**SESSION 14**

**LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... THU 1:00 PM TO 3:00 PM**

**High Peak Power/High Energy Fiber Amplifiers**

Session Chair: **Clifford E. Headley III**, OFS Fitel, LLC (USA)

1:00 pm: **Monolithic fluorine-codoped Yb amplifier for megawatt peak power generation and high beam quality**, Martin Leich, André Kalide, Tina Eschrich, Martin Lorenz, Anka Schwuchow, Jens Kobelke, Jörg Bierlich, Katrin Wondraczek, Leibniz-Institut für Photonische Technologien e.V. (Germany); Dörte Schönfeld, Andreas Langner, Clemens Schmitt, Jaqueline Plass, Gerhard Schötz, Heraeus Quarzglas GmbH & Co. KG (Germany); Matthias Jäger, Leibniz-Institut für Photonische Technologien e.V. (Germany) ..... [11260-67]

1:20 pm: **High power UV pulsed laser with LMA tapered fiber**, Vincent Roy, Louis Desbiens, Marc Deladurantaye, Yves Taillon, INO (Canada) . . . [11260-68]

1:40 pm: **300W picosecond fiber laser based on an Yb-doped PM tapered fiber amplifier**, Christophe Pierre, Sébastien Vidal, ALPhANOV (France); Julien Didierjean, Eolite Lasers (France); Johan Boulet, ALPhANOV (France)[11260-69]

2:00 pm: **Green picosecond narrow-linewidth tapered fiber laser system**, Vasilii Ustimchik, Ampliconix Oy (Finland); Andrei Fedotov, Tampere Univ. (Finland); Joona Rissanen, Ampliconix Oy (Finland) and Tampere Univ. (Finland); Teppo Noronen, Ampliconix Oy (Finland); Regina Gumenyuk, Tampere Univ. (Finland); Yuri Chamorovskii, Kotelnikov Institute of Radioengineering and Electronics (Fryazino branch) (Russian Federation); Valery Filippov, Ampliconix Oy (Finland) ..... [11260-70]

2:20 pm: **High peak power pulsed fiber laser with high efficiency based on an ytterbium doped powder sinter fiber**, Guillaume Canat, Maxime Chenou, Alain Mugnier, Paul Mouchel, Keopsys by LUMIBIRD (France); Céline Canal, Quantel Group (France); Romain Dauliat, Baptiste Leconte, Philippe Roy, XLIM (France)..... [11260-71]

2:40 pm: **Generation of picosecond pulses with 150 W of average and 0.92 MW of peak power from an Yb-doped tapered fiber MOPA**, Konstantin K. Bobkov, Andrey E. Levchenko, Vladimir V. Velmskin, Tatiana A. Kochergina, Svetlana S. Aleshkina, Mikhail M. Bubnov, Fiber Optics Research Ctr. (Russian Federation); Denis S. Lipatov, Alexander Yu. Laptev, Alexei N. Guryanov, G. G. Devyatkykh Institute of Chemistry of High-Purity Substances (Russian Federation); Mikhail E. Likhachev, Fiber Optics Research Ctr. (Russian Federation) ..... [11260-72]

Coffee Break ..... Thu 3:00 pm to 3:30 pm

**SESSION 15**

**LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... THU 3:30 PM TO 5:30 PM**

**kW-Class Fiber Lasers and Amplifiers II**

Session Chair: **Manoj Kanskar**, nLIGHT, Inc. (USA)

3:30 pm: **16kW single mode CW laser with dynamic beam for material processing**, Eyal Shekel, Civan Advanced Technologies Ltd. (Israel) [11260-73]

3:50 pm: **8-kW single stage all-fiber Yb-doped fiber laser with a BPP of 1 mm-mrad**, Yu Wang, Rintaro Kitahara, Wataru Kiyoyama, Yuki Shirakura, Takuya Kurihara, Yasuo Nakanishi, Tatsuya Yamamoto, Michio Nakayama, Shinya Ikoma, Kensuke Shima, Fujikura Ltd. (Japan) ..... [11260-74]

4:10 pm: **Passively cooled pump signal combiners at 2.1 kW for fiber laser and amplifier systems**, Lalitkumar Bansal, Robert Sienkowski, Jose Pincha, S. Rosario, Christopher Neale, Joel D. Mann, Clifford E. Headley, OFS Fitel, LLC (USA) ..... [11260-75]

4:30 pm: **Yb/Ce co-doped aluminosilicate PM fibers by VAD process for high power amplification of narrow linewidth source**, Jaesun Kim, Hyungsu Cho, Gaye Park, Junho Lee, Daeyoung Kim, Dae Seung Moon, ChiHwan Ouh, Taihan Fiberoptics Co., Ltd. (Korea, Republic of); Seongmook Jeong, Hwanseok Yang, Ki Hyuck Kim, LIG Nex1 Co., Ltd. (Korea, Republic of); Min Kyu Park, Ground Technology Research Institute, Agency for Defense Development (Korea, Republic of); Jaewon Han, Chanho Hwang, Taihan Fiberoptics Co., Ltd. (Korea, Republic of) ..... [11260-76]

4:50 pm: **Fiber Bragg gratings in active multimode XLMA fibers for high-power kW-class fiber lasers**, Sarah Klein, Martin Giesberts, Patrick Baer, Oliver Fitzau, Martin Traub, Hans-Dieter Hoffmann, Fraunhofer-Institut für Lasertechnik ILT (Germany)..... [11260-77]

5:10 pm: **Analysis of fabrication techniques and material systems for kW fibers limited by TMI**, Thomas Schreiber, Nicoletta Haarlammert, Stefan Kuhn, Christian Hupel, Johannes Nold, Steffen Schulze, Friedrich Möller, Victor Distler, Maximilian Strecker, Gonzalo Palma-Vega, Sigrun Hein, Denny Häßner, Till Walbaum, Ramona Eberhardt, Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11260-78]

**FIBER LASERS BEST STUDENT PAPER AWARDS CEREMONY**

**LOCATION: ROOM 205 (LEVEL 2 SOUTH) ..... THU 5:30 PM TO 5:40 PM**

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LASE

# CONFERENCE 11261

LOCATION: ROOM 206 (LEVEL 2 SOUTH)

Monday–Wednesday 3–5 February 2020 • Proceedings of SPIE Vol. 11261

## Components and Packaging for Laser Systems VI

Conference Chairs: **Alexei L. Glebov**, OptiGrate - IPG Photonics Corp. (USA); **Paul O. Leisher**, Lawrence Livermore National Lab. (USA)

Program Committee: **Igor Anisimov**, Air Force Research Lab. (USA); **Jens Biesenbach**, DILAS Diodenlaser GmbH (Germany); **Gunnar Böttger**, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (Germany); **Jenna Campbell**, Freedom Photonics, LLC (USA); **Joseph L. Dallas**, Avo Photonics, Inc. (USA); **Martin Forrer**, FISBA AG (Switzerland); **Manoj Kanskar**, nLIGHT Corp. (USA); **Alexander V. Laskin**, AdlOptica Optical Systems GmbH (Germany); **Xingsheng Liu**, Xi'an Institute of Optics and Precision Mechanics (China); **Christian V. Poulsen**, NKT Photonics Inc. (USA); **Mark A. Stephen**, NASA Goddard Space Flight Ctr. (USA); **Takunori Taira**, Institute for Molecular Science (Japan); **François Trépanier**, TeraXion Inc. (Canada); **Torsten Vahrenkamp**, ficonTEC Service GmbH (Germany); **Alexander Yusim**, IPG Photonics Corp. (USA); **Chung-En Zah**, Focuslight Technologies, Inc. (China); **Arnaud Zoubir**, ALPHANOV (France)

### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 206 (LEVEL 2 SOUTH) ..... MON 10:30 AM TO 12:20 PM

#### Advanced Laser Packaging Solutions

Session Chair: **Jenna Campbell**, Freedom Photonics, LLC (USA)

10:30 am: **High performance integrated photonic components for laser systems** (*Invited Paper*), Gordon Morrison, Yuvaraj Dora, Steven B. Estrella, Hannah Grant, Jes Sherman, Kristoffer Ottosson, Jason Seifert, Trevor Cooper, Don Kebort, Michelle Labrecque, Jenna Campbell, Kenneth A. Hay, Paul O. Leisher, Daniel Renner, Leif Johansson, Milan Mashanovitch, Freedom Photonics, LLC (USA) ..... [11261-1]

11:00 am: **Ultrafast laser bonding of glasses and crystals to metals for epoxy-free optical instruments**, Robert E. Lafon, Steven X. Li, Frankie Micalizzi, NASA Goddard Space Flight Ctr. (USA) ..... [11261-2]

11:20 am: **You're not done yet: Prototype to production**, Sven Mahnkopf, Thomas L. Haslett, Avo Photonics, Inc. (USA) ..... [11261-3]

11:40 am: **3D-printed, low-cost, lightweight optomechanics for a compact, low-power solid state amplifier system**, Fabian Kranert, Jana Budde, Laser Zentrum Hannover e.V. (Germany); Philipp Neef, Technische Univ. Clausthal (Germany); Robert Bernhard, Technische Univ. Clausthal (Germany) and Laser Zentrum Hannover e.V. (Germany); Katharina Rettschlag, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany); Tobias Grabe, Leibniz Univ. Hannover (Germany); Marius Lammers, Hochschule Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany); Andreas Wienke, Jörg Neumann, Laser Zentrum Hannover e.V. (Germany); Henning Wiche, Technische Univ. Clausthal (Germany); Volker Wesling, Technische Univ. Clausthal (Germany) and Laser Zentrum Hannover e.V. (Germany); Roland Lachmayer, Leibniz Univ. Hannover (Germany) and Laser Zentrum Hannover e.V. (Germany); Henning Ahlers, Hochschule Hannover (Germany); Dietmar Kracht, Laser Zentrum Hannover e.V. (Germany) ..... [11261-4]

12:00 pm: **Dielectric flat lens for the MIR region**, Maxime Guais, Grégory Maisons, Johan Abautret, mirSense (France); Delphine Marris-Morini, Ctr. de Nanosciences et de Nanotechnologies (France); Mathieu Carras, mirSense (France) ..... [11261-5]

Lunch Break ..... Mon 12:20 pm to 1:30 pm

#### SESSION 2

LOCATION: ROOM 206 (LEVEL 2 SOUTH) ..... MON 1:30 PM TO 3:00 PM

#### Laser Optics and Optical Assembly

Session Chair: **Mark A. Stephen**, NASA Goddard Space Flight Ctr. (USA)

1:30 pm: **Stable and robust optical assemblies for optical systems and lasers** (*Invited Paper*), Ludovic Fulop, Kyllia (France) ..... [11261-6]

2:00 pm: **Glass diffuser with constant power density in 360° LIDAR illumination**, Dirk Hauschild, Yong Liang, Alexei Krasnaberski, LIMO GmbH (Germany) ..... [11261-7]

2:20 pm: **Innovative solutions to meet thermal performance of high-power laser systems**, Bryan Muzyka, Advanced Cooling Technologies, Inc. (USA) ..... [11261-8]

2:40 pm: **Automated sensor-guided packaging of diamond tools**, Susanne Ehret, Maximilian Hoeren, Marvin Berger, Arno Schmetz, Daniel Zontar, Christian Brecher, Tobias Müller, Gordon Dave Saunders, Fraunhofer-Institut für Produktionstechnologie IPT (Germany) ..... [11261-9]

Coffee Break ..... Mon 3:00 pm to 3:30 pm

#### LASE PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) ..... MON 3:30 PM TO 5:40 PM

3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)

3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)

3:40 pm: **VCSEL: Born Small and Grown Big** (*Plenary*)  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)

4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources** (*Plenary*)  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)

5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science** (*Plenary*)  
**Robert L. Byer**, Stanford Univ. (USA)

### TUESDAY 4 FEBRUARY

#### SESSION 3

LOCATION: ROOM 206 (LEVEL 2 SOUTH) ..... TUE 8:20 AM TO 10:00 AM

#### Laser Diode Packaging I

Session Chair: **Paul O. Leisher**, Freedom Photonics, LLC (USA)

8:20 am: **High precision automated tab assembly with micro-optics for optimized high-power diode laser collimation**, Martin Forrer, Andreas Kunz, Helen Strub, Hansruedi Moser, FISBA AG (Switzerland); Christian Brecher, Maximilian Hoeren, Daniel Zontar, Fraunhofer-Institut für Produktionstechnologie IPT (Germany) ..... [11261-10]

8:40 am: **Novel packaging for high power CW 250W with low smile laser diode array based on conductive cooling**, Hongyou Zhang, Pengfei Zhu, Tuanwei Fu, Chung-en Zah, Xingsheng Liu, Focuslight Technologies, Inc. (China) ..... [11261-11]

9:00 am: **Miniature rugged fiber-coupled hermetic source/detector module for fiber optic gyro applications**, Arlene Smith, David R. Demmer, Jace C. Wandrisco, Thomas L. Haslett, Avo Photonics, Inc. (USA) ... [11261-12]

9:20 am: **Novel approach for mounting high power diode laser bars on passive copper heatsinks**, Matthias Schroeder, Ekkehard Werner, Petra Hennig, Marco Koschorreck, JENOPTIK Laser GmbH (Germany) ... [11261-13]

9:40 am: **High power, wavelength-stabilized 1532 nm diode laser pump modules for high energy laser applications**, Jenna Campbell, Michelle LaBrecque, Paul O. Leisher, Freedom Photonics, LLC (USA); Gordon Morrison, Freedom Photonics (USA); Keith Guinn, Milan Mashanovitch, Freedom Photonics, LLC (USA); Tadej Semenic, Avijit Bhunia, Teledyne Scientific Co. (USA); Daniel Renner, Freedom Photonics, LLC (USA) . . . . . [11261-14]  
 Coffee Break . . . . . Tue 10:00 am to 10:30 am

**SESSION 4**

**LOCATION: ROOM 206 (LEVEL 2 SOUTH) . . . . . TUE 10:30 AM TO 12:20 PM**

**Laser Diode Packaging II**

Session Chair: **Chung-en Zah**, Focuslight Technologies, Inc. (USA)  
 10:30 am: **Laser diode packaging for DoD applications (Invited Paper)**, Sean D. Ross, Air Force Research Lab. (USA) . . . . . [11261-15]  
 11:00 am: **Laser interferometer space antenna: Master oscillator packaging**, Julia Majors, David R. Demmer, Ryan Ehid, Avo Photonics, Inc. (USA); Kenji Numata, Anthony Yu, Thomas Kane, Scott Merritt, NASA Goddard Space Flight Ctr. (USA); Oleg Konoplev, Science Systems and Applications, Inc. (USA) and NASA Goddard Space Flight Ctr. (USA); Thomas L. Haslett, Avo Photonics, Inc. (USA) . . . . . [11261-16]  
 11:20 am: **Thermoreflectance-based measurements of facet optical absorption in aged high-power diode lasers**, Aman Kumar Jha, Chen Li, Kevin P. Pipe, Univ. of Michigan (USA); Mark T. Crowley, Daniel Fullager, Jason D. Helmrich, Prabhu Thiagarajan, Lasertel, Inc. (USA); Robert J. Deri, Rebecca B. Swertfeger, Lawrence Livermore National Lab. (USA); Paul O. Leisher, Freedom Photonics, LLC (USA) . . . . . [11261-17]  
 11:40 am: **Compact packaging of multi-wavelength gas sensors up to the MWIR**, Willi G. Mantei, Benedikt Stender, Ruth Houbertz, Multiphoton Optics GmbH (Germany); Michael von Edlinger, Michael Legge, Johannes Koeth, nanoplus Nanosystems and Technologies GmbH (Germany) . . . . . [11261-18]  
 12:00 pm: **Total holographic characterization of suspension Particles: The xSight Instrument**, Thomas L. Haslett, Robert Krause, David R. Demmer, Avo Photonics, Inc. (USA); David G. Grier, Fook Chiong Cheong, Laura Philips, David Ruffner, Spheryx, Inc. (USA) . . . . . [11261-19]  
 Lunch/Exhibition Break . . . . . Tue 12:20 pm to 2:00 pm

**SESSION 5**

**LOCATION: ROOM 206 (LEVEL 2 SOUTH) . . . . . TUE 2:00 PM TO 3:30 PM**

**High Power/Energy Laser Components and Packaging**

Session Chair: **Christian V. Poulsen**, NKT Photonics A/S (Denmark)  
 2:00 pm: **Disk lasers: Path to compact modular designs for high performance (Invited Paper)**, John Vetrovec, Aqwest, LLC (USA) . . . [11261-20]  
 2:30 pm: **Redetermination of the spectral dependence of the Verdet coefficients of terbium gallium garnet and potassium terbium fluoride**, David E. Zelmon, Michael Mueller, Air Force Research Lab. (USA); Kevin T. Stevens, Gregory Foundos, Northrop Grumman SYNOPTICS (USA) . . . . . [11261-21]  
 2:50 pm: **Diode pumped passively Q-switched Nd:YAG/Cr:YAG solid-state lasers with a stable output of several mJ at 1064 nm over a wide temperature range from -30°C to 90°C**, Yingmin Fan, Chung-en Zah, Dihai Wu, Chen Gao, Yong Li, Xingsheng Liu, Focuslight Technologies, Inc. (China) . . . . . [11261-22]  
 3:10 pm: **High power thulium fiber laser systems for airborne and spaceborne missions**, Doruk Engin, William Rudd, Mark Storm, Mark Long, Viatcheslav Litvinovitch, Lawrence Holley, Nicholas W. Sawruk, Fibertek, Inc. (USA) . . . . . [11261-23]  
 Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

**SESSION 6**

**LOCATION: ROOM 206 (LEVEL 2 SOUTH) . . . . . TUE 4:00 PM TO 5:30 PM**

**High Power/Energy Laser Components I: Bragg Gratings**

Session Chair: **Alexander Yusim**, IPG Photonics Corp. (USA)  
 4:00 pm: **High performance FBG-based components for kilowatt fiber lasers power scaling (Invited Paper)**, Guillaume Brochu, Samuel Gouin, Evelyne Brown-Dussault, Mathieu Huneault, Dominic Faucher, Mathieu Faucher, François Trépanier, TeraXion Inc. (Canada) . . . . . [11261-24]  
 4:30 pm: **Multiplexed chirped volume Bragg gratings**, Vadim Smirnov, Ruslan Vasilyeu, Alexei L. Glebov, Leonid B. Glebov, OptiGrate Corp. (USA) . . . . . [11261-25]  
 4:50 pm: **Inner-cladding pump reflector based on chirped volume Bragg gratings**, Lauris Talbot, Pascal Paradis, Martin Bernier, Univ. Laval (Canada) . . . . . [11261-26]  
 5:10 pm: **Nonlinearly chirped fiber Bragg gratings by selective refractive index tuning using femtosecond laser pulses**, Timothy Oshibughie Imogore, Ria G. Krämer, Maximilian Heck, Thorsten A. Goebel, Daniel Richter, Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11261-27]

**POSTERS-TUESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Tuesday 10:00 AM– 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Narrow-linewidth, tunable external cavity diode lasers based on quantum-dot RSOA and Si3N4 microresonators in the hybrid platform**, Yeyu Zhu, Siwei Zeng, Ying Wu, Yunsong Zhao, Lin Zhu, Clemson Univ. (USA) . . . . . [11261-37]  
**Investigation of intensity distribution of VCSEL arrays with commercial lenses**, ByeongYun Han, Sang-Muk Lee, Young-Hwan Choi, SangMin Lee, Seung-Hyun Hong, Dong-Wook Shin, Jong-Woo Kim, Gi-Hwan Kim, Seong-Hyun Jhun, ChangHyun Park, Seung-Han Park, Yonsei Univ. (Korea, Republic of) . . . . . [11261-38]  
**Temperature distribution induced spectral broadening of high-power diode lasers**, Di-Hai Wu, Xi'an Institute of Optics and Precision Mechanics (China); Chung-En Zah, Focuslight Technologies, Inc. (China); Xingsheng Liu, Xi'an Institute of Optics and Precision Mechanics (China) . . . . . [11261-39]  
**High-strength high-efficiency cladding light strippers with CO<sub>2</sub> laser ablation**, Gongwen Zhu, Wenxin Zheng, AFL (USA) . . . . . [11261-40]  
**Adjoint method and inverse design for diffractive beam splitters**, Dong Cheon Kim, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and HOLOEYE Photonics AG (Germany); Andreas Hermerschmidt, Pavel Dyachenko, HOLOEYE Photonics AG (Germany); Toralf Scharf, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11261-41]  
**Thermal resistance network of a microchannel heat sink for cooling a high-power diode laser bar**, Di-Hai Wu, Xi'an Institute of Optics and Precision Mechanics (China); Chung-En Zah, Xingsheng Liu, Focuslight Technologies, Inc. (China) . . . . . [11261-43]  
**Development of a small RGB-laser light engine**, Wolfgang Reinert, Pauline Malaurie, Fraunhofer-Institut für Siliziumtechnologie (Germany) . . . . [11261-44]

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# CONFERENCE 11261

## WEDNESDAY 5 FEBRUARY

### SESSION 7

LOCATION: ROOM 206 (LEVEL 2 SOUTH) ..... WED 8:30 AM TO 10:00 AM

#### High Power/Energy Laser Components II

Session Chair: **Martin Forrer**, FISBA AG (Switzerland)

8:30 am: **Anti-reflective meta-surfaces (Motheys) on optical fibers: An alternative to AR coatings** (*Invited Paper*), Devinder Saini, Fiberguide Industries, Inc. (USA) ..... [11261-29]

9:00 am: **Compact and highly efficient transmission gratings for the mitigation of nonlinear effects in fiber laser applications**, Maximilian Heck, Ria G. Krämer, Daniel Richter, Thorsten A. Goebel, Tobias Ullsperger, Friedrich-Schiller-Univ. Jena (Germany); Andreas Tünnermann, Stefan Nolte, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Friedrich-Schiller-Univ. Jena (Germany) ..... [11261-30]

9:20 am: **Filtering characteristics and image relay of the three-lens slit spatial filter for the high-power lasers**, Xiao Yuan, Soochow Univ. (China); Han Xiong, Suzhou Univ. of Science and Technology (China); Xiang Zhang, Fan Gao, Tiancheng Yu, Baoxing Xiong, Soochow Univ. (China) ..... [11261-31]

9:40 am: **Novel hollow-core chalcogenide fiber with anti-resonant arches for high-power infrared laser transmission**, Francois Chenard, Oseas Alvarez, Andrew Buff, IRflex Corporation (USA) ..... [11261-32]

Coffee Break ..... Wed 10:00 am to 10:30 am

### SESSION 8

LOCATION: ROOM 206 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 12:00 PM

#### High Power/Energy Laser Components III

Session Chair: **Joseph L. Dallas**, Avo Photonics, Inc. (USA)

10:30 am: **Compact and energy efficient IR laser architecture** (*Invited Paper*), Dirk Hauschild, Stephan Schneider, Andre Gruetz, LIMO GmbH (Germany) ..... [11261-33]

11:00 am: **Output laser coupler for coherent beam combining**, Victor I. Kopp, Jongchul Park, Jonathan Singer, Daniel Neugroschl, Chiral Photonics, Inc. (USA) ..... [11261-34]

11:20 am: **Laser damage, a new US standard: What is in it for me?**, Donna J. Howland, Jonathan Arenberg, Northrop Grumman Corp. (USA); Michael D. Thomas, Spica Technologies, Inc. (USA); Trey Turner, Research Electro-Optics, Inc. (USA); John Bellum, Coherent Technologies, Inc. (USA); Ella Field, Sandia National Labs. (USA); C. Wren Carr, Lawrence Livermore National Lab. (USA); Matthew Brophy, Optimax Systems, Inc. (USA); Allen Krisiloff, Triptar Lens Co., Inc. (USA); Nathan Carlie, Edmund Optics Inc. (USA) ..... [11261-35]

11:40 am: **An achromat made from a single optical material**, Joel Bagwell, Edmund Optics Inc. (USA) ..... [11261-36]

### Startup Challenge

Wednesday • Moscone West Level 2

Hear pitches for the “best of the best” new photonics businesses; open to all attendees

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# CONFERENCE 11262

LOCATION: ROOM 203 (LEVEL 2 SOUTH)

Sunday–Tuesday 2–4 February 2020 • Proceedings of SPIE Vol. 11262

# High-Power Diode Laser Technology XVIII

Conference Chair: **Mark S. Zediker**, NUBURU, Inc. (USA)

Program Committee: **Friedrich G. Bachmann**, FriBa LaserNet (Germany); **Stefan W. Heinemann**, TRUMPF Photonics (USA); **Volker Krause**, Laserline GmbH (Germany); **Robert Martinsen**, nLIGHT Corp. (USA); **Erik P. Zucker**, Erik Zucker Consulting (USA)

## SUNDAY 2 FEBRUARY

### SESSION 1

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... SUN 8:00 AM TO 10:00 AM

#### IR Laser Devices and Package Technology I

Session Chair: **Robert Martinsen**, nLIGHT, Inc. (USA)

8:00 am: **1 kW cw fiber-coupled diode laser with enhanced brightness**, Joan J. Montiel-Ponsoda, Guillermo Garre-Werner, MONOCROM S.L. (Spain); Volker Raab, Raab-Photonik GmbH (Germany); Gemma Safont, MONOCROM S.L. (Spain); Darius Gailevicius, Femtika UAB (Lithuania); Sandeep Gawali, Univ. Politècnica de Catalunya (Spain); Vytautas Purlys, Femtika UAB (Lithuania); Carsten Bree, Mindaugas Radziunas, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); Crina Cojocaru, Jose Trull, Kestutis Staliunas, Univ. Politècnica de Catalunya (Spain). . . . . [11262-1]

8:20 am: **Highly efficient 9xx-nm band single emitter laser diodes optimized for high output power operation**, Yuji Yamagata, Fujikura Ltd. (Japan); Yoshikazu Kaifuchi, OPTOENERGY Inc. (Japan); Ryozauro Nogawa, Kyohei Yoshida, Masayuki Yamaguchi, Fujikura Ltd. (Japan). . . . . [11262-2]

8:40 am: **Efficient, high power 780 nm pumps for high energy class mid-infrared solid state lasers**, Paul A. Crump, Markus Niemeyer, Marko Hübner, Seval Arslan, Paul Simon Basler, Dominik Martin, André Maaßdorf, Armin Ginolas, Günther Tränkle, Ferdinand-Braun-Institut (Germany). . . [11262-3]

9:00 am: **Design progress for higher efficiency and brightness in 1 kW diode-laser bars**, Matthias M. Karow, Dominik Martin, Pietro Della Casa, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany); Götz Erbert, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Ghana); Paul A. Crump, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany). . . . . [11262-4]

9:20 am: **Advances in diode laser bar power and reliability for multi-kW disk laser pump sources**, Stewart D. McDougall, Tobias Barnowski, Geunmin Ryu, Stefan Heinemann, Thilo Vethake, Xiaohang Liu, Ching-Long Jiang, Hagen Zimer, TRUMPF Photonics, Inc. (USA). . . . . [11262-5]

9:40 am: **Physics of failure based reliability model of high-power InGaAs-AlGaAs strained QW lasers prone to COBD failure**, Yongkun Sin, Sean Stuart, Miles Brodie, Zachary Lingley, The Aerospace Corp. (USA). . . . . [11262-6]

Coffee Break. . . . . Sun 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... SUN 10:30 AM TO 12:10 PM

#### IR Laser Devices and Package Technology II

Session Chair: **Friedrich G. Bachmann**, FriBa LaserNet (Germany)

10:30 am: **High power and reliable 793nm T-bar and single emitter for thulium-doped fiber laser pumping**, Guoli Liu, Sami Lehkonen, Jingwei Li, Heiko Winhold, Thomas Rothacker, Farid Ahmed, Michael Peters, Coherent, Inc. (USA); Paul Wolf, Sandra Ahlert, Heiko Kissel, Bernd Köhler, Coherent, Inc. (Germany). . . . . [11262-7]

10:50 am: **Performance comparison between model-based and machine learning approaches for the automated active alignment of FAC-lenses**, Maximilian Hoeren, Christian Brecher, Daniel Zontar, Marvin Berger, Arno Schmetz, Armin Tavakolian, Fraunhofer-Institut für Produktionstechnologie IPT (Germany). . . . . [11262-8]

11:10 am: **High brightness diodes and 600W 62% Low SWaP fiber-coupled package**, Manoj Kanskar, nLIGHT, Inc. (USA). . . . . [11262-9]

11:30 am: **Offline development of active alignment based on empirical virtual environments**, Daniel Zontar, Maximilian Hoeren, Susanne Ehret, Marvin Berger, Arno Schmetz, Armin Tavakolian, Christian Brecher, Fraunhofer-Institut für Produktionstechnologie IPT (Germany). . . . . [11262-10]

11:50 am: **Kilowatt wavelength-stabilized CW and QCW diode laser**, Dan Xu, Di Ma, Zhenkun Yu, Lei Xu, BWT Beijing Ltd. (China). . . . . [11262-33]

Lunch/BiOS Expo Break. . . . . Sun 12:10 pm to 1:40 pm

### SESSION 3

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... SUN 1:40 PM TO 3:20 PM

#### Laser for 3D Sensing and Lidar

Session Chair: **Stefan W. Heinemann**, TRUMPF Photonics, Inc. (USA)

1:40 pm: **Lidar sensors for autonomous driving**, David A. Schleunig, Waymo, LLC (USA). . . . . [11262-34]

2:00 pm: **High peak power laser diodes at 1.5 um with integrated wavelength locking element**, Antti Aho, Jukka Viheriälä, Heikki Virtanen, Topi Uusitalo, Mervi Koskinen, Jarno Reuna, Mircea Guina, Tampere Univ. (Finland). . . . . [11262-12]

2:20 pm: **Wavelength stabilized high pulse power laser bars for line-flash automotive LIDAR**, Andrea Knigge, Heike Christopher, Andreas Klehr, Jörg Fricke, Armin Liero, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany); Tobias Honig, Eckhard Langenbach, FISBA OPTIK GmbH (Germany); Hans Wenzel, Günther Tränkle, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany). . . . . [11262-13]

2:40 pm: **Combined range and vibration sensing system with external cavity frequency swept laser**, Jeong Won Kim, Hansol Jang, Gyeong Hun Kim, Chang-Seok Kim, Pusan National Univ. (Korea, Republic of) . . . [11262-14]

3:00 pm: **Pulse laser diode modules for high-power, high-frequency operation**, Nikita Pikhtin, Dmitrii Veselov, Yulia Bobretsova, Aleksandr Klimov, Aleksandr Bondarev, Andrey Lyutetskiy, Vladislav Strelets, Sergey Slipchenko, Peter S. Kop'ev, Ioffe Institute (Russian Federation). . . . . [11262-15]

Coffee Break. . . . . Sun 3:20 pm to 3:50 pm

### SESSION 4

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... SUN 3:50 PM TO 5:10 PM

#### Wavelength Stabilized Devices

Session Chair: **Volker Krause**, Laserline GmbH (Germany)

3:50 pm: **High-brightness wavelength stabilized fiber-coupled diode laser modules for DPSS and fiber laser pumping**, David M. Hemenway, nLIGHT, Inc. (USA). . . . . [11262-16]

4:10 pm: **High-power, high-beam quality miniaturized laser module for pumping of solid state lasers at 980 nm**, Philipp Hildenstein, Alexander Sahn, David Feise, Ferdinand-Braun-Institut (Germany); Martin Gorjan, Spectra Physics (Austria); Simone Tacchini, University of Pavia (Italy); Katrin Paschke, Günther Tränkle, Ferdinand-Braun-Institut (Germany). . . . . [11262-17]

4:30 pm: **High power wavelength stabilized multi-emitter semiconductor laser module using highly manufacturable DBR diode lasers**, Roberto Paoletti, Simone Codato, Claudio Coriasso, Fulvio Gaziano, Paola Gotta, Alberto Maina, Pier De Melchiorre, Giancarlo Meneghini, Giuliana Morello, Giulia Pippione, Ezio Riva, Marzia Rosso, Alessandro Stano, Maurizio Gattiglio, Prima Electro S.p.A. (Italy). . . . . [11262-19]

4:50 pm: **Reliable high-spectral-radiance 635 nm tapered diode lasers with monolithically integrated distributed Bragg reflector**, Katrin Paschke, Gunnar Blume, Johannes Pohl, David Feise, Peter Ressel, Alexander Sahn, Bernd Sumpf, Ferdinand-Braun-Institut (Germany). . . . . [11262-20]

LASE

# CONFERENCE 11262

## MONDAY 3 FEBRUARY

### SESSION 5

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... MON 8:30 AM TO 10:00 AM

#### Blue Laser Systems

Session Chair: **Erik Zucker**, Erik Zucker Consulting (USA)

8:30 am: **Developments of high power blue diode laser systems for laser metal deposition and welding of pure copper materials** (*Invited Paper*), Masahiro Tsukamoto, Osaka Univ. (Japan) ..... [11262-21]

9:00 am: **Kilowatt-class high power fiber-coupled diode lasers at 450nm**, Tobias Könning, Florian Harth, Philipp König, Paul Wolf, Michael Stoiber, Heiko Kissel, Bernd Köhler, Coherent, Inc. (Germany) ..... [11262-22]

9:20 am: **High brightness 100 W-50  $\mu$ m delivery blue laser diode modules**, Martina Riva, Politecnico di Torino (Italy); Giammarco Rossi, Andrea Braglia, OPI Photonics s.r.l. (Italy); Guido Perrone, Politecnico di Torino (Italy) [11262-23]

9:40 am: **Scalable blue laser system architecture**, Jean-Philippe M. Fève, Mark Zediker, Matthew Silva Sa, NUBURU, Inc. (USA); Chad Mitchell, NUBURU (USA) ..... [11262-24]

Coffee Break ..... Mon 10:00 am to 10:30 am

### SESSION 6

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... MON 10:30 AM TO 11:50 AM

#### Blue Laser Technology

Session Chair: **Erik Zucker**, Erik Zucker Consulting (USA)

10:30 am: **Blue high power InGaN semiconductor laser diodes: Design optimization of laser bars and single emitters for best performance and reliability** (*Invited Paper*), Harald König, Muhammad Ali, Sven Gerhard, Urs Heine, Soenke Tautz, Christoph Eichler, Georg Brüderl, Matthias Peter, Alfred Lell, Martin Behringer, Markus Keidler, Tobias Hauptelshofer, Christoph Walter, OSRAM Opto Semiconductors GmbH (Germany); Anne Balck, Markus Baumann, Volker Krause, Laserline GmbH (Germany) ..... [11262-25]

10:50 am: **High brightness MOCVD-grown laser diodes using RPCVD tunnel junctions**, Josh D. Brown, Satya Barik, Qian Gao, Brad Siskavitch, Marie Wintrebart-Fouquet, Alanna Fernandes, Patrick Chen, Chris Byrnes, BluGlass, Ltd. (Australia); Mahmoud Behzadirad, Ashwin K. Rishinaramangalam, Daniel Feezell, The Univ. of New Mexico (USA); Ian Mann, BluGlass, Ltd. (Australia) ..... [11262-26]

11:10 am: **A high power InGaN laser array with built-in smile suppression structure**, Shinichiro Nozaki, Masao Kawaguchi, Takahiro Nibu, Hiroyuki Hagino, Atsunori Mochida, Takashi Kano, Shinichi Takigawa, Takuma Katayama, Tsuyoshi Tanaka, Panasonic Corp. (Japan); Kouji Oomori, Panasonic Smart Factory Solutions Co., Ltd. (Japan) ..... [11262-27]

11:30 am: **Optical materials for digital projection**, Ralf Jedamzik, Volker Hagemann, Volker Dietrich, Uwe Petzold, SCHOTT AG (Germany) ..... [11262-28]

Lunch Break ..... Mon 11:50 am to 1:20 pm

### SESSION 7

LOCATION: ROOM 203 (LEVEL 2 SOUTH) ..... MON 1:20 PM TO 2:20 PM

#### Wavelength Multiplexed Modules

Session Chair: **Robert Martensen**, nLIGHT, Inc. (USA)

1:20 pm: **Advances in blue and near-IR high-power/high-brightness direct diode lasers using wavelength beam combining**, Francisco Villarreal, Wang Zhou, John Roethle, Matthew Sauter, Keita Inoue, Bryan Lochman, Bien Chann, TeraDiode, Inc. (USA) ..... [11262-29]

1:40 pm: **Development of a 350W, 50 $\mu$ m, 0.15NA wavelength stabilized fiber coupled laser diode module for pumping Yb-doped fiber laser**, Hao Yu, Sichuan Univ. (China); Huadong Pan, Shaoyang Tan, Shujuan Sun, Suzhou Everbright Photonics Co., Ltd. (China); Juan Li, Jun Wang, Sichuan Univ. (China) ..... [11262-30]

2:00 pm: **Power scaling of laser diode modules using high-power DBR chips**, Alessandro Mirigaldi, Politecnico di Torino (Italy); Paola Gotta, Claudio Coriasso, Roberto Paoletti, Convergent Photonics (Italy); Guido Perrone, Politecnico di Torino (Italy) ..... [11262-31]

Coffee Break ..... Mon 2:20 pm to 3:30 pm

### LASE PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) ..... MON 3:30 PM TO 5:40 PM

3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)

3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)

3:40 pm: **VCSEL: Born Small and Grown Big** (*Plenary*)  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)

4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources** (*Plenary*)  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)

5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science** (*Plenary*)  
**Robert L. Byer**, Stanford Univ. (USA)

## TUESDAY 4 FEBRUARY

### POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

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**High power laser diodes for non-contact energy transfer**, Hal S. Gokturk, Ecoken (USA) ..... [11262-32]

**Improvement of high-power coupling efficiency for small-core optical fiber used in biomedical applications**, Van Gia Truong, Hyun Wook Kang, Van Nam Tran, Pukyong National Univ. (Korea, Republic of) ..... [11262-11]

**FOV control of segmented NIR VCSEL arrays for next-generation flash LiDARs**, Babu Dayal Padullaparthi, Photonic Components DFM Ltd. (Hong Kong, China); Takemasa Tamanuki, Yokohama National Univ. (Japan); Dieter H. Bimberg, Changchun Institute of Optics, Fine Mechanics and Physics (China); Dieter H. Bimberg, Technische Univ. Berlin (Germany). . . . . [11262-35]

# CONFERENCE 11263

LOCATION: ROOM 208 (LEVEL 2 SOUTH)

Tuesday–Wednesday 4–5 February 2020 • Proceedings of SPIE Vol. 11263

# Vertical External Cavity Surface Emitting Lasers (VECSELS) X

Conference Chair: **Jennifer E. Hastie**, Univ. of Strathclyde (United Kingdom)

Program Committee: **Juan L. Chilla**, Coherent, Inc. (USA); **Arnaud Garnache**, Univ. de Montpellier (France); **Mircea Guina**, Tampere Univ. (Finland); **Michael Jetter**, Univ. Stuttgart (Germany); **Elyahou Kapon**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Ursula Keller**, ETH Zurich (Switzerland); **Walter Lubeigt**, M Squared Lasers Ltd. (United Kingdom); **Jerome V. Moloney**, Wyant College of Optical Sciences (USA); **Wolfgang Stolz**, NAsP III/V GmbH (Germany); **Anne C. Tropper**, Univ. of Southampton (United Kingdom); **Keith G. Wilcox**, Univ. of Dundee (United Kingdom)

Conference Co-Sponsor:



## TUESDAY 4 FEBRUARY

### SESSION 1

LOCATION: ROOM 208 (LEVEL 2 SOUTH) ..... TUE 8:00 AM TO 10:00 AM

#### Modelocked VECSELS

Session Chair: **Mircea Guina**, Tampere Univ. (Finland)

8:00 am: **Tutorial on short pulse generation with VECSELS and MIXSELS** (*Keynote Presentation*), Ursula Keller, ETH Zurich (Switzerland) ..... [11263-1]

8:50 am: **Short pulse generation from electrically pumped VECSELS** (*Invited Paper*), Nikolai B. Chichkov, Aston Univ. (United Kingdom); Anton V. Kovalev, ITMO Univ. (Russian Federation); Amit Yadav, Aston Univ. (United Kingdom); Ksenia A. Fedorova, Philipps-Univ. Marburg (Germany); Evgeny A. Viktorov, ITMO Univ. (Russian Federation); Edik U. Rafailov, Aston Univ. (United Kingdom) ..... [11263-2]

9:20 am: **Microscopic modeling of transverse non-equilibrium dynamics in mode-locked VECSELS**, Samuel McLaren, Isak Kilen, Jerome V. Moloney, The Univ. of Arizona (USA) ..... [11263-3]

9:40 am: **Pseudo mode-locking**, Günter Steinmeyer, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) ..... [11263-4]

Coffee Break. .... Tue 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 208 (LEVEL 2 SOUTH) ..... TUE 10:30 AM TO 12:10 PM

#### Specially Designed VECSELS I

Session Chair: **Jennifer E. Hastie**, Univ. of Strathclyde (United Kingdom)

10:30 am: **Infrared laser threshold magnetometry using diamond NV centers** (*Invited Paper*), Yannick Dumeige, Fonctions Optiques pour les Technologies de l'information (France); Jean-Francois Roch, Fabien Bretenaker, Lab. Aimé Cotton (France); Thierry Debuisschert, Thales Research & Technology (France); Victor Acosta, The Univ. of New Mexico (USA); Christoph Becher, Univ. des Saarlandes (Germany); Georgios Chatzidrosos, Arne Wickenbrok, Lykourgos Bougas, Alexander Wilzewski, Dmitry Budker, Johannes Gutenberg Univ. Mainz (Germany) ..... [11263-5]

11:00 am: **Tantalum pentoxide waveguides for spectral broadening of mode-locked vertical external cavity surface emitting lasers**, Jonathan R. C. Woods, Amy S. K. Tong, Cosimo Lacava, Periklis Petropoulos, Anne C. Tropper, James S. Wilkinson, Vasilis Apostolopoulos, Univ. of Southampton (United Kingdom) ..... [11263-6]

11:20 am: **Generation and stabilization of continuous wave THz emission from a bi-color VECSEL**, Jerome V. Moloney, Wyant College of Optical Sciences (USA); Thibault A. G. Bondaz, The Univ. of Arizona (USA); Alexandre Laurain, Finisar Corp. (USA); John G. McInerney, Univ. College Cork (Ireland) ..... [11263-7]

11:40 am: **Thorough investigation of mode-coupling in VECSELS: Towards robust dual-frequency operation of a single-axis laser** (*Invited Paper*), Mehdi Alouini, Gaelle Breville, Salvatore Pes, Cyril Paranthoën, Mathieu Perrin, Christophe Levallois, Cyril Hamel, Herve Folliot, Univ. de Rennes 1 (France); Arthur Vallet, Laurent Chusseau, Univ. de Montpellier (France); Alexandru Mereuta, Andrei Caliman, Elyahou Kapon, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11263-8]

Lunch/Exhibition Break ..... Tue 12:10 pm to 1:30 pm

### SESSION 3

LOCATION: ROOM 208 (LEVEL 2 SOUTH) ..... TUE 1:30 PM TO 3:30 PM

#### Single Frequency

Session Chair: **Ursula Keller**, ETH Zurich (Switzerland)

1:30 pm: **Longitudinal scaling of VECSEL output power maintaining narrow linewidth** (*Invited Paper*), Yushi Kaneda, Dustin Mitten, The Univ. of Arizona (USA); Michael Hart, Stephen H. Warner, Hart Scientific Consulting International LLC (USA); Jussi-Pekka Penttinen, Mircea Guina, Vexlum Ltd. (Finland) ..... [11263-9]

2:00 pm: **High-power single-frequency intracavity doubled VECSEL at 589 nm for sodium guidestar**, Steven E. Rako, Gregory J. Fetzer, Arete Associates (USA); Sandy Sandalphon, Cinnabar Optics LLC (USA); Céline d'Orgeville, The Australian National Univ. (Australia); Jussi-Pekka Penttinen, Mircea Guina, Vexlum Ltd. (Finland); Nathan Woody, Luke Hill, Steven Floyd, Thad Baringer, Arete Associates (USA) ..... [11263-10]

2:20 pm: **Spectroscopy of cold Strontium atoms with a sub-kHz linewidth AlGaInP semiconductor disk laser**, Paulo Hisao Moriya, Scottish Universities Physics Alliance, Univ. of Strathclyde (United Kingdom); Shengnan Zhang, The Univ. of Birmingham (United Kingdom); Peter Schlosser, Fraunhofer UK Ctr. for Applied Photonics (United Kingdom); Yeshpal Singh, Kai Bongs, The Univ. of Birmingham (United Kingdom); Jennifer E. Hastie, Scottish Universities Physics Alliance, Univ. of Strathclyde (United Kingdom) ..... [11263-11]

2:40 pm: **Engineering SDL systems for single-frequency applications** (*Invited Paper*), Peter Schlosser, Craig Hunter, Brynmor Jones, Loyd McKnight, Fraunhofer UK Research Ltd. (United Kingdom) ..... [11263-12]

3:10 pm: **Low noise tunable integrated semiconductor laser: Dynamic instability and route to single frequency operation**, Arnaud Garnache, Institut d'Électronique et des Systèmes, Univ. de Montpellier, CNRS (France); Baptiste Chomet, Ecole Normale Supérieure, CNRS (France); Laurence Ferrières, Innoptics SAS (France); Nathan Vigne, Institut d'Électronique et des Systèmes, CNRS (France); Grégoire Beaudoin, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Mohamed Seghilani, Institut National de la Recherche Scientifique (Canada); Mikhaël Myara, Stéphane Blin, Institut d'Électronique et des Systèmes, CNRS (France); Luc Legratiet, Isabelle Sagnes, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Philippe Lalanne, Lab. Photonique, Numérique et Nanosciences, Institut d'Optique Graduate School, CNRS (France); Vincent Lecocq, Stéphane Denet, Innoptics SAS (France) ..... [11263-13]

Coffee Break. .... Tue 3:30 pm to 4:00 pm

# CONFERENCE 11263

## PANEL DISCUSSION

LOCATION: ROOM 208 (LEVEL 2 SOUTH) ..... 4:00 PM TO 5:20 PM

### VECSELS 10th Anniversary Panel: Future Directions for Research and Applications

Moderator: **Jennifer E. Hastie**, Univ. of Strathclyde (United Kingdom)

Panelists:

**Juan L. Chilla**, Coherent, Inc. (USA)

**Arnaud Garnache**, Univ. de Montpellier (France)

**Mircea Guina**, Tampere Univ. (Finland)

**Ursula Keller**, ETH Zurich (Switzerland)

**Jerome V. Moloney**, Wyant College of Optical Sciences (USA)

**Wolfgang Stolz**, NAsP III/V GmbH (Germany)

## WEDNESDAY 5 FEBRUARY

### SESSION 4

LOCATION: ROOM 208 (LEVEL 2 SOUTH) ..... WED 8:30 AM TO 9:50 AM

#### Materials

Session Chair: **Eli Kapon**,

Ecole Polytechnique Fédérale de Lausanne (Switzerland)

8:30 am: **Progress towards transfer printing of II-VI and III-V DBR-free VECSELS**, George A. Chappell, Benoit Guilhabert, Ian M. Watson, Martin D. Dawson, Univ. of Strathclyde (United Kingdom); Maria C. Tamargo, The City College of New York (USA); Jennifer E. Hastie, Univ. of Strathclyde (United Kingdom) ..... [11263-14]

8:50 am: **A membrane external-cavity surface-emitting laser (MECSEL) with emission around 825 nm**, Hoy-My Phung, Hermann Kahle, Jussi-Pekka Penttinen, Patrik Rajala, Sanna Ranta, Mircea Guina, Tampere Univ. (Finland) ..... [11263-15]

9:10 am: **SWIR MECSEL emitting above 1600 nm**, Artur Broda, Bartosz Jezewski, Iwona Sankowska, Krzysztof Czuba, Aleksandr Kuzmich, Jan Muszalski, Institute of Electron Technology (Poland) ..... [11263-16]

9:30 am: **High-power InAs quantum dot VECSEL with fundamental mode emission at 1.5  $\mu\text{m}$** , Kostiantyn Nechay, Tampere Univ. (Finland); Alexandru Mereuta, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Cyril Paranthoën, Gaëlle Brevalle, Christophe Levallois, Mehdi Alouini, Nicolas Chevalier, Univ. de Rennes 1 (France); Grigore Suruceanu, Andrei Caliman, LakeDiamond S.A. (Switzerland); Eli Kapon, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Mircea Guina, Tampere Univ. (Finland) ..... [11263-18]

Coffee Break ..... Wed 9:50 am to 10:20 am

### SESSION 5

LOCATION: ROOM 208 (LEVEL 2 SOUTH) ..... WED 10:20 AM TO 11:40 AM

#### Specially Designed VECSELS II

Session Chair: **Vasilis Apostolopoulos**, Univ. of Southampton (United Kingdom)

10:20 am: **Spatially modeless VECSEL: Localized structures and solitons** (*Invited Paper*), Arnaud Garnache, Nathan Vigne, Institut d'Électronique et des Systèmes, Univ. de Montpellier, CNRS (France); Adrian Bartolo, Institut de Physique de Nice, Univ. Cote d'Azur, CNRS (France); Grégoire Beaudoin, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Julien Javaloyes, Univ. de les Illes Balears (Spain); Mathias Marconi, Institut de Physique de Nice, CNRS (France); Isabelle Sagnes, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Mikhaël Myara, Institut d'Électronique et des Systèmes, Univ. de Montpellier, CNRS (France); Massimo Giudici, Institut de Physique de Nice, CNRS (France) ..... [11263-19]

10:50 am: **Comb tooth resolved MIR spectroscopy using a VECSEL frequency comb and a virtually-imaged phased array spectrometer** (*Invited Paper*), Robert Rockmore, Wyant College of Optical Sciences (USA); Ricky Gibson, Air Force Research Lab. (USA); R. Jason Jones, Jerome V. Moloney, Wyant College of Optical Sciences (USA) ..... [11263-20]

11:20 am: **Advances in low threshold VECSELS for direct solar pumping**, Keith G. Wilcox, Conor Smyth, Karen Westland, Univ. of Dundee (United Kingdom) ..... [11263-21]

#### VECSELS BEST STUDENT PAPER AWARD CEREMONY

LOCATION: ROOM 208 (LEVEL 2 SOUTH) ..... 11:40 AM TO 11:50 AM

Presented by: **Juan L. Chilla**, Coherent, Inc. (USA)

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# CONFERENCE 11264

LOCATION: ROOM 204 (LEVEL 2 SOUTH)

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# Nonlinear Frequency Generation and Conversion: Materials and Devices XIX

*Conference Chairs:* **Peter G. Schunemann**, BAE Systems (USA); **Kenneth L. Schepler**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

*Program Committee:* **Darrell J. Armstrong**, Sandia National Labs. (USA); **Carlota Canalias**, KTH Royal Institute of Technology (Sweden); **Shekhar Guha**, Air Force Research Lab. (USA); **Rita D. Peterson**, Air Force Research Lab. (USA); **Valentin Petrov**, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); **Christopher R. Phillips**, ETH Zurich (Switzerland); **Chaitanya Kumar Suddapalli**, ICFO - Institut de Ciències Fotòniques (Spain); **Konstantin L. Vodopyanov**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Vladislav V. Yakovlev**, Texas A&M Univ. (USA)

## MONDAY 3 FEBRUARY

### SESSION 1

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... MON 8:00 AM TO 9:50 AM

#### Frequency Combs

Session Chair: **Peter G. Schunemann**, BAE Systems (USA)

8:00 am: **Mid-infrared frequency combs and crystalline mirrors** (*Invited Paper*), Oliver H. Heckl, Georg Winkler, Lukas Perner, Univ. Wien (Austria); Gar-Wing Truong, Crystalline Mirror Solutions, LLC (USA); Aline S. Mayer, Univ. Wien (Austria); Garrett Cole, Crystalline Mirror Solutions, LLC (USA) ..... [11264-1]

8:30 am: **A 0.5 MW few-cycle Er:Fiber frequency comb for nonlinear generation from the visible to mid-infrared**, Daniel M. Lesko, Henry Timmers, Sida Xing, Abijith S. Kowligy, Alexander J. Lind, Scott A. Diddams, National Institute of Standards and Technology (USA) ..... [11264-2]

8:50 am: **Milliwatt midinfrared from intrapulse difference frequency with a single erbium fiber laser**, Kevin F. Lee, IMRA America, Inc. (USA); Peter G. Schunemann, BAE Systems (USA); Martin E. Fermann, IMRA America, Inc. (USA) ..... [11264-3]

9:10 am: **Resonant radiation of mid-infrared laser filaments pumped by femtosecond Cr:ZnSe laser pulses**, Sang-Hoon Nam, Massachusetts Institute of Technology (USA); Garima Chaudhary Nagar, Dennis Dempsey, Bonggu Shim, Binghamton Univ. (USA) ..... [11264-4]

9:30 am: **High repetition rate sub-picosecond pulse generation through compression of adaptively optimised frequency combs based on phase-modulated continuous wave lasers**, B. S. Vikram, Roopa Prakash, Divya Nair, Shankar Kumar Selvaraja, V. R. Supradeepa, Indian Institute of Science (India) ..... [11264-5]

Coffee Break ..... Mon 9:50 am to 10:20 am

### SESSION 2

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... MON 10:20 AM TO 11:50 AM

#### Supercontinuum Generation

Session Chair: **Valentin Petrov**, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany)

10:20 am: **Multi-octave infrared femtosecond continuum generation in Cr:ZnS-GaSe and Cr:ZnS-ZGP tandems** (*Invited Paper*), Sergey Vasilyev, Igor Moskalev, Viktor Smolski, Jeremy Peppers, Mikhail Mirov, IPG Photonics Corp. (USA); Andrey Muraviev, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Kevin T. Zawilski, Peter G. Schunemann, BAE Systems (USA); Sergey Mirov, IPG Photonics Corp. (USA); Konstantin Vodopyanov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Valentin Gapontsev, IPG Photonics Corp. (USA) ..... [11264-6]

10:50 am: **Ultrafast white-light generation in capillary fibers**, Riccardo Piccoli, Institut National de la Recherche Scientifique (Canada); Jeffrey Brown, Ecole Polytechnique (France) and Ctr. de Physique Théorique, CNRS (France); Young-Gyun Jeong, Andrea Rovere, Institut National de la Recherche Scientifique (Canada); Mette B. Gaarde, Louisiana State Univ. (USA); John C. Travers, Heriot-Watt Univ. (United Kingdom); Arnaud Couairon, Ecole Polytechnique (France) and Ctr. de Physique Théorique, CNRS (France); Bruno E. Schmidt, few-cycle Inc. (Canada); Roberto Morandotti, Luca Razzari, Institut National de la Recherche Scientifique (Canada) ..... [11264-7]

11:10 am: **2-10  $\mu\text{m}$  mid-infrared supercontinuum generation in cascaded optical fibers: Experiment and modelling**, Sébastien Venck, Laurent Brilland, Radwan Chahal, SelenOptics (France); Johann Troles, Marcello Meneghetti, Institut des Sciences Chimiques de Rennes (France); Franck Joulain, Solenn Cozic, Samuel Poulain, Le Verre Fluoré (France); Guillaume Huss, LEUKOS (France); François St-Hilaire, Amar Nath Ghosh, John M. Dudley, Thibaut Sylvestre, Institut Franche-Comte Electronique Mecanique Thermique et Optique (France) ..... [11264-8]

11:30 am: **Demonstration of mid-IR supercontinuum generation using all-normal dispersion engineered tapered chalcogenide fiber**, Than Singh Saini, Hoa Phuoc Trung Nguyen, Luo Xing, Tong H. Tuan, Takenobu Suzuki, Yasutake Ohishi, Toyota Technological Institute (Japan) ..... [11264-9]

Lunch Break ..... Mon 11:50 am to 1:30 pm

### SESSION 3

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... MON 1:30 PM TO 3:00 PM

#### Optical Parametric Devices and Applications I

Session Chair: **Darrell J. Armstrong**, Sandia National Labs. (USA)

1:30 pm: **Back-conversion suppressed parametric frequency conversion for ultrawide bandwidth and ultrahigh efficiency devices** (*Invited Paper*), Jeffrey Moses, Cornell Univ. (USA) ..... [11264-10]

2:00 pm: **Widely-tunable single fiber laser OPO for multimodal microscopy**, Benjamin M. Cromey, Sean Crystal, Orkhongua Batjargal, Yukun Qin, Khanh Kieu, The Univ. of Arizona (USA) ..... [11264-11]

2:20 pm: **Narrow-band non-resonant optical parametric oscillator**, Li Wang, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) and Hefei Institutes of Physical Science (China); Andrey A. Boyko, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) and Novosibirsk State Univ. (Russian Federation) and Special Technologies, Ltd. (Russian Federation); Andre Schirrmacher, Canlas Laser Processing GmbH (Germany); Edlef Büttner, APE Angewandte Physik & Elektronik GmbH (Germany); Ning Ye, Ge Zhang, Fujian Institute of Research on the Structure of Matter (China); Weidong Chen, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) and Fujian Institute of Research on the Structure of Matter (China); Valentin Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) ..... [11264-12]

2:40 pm: **Ultra-broadband spontaneous parametric downconversion in periodically poled lithium niobate and electro-optic tuning of the optical parametric oscillation**, Myoungsik Cha, Pusan National Univ. (Korea, Republic of) ..... [11264-13]

Coffee Break ..... Mon 3:00 pm to 3:30 pm

LASE

# CONFERENCE 11264

## LASE PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . . MON 3:30 PM TO 5:40 PM

- 3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)
- 3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)
- 3:40 pm: **VCSEL: Born Small and Grown Big (Plenary)**  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)
- 4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources (Plenary)**  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)
- 5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science (Plenary)**  
**Robert L. Byer**, Stanford Univ. (USA)

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 204 (LEVEL 2 SOUTH) . . . . . TUE 8:00 AM TO 9:50 AM

#### Infrared Generation

Session Chair: **Shekhar Guha**, Air Force Research Lab. (USA)

- 8:00 am: **Progress in ultrafast, mid-infrared optical parametric chirped pulse amplifiers pumped at 1  $\mu\text{m}$  (Invited Paper)**, Mark Mero, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) . [11264-14]
- 8:30 am: **Electronically tunable, broadband middle infrared picosecond pulse generation via  $\chi^{(3)}$  interactions**, Vladislav V. Yakovlev, Texas A&M Univ. (USA) . . . . . [11264-15]
- 8:50 am: **Recent advances in high-power 2  $\mu\text{m}$  fiber lasers for frequency conversion into the mid-IR**, Patrick Forster, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany) and Karlsruher Institut für Technologie (Germany); Clément Romano, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); Marc Eichhorn, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany) and Karlsruher Institut für Technologie (Germany); Christelle Kieleck, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany) . . . . . [11264-16]
- 9:10 am: **2.4-18  $\mu\text{m}$  tunable, picosecond parametric source for the generation of narrowband,  $\chi^{(2)}$ -level pulses with sub-8 cm<sup>-1</sup> spectral bandwidth and 20 kHz repetition rate**, Matthias Baudisch, APE Angewandte Physik & Elektronik GmbH (Germany); Moritz Hinkelmann, Dieter Wandt, Jörg Neumann, Laser Zentrum Hannover e.V. (Germany); Ingo Rimke, APE Angewandte Physik & Elektronik GmbH (Germany) . . . . . [11264-17]
- 9:30 am: **Compact high repetition rate difference frequency generation system based on an Yb-fiber laser**, Carsten Cleff, Stefan Matern, Peter Adel, Menlo Systems GmbH (Germany); Peter G. Schunemann, BAE Systems (USA); Marc Fischer, Ronald Holzwarth, Menlo Systems GmbH (Germany) . [11264-18]
- Coffee Break . . . . . Tue 9:50 am to 10:20 am

### SESSION 5

LOCATION: ROOM 204 (LEVEL 2 SOUTH) . . . . . TUE 10:20 AM TO 11:30 AM

#### Nonlinear Waveguide Devices

Session Chair: **Kenneth L. Schepler**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

- 10:20 am: **Watt-level 780 nm SHG in Zn indiffused MgO:PPLN ridge waveguides with 70% conversion efficiency (Invited Paper)**, Corin B. E. Gawith, Lewis G. Carpenter, Alan C. Gray, Peter G. R. Smith, Sam A. Berry, Univ. of Southampton (United Kingdom) . . . . . [11264-19]
- 10:50 am: **Zn indiffused ridge PPLN waveguides for highly anti-correlated single photon pairs**, Sam A. Berry, Univ. of Southampton (United Kingdom); Jamie Francis-Jones, Univ. of Oxford (United Kingdom); Lewis G. Carpenter, Univ. of Southampton (United Kingdom); Ian A. Walmsley, Imperial College London (United Kingdom); Corin B. E. Gawith, Univ. of Southampton (United Kingdom) . . . . . [11264-20]
- 11:10 am: **SHG and SPDC in a microdisk-based integrated photonic circuit**, Iannis Roland, Adrien Borne, Marco Ravaro, Romain De Oliveira, Stephan Suffit, Univ. Paris Diderot (France); Aristide Lemaître, Ctr. de Nanosciences et de Nanotechnologies (France) and CNRS (France) and Univ. Paris-Saclay (France); Ivan Favero, Giuseppe Leo, Univ. Paris Diderot (France) . . . . . [11264-21]
- Lunch/Exhibition Break . . . . . Tue 11:30 am to 1:00 pm

### SESSION 6

LOCATION: ROOM 204 (LEVEL 2 SOUTH) . . . . . TUE 1:00 PM TO 2:40 PM

#### New Concepts of Nonlinear Optics

Session Chair: **Valentin Petrov**, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany)

- 1:00 pm: **Large time-dependent nonlinear phase shift of transparent conducting oxides at epsilon-near-zero**, Sepehr Benis, Natalia Munera, Eric W. Van Stryland, David J. Hagan, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11264-22]
- 1:20 pm: **High-harmonic generation from topological insulators**, Denitsa R. Baykusheva, Stanford Univ. (USA); Alexis Chacón, Los Alamos National Lab. (USA); Jian Lu, Stanford Univ. (USA); Trevor P. Bailey, Univ. of Michigan (USA); Jonathan A. Sobota, SLAC National Accelerator Lab. (USA) and Stanford Institute for Materials & Energy Sciences (USA); Hadas Soifer, Patrick S. Kirchmann, Costel R. Rotundu, Stanford Institute for Materials & Energy Sciences (USA) and SLAC National Accelerator Lab. (USA); Tony Heinz, Stanford Univ. (USA); Citrad Uher, Univ. of Michigan (USA); David A. Reis, Shambhu Ghimire, Stanford Univ. (USA) . . . . . [11264-23]
- 1:40 pm: **Observation of extremely large nonlinear refractive index in water vapor in THz regime**, Payman Rasekh, Murat Yildirim, Akbar Safari, Jean-Michel Ménard, Ravi Bhardwaj, Ksenia Dolgaleva, Univ. of Ottawa (Canada); Robert W. Boyd, Univ. of Ottawa (Canada) and Univ. of Rochester (USA) . . . . . [11264-24]
- 2:00 pm: **Frequency conversion of ultrafast, higher order vector vortex beams**, Ravi Kiran Saripalli, Anirban Ghosh, Physical Research Lab. (India); Apurv C. Nellikka, Tecnológico de Monterrey (Mexico); Goutam K. Samanta, Physical Research Lab. (India) . . . . . [11264-25]
- 2:20 pm: **Nonlinear pulse compression in a dispersion-alternating fiber**, Niklas M. Lüpken, Carsten Fallnich, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [11264-26]
- Coffee Break . . . . . Tue 2:40 pm to 3:10 pm

SESSION 7

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... TUE 3:10 PM TO 6:00 PM

New Nonlinear Materials

Session Chair: **Kenneth L. Schepler**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

3:10 pm: **Recent progress on the characterization of the properties and laser frequency conversion performance of the new mid-IR NLO crystal BaGa4Se7** (*Invited Paper*), Jiyong Yao, Technical Institute of Physics and Chemistry (China) ..... [11264-27]

3:40 pm: **Determination of Sellmeier's equations and nonlinear coefficients of the BGSe crystal, and calculation of infrared emission from phase-matched optical parametric generation**, Benoit Boulanger, Feng Guo, Patricia Segonds, Elodie Boursier, Jérôme Debray, Univ. Grenoble Alpes (France); Valeriy Badikov, Dmitri Badikov, Kuban State Technological Univ. (Russian Federation); Vladimir Panyutin, Valentin Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) . [11264-28]

4:00 pm: **Vapor transport growth of pure and Cr-doped ZnSe and ZnS single crystals**, Peter G. Schunemann, Kevin T. Zawilski, BAE Systems (USA) ..... [11264-29]

4:20 pm: **Thick HVPE growth of ZnSe on GaAs and OP-GaAs templates for nonlinear frequency conversion**, Shivashankar Vangala, Air Force Research Lab. (USA); Meagan Parker, Duane Brinegar, Air Force Research Lab. (USA) and KBRwyle (USA); Vladimir Tassev, Michael Snure, Air Force Research Lab. (USA) ..... [11264-30]

4:40 pm: **Power scaling of CdSiP2 for 2-micron pumped OPOs**, Kevin T. Zawilski, Peter G. Schunemann, Leonard A. Pomeranz, Spencer L. Horton, BAE Systems (USA); Carl Liebig, F. Kenneth Hopkins, Kent Averett, Air Force Research Lab. (USA) ..... [11264-31]

5:00 pm: **Measurement of laser damage threshold of CdSiP2 at 1064 nm and 1550 nm**, Amelia Carpenter, Air Force Research Lab. (USA); Kevin T. Zawilski, Peter G. Schunemann, BAE Systems (USA); Shekhar Guha, San-Hui Chi, Air Force Research Lab. (USA) ..... [11264-32]

5:20 pm: **Midwave infrared ultrashort pulse laser frequency conversion in single crystal, polycrystalline, and amorphous optical materials**, Michael Tripepi, The Ohio State Univ. (USA); Michael G. Hastings, The Univ. of Arizona (USA); Aaron Schweinsberg, U.S. Army Combat Capabilities Development Command (USA); Laura Vanderhoef, U.S. Army Research Lab. (USA); Christopher Wolfe, Trenton Ensley, U.S. Army Combat Capabilities Development Command (USA); Miroslav Kolesik, Jerome Moloney, The Univ. of Arizona (USA); Enam Chowdhury, The Ohio State Univ. (USA); Anthony R. Valenzuela, U.S. Army Combat Capabilities Development Command (USA) ..... [11264-33]

5:40 pm: **Z-scan measurements of nonlinear optical phenomena in the mid-IR**, Jamie J. Gengler, UES, Inc. (USA); Manuel Ferdinandus, Air Force Institute of Technology (USA); Carl Liebig, Air Force Research Lab. (USA) ..... [11264-34]

POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Tuesday 10:00 AM– 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**New thermo-optic dispersion formula for AgGaSe2**, Kiyoshi Kato, Chitose Institute of Science and Technology (Japan); Takayuki Okamoto, Okamoto Optics Works, Inc. (Japan); Jim Jacob, Actinix (USA); Nobuhiro Umemura, Chitose Institute of Science and Technology (Japan) ..... [11264-58]

**Nonlinear optical properties of atmospheric air and aqueous solutions under a high external electric field**, Kassie S. Marble, Christopher B. Marble, Texas A&M Univ. (USA); Hunter J. Tellef, Texas A&M Univ. (USA) and Univ. of North Texas (USA); Vladislav V. Yakovlev, Texas A&M Univ. (USA) ... [11264-59]

**Highly efficient mid-infrared optical parametric amplifier in ZnGeP2 pumped by a 2.4 μm femtosecond Cr:ZnSe laser**, Sang-Hoon Nam, Massachusetts Institute of Technology (United States); Bianka Csanaková, Institute of Physics of the CAS, v.v.i. (Czech Republic); Kyung-Han Hong, Massachusetts Institute of Technology (USA) ..... [11264-60]

**Compact broadband femtosecond MIR source for hybrid sum frequency generation spectroscopy systems**, Karolis Madeikis, Rokas Danilevicius, EKSPLA (Lithuania) and Ctr. for Physical Sciences and Technology (Lithuania); Audrius Zaukevicius, EKSPLA (Lithuania); Tadas Bartulevicius, Laurynas Veselis, Andrejus Michailovas, EKSPLA (Lithuania) and Ctr. for Physical Sciences and Technology (Lithuania) ..... [11264-61]

**Periodically poled LiNbO3 wavelength converter with buried waveguide in telecommunication wavelength**, Tadashi Kishimoto, Koji Inafune, Oki Electric Industry Co., Ltd. (Japan); Yoh Ogawa, Norihiko Sekine, National Institute of Information and Communications Technology (Japan); Hitoshi Murai, Hironori Sasaki, Oki Electric Industry Co., Ltd. (Japan) ..... [11264-62]

**New design strategy of organic nonlinear crystals via suppression of phonon vibrational modes for gap-free broadband THz generation**, Won Tae Kim, KAIST (Korea, Republic of); Myeong-Hoon Shin, Se-In Kim, Seung-Heon Lee, Ajou Univ. (Korea, Republic of); In Cheol Yu, KAIST (Korea, Republic of); Mojca Jazbinsek, Zürcher Hochschule für Angewandte Wissenschaften (Switzerland); Woojin Yoon, Hoseop Yun, Ajou Univ. (Korea, Republic of); Dongwook Kim, Kyonggi Univ. (Korea, Republic of); O-Pil Kwon, Ajou Univ. (Korea, Republic of); Fabian Rotermund, KAIST (Korea, Republic of) ..... [11264-63]

**Mid-infrared supercontinuum generation in an all-solid hybrid microstructured optical fiber**, Hoa Phuoc Trung Nguyen, Hoang Tuan Tong, Than Singh Saini, Xing Luo, Takenobu Suzuki, Yasutake Ohishi, Toyota Technological Institute (Japan) ..... [11264-64]

**Gain equalizable optical parametric amplifiers using few-mode fiber**, Nan Huo, Tianjin Univ. (China) ..... [11264-65]

**Enhancement of stimulated Brillouin scattering thresholds of high power narrow-linewidth fiber lasers through a simple line-broadening scheme using a combination of sinusoidal and white noise phase modulation**, B. S. Vikram, Roopa Prakash, Santosh Aparanji, V. R. Supradeepa, Indian Institute of Science (India) ..... [11264-66]

**Non-walk-off CW 355 nm generation combined with PP-LBGO and 1064 nm PM-CW fiber laser**, Kazuma Dobashi, Shunsuke Watanabe, Masayuki Hoshi, Koichi Imai, Mitsuyoshi Sakairi, Junji Hirohashi, Satoshi Makio, Oxide Corp. (Japan) ..... [11264-68]

**Phase-matching properties of LiIn(SxSe1-x) for THG of a CO2 laser at 10.5910 μm**, Kentaro Miyata, RIKEN (Japan); Kiyoshi Kato, Chitose Institute of Science and Technology (Japan); Valentin Petrov, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) ..... [11264-69]

**Modeling the propagation of broadband THz pulses: Effects of dispersion, diffraction, and time-varying nonlinear refraction**, Payman Rasekh, Mohammad saliminabi, Murat Yildirim, Univ. of Ottawa (Canada); Robert W. Boyd, Univ. of Ottawa (Canada) and Institute of Optics, University of Rochester (USA); Jean-Michel Ménard, Ksenia Dolgaleva, Univ. of Ottawa (Canada) ..... [11264-70]

**Suspended-core fluoride fiber for broadband supercontinuum generation**, Yu Li, Longfei Wang, Meisong Liao, Long Zhang, Wanjun Bi, Tianfeng Xue, Yinyao Liu, Renli Zhang, Shanghai Institute of Optics and Fine Mechanics (China); Ohishi Yasutake, Toyota Technological Institute (Japan) .... [11264-71]

**Supermode supercontinuum generation in the cladding of a photonic crystal fiber**, Tobias Baselt, Westsächsische Hochschule Zwickau (Germany); Christopher Taudt, Westsächsisches Hochschule Zwickau (Germany); Bryan Nelsen, Westsächsische Hochschule Zwickau (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany); Andrés Fabián Lasagni, TU Dresden (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany); Peter Hartmann, Westsächsische Hochschule Zwickau (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany) ..... [11264-72]

**Modeling of intermodal couplings in large-mode area Yb-doped double-cladding fibers applied in continuous-wave high power fiber lasers**, Weixuan Lin, Martin Rochette, McGill Univ. (Canada) ..... [11264-73]

**Development of ultra-wideband frequency domain optical parametric amplification**, Jumpei Ogino, Zhaoyang Li, Shigeki Tokita, Koji Tsubakimoto, Noriaki Miyayaga, Junji Kawanaka, Osaka Univ. (Japan) ..... [11264-75]

**LBO grown crystals habitus modification by the heat field configuration**, Alexander E. Kokh, Nadezda G. Kononova, Vasily Vlezko, Dmitry Kokh, V. S. Sobolev Institute of Geology and Mineralogy (Russian Federation) ..... [11264-76]

**Nonlinear cross-polarization generation of optical wave propagating through a nanorods-based hyperbolic metamaterial**, Surawut Wicharn, Srinakharinwrot Univ. (Thailand); Prathan Buranasiri, King Mongkut's Institute of Technology Ladkrabang (Thailand) ..... [11264-77]

**Design of simultaneous multi-color coherent light generation in single MgO:PPLN bulk crystal**, Dismas Kirchirich Choge, David Wafula Waswa, Kennedy Muguro Mwaura, Univ. of Eldoret (Kenya); Wanguo LIANG, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences (China) ..... [11264-78]

LASE

# CONFERENCE 11264

**Tunable, CW visible laser sources by frequency doubling of broadly tunable Raman fiber lasers**, Arun Surendran, Ctr. for Nano Science and Engineering (CeNSE) (India); Vatsal Gehlot, Indian Institute of Science (India); Santosh Aparanji, V. R. Supradeepa, Ctr. for Nano Science and Engineering (CeNSE) (India) ..... [11264-79]

**Cascaded nonlinearity influence to high power femtosecond optical parametric oscillator**, Ignas Stasevicius, Light Conversion Ltd. (Lithuania) ..... [11264-81]

## WEDNESDAY 5 FEBRUARY

### SESSION 8

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... WED 8:00 AM TO 10:00 AM

#### Visible-UV Generation

Session Chair: **Darrell J. Armstrong**, Sandia National Labs. (USA)

8:00 am: **Nonlinear wave shaping in optically induced nonlinear photonic crystals**, Wieslaw Z. Krolikowski, The Australian National Univ. (Australia) and Texas A&M Univ. at Qatar (Qatar); Leszek Mazur, Texas A&M Univ. at Qatar (Qatar) and Wroclaw Univ. of Science and Technology (Poland); Shan Liu, The Australian National Univ. (Australia); Krzysztof Switkowski, Warsaw Univ. of Technology (Poland); Dawei Liu, Yan Sheng, The Australian National Univ. (Australia) ..... [11264-35]

8:20 am: **High power, tunable, ultrafast yellow laser using cascaded second harmonic generation of mid-IR Cr<sup>2+</sup>:ZnS laser in MgO:PPLN crystals**, Anirban Ghosh, Deepika Yadav, Ravi Kiran Saripalli, Goutam K. Samanta, Physical Research Lab. (India) ..... [11264-37]

8:40 am: **High-efficiency single-pass >100mW continuous-wave UV-355nm generation by focusing optimization of 1064nm cascaded third harmonic generation in periodically poled lithium niobate crystals**, Chen-Shao Hsu, Jui-Yu Lai, Dong-Yi Wu, Chih-Rong Chen, Karin Wu, Ming-Hsien Chou, HC Photonics Corp. (Taiwan) ..... [11264-38]

9:00 am: **Shaping of picosecond laser pulses by second harmonic generation with time predelay**, Martin Duda, Institute of Physics of the CAS, v.v.i. (Czech Republic) and Czech Technical Univ. in Prague (Czech Republic); Ondřej Novák, Michal Chyž, Institute of Physics of the CAS, v.v.i. (Czech Republic); Václav Kubeček, Czech Technical Univ. in Prague (Czech Republic); Martin Smr, Tomáš Mocek, Institute of Physics of the CAS, v.v.i. (Czech Republic) ..... [11264-39]

9:20 am: **Generating kW laser light at 532 nm via second harmonic generation of a high power Yb-doped fiber amplifier**, Peyman Ahmadi, Daniel Creeden, Daniel Aschaffenburg, Vadim Mogan, Mitchell Underwood, Coherent | Nufern (USA) ..... [11264-40]

9:40 am: **Dual-channel laser system with gap-less tuning from 250-1300 nm at megahertz repetition rates for time-resolved photoelectron-emission microscopy and spectroscopy**, Michael Schulz, Gregor Indorf, Jan Buss, Torsten Golz, Ivanka Grguras, Robert Riedel, Class 5 Photonics GmbH (Germany) ..... [11264-41]

Coffee Break ..... Wed 10:00 am to 10:30 am

### SESSION 9

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 11:40 AM

#### THz Generation and Detection

Session Chair: **Peter G. Schunemann**, BAE Systems (USA)

10:30 am: **Robust and systematic method to optimize single-cycle THz setups based on phase-matching via tilted pulse fronts**, Tobias Kroh, Timm Rohwer, Lu Wang, Umit Demirbas, Huseyin Cankaya, Franz Kärtner, Nicholas Matlis, Deutsches Elektronen-Synchrotron (Germany) ..... [11264-42]

10:50 am: **Recent progress on highly nonlinear organic crystals for efficient broadband THz wave generation** (*Invited Paper*), Bong Joo Kang, Won Tae Kim, KAIST (Korea, Republic of); Seung-Heon Lee, Ajou Univ. (Korea, Republic of); Mojca Jazbinsek, Zürcher Hochschule für Angewandte Wissenschaften (Switzerland); O-Pil Kwon, Ajou Univ. (Korea, Republic of); Fabian Rotermund, KAIST (Korea, Republic of) ..... [11264-43]

11:20 am: **Calculation of THz emission from phase-matched difference-frequency-generation in eight nonlinear crystals from time-domain-spectroscopy data**, Benoit Boulanger, Cyril Bernerd, Patricia Segonds, Jérôme Debray, Univ. Grenoble Alpes (France); Jean-Francois Roux, Emilie Herault, Jean-Louis Coutaz, Univ. Savoie Mont Blanc (France); Ichiro Shoji, Chuo Univ. (Japan); Hiroaki Minamide, Hiromasa Ito, RIKEN (Japan); Dominique Lupinski, Cristal Laser S.A. (France); Kevin T. Zawilski, Peter G. Schunemann, BAE Systems (USA); Xinyuan Zhang, Jiyang Wang, Tianjin Univ. of Technology (China) ..... [11264-44]

Lunch/Exhibition Break ..... Wed 11:40 am to 1:00 pm

### SESSION 10

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... WED 1:00 PM TO 2:50 PM

#### Optical Parametric Devices and Applications II

Session Chair: **Rita D. Peterson**, Air Force Research Lab. (USA)

1:00 pm: **Continuous-wave optical parametric oscillators for mid-infrared spectroscopy** (*Invited Paper*), Markku M. Vainio, Univ. of Helsinki (Finland) ..... [11264-45]

1:30 pm: **Mid-IR upconversion imaging: Theory and applications**, Christian Pedersen, DTU Fotonik (Denmark) ..... [11264-46]

1:50 pm: **An experimental demonstration of coherent combining applied to optical parametric oscillators**, Rodwane Chtouki, Pierre Bourdon, Anne Durécu, Laurent Lombard, Christophe Planchat, Myriam Raybaut, Antoine Godard, ONERA (France) ..... [11264-47]

2:10 pm: **High-average-power, mid-infrared, widely tunable, picosecond optical parametric oscillator based on OP-GaAs**, Qiang Fu, Univ. of Southampton (United Kingdom) ..... [11264-48]

2:30 pm: **Nonlinear interferometers for broadband mid-infrared spectroscopy**, Chiara Lindner, Sebastian Wolf, Jens Kießling, Frank Kühnemann, Fraunhofer-Institut für Physikalische Messtechnik IPM (Germany) ..... [11264-49]

Coffee Break ..... Wed 2:50 pm to 3:20 pm

### SESSION 11

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... WED 3:20 PM TO 6:00 PM

#### Stimulated Raman and Brillouin Processes

Session Chair: **Vladislav V. Yakovlev**, Texas A&M Univ. (USA)

3:20 pm: **Measuring the complex vibrational susceptibility in stimulated Raman scattering for vibrational phase imaging**, Carlo Valensise, Alejandro De La Cadena Perez Gallardo, Vikas Kumar, Daniele Viola, Giulio Cerullo, Dario Polli, Politecnico di Milano (Italy) ..... [11264-50]

3:40 pm: **Polarization of Brillouin scattered light in silica nanofibers**, Camille Buret, Martin Hauden, Jacques Chrétien, Adrien Godet, Thibaut Sylvestre, Jean-Charles Beugnot, FEMTO-ST (France); Kien Phan Huy, Univ. de Franche-Comté (France) ..... [11264-51]

4:00 pm: **Continuous-wave coherent Raman spectroscopy via plasmonic enhancement for picomolar detection**, Yashar E. Monfared, Dalhousie Univ. (Canada); Travis M. Shaffer, Sanjiv S. Gambhir, Stanford Univ. (USA); Kevin C. Hewitt, Dalhousie Univ. (Canada) ..... [11264-52]

4:20 pm: **Raman polarizability tensor in potassium dihydrogen phosphate and deuterated potassium dihydrogen phosphate crystals**, Tanya Z. Kosci, Terrance J. Kessler, Hu Huang, Stavros G. Demos, Lab. for Laser Energetics (USA) ..... [11264-53]

4:40 pm: **Watt level pulsed Tm:YLF / KGW Raman laser operating at near-IR wavelengths**, Salman Noach, Eytan Perez, Eytan Perez, Rotem Nahear, Neria Suliman, Jerusalem College of Technology (Israel); Gilad Marcus, The Hebrew Univ. of Jerusalem (Israel) ..... [11264-54]

5:00 pm: **Frequency doubling of graded-index fiber Raman lasers with multimode diode pumping**, Sergey A. Babin, Institute of Automation and Electrometry (Russian Federation) and Novosibirsk State Univ. (Russian Federation); Aleksey G. Kuznetsov, Ekaterina A. Evmenova, Ekaterina I. Dontsova, Sergey I. Kablukov, Institute of Automation and Electrometry (Russian Federation) ..... [11264-55]

5:20 pm: **Hollow-core fiber enhanced CW CARS of gases**, DSheng Xiong, Yusi Bai, Xinbing Wang, Duluo Zuo, Huazhong Univ. of Science and Technology (China) ..... [11264-56]

5:40 pm: **Conception and reproducibility study of efficient evanescent Raman converters based a nanofiber immersed in a liquid**, Maha Bouhadida, Institut d'Optique Graduate School (France); Jean-Charles Beugnot, FEMTO-ST (France); Philippe Delaye, Institut d'Optique Graduate School (France); Kien Phan Huy, FEMTO-ST (France); Sylvie Lebrun, Institut d'Optique Graduate School (France) ..... [11264-57]

# CONFERENCE 11265

LOCATION: ROOM 210 (LEVEL 2 SOUTH)

Tuesday 4 February 2020 • Proceedings of SPIE Vol. 11265

## Real-time Measurements, Rogue Phenomena, and Single-Shot Applications V

Conference Chairs: **Daniel R. Solli**, Univ. of California, Los Angeles (USA); **Georg Herink**, Univ. Bayreuth (Germany); **Serge Bielawski**, Univ. des Sciences et Technologies de Lille (France)

Program Committee: **Nail Akhmediev**, The Australian National Univ. (Australia); **Mohammad H. Asghari**, Univ. of California, Los Angeles (USA); **Corey V. Bennett**, Lawrence Livermore National Lab. (USA); **John M. Dudley**, FEMTO-ST, Univ. de Franche-Comté, CNRS (France); **Moti Fridman**, Bar-Ilan Univ. (Israel); **Hideaki Furukawa**, National Institute of Information and Communications Technology (Japan); **Goëry Genty**, Tampere Univ. of Technology (Finland); **Takuro Ideguchi**, The Univ. of Tokyo (Japan); **Bahram Jalali**, Univ. of California, Los Angeles (USA); **Dario Polli**, Politecnico di Milano (Italy); **Claus Ropers**, Georg-August-Univ. Göttingen (Germany); **Günter Steinmeyer**, Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy (Germany); **Pierre Suret**, Lab. de Physique des Lasers, Atomes et Molécules (France); **Masayuki Suzuki**, Aichi Medical Univ. (Japan); **Majid Taki**, Univ. des Sciences et Technologies de Lille (France); **Giovanna Tissoni**, Institut de Physique de Nice (France)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... TUE 9:10 AM TO 10:18 AM

#### Nonlinear Dynamics, Solitons and Rogue Waves

Session Chair: **Georg Herink**, Univ. Bayreuth (Germany)

9:10 am: **Single-shot observations of the noise-induced modulation instability in optical fibers** (*Invited Paper*), Pierre Suret, Alexandre Lebel, Adrien Kraych, Francois Copie, Alexey Tikan, Stephane Randoux, Lab de Physique des Lasers, Atomes et Molécules (France) ..... [11265-1]

9:32 am: **Phase retrieval in non-classical twin beams generated through modulational instability in hollow-core PCF** (*Invited Paper*), Nicolas Y. Joly, Daniel Häupl, Jonas Hammer, Philip Russell, Maria V. Chekhova, Max-Planck-Institut für die Physik des Lichts (Germany) ..... [11265-2]

9:54 am: **Instabilities in fiber-optics systems: from real-time measurements to machine learning**, Goëry Genty, Tampere Univ. (Finland); John M. Dudley, Univ. Bourgogne Franche-Comté (France); Piotr Ryczkowski, Lauri Salmela, Tampere Univ. (Finland); Cyril Billet, Coraline Lapre, Univ. Bourgogne Franche-Comté (France) ..... [11265-3]

10:06 am: **Buildup of noise-like pulses in ultrafast fiber lasers**, Zhiqiang Wang, Massachusetts General Hospital (USA) and Nanjing Univ. of Posts and Telecommunications (China) and Univ. Bourgogne Franche-Comté (France) ..... [11265-4]

Coffee Break ..... Tue 10:18 am to 10:50 am

#### SESSION 2

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... TUE 10:50 AM TO 12:10 PM

#### Nonlinear Dynamics in Lasers and Microresonators I

Session Chair: **Daniel R. Solli**, Univ. of California, Los Angeles (USA)

10:50 am: **Ultrafast electro-optic frequency combs for rapid measurements** (*Invited Paper*), Scott B. Papp, National Institute of Standards and Technology (USA) ..... [11265-5]

11:12 am: **Observation and manipulation of chimera-like states in passive Kerr resonators** (*Invited Paper*), Miro Erkintalo, The Univ. of Auckland (New Zealand) ..... [11265-6]

11:34 am: **How equidistant are microresonator frequency combs?**, Günter Steinmeyer, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) ..... [11265-7]

11:46 am: **Ultrashort soliton bound-states: Interactions of solitons and rapid all-optical control**, Georg Herink, Alexandra Völkel, Univ. Bayreuth (Germany); Felix Kurtz, Claus Ropers, Georg-August-Univ. Göttingen (Germany) ..... [11265-8]

11:58 am: **Time-stretched all-fiber supercontinuum source for spectroscopy**, Philip G. Westergaard, OFS Fitel Denmark ApS (Denmark) ..... [11265-9]

Lunch/Exhibition Break ..... Tue 12:10 pm to 2:00 pm

#### SESSION 3

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... TUE 2:00 PM TO 2:58 PM

#### Nonlinear Dynamics in Lasers and Microresonators II

Session Chair: **Serge Bielawski**,

Lab. de Physique des Lasers, Atomes et Molécules (France)

2:00 pm: **Passive-cavity ultrashort-pulse sources based on novel soliton formation** (*Invited Paper*), Christopher Spieß, Qian Yang, Xue Dong, Victor Bucklew, William Renninger, The Institute of Optics, Univ. of Rochester (USA) ..... [11265-10]

2:22 pm: **Ultra-low jittering of soliton molecular binding separation towards few hundreds of attoseconds**, Defeng Zou, Youjian Song, Yajing Zhang, Haosen Shi, Minglie Hu, Tianjin Univ. (China) ..... [11265-11]

2:34 pm: **Behavioral similarity of dissipative solitons in a bidirectional mode-locked fiber laser**, Ying Yu, Cihang Kong, Bowen Li, Jiqiang Kang, Yu-Xuan Ren, The Univ. of Hong Kong (China); Zhi-Chao Luo, South China Normal Univ. (China); Kenneth Kin-Yip Wong, The Univ. of Hong Kong (China) ..... [11265-12]

2:46 pm: **Stability of a long cavity laser**, Svetlana Slepneva, Institut de Physique de Nice, CNRS (France) and Cork Institute of Technology (Ireland) and Tyndall National Institute (Ireland); Uday Munivenkatappa, Cork Institute of Technology (Ireland); Alexander Pimenov, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); Evgeny Viktorov, ITMO Univ. (Russian Federation); Andrei G. Vladimirov, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); Guillaume Huyet, CNRS (France) ..... [11265-13]

Coffee Break ..... Tue 2:58 pm to 3:30 pm

#### SESSION 4

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... TUE 3:30 PM TO 5:12 PM

#### Real-time and Time-stretch Instruments

Session Chair: **Georg Herink**, Univ. Bayreuth (Germany)

3:30 pm: **Continuous active multiplexing of frequency heralded single photons** (*Invited Paper*), Stephane Clemmen, Univ. Libre de Bruxelles (Belgium) and Univ. Gent (Belgium) ..... [11265-14]

3:52 pm: **High-speed vibrational imaging through broadband coherent Raman spectroscopy** (*Invited Paper*), Dario Polli, Carlo Valensise, Alejandro De La Cadena Perez Gallardo, Marco Marangoni, Giulio Cerullo, Politecnico di Milano (Italy) ..... [11265-15]

4:14 pm: **Infrared absorption spectroscopy of dynamically compressed water** (*Invited Paper*), Daniel Dolan, Sandia National Labs. (USA); Darrell Ramsey, Mission Support and Test Services LLC (USA) ..... [11265-16]

4:36 pm: **Coherent differential time-stretch THz data acquisition**, Tianwei Jiang, Cejo Lonappan, Univ. of California, Los Angeles (USA); Clément Evain, Christophe Szwaj, Eléonore Roussel, Marc Le Parquier, Serge Bielawski, Univ. de Lille (France); Bahram Jalali, Univ. of California, Los Angeles (USA) ..... [11265-17]

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# CONFERENCE 11265

4:48 pm: **Compressed Ultrafast Spectral Temporal (CUST) photography**, Lu Yu, Xi'an Jiaotong Univ. (China) and City Univ. of Hong Kong (Hong Kong, China); Feng Chen, Xi'an Jiaotong Univ. (China); Lidai Wang, City Univ. of Hong Kong (Hong Kong, China) . . . . . [11265-18]

5:00 pm: **CW time-lens**, Moti Fridman, Bar-Ilan Univ. (Israel); Michelle Sander, Boston Univ. (USA) . . . . . [11265-19]

## POSTERS-TUESDAY

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Tuesday 10:00 AM– 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Multimode time-lens**, Moti Fridman, Bar-Ilan Univ. (Israel) . . . . . [11265-20]

**Single-shot three-dimensional imaging with all-optical information processing using phase-controlled chirped optical frequency comb**, Takashi Kato, Hiroataka Ishii, Kazuhiro Terada, The Univ. of Electro-Communications (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan); Tamaki Moritoh, The Univ. of Electro-Communications (Japan); Kaoru Minoshima, The Univ. of Electro-Communications (Japan) and JST-ERATO MINOSHIMA Intelligent Optical Synthesizer Project (Japan) . . . . . [11265-21]

**Extremely robust pulse retrieval from even noisy second-harmonic-generation frequency-resolved optical gating traces**, Rana Jafari, Rick Trebino, Georgia Institute of Technology (USA) . . . . . [11265-22]

**Measuring of the petroleum product leaks by distributed systems**, Jakub Jaros, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [11265-23]

**Open-path remote sensing for multi-species gas detection using a broadband optical parametric oscillator**, Oguzhan Kara, Frazer Sweeney, Marius Rutkauskas, Heriot-Watt Univ. (United Kingdom); Carl Farrell, Christopher G. Leburn, Chromacity Ltd. (United Kingdom); Derryck T. Reid, Heriot-Watt Univ. (United Kingdom) . . . . . [11265-24]

# CONFERENCE 11266

LOCATION: ROOM 202 (LEVEL 2 SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11266

## Laser Resonators, Microresonators, and Beam Control XXII

Conference Chairs: **Alexis V. Kudryashov**, Institute of Geosphere Dynamics (Russian Federation); **Alan H. Paxton**, Air Force Research Lab. (USA); **Vladimir S. Ilchenko**, GM Cruise LLC (USA)

Conference Co-Chair: **Andrea M. Armani**, The Univ. of Southern California (USA)

Program Committee: **Lutz Aschke**, TRUMPF Lasertechnik GmbH (Germany); **Gaurav Bahl**, Univ. of Illinois (USA); **Paul E. Barclay**, Univ. of Calgary (Canada); **Hui Cao**, Yale Univ. (USA); **Yanne K. Chembo**, Univ. of Maryland, College Park (France); **Jean-Claude M. Diels**, The Univ. of New Mexico (USA); **Hans Joachim Eichler**, Technische Univ. Berlin (Germany); **Andrew Forbes**, Univ. of the Witwatersrand, Johannesburg (South Africa); **Pierre Galarneau**, INO (Canada); **Thomas Graf**, Univ. Stuttgart (Germany); **Qing Gu**, The Univ. of Texas at Dallas (USA); **Stefan Hambücker**, INGENERIC GmbH (Germany); **Tobias J. Kippenberg**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **James R. Leger**, Univ. of Minnesota, Twin Cities (USA); **Andrey B. Matsko**, Jet Propulsion Lab. (USA); **Gualtiero Nunzi Conti**, Istituto di Fisica Applicata “Nello Carrara” (Italy); **Andrew W. Poon**, Hong Kong Univ. of Science and Technology (Hong Kong, China); **Michael J. Scaggs**, Haas Laser Technologies, Inc. (USA); **Julia V. Sheldakova**, Russian Academy of Sciences (Russian Federation); **Haiyin Sun**, ChemImage Corp. (USA); **Yun-Feng Xiao**, Peking Univ. (China); **Lei Xu**, Fudan Univ. (China); **Jonathan M. Ward**, Okinawa Institute of Science and Technology Graduate Univ. (Japan); **Lan Yang**, Washington Univ. in St. Louis (USA)

### MONDAY 3 FEBRUARY

#### SESSION 1

LOCATION: ROOM 202 (LEVEL 2 SOUTH) . . . . . MON 1:45 PM TO 2:55 PM

#### WGM Microsensors

Session Chair: **Andrea M. Armani**, The Univ. of Southern California (USA)

1:45 pm: **Laser emission microscope for cancer diagnosis** (*Invited Paper*), Yunlu Sun, Xudong Fan, Univ. of Michigan (USA) . . . . . [11266-1]

2:10 pm: **Fabry-Perot cavity optomechanical system for high precision accelerometry**, David A. Long, Feng Zhou, Yiliang Bao, Ramgopal Madugani, Thomas W. LeBrun, Jason J. Gorman, National Institute of Standards and Technology (USA) . . . . . [11266-2]

2:30 pm: **Optical microresonators for single-particle spectroscopy and microscopy** (*Invited Paper*), Hoang Long Nguyen, Levi Hogan, Erik H. Horak, Feng Pan, Morgan T. Rea, Cecilia H. Vollbrecht, Randall H. Goldsmith, Univ. of Wisconsin-Madison (USA) . . . . . [11266-3]

Coffee Break. . . . . Mon 2:55 pm to 3:30 pm

#### LASE PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . . MON 3:30 PM TO 5:40 PM

3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)

3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)

3:40 pm: **VCSEL: Born Small and Grown Big** (*Plenary*)  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)

4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources** (*Plenary*)  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)

5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science** (*Plenary*)  
**Robert L. Byer**, Stanford Univ. (USA)

### TUESDAY 4 FEBRUARY

#### SESSION 2

LOCATION: ROOM 202 (LEVEL 2 SOUTH) . . . . . TUE 8:20 AM TO 10:15 AM

#### Crystalline WGM Microresonators and Applications I

Session Chair: **Vladimir S. Ilchenko**, GM Cruise LLC (USA)

8:20 am: **Electro-optic adiabatic frequency conversion in a non-centrosymmetric microresonator**, Yannick Minet, Univ. of Freiburg (Germany); Ingo Breunig, Karsten Buse, Univ. of Freiburg (Germany) and Fraunhofer-Institut für Physikalische Messtechnik IPM (Germany) . . . . . [11266-4]

8:40 am: **High-precision measurement of a propagation loss of low-loss single-mode optical waveguides on lithium niobate on insulator**, Jintian Lin, Shanghai Institute of Optics and Fine Mechanics (China); Junxia Zhou, East China Normal Univ. (China); Rongbo Wu, Shanghai Institute of Optics and Fine Mechanics (China); Ya Cheng, Shanghai Institute of Optics and Fine Mechanics (China) and East China Normal Univ. (China) . . . . . [11266-5]

9:00 am: **Crystalline silicon WGM microresonators for near IR and mid IR photonics** (*Invited Paper*), Igor A. Bilenko, M.V. Lomonosov Moscow State Univ. (Russian Federation) . . . . . [11266-6]

9:25 am: **Juggling with light: Powerful second-order nonlinear effects in whispering gallery resonators!** (*Invited Paper*), Karsten Buse, Ingo Breunig, Univ. of Freiburg (Germany) and Fraunhofer-Institut für Physikalische Messtechnik IPM (Germany) . . . . . [11266-7]

9:50 am: **Ultra-low loss lithium niobate photonics** (*Invited Paper*), Ya Cheng, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [11266-8]

Coffee Break. . . . . Tue 10:15 am to 10:45 am

#### SESSION 3

LOCATION: ROOM 202 (LEVEL 2 SOUTH) . . . . . TUE 10:45 AM TO 12:00 PM

#### Crystalline WGM Microresonators and Applications II

Session Chair: **Andrea M. Armani**, The Univ. of Southern California (USA)

10:45 am: **Soliton microcombs for LIDAR** (*Invited Paper*), Tobias J. Kippenberg, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11266-9]

11:10 am: **Electro-optic frequency combs and applications** (*Invited Paper*), Marko Loncar, Harvard John A. Paulson School of Engineering and Applied Sciences (USA) . . . . . [11266-10]

11:35 am: **Optical microresonators in clocks: Needs and status** (*Invited Paper*), Andrey B. Matsko, Jet Propulsion Lab. (USA) . . . . . [11266-11]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

# CONFERENCE 11266

## SESSION 4

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... TUE 1:30 PM TO 3:15 PM

### Kerr Optical Frequency Microcombs with WGM

Session Chair: **Jonathan M. Ward**, Okinawa Institute of Science and Technology Graduate Univ. (Japan)

1:30 pm: **Nonlinear filtering with dissipative Kerr solitons** (*Invited Paper*), Victor Brasch, CSEM SA (Switzerland); Ewelina Obrzud, CSEM SA (Switzerland) and Univ. de Genève (Switzerland); Steve Lecomte, Tobias Herr, CSEM SA (Switzerland) ..... [11266-12]

1:55 pm: **Silicon oxynitride microresonators for Kerr frequency combs**, Dongyu Chen, Andre Kovach, The Univ. of Southern California (USA); Feifei Lian, Sumiko Poust, Vincent Gambin, Northrop Grumman Corp. (USA); Andrea M. Armani, The Univ. of Southern California (USA) ..... [11266-13]

2:15 pm: **Frequency comb generation in non-centrosymmetric optical microresonators**, Jan Szabados, Univ. of Freiburg (Germany); Ingo Breunig, Karsten Buse, Univ. of Freiburg (Germany) and Fraunhofer-Institut für Physikalische Messtechnik IPM (Germany) ..... [11266-14]

2:35 pm: **Continuous scanning of a dissipative Kerr micro-resonator soliton comb**, Naoya Kuse, IMRA America, Inc. (USA) and Tokushima Univ. (Japan); Tomohiro Tetsumoto, IMRA America, Inc. (USA); Gabriele Navickaite, Michael Geiselmann, LiGenTec SA (Switzerland); Martin E. Fermann, IMRA America, Inc. (USA) ..... [11266-15]

2:55 pm: **Advances in optical frequency comb generation using whispering-gallery mode resonators**, Yanne K. Chembo, Univ. of Maryland, College Park (USA) ..... [11266-16]

Coffee Break ..... Tue 3:15 pm to 3:45 pm

## SESSION 5

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... TUE 3:45 PM TO 5:35 PM

### Configurable WGM and Excitation

Session Chair: **Yanne K. Chembo**, Univ. of Maryland, College Park (USA)

3:45 pm: **All-optically triggerable organic/inorganic photonic devices** (*Invited Paper*), Andrea M. Armani, Jinghan He, Andre Kovach, Patrick Saris, The Univ. of Southern California (USA) ..... [11266-17]

4:10 pm: **Point-and-play: Fiber optic nano-antenna for excitation and collection of whispering gallery modes** (*Invited Paper*), Jonathan M. Ward, Fuchuan Lei, Sile Nic Chormaic, Okinawa Institute of Science and Technology Graduate Univ. (Japan); Jochen Fick, Institut NÉEL, Ctr. National de la Recherche Scientifique (France) and Grenoble INP (France) and Univ. Grenoble Alpes (France); Samir Mondal, Council of Scientific & Industrial Research (India); Pooj Gupta, Academy of Scientific & Innovative Research (India); Stephy Vincent, Okinawa Institute of Science and Technology Graduate Univ. (Japan) ..... [11266-18]

4:35 pm: **Generation of arbitrary higher order Poincare beams from a visible metasurface laser**, Hend Sroor, Univ. of Shanghai for Science and Technology (China); Yao-Wei Huang, Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard Univ. (USA) and National Univ. of Singapore (Singapore); Bereneice Sephton, Univ. of the Witwatersrand, Johannesburg (South Africa); Darryl Naidoo, CSIR National Laser Ctr. (South Africa) and Univ. of the Witwatersrand, Johannesburg (South Africa); Adam Valles, Univ. of the Witwatersrand, Johannesburg (South Africa); Cheng-Wei Qiu, National Univ. of Singapore (Singapore); Qiwen Zhan, Univ. of Shanghai for Science and Technology (China); Antonio Ambrosio, Ctr. for Nanoscale Systems, Harvard Univ. (USA); Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences, Harvard Univ. (USA); Andrew Forbes, Univ. of the Witwatersrand, Johannesburg (South Africa) ..... [11266-19]

4:55 pm: **Optically tunable on-chip microresonator**, Andre Kovach, Jinghan He, Dongyu Chen, Patrick Saris, Andrea M. Armani, The Univ. of Southern California (USA) ..... [11266-20]

5:15 pm: **Exciting whispering gallery modes in liquid micro-cavities using sub-micron size tapered fibers**, Meenakshi Gaira, C. S. Unnikrishnan, Tata Institute of Fundamental Research (India) ..... [11266-21]

## POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Tuesday 10:00 AM–5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Extra-cavity laser beam shaping using an amplifier**, Lebohang T. Bell, Council of Scientific & Industrial Research (South Africa) ..... [11266-49]

**Versatile bio-organism detection using microspheres for bio-degradation and bio-remediation studies**, Logan Echeveria, Univ. of California, Davis (USA); Sean Gilmore, Sara Harrison, Allan Chang, Lawrence Livermore National Lab. (USA); Payal Singh, Univ. of California, San Diego (USA); Kenneth Heinz, Tiziana C. Bond, Lawrence Livermore National Lab. (USA) ..... [11266-50]

**MicroResonators for Compact Optical Sensors (uRCOS)**, Tiziana C. Bond, Lawrence Livermore National Lab. (USA); Payal Singh, Univ. of California, San Diego (USA); Sara Harrison, Allan Chang, Kenneth Heinz, Sara Levenson, Lawrence Livermore National Lab. (USA); Logan Echeveria, Univ. of California, Davis (USA) ..... [11266-51]

**A stretched-pulse mode-locked laser source at a central wavelength of 1250 nm**, Onur Caki, Izmir Biomedicine and Genome Ctr., Dokuz Eylül Univ. (Turkey) and Izmir Institute of Technology (Turkey); Ibrahim Akkaya, Serhat Tozburun, Izmir Biomedicine and Genome Ctr., Dokuz Eylül Univ. (Turkey) ..... [11266-52]

**Micro-bottle resonator as sensors using whispering gallery modes**, Yusra Jat, Carleton Univ. (Canada) ..... [11266-53]

**Random lasers using cracks**, Itir Bakis Dogru, Emir Salih Magden, Erkan Senses, Sedat Nizamoglu, Koç Univ. (Turkey) ..... [11266-54]

**Design of efficient Gauss to top-hat converters using geometrical phase elements inscribed in the glass by femtosecond laser pulses**, Pavel Gotovski, Ctr. for Physical Sciences and Technology (Lithuania); Ernestas Nacius, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Vytautas Jukna, Vilnius Univ. (Lithuania) and Ctr. for Physical Sciences and Technology (Lithuania); Sergej Orlov, Ctr. for Physical Sciences and Technology (Lithuania); Orestas Ulcinas, Workshop of Photonics (Lithuania); Justas Baltrukonis, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Titas Gertus, Light Conversion Ltd. (Lithuania) ..... [11266-55]

**Sub-ms reaction detection using sweep source laser based whispering gallery mode sensor**, Seunghun Lee, Heesang Ahn, Hyerin Song, Taeyeon Kim, Kyujung Kim, Pusan National Univ. (Korea, Republic of) ..... [11266-56]

**Miniature bimorph deformable mirror for laser beam shaping**, Julia V. Sheldakova, Ilya Galaktionov, Alexander N. Nikitin, Alexey Rukosuev, Vadim Samarkin, Vladimir Toporovsky, Institute of Dynamics of Geospheres (Russian Federation); Alexis Kudryashov, Institute of Dynamics of Geospheres (Russian Federation) and Moscow Polytechnic Univ. (Russian Federation) ..... [11266-57]

**Iron: zinc selenide laser, pumping with pulse width that is shorter than or comparable to the population-inversion lifetime**, Alan H. Paxton, Chunte Lu, Ron Kaspi, Air Force Research Lab. (USA) ..... [11266-58]

**Repetition rate tuning of dissipative Kerr soliton in microresonators**, Chunhua Dong, Univ. of Science and Technology of China (China) ... [11266-59]

WEDNESDAY 5 FEBRUARY

SESSION 6

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... WED 8:30 AM TO 10:00 AM

**Lasers with WGM resonators**

Session Chair: **Andrey B. Matsko**, OEwaves, Inc. (USA)

8:30 am: **780nm narrow-linewidth self-injection-locked WGM lasers** (*Invited Paper*), Yu-Hung Lai, Anatoliy A. Savchenkov, Danny Eliyahu, Setareh Ganji, Robert D. Moss, Andrey B. Matsko, Skip Williams, OEwaves, Inc. (USA) ..... [11266-23]

8:55 am: **On-chip Brillouin lasers based on 10 million-Q chalcogenide resonators without direct etch process**, Sangyoon Han, Dae-Gon Kim, Joonhyuk Hwang, In Hwan Do, Dongin Jeong, Yong-Hee Lee, KAIST (Korea, Republic of); Duk-Yong Choi, The Australian National Univ. (Australia); Hansuek Lee, KAIST (Korea, Republic of) ..... [11266-24]

9:15 am: **Tunable single-frequency lasing in whispering gallery resonators**, Ingo Breunig, Simon J Herr, Karsten Buse, Univ. of Freiburg (Germany) and Fraunhofer-Institut für Physikalische Messtechnik IPM (Germany) . . . [11266-25]

9:35 am: **Mixing microwave and light: Electro-optic frequency combs and more** (*Invited Paper*), Madhuri Kumari, Nicholas Lambert, Univ. of Otago (New Zealand) and The Dodd-Walls Ctr. for Photonic and Quantum Technologies (New Zealand); Alfredo Rueda, Institute of Science and Technology Austria (Austria); Florian Selmeir, The Dodd-Walls Ctr. for Photonic and Quantum Technologies (New Zealand); Harald G. L. Schwefel, Univ. of Otago (New Zealand) and The Dodd-Walls Ctr. for Photonic and Quantum Technologies (New Zealand)..... [11266-26]

Coffee Break. ....Wed 10:00 am to 10:30 am

SESSION 7

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 12:35 PM

**Quantum Optics with WGM Resonators**

Session Chair: **Victor Brasch**, CSEM SA (Switzerland)

10:30 am: **Gaussian and non-Gaussian multimode entangled states of optical frequency combs** (*Invited Paper*), Nicolas Treps, Lab. Kastler Brossel, Sorbonne Univ. (France)..... [11266-27]

10:55 am: **On-chip quantum frequency combs for complex photon state generation** (*Invited Paper*), Michael Kues, Leibniz Univ. Hannover (Germany) and Institut National de la Recherche Scientifique (Canada); Stefania Sciara, Piotr Roztocky, Bennet Fischer, Institut National de la Recherche Scientifique (Canada); Christian Reimer, Hyperlight Corp. (USA); Mehedi Islam, Luis Romero Cortés, YanBing Zhang, Institut National de la Recherche Scientifique (Canada); Alfonso Cino, Univ. degli Studi di Palermo (Italy); Sai T. Chu, City Univ. of Hong Kong (Hong Kong, China); Brent E. Little, State Key Lab. of Transient Optics and Photonics, Xi'an Institute of Optics and Precision Mechanics (China); David J. Moss, Swinburne Univ. of Technology (Australia); Lucia Caspani, Univ. of Strathclyde (United Kingdom); William J. Munro, NTT Basic Research Labs., Nippon Telegraph and Telephone Corp. (Japan); José Azaña, Institut National de la Recherche Scientifique (Canada); Roberto Morandotti, Institut National de la Recherche Scientifique (Canada) and Univ. of Electronic Science and Technology of China (China) and ITMO Univ. (Russian Federation) . . . [11266-28]

11:20 am: **Quantum computing in the optical frequency comb of one optical parametric oscillator** (*Invited Paper*), Olivier Pfister, Univ. of Virginia (USA)..... [11266-29]

11:45 am: **Integration of quantum emitters and detectors** (*Invited Paper*), Valery Zwiller, Samuel Gyger, Thomas Lettner, Lucas Schweickert, Katharina Zeuner, Eva Schöll, Ali Elshaari, Klaus Jöns, Stephan Steinhauer, KTH Royal Institute of Technology (Sweden); Julien Zichi, Andreas Fognini, Ronan Gourgues, Sander Dorenbos, Single Quantum B.V. (Netherlands) . . . [11266-30]

12:10 pm: **Towards octave-spanning frequency comb in crystalline AlN-on-sapphire microresonators** (*Invited Paper*), Hong X. Tang, Yale Univ. (USA)..... [11266-31]

Lunch/Exhibition Break .....Wed 12:35 pm to 1:55 pm

SESSION 8

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... WED 1:55 PM TO 3:15 PM

**Beam Shaping I**

Session Chair: **Stefan Hambücker**, INGENERIC GmbH (Germany)

1:55 pm: **What is the maximum accessible OAM from spatial light modulators?**, Jonathan Pinnell, Valeria Rodriguez-Fajardo, Andrew Forbes, Univ. of the Witwatersrand, Johannesburg (South Africa) ..... [11266-32]

2:15 pm: **Achromatic holographic phase mask for broadband lasers beam conversion**, Oussama Mhibik, Ivan Divliansky, Marc Segall, Leonid Glebov, Univ. of Central Florida (USA) ..... [11266-33]

2:35 pm: **Generation of vortex beams using holographic phase masks in photo-thermo-refractive glass**, Oussama Mhibik, Zachary Labossiere, Ivan Divliansky, Leonid Glebov, Univ. of Central Florida (USA) . . . . . [11266-34]

2:55 pm: **Generation of Bessel type beams via phase shifted axicons encoded in geometrical phase elements**, Ernestas Nacius, Pavel Gotovski, Vytautas Jukna, Ctr. for Physical Sciences and Technology (Lithuania); Orestas Ulcinas, Workshop of Photonics (Lithuania); Sergej Orlov, Titas Gertus, Ctr. for Physical Sciences and Technology (Lithuania)..... [11266-35]

Coffee Break. ....Wed 3:15 pm to 3:45 pm

SESSION 9

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... WED 3:45 PM TO 4:45 PM

**Beam Shaping II**

Session Chair: **Stefan Hambücker**, INGENERIC GmbH (Germany)

3:45 pm: **Square top-hat and round top-hat laser beam shaping with multi-plane light conversion for femtosecond laser material microprocessing**, Clément Jacquard, CAILabs (France); Girolamo Mincuzzi, Marc Faucon, Aurélien Sikora, Rainer Kling, ALPHANOV (France); Gwenn Pallier, Nicolas Laurenchet, Pu Jian, Olivier Pinel, Guillaume Labroille, CAILabs (France)..... [11266-36]

4:05 pm: **Control of laser beam intensity distribution, OAM, and coherence length based on fiber array coherent combining**, Vadim V. Dudorov, Valerii P. Aksenov, V. E. Zuev Institute of Atmospheric Optics (Russian Federation); Valeriy V. Kolosov, V. E. Zuev Institute of Atmospheric Optics (Russian Federation) and Tomsk Scientific Ctr. (Russian Federation); Mikhail E. Levitsky, V. E. Zuev Institute of Atmospheric Optics (Russian Federation) and TOPAZ (Russian Federation)..... [11266-37]

4:25 pm: **Dynamic coherent beam combining based on a setup of microlens arrays**, Maik Prossotowicz, TRUMPF Laser GmbH (Germany); Andreas Heimes, TRUMPF Laser- und Systemtechnik GmbH (Germany); Florian Jansen, Hans-Jürgen Otto, Sören Kumkar, Raphael Scelle, Aleksander Budnicki, TRUMPF Laser GmbH (Germany); Daniel Flamm, TRUMPF Laser- und Systemtechnik GmbH (Germany) ..... [11266-38]

THURSDAY 6 FEBRUARY

SESSION 10

LOCATION: ROOM 202 (LEVEL 2 SOUTH) ..... THU 8:00 AM TO 10:00 AM

**Laser Mode Control**

Session Chair: **Alan H. Paxton**, Air Force Research Lab. (USA)

8:00 am: **Multiline oscillation of Q-switched cavity-dumped CO<sub>2</sub> laser with intracavity diffraction grating**, Yuzuru Tadokoro, Tatsuya Yamamoto, Junichi Nishimae, Mitsubishi Electric Corp. (Japan) ..... [11266-39]

8:20 am: **Three-level Nd:YLF/KGW Raman laser at 990 nm directly pumped by a beam-shaped diode bar at 872 nm**, Allan Bereczki, Niklaus U. Wetter, Instituto de Pesquisas Energéticas e Nucleares (Brazil) ..... [11266-40]

8:40 am: **Design of an external cavity semiconductor laser for intra-cavity beam combining**, Sara Piccione, Lorenzo Pavesi, Univ. degli Studi di Trento (Italy) ..... [11266-41]

9:00 am: **Thermal and population induced lensing in Alexandrite lasers**, Goronwy Tawy, Jian Wang, Michael J. Damzen, Imperial College London (United Kingdom) ..... [11266-42]

LASE

# CONFERENCE 11266

9:20 am: **Dynamically stable lasers from commercial Nd:YAG modules with high beam quality and single-frequency: The correct choice of the fundamental waist size at the rod**, Allan Berezcki, Niklaus U. Wetter, Instituto de Pesquisas Energéticas e Nucleares (Brazil) . . . . . [11266-43]

9:40 am: **Multi-kilowatt fibre laser with azimuthal mode output beam for advanced material processing**, Christophe A. Codemard, SPI Lasers UK Ltd. (United Kingdom); Natasha Vukovic, Jaclyn S. Chan, Michalis N. Zervas, Optoelectronics Research Ctr. (United Kingdom); Stephen J. Keen, Rongsheng Chen, Richard Jesset, Iain Botheroyd, Mike Durkin, Mark Greenwood, SPI Lasers UK Ltd. (United Kingdom) . . . . . [11266-44]

Coffee Break. . . . . Thu 10:00 am to 10:30 am

## SESSION 11

LOCATION: ROOM 202 (LEVEL 2 SOUTH) . . . . . THU 10:30 AM TO 11:50 AM

### Adaptive Optics, Laser Diagnostics, Nonlinear Propagation

Session Chair: **Julia V. Sheldakova**,  
Active Optics Night N Ltd. (Russian Federation)

10:30 am: **Applicability of small size wavefront correctors to compensate for wavefront distortions in laser systems**, Vladimir Toporovsky, Moscow Polytechnic Univ. (Russian Federation) and Institute of Dynamics of Geospheres (Russian Federation); Alexis Kudryashov, Institute of Dynamics of Geospheres (Russian Federation) and Moscow Polytechnic Univ. (Russian Federation); Alexey Rukosuev, Vadim Samarkin, Julia V. Sheldakova, Institute of Dynamics of Geospheres (Russian Federation) . . . . . [11266-45]

10:50 am: **M-squared laser measurement as simple as measuring laser power**, Michael J. Scaggs, Gilbert Haas, Haas Laser Technologies, Inc. (USA) . . . . . [11266-46]

11:10 am: **Focusing laser beam through pinhole using stacked-actuator deformable mirror**, Alexander N. Nikitin, Ilya Galaktionov, Julia V. Sheldakova, Institute of Dynamics of Geospheres (Russian Federation); Alexis Kudryashov, Institute of Dynamics of Geospheres (Russian Federation) and Moscow Polytechnic Univ. (Russian Federation); Vadim Samarkin, Alexey Rukosuev, Vladimir Toporovsky, Institute of Dynamics of Geospheres (Russian Federation) . . . . . [11266-47]

11:30 am: **Pulse propagation through an EIT medium in presence of permanent dipole moment**, Nilamoni Daloi, Tarak N Dey, Indian Institute of Technology Guwahati (India) . . . . . [11266-48]

## Photonics West Industry Stage

Tuesday – Thursday • Hall DE

Keynotes and panels open to all attendees

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# CONFERENCE 11267

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH)

Monday–Wednesday 3–5 February 2020 • Proceedings of SPIE Vol. 11267

# Laser Applications in Microelectronic and Optoelectronic Manufacturing (LAMOM) XXV

*Conference Chairs:* **Gediminas Račiukaitis**, Ctr. for Physical Sciences and Technology (Lithuania); **Carlos Molpeceres**, Univ. Politécnica de Madrid (Spain)

*Conference Co-Chairs:* **Jie X. Qiao**, Rochester Institute of Technology (USA); **Aiko Narazaki**, National Institute of Advanced Industrial Science and Technology (Japan)

*Program Committee:* **Craig B. Arnold**, Princeton Univ. (USA); **Jan J. Dubowski**, Univ. de Sherbrooke (Canada); **Costas P. Grigoropoulos**, Univ. of California, Berkeley (USA); **Bo Gu**, Bos Photonics (USA); **Henry Helvajian**, The Aerospace Corp. (USA); **Guido Hennig**, Daetwyler Graphics AG (Switzerland); **Heinz P. Huber**, Hochschule für Angewandte Wissenschaften München (Germany); **Tetsuya Makimura**, Univ. of Tsukuba (Japan); **Michel Meunier**, Ecole Polytechnique de Montréal (Canada); **Yoshiki Nakata**, Osaka Univ. (Japan); **Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland); **Hiroyuki Niino**, National Institute of Advanced Industrial Science and Technology (Japan); **Alberto Piqué**, U.S. Naval Research Lab. (USA); **Andrei V. Rode**, The Australian National Univ. (Australia); **Stephan Roth**, BLZ Bayerisches Laserzentrum GmbH (Germany); **Klaus Sokolowski-Tinten**, Univ. Duisburg-Essen (Germany); **Razvan Stoian**, Lab. Hubert Curien (France); **Koji Sugioka**, RIKEN (Japan); **Xianfan Xu**, Purdue Univ. (USA); **Steven M. Yalisove**, Univ. of Michigan (USA)

*Conference Co-Sponsors:*



Plymouth Grating Laboratory



## MONDAY 3 FEBRUARY

### SESSION 1

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . MON 8:20 AM TO 10:20 AM

#### LAMOM XXV Anniversary

Session Chair: **Jan J. Dubowski**, Univ. de Sherbrooke (Canada)

8:20 am: **LAMOM history and future** (*Invited Paper*), Jan J. Dubowski, Univ. de Sherbrooke (Canada) . . . . . [11267-1]

8:50 am: **Ultrafast lasers: Reliable tools for advanced materials processing** (*Invited Paper*), Koji Sugioka, RIKEN Ctr. for Advanced Photonics (Japan) . . . . . [11267-2]

9:20 am: **LAMOM XXV: Perspectives from an industrial physicist** (*Invited Paper*), Jan Kleinert, ESI, Inc. (USA) . . . . . [11267-3]

9:50 am: **Advanced laser material processing of steel and silicon** (*Invited Paper*), Thomas Kiedrowski, Robert Bosch GmbH (Germany) . . . . . [11267-4]

Coffee Break . . . . . Mon 10:20 am to 10:50 am

### SESSION 2

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . MON 10:50 AM TO 12:10 PM

#### Laser Processing of Polymers

Session Chair: **Jie X. Qiao**, Rochester Institute of Technology (USA)

10:50 am: **Optical waveguide on silicon made by zone melting method**, Uriel Hanuka, Yair Zigman, Maor Tiferet, Zeev Zalevsky, Moshe Sinvani, Bar-Ilan Univ. (Israel) . . . . . [11267-42]

11:10 am: **Polymer processing with ultra-short pulses in UV and DUV for consumer electronics**, Ulf Quentín, Florian Kanal, TRUMPF Laser- und Systemtechnik GmbH (Germany); Dirk H. Sutter, Aleksander Budnicki, Marc Sailer, TRUMPF Laser GmbH (Germany) . . . . . [11267-5]

11:30 am: **Laser processing of polymeric materials by quantum cascade lasers**, Tadatake Sato, Nobuhiro Umebayashi, Masayuki Kakehata, Hidehiko Yashiro, National Institute of Advanced Industrial Science and Technology (Japan); Naota Akikusa, Tadatake Edamura, Hamamatsu Photonics K.K. (Japan) . . . . . [11267-6]

11:50 am: **High speed laser printing and sintering of flexible RFID antennas and fingerprint sensors**, Ioannis Theodorakos, Filimon Zacharatos, Marina Makrygianni, Ioanna Zergioti, National Technical Univ. of Athens (Greece); Merijn Giesbers, Gari Arutinov, Holst Ctr. (Netherlands); Simon Tuohi, Daniel Arnaldo, Dimitris Karnakis, Oxford Lasers Ltd. (United Kingdom); Semyon Melamed, Ayala Kabla, Fernando De la Vega, PV Nano Cell Ltd. (Israel); Darshana Kariyapperuma, Brian Cobb, Richard Price, PragmatIC (United Kingdom); Patrick Too, Shane Norval, FlexEnable Ltd. (United Kingdom); Jonathan Ankri, Arye Schwarzbbaum, Alon Melamed, Orbotech Ltd. (Israel) . . . . . [11267-47]

Lunch Break . . . . . Mon 12:10 pm to 1:20 pm

### SESSION 3

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . . MON 1:20 PM TO 3:10 PM

#### Ultrafast Laser-induced Modifications in Transparent Materials

Joint Session with 11267 and 11270

Session Chair: **Roberto Osellame**, CNR-Istituto di Fotonica e Nanotecnologie (Italy)

1:20 pm: **On the use of femtosecond laser for tuning materials properties** (*Invited Paper*), Yves Bellouard, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11267-8]

1:50 pm: **Digital tools for laser parameters optimization in femtosecond processing**, Eric Audouard, Pierre Constant, Amelie Letan, Konstantin Mishchik, Clemens Hönninger, Eric P. Mottay, Amplitude Systèmes (France) . . . . . [11270-50]

2:10 pm: **Femtosecond laser micromachining in hydrophobic intraocular lenses: Efficacy and material effects**, Dan Yu, Ruiting Huang, Wayne H. Knox, Univ. of Rochester (USA) . . . . . [11270-51]

2:30 pm: **Laser induced modifications in transparent materials using azimuthally modulated axicon beams**, Paulius Slevas, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Sergej Orlov, Ctr. for Physical Sciences and Technology (Lithuania); Ernestas Nacius, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Orestas Ulcinas, Workshop of Photonics (Lithuania); Pavel Gotovski, Ctr. for Physical Sciences and Technology (Lithuania); Justas Baltrukonis, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Vytautas Jukna, Ctr. for Physical Sciences and Technology (Lithuania) . . . . . [11267-9]



# CONFERENCE 11267

2:50 pm: **High quality Bessel beam generation through reflective axicon for femtosecond laser glass microprocessing**, Antonin Billaud, CAILabs (France); Maik Steinbach, Patrick Taschner, Arndt Hohnholz, Laser Zentrum Hannover e.V. (Germany); Gwenn Pallier, Sami Laroui, Pu Jian, Olivier Pinel, CAILabs (France); Jürgen Koch, Laser Zentrum Hannover e.V. (Germany); Guillaume Labroille, CAILabs (France) ..... [11267-10]  
Coffee Break ..... Mon 3:10 pm to 3:30 pm

## LASE PLENARY SESSION

**LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) ..... MON 3:30 PM TO 5:40 PM**

- 3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)
- 3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)
- 3:40 pm: **VCSEL: Born Small and Grown Big (Plenary)**  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)
- 4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources (Plenary)**  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)
- 5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science (Plenary)**  
**Robert L. Byer**, Stanford Univ. (USA)

## TUESDAY 4 FEBRUARY

### SESSION 4

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . TUE 8:10 AM TO 10:00 AM**

#### Laser-based Processes for Electronics

- Session Chair: **Carlos Molpeceres**, Univ. Politécnica de Madrid (Spain)
- 8:10 am: **Laser microfabrication focused on transparent and flexible electronics (Invited Paper)**, Seung Hwan Ko, Seoul National Univ. (Korea, Republic of) ..... [11267-11]
- 8:40 am: **Selective surface activation induced by laser (SSAIL): The technology of electric circuit formation on free form dielectric surfaces**, Karolis Ratautas, Aldona Jagminienė, Ina Stankevičienė, Eugenijus Norkus, Gediminas Račiukaitis, Ctr. for Physical Sciences and Technology (Lithuania) ..... [11267-12]
- 9:00 am: **Surface functionalization of flexographic printing forms using a femtosecond laser for adjustable material transfer in MID production processes**, Alexander Wienke, Laser Zentrum Hannover e.V. (Germany); Gerd-Albert Hoffmann, Leibniz Univ. Hannover (Germany); Jürgen Koch, Peter Jäschke, Stefan Kaieler, Laser Zentrum Hannover e.V. (Germany); Ludger Overmeyer, Hannoversches Zentrum für Optische Technologien (Germany) ..... [11267-13]
- 9:20 am: **Laser-induced forward transfer of bioactive materials with PDMS-based optical stamp**, Aiko Narazaki, Ayako Oyane, National Institute of Advanced Industrial Science and Technology (Japan); Hirofumi Miyajima, Hokkaido Univ. (Japan) ..... [11267-14]
- 9:40 am: **Laser processing of titanium: Oxide formation for electronic applications**, Kristin Charipar, U.S. Naval Research Lab. (USA); Christopher Musi, Nova Research, Inc. (USA); Heungsoo Kim, Alberto Piqué, Nicholas A. Charipar, U.S. Naval Research Lab. (USA) ..... [11267-15]  
Coffee Break ..... Tue 10:00 am to 10:30 am

### SESSION 5

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . TUE 10:30 AM TO 12:20 PM**

#### Laser Nanoprocessing

- Session Chair: **Aiko Narazaki**, National Institute of Advanced Industrial Science and Technology (Japan)
- 10:30 am: **Nanoparticle synthesis via femtosecond laser reduction in liquid (Invited Paper)**, Katharine M. Tibbetts, Virginia Commonwealth Univ. (USA) ..... [11267-16]
- 11:00 am: **Energy generation on an array of nanoparticles on a surface**, Peng-Sheng Wei, J. Y. Hong, T. C. Fu, M. C. Chou, National Sun Yat-sen Univ. (Taiwan) ..... [11267-17]
- 11:20 am: **Influence of crystal lattice orientation onto the formation of LIPSS, ripples, and cavities for iron and iron alloys in ultrashort pulse laser machining**, Stefan M. Remund, Silvan D. Gerber, Josef Zürcher, Markus Gafner, Beat Neuenschwander, Berner Fachhochschule Technik und Informatik (Switzerland) ..... [11267-18]
- 11:40 am: **Effect of front-contact laser texturing in thin-film solar cells**, David Canteli, Univ. Politécnica de Madrid (Spain); Ignacio Torres, Susana Fernández, José D. Santos, Ctr. de Investigaciones Energéticas, Medioambientales y Tecnológicas (Spain); Miguel Morales, Carlos Molpeceres, Univ. Politécnica de Madrid (Spain) ..... [11267-19]
- 12:00 pm: **Ultra-low power laser nano-printing of structural color and high-resolution optical circuits**, Redha Al Ibrahim, Ning Li, Andrea Fratolocci, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11267-20]  
Lunch/Exhibition Break ..... Tue 12:20 pm to 1:50 pm

### SESSION 6

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . TUE 1:50 PM TO 3:40 PM**

#### Upscaling Laser Processing Utilizing Advanced Beam Shaping

- Session Chair: **Guido Hennig**, Daetwyler Graphics AG (Switzerland)
- 1:50 pm: **Tailoring the propagation properties of fibers by localized fs laser modifications (Invited Paper)**, Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Thorsten A. Goebel, Maximilian Heck, Timothy O. Imogore, Ria G. Kraemer, Christian Matzdorf, Daniel Richter, Friedrich-Schiller-Univ. Jena (Germany) ..... [11267-21]
- 2:10 pm: **Use of spatial light modulators for flexible 2D and 3D femtosecond laser processing (Invited Paper)**, Konstantin Mishchik, Adrien Ladan, Axel Chambinaud, Clemens Hönninger, Eric Audouard, Eric P. Mottay, Amplitude Systèmes (France) ..... [11267-22]
- 2:40 pm: **High-precision ultrashort pulsed laser processing of metal foils using an advanced multibeam optic**, Thilo Barthels, Fraunhofer-Institut für Lasertechnik ILT (Germany) ..... [11267-23]
- 3:00 pm: **Ultrafast stamping by combination of synchronized galvanometer scanning with DOE's or SLM**, Beat Neuenschwander, Markus Gafner, Stefan M. Remund, Michalina W. Chaja, Berner Fachhochschule Technik und Informatik (Switzerland) ..... [11267-24]
- 3:20 pm: **Scaling ultrashort pulsed percussion drilling processes using advanced beam shaping**, Daniel G. Grossmann, Daniel Flamm, Malte Kumkar, TRUMPF Laser- und Systemtechnik GmbH (Germany) ..... [11267-25]  
Coffee Break ..... Tue 3:40 pm to 4:10 pm

### SESSION 7

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . TUE 4:10 PM TO 5:40 PM**

#### Towards High-efficient Laser Ablation

- Session Chair: **Jie X. Qiao**, Rochester Institute of Technology (USA)
- 4:10 pm: **Influence of pulse duration and separation on ultrafast single pulse laser ablation in industrial bulk metals: Complete time-resolved surface dynamics and its implications to laser material processing (Invited Paper)**, Jan Winter, Maximilian Spellauge, Philipp Gies, Jens Hermann, Hochschule für Angewandte Wissenschaften München (Germany); Michael Schmidt, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Heinz P. Huber, Hochschule für Angewandte Wissenschaften München (Germany) ..... [11267-26]

4:40 pm: **Machining metals and silicon with GHz bursts: Surprising tremendous reduction of the specific removal rate for surface structuring applications**, Beat Neuenschwander, Stefan M. Remund, Michalina W. Chaja, Markus Gafner, Thomas Hirsiger, Berner Fachhochschule Technik und Informatik (Switzerland); Aivaras Urniezius, Simas Butkus, Light Conversion Ltd. (Lithuania) ..... [11267-27]

5:00 pm: **High-efficiency laser milling by bursts of ultrashort (fs-ps) light pulses**, Andrius Žemaitis, Paulius Gečys, Gediminas Račiukaitis, Mindaugas Gedvilas, Ctr. for Physical Sciences and Technology (Lithuania) ..... [11267-28]

5:20 pm: **Micromachining flexibility by tunable ultrashort pulse duration, pulse on demand, and hybrid processing from single pulse to GHz burst with TruMicro Series 2000**, Florian Jansen, Marc Sailer, Axel Fehrenbacher, Aleksander Budnicki, Holger Diekamp, Raphael Scelle, Chuong Tan, TRUMPF Laser GmbH (Germany); Florian Kanal, Ulf Quentin, TRUMPF Laser- und Systemtechnik GmbH (Germany) ..... [11267-29]

## POSTERS-TUESDAY

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Tuesday 10:00 AM– 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Fabrication of microswelling structure on silicone rubber by 193-nm ArF excimer laser-induced photodissociation**, Misaki Yokoyama, Tsuyoshi Yoshida, National Defense Academy (Japan); Nobuyuki Matsuki, Kanagawa Univ. (Japan); Masayuki Okoshi, National Defense Academy (Japan) ..... [11267-7]

**Precision beam shaping technique for interference laser processing and fabrication of chiral structure in lattice**, Yuki Kosaka, Yoshiki Nakata, Noriaki Miyanaga, Osaka Univ. (Japan) ..... [11267-34]

**Fabrication of submicrometer periodic nanostructures using pulsed laser interference for efficient light trapping in optoelectronic devices**, Saraswati Behera, Yunran Wang, Im Sik Han, Chaoyuan Jin, Mark Hopkinson, The Univ. of Sheffield (United Kingdom) ..... [11267-46]

## WEDNESDAY 5 FEBRUARY

### SESSION 8

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . WED 8:30 AM TO 10:00 AM**

### Ultrafast Laser Processing of Glass, Ceramics and Semiconductors

Session Chair: **Tadatake Sato**, National Institute of Advanced Industrial Science and Technology (Japan)

8:30 am: **Ultrafast and precision processing of glass by selective absorption of fiber-laser pulse into femtosecond-laser-induced filament (Invited Paper)**, Yusuke Ito, Reina Yoshizaki, The Univ. of Tokyo (Japan); Akihiro Shibata, Ikuo Nagasawa, AGC Inc. (Japan); Keisuke Nagato, Naohiko Sugita, The Univ. of Tokyo (Japan) ..... [11267-30]

9:00 am: **Nonthermal/thermal process boundary in ultrashort pulse laser processing of various ceramics**, Hideyuki Takada, Aiko Narazaki, Dai Yoshitomi, Kenji Torizuka, National Institute of Advanced Industrial Science and Technology (Japan); Yohei Kobayashi, The Univ. of Tokyo (Japan) ..... [11267-31]

9:20 am: **Improvement of laser polishing efficiency with multiple continuous-wave laser beams**, Wenxuan Zhang, Princeton Univ. (USA); Kiwan Wong, Hong Kong Univ. of Science and Technology (Hong Kong, China); Craig Arnold, Princeton Univ. (USA) ..... [11267-32]

9:40 am: **Micro-laser assisted machining of semi-conductors**, Hossein Shahinian, Jayesh A. Navare, Charan Bodlapati, Dmytro Zaytsev, Di Kang, Megan M. Arlt, Deepak Ravindra, Micro-LAM, Inc. (USA) .. [11267-33]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

### SESSION 9

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) .WED 10:30 AM TO 12:00 PM**

### Modelling and Process Control

Session Chair: **Gediminas Račiukaitis**, Ctr. for Physical Sciences and Technology (Lithuania)

10:30 am: **High-precision laser ablation using OCT closed-loop control (Invited Paper)**, Daniel Holder, Matthias Buser, Artur Leis, Steffen Boley, Rudolf Weber, Thomas Graf, Univ. Stuttgart (Germany) ..... [11267-35]

11:00 am: **Thermal-hydraulic modeling and acoustic correlation**, Vincent Bruyere, SIMTEC (France); Nicolas Authier, CEA-Valduc (France); Patrick Namy, SIMTEC (France) ..... [11267-36]

11:20 am: **Universal picometer interferometry unveils ultra-precise devices from scrap**, Pooja Munjal, Kamal P. Singh, Indian Institute of Science Education and Research Mohali (India) ..... [11267-37]

11:40 am: **Position observer based galvanometer scanner and XY stage synchronization for large area processing**, Keith J. Dowling, Mark S. Lucas, Jin Li, Seethram Sivam, Bhavesh A. Bhut, Yu John Hsu, Cambridge Technology, A Novanta Co. (USA) ..... [11267-38]

Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:30 pm

### SESSION 10

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . . WED 1:30 PM TO 3:30 PM**

### Integration OD Devices Inside Bulk Transparent Materials

Session Chair: **Carlos Molpeceres**, Univ. Politécnica de Madrid (Spain)

1:30 pm: **3D glass nanofluidics fabricated by femtosecond laser processing for study of cancer cell metastasis and invasion (Invited Paper)**, Felix Sima, Institutul National pentru Fizica Laserilor, Plasmei si Radiatiei (Romania); Hiroyuki Kawano, RIKEN (Japan); Atsushi Miyawaki, RIKEN Ctr. for Brain Science (Japan); Kotaro Obata, RIKEN Ctr. for Advanced Photonics (Japan); Daniela Serien, RIKEN (Japan); Koji Sugioka, RIKEN Ctr. for Advanced Photonics (Japan) ..... [11267-39]

2:00 pm: **Femtosecond laser fabrication of FBG and its application to radiation resistance**, Hun-Kook Choi, Young-Jun Jung, Bong-Ahn Yu, Gwangju Institute of Science and Technology (Korea, Republic of); Jong Yeol Kim, Korea Atomic Energy Research Institute (Korea, Republic of); Md. Shamim Ahsan, Khulna Univ. (Bangladesh); Ik-Bu Sohn, Gwangju Institute of Science and Technology (Korea, Republic of) ..... [11267-40]

2:20 pm: **Nonlinear femtosecond pulse-propagation simulation and experiment for laser-based-waveguide-writing in crystal materials**, Tao Feng, Aktiwave LLC (USA); Pankaj K. Sahoo, Rochester Institute of Technology (USA); Christophe Dorrer, Aktiwave LLC (USA); Jie Qiao, Rochester Institute of Technology (USA) and Aktiwave LLC (USA) ..... [11267-41]

2:40 pm: **Single and dual wavelength double fs-pulse laser irradiation for transparent material processing**, John Lopez, Ctr. Lasers Intenses et Applications, CNRS (France); Kevin Gaudfrin, ALPhANOV (France) and Ctr. Lasers Intenses et Applications, CNRS (France); Konstantin Mishchik, Martin Delaigue, Clemens Hönninger, Eric Audouard, Amplitude Systèmes (France); Rainer Kling, ALPhANOV (France); Guillaume Duchateau, Ctr. Lasers Intenses et Applications, CNRS (France) ..... [11267-43]

3:00 pm: **From proof of principle to >98.5% high speed yield of a laser processing tool (Invited Paper)**, Ralf Terbrueggen, Corning Laser Technologies GmbH (Germany) ..... [11267-44]

### LAMOM BEST STUDENT PAPER AWARDS CEREMONY

**LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . . . . 3:50 PM TO 4:00 PM**

Presented by: **Gediminas Račiukaitis**, Ctr. for Physical Sciences and Technology (Lithuania)

AWARD SPONSORS:



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# CONFERENCE 11268

LOCATION: MONDAY—ROOM 158 (UPPER MEZZANINE SOUTH);

TUESDAY-THURSDAY—ROOM 153 (UPPER MEZZANINE SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11268

# Laser-based Micro- and Nanoprocessing XIV

Conference Chair: **Udo Klotzbach**, Fraunhofer IWS Dresden (Germany)

Conference Co-Chairs: **Akira Watanabe**, Tohoku Univ. (Japan); **Rainer Kling**, ALPhANOV (France)

Program Committee: **Antonio Ancona**, CNR-Istituto di Fotonica e Nanotecnologie (Italy); **Jörn Bonse**, Bundesanstalt für Materialforschung und -prüfung (Germany); **Ya Cheng**, Shanghai Institute of Optics and Fine Mechanics (China); **Jiyeon Choi**, Univ. of Science and Technology (Korea, Republic of); **Korea Institute of Machinery & Materials** (Korea, Republic of); **Francois Courvoisier**, Univ. de Franche-Comté (France); **Ulrike Fuchs**, asphericon GmbH (Germany); **Chunlei Guo**, Univ. of Rochester (USA); **Miguel Holgado Bolaños**, Univ. Politécnica de Madrid (Spain); **Minghui Hong**, National Univ. of Singapore (Singapore); **Andrés-Fabián Lasagni**, TU Dresden (Germany); **Yongfeng Lu**, Univ. of Nebraska-Lincoln (USA); **Yoshiki Nakata**, Osaka Univ. (Japan); **Wilhelm Pflöging**, Karlsruhe Institute of Technology (Germany); **Ulf Quentin**, TRUMPF Laser- und Systemtechnik GmbH (Germany); **Gert-Willem Römer**, Univ. of Twente (Netherlands); **Razvan Stoian**, Lab. Hubert Curien (France); **Koji Sugioka**, RIKEN (Japan); **Hong-Bo Sun**, Tsinghua Univ. (China); **Jorma Vihinen**, Tampere Univ. of Technology (Finland); **Kunihiko Washio**, Paradigm Laser Research Ltd. (Japan); **Michael J. Withford**, Macquarie Univ. (Australia); **Xianfan Xu**, Purdue Univ. (USA); **Haibin Zhang**, ESI, Inc. (USA)

## MONDAY 3 FEBRUARY

### SESSION 1

LOCATION: ROOM 158 (UPPER MEZZANINE SOUTH) . MON 9:00 AM TO 12:30 PM

#### Microfluidics and Medical Micro Systems

Joint Session with 11235 and 11268

Session Chairs: **Holger Becker**, microfluidic ChipShop GmbH (Germany); **Udo Klotzbach**, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany)

9:00 am: **Recent advances in 3D printing of pure proteinaceous microstructures by femtosecond laser direct write** (*Invited Paper*), Daniela Serien, Hiroyuki Kawano, Atsushi Miyawaki, Koji Sugioka, RIKEN (Japan). . . . . [11268-1]

9:30 am: **Kombispec: a combination of polymer-based microspectrometer and microfluidic consumables for the fast on-site analytics in food production**, Holger Becker, Sebastian Schattschneider, microfluidic ChipShop GmbH (Germany); Juliane Gottwald, Eurofins Germany (Germany); Jörg A. Schenk, Hybrotec GmbH (Germany); Richard Klemm, microfluidic ChipShop GmbH (Germany) . . . . . [11235-25]

9:50 am: **Characterization of biomedical glass devices fabricated by ultrafast laser assisted processes**, Jiyeon Choi, Korea Institute of Machinery & Materials (Korea, Republic of); Sung-il Kim, Korea Institute of Machinery & Materials (Korea, Republic of) and Hanbat National Univ. (Korea, Republic of); Sanghoon Ahn, Korea Institute of Machinery & Materials (Korea, Republic of); Yeun-Ho Jung, Chiwan Koo, Hanbat National Univ. (Korea, Republic of). . . . . [11268-2]

10:10 am: **Control of cell arrangement on PMMA surface by femtosecond laser induced periodic nanostructures**, Naoki Shinohara, Masahiro Tsukamoto, Osaka Univ. (Japan); Yuji Sato, Japan Atomic Energy Agency (Japan). . . . . [11268-3]

Coffee Break. . . . . Mon 10:30 am to 11:00 am

11:00 am: **Biological analysis in 3D optofluidic devices fabricated by femtosecond laser micromachining** (*Invited Paper*), Petra Paiè, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Roberto Memeo, Federico Sala, Andrea Bassi, Politecnico di Milano (Italy); Roberto Osellame, Francesca Bragheri, CNR-Istituto di Fotonica e Nanotecnologie (Italy). . . . . [11268-4]

11:30 am: **Effects of the dissolved gases in water on microbubble oscillation under photothermal heating**, Nao Hiroshige, Mitsubishi Electric Corp. (Japan); Kyoko Namura, Shunsuke Okai, Motofumi Suzuki, Kyoto Univ. (Japan). . . . . [11268-5]

11:50 am: **Alteration of fluorescence in different pH environments for green fluorescent protein microstructures fabricated by femtosecond laser direct write**, Daniela Serien, Hiroyuki Kawano, Atsushi Miyawaki, Koji Sugioka, RIKEN (Japan) . . . . . [11235-26]

12:10 pm: **Rapid prototyping of alumina-based microfluidic reactors**, Frederik Kotz, Lucas M. Kneißl, Patrick Risch, Bastian E. Rapp, Univ. of Freiburg (Germany). . . . . [11235-27]

Lunch Break . . . . . Mon 12:30 pm to 3:30 pm

## LASE PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . . MON 3:30 PM TO 5:40 PM

3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)

3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)

3:40 pm: **VCSEL: Born Small and Grown Big** (*Plenary*)  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)

4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources** (*Plenary*)  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)

5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science** (*Plenary*)  
**Robert L. Byer**, Stanford Univ. (USA)

## TUESDAY 4 FEBRUARY

### SESSION 2

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . TUE 8:00 AM TO 10:40 AM

#### NOTE ROOM CHANGE

#### Laser Micro Structuring and Processing

Session Chair: **Udo Klotzbach**, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany)

8:00 am: **Three-dimensional laser printing of macro-scale glass objects at a micro-scale resolution**, Peng Wang, Shanghai Institute of Optics and Fine Mechanics (China); Ya Cheng, Shanghai Institute of Optics and Fine Mechanics (China) and East China Normal Univ. (China); Wei Chu, Shanghai Institute of Optics and Fine Mechanics (China). . . . . [11268-6]

8:20 am: **Enhanced ablation using GHz-pulsed fs laser** (*Invited Paper*), Sami T. Hendow, Hidetomo Takahashi, Mariko Yamaguchi, Jingzhou Xu, IMRA America, Inc. (USA) . . . . . [11268-7]

8:50 am: **Enhanced ablation rates of silicon and metals using GHz fs lasers** (*Invited Paper*), Konstantin Mishchik, Guillaume Bonamis, Eric Audouard, Amplitude Systèmes (France); John Lopez, Ctr. Lasers Intenses et Applications, CNRS (France) and CEA (France) and Univ. de Bordeaux (France); Eric P. Mottay, Clemens Hönninger, Amplitude Systèmes (France); Inka B. Manek-Hönninger, Ctr. Lasers Intenses et Applications, CNRS (France) and CEA (France) and Univ. de Bordeaux (France). . . . . [11268-8]

9:20 am: **Surface treatment with GHz-bursts**, Fabian Nyenhuis, Andreas Michalowski, Robert Bosch GmbH (Germany); Johannes A. L'huillier, Photonik-Zentrum Kaiserslautern e.V. (Germany). . . . . [11268-9]

9:40 am: **Laser ablation in liquids and in air at ultrafast time scale**, Alexander Kanitz, Ruhr-Univ. Bochum (Germany); Daniel J. Förster, Rudolf Weber, Univ. Stuttgart (Germany); Jan S. Hoppius, Andreas Ostendorf, Evgeny L. Gurevich, Ruhr-Univ. Bochum (Germany). . . . . [11268-10]

10:00 am: **Sub-diffraction direct laser writing by a combination of STED and ESA**, Sebastian Engel, Christoph Wenisch, Stephan Graef, Frank A. Müller, Friedrich-Schiller-Univ. Jena (Germany) ..... [11268-11]

10:20 am: **Femtosecond laser induced ablation dynamics probing by emission and scattering spectroscopy under various vacuum conditions**, Jinhong Jeun, Samsung Display Co., Ltd. (Korea, Republic of); Minok Park, Univ. of California, Berkeley (USA); Gyoowan Han, Seongho Jeong, Cheollae Roh, Samsung Display Co., Ltd. (Korea, Republic of); Costas P. Grigoropoulos, Univ. of California, Berkeley (USA) ..... [11268-12]  
Coffee Break ..... Tue 10:40 am to 11:10 am

**SESSION 3**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . TUE 11:10 AM TO 12:50 PM**

**Laser Micro/Nano Processing on Transparent Material I**

Session Chair: **Akira Watanabe**, Tohoku Univ. (Japan)

11:10 am: **Advances in transparent materials processing by ultrashort laser pulses** (*Invited Paper*), Malte Kumkar, TRUMPF Laser- und Systemtechnik GmbH (Germany); Michael Jenne, TRUMPF Laser- und Systemtechnik GmbH (Germany) and Institute of Applied Physics (Germany); Daniel G. Grossmann, Felix Zimmermann, Daniel Flamm, Myriam Kaiser, TRUMPF Laser- und Systemtechnik GmbH (Germany); Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) ..... [11268-13]

11:40 am: **Laser-based manufacturing of 2.5D bodies of polylactide** (*Invited Paper*), Horst Exner, Tina Viertel, Robby Ebert, Laserinstitut Hochschule Mittweida (Germany) ..... [11268-14]

12:10 pm: **Laser process of transparent conducting surfaces for terahertz bandpass ultrathin metamaterials**, Hongtao Ding, The Univ. of Iowa (USA) ..... [11268-15]

12:30 pm: **Evaluation of laser induced nanostructures on float glass**, Jagdheesh R., HiLASE Ctr. (Czech Republic) ..... [11268-16]

Lunch/Exhibition Break ..... Tue 12:50 pm to 2:20 pm

**SESSION 4**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . TUE 2:20 PM TO 4:10 PM**

**Laser Micro/Nano Processing on Transparent Material II**

Session Chair: **Rainer Kling**, ALPhANOV (France)

2:20 pm: **Femtosecond laser functionalized surfaces inspired by nature** (*Invited Paper*), Camilo Florian Baron, Bundesanstalt für Materialforschung und -prüfung (Germany); Javier Solis, Jan Siegel, Instituto de Óptica “Daza de Valdés” (Spain); Jörg Krüger, Jörn Bonse, Bundesanstalt für Materialforschung und -prüfung (Germany) ..... [11268-17]

2:50 pm: **Patterning of transparent polymers using high-throughput methods: application in flexible perovskite solar cells with enhanced light trapping**, Marcos Soldera, TU Dresden (Germany) and PROBIEN-CONICET, Univ. Nacional del Comahue (Argentina); Qiong Wang, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); Flavio Soldera, Department Materials Science and Engineering, Saarland University (Germany); Valentin Lang, TU Dresden (Germany); Antonio Abate, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); Andrés Fabián Lasagni, TU Dresden (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany) ..... [11268-18]

3:10 pm: **Ablation of amorphous Poly(ethyl)ketone (PEEK) by a femtosecond Ti:sapphire laser**, Qianliang Li, Walter Perrie, Yue Tang, Univ. of Liverpool (United Kingdom); Olivier Allegre, Zhaoqing Li, The Univ. of Manchester (United Kingdom); Stuart P. Edwardson, Geoff Dearden, Univ. of Liverpool (United Kingdom) ..... [11268-19]

3:30 pm: **Optofluidics in alumino-borosilicate glass by femtosecond laser micromachining**, Andrea Crespi, Politecnico di Milano (Italy) and Consiglio Nazionale delle Ricerche (Italy); Francesca Bragheri, Consiglio Nazionale delle Ricerche (Italy); Roberto Osellame, Consiglio Nazionale delle Ricerche (Italy) and Politecnico di Milano (Italy) ..... [11268-20]

3:50 pm: **Photoinscription of optical microstructures in fused silica with few-cycle pulses**, Federico J. A. Furch, W. Dieter Engel, Tobias Witting, Armando Perez-Leija, Marc J. J. Vrakking, Alexandre Mermillod-Blondin, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) ..... [11268-21]

Coffee Break ..... Tue 4:10 pm to 4:40 pm

**SESSION 5**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . TUE 4:40 PM TO 6:00 PM**

**Laser Micro/Nano Processing on Metal**

Session Chair: **Kunihiko Washio**, Paradigm Laser Research Ltd. (Japan)

4:40 pm: **Femtosecond laser induced micro/nano structures on metals**, Chung-Wei Cheng, Yi-Hsien Liu, National Chiao Tung Univ. (Taiwan); Jinn Kuen Chen, Univ. of Missouri (USA) ..... [11268-22]

5:00 pm: **Laser polishing using ultrashort pulse laser**, Andreas Brenner, Fraunhofer-Institut für Lasertechnik ILT (Germany); Leon Rötter, RWTH Aachen Univ. (Germany); Johannes Finger, Fraunhofer-Institut für Lasertechnik ILT (Germany) ..... [11268-23]

5:20 pm: **Surface roughness prediction of laser polished additively manufactured Ti-6Al-4V**, Juliana dos Santos Solheid, Karlsruher Institut für Technologie (Germany); Ahmed Elkaseer, Karlsruher Institut für Technologie (Germany) and Port Said Univ. (Egypt); Torsten Wunsch, Amal Charles, Hans Jürgen Seifert, Karlsruher Institut für Technologie (Germany); Wilhelm Pfeeding, Karlsruhe Nano Micro Facility, Karlsruher Institut für Technologie (Germany) ..... [11268-24]

5:40 pm: **Ultrashort-pulse laser micro-polishing of lithium niobate by using UV-ps pulses**, Mareike Schäfer, Johannes A. L’huillier, Photonik-Zentrum Kaiserslautern e.V. (Germany) ..... [11268-25]

**POSTERS-TUESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Tuesday 10:00 AM–5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Structuring of forming tools for lubricant-free deep drawing**, Theresa Jähmig, Seyed Ali Mousavi, Alexander Brosius, Andrés Fabián Lasagni, TU Dresden (Germany) ..... [11268-27]

**Large area processing of steel surfaces using direct laser interference patterning**, Stephan Milles, Robert Baumann, Johannes Dahms, Andrés Fabián Lasagni, TU Dresden (Germany) ..... [11268-31]

**5D data storage by using direct laser writing in silver containing glass**, ChangHyun Park, Yonsei Univ. (Korea, Republic of) and Ctr. Lasers Intenses et Applications, CNRS (France); Yannick Petit, Ctr. Lasers Intenses et Applications, CNRS (France) and Univ. de Bordeaux (France); Sylvain Danto, Thierry Cardinal, Institut de Chimie de la Matière Condensée de Bordeaux, CNRS (France) and Univ. de Bordeaux (France); Seung-Han Park, Yonsei Univ. (Korea, Republic of); Lionel Canioni, Ctr. Lasers Intenses et Applications, CNRS (France) and CEA (France) and Univ. de Bordeaux (France) ..... [11268-45]

**Laser-induced forward transfer and reduction of graphene oxide in silk fibroin**, Cleber R. Mendonça, Kelly Tasso, Moliría Santos, Instituto de Física de São Carlos (Brazil); Murilo Facure, Embrapa Instrumentação Agropecuária (Brazil); Marcelo Andrade, Francineide Araujo, Instituto de Física de São Carlos (Brazil); Daniel S. Correa, Embrapa Instrumentação Agropecuária (Brazil); Sidney Ribeiro, Univ. Estadual Paulista “Júlio de Mesquita Filho” (Brazil) ..... [11268-61]

**Incubation effect study of GaN films under ultrafast laser pulse micromachining**, Gustavo F. B. Almeida, Univ. Federal de Uberlândia (Brazil) and Univ. de São Paulo (Brazil); Lucas K. Nolasco, Gustavo R. Barbosa, Univ. de São Paulo (Brazil); Andreas Schneider, Univ. Bremen (Germany); Angelina Jaros, Irene Mangano-Clavero, Christoph Margenfeld, Andreas Waag, Tobias Voss, Technische Univ. Braunschweig (Germany); Cleber R. Mendonça, Univ. de São Paulo (Brazil) ..... [11268-62]

**Comparative study between laser blasted and sandblasted surfaces of Ti6Al4V**, Mohammad Ahmed, Tian Long See, The Manufacturing Technology Ctr. Ltd. (United Kingdom) ..... [11268-63]

**Laser ablation with a multi-beam setup based on excited state absorption**, Christoph Wenisch, Sebastian Engel, Frank A. Müller, Stephan Graef, Friedrich-Schiller-Univ. Jena (Germany) ..... [11268-64]

**A micro patterning method for Al thin film deposited on polycarbonate**, Tsuyoshi Yoshida, Masayuki Okoshi, National Defense Academy (Japan); Hidetoshi Nojiri, Renias Co., Ltd. (Japan) ..... [11268-66]



**Influence of direct fs-laser writing experimental conditions on the production of color center in diamond**, Juliana M. P. Almeida, Univ. de São Paulo (Brazil); Charlie Oncebay, Univ. of São Paulo (Brazil); Gustavo F. B. Almeida, Univ. Federal de Uberlândia (Brazil) and Univ. de São Paulo (Brazil); Sérgio R. Muniz, Cleber R. Mendonça, Instituto de Física de São Carlos (Brazil) . . . . . [11268-67]

**Laser-induced crystalline phase transition for hematite nanowire and application to photo-electrochemical water splitting**, Heejung Kong, Junyeob Yeo, Suwon Hwang, Taeseung Hwang, Kyungpook National Univ. (Korea, Republic of) . . . . . [11268-68]

**Formation of optical needles by Pancharatnam-Berry phase element for laser-induced modifications in transparent materials**, Pavel Gotovski, Ctr. for Physical Sciences and Technology (Lithuania); Justas Baltrukonis, Ctr. for Physical Science and Technology (Lithuania) and Workshop of Photonics (Lithuania); Ernestas Naciuis, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Sergej Orlov, Ctr. for Physical Sciences and Technology (Lithuania); Orestas Ul?inas, Workshop of Photonics (Lithuania); Vytautas Jukna, Vilnius Univ. (Lithuania) and Ctr. for Physical Sciences and Technology (Lithuania); Titas Gertus, Light Conversion Ltd. (Lithuania) . . . . . [11268-69]

**Smart ultra short pulse laser processing with rotating beam: Laser micro drilling, cutting, and turning**, Florian Lendner, GFH GmbH (Germany) . . . . . [11268-70]

**Al doping of 4H-SiC by excimer laser irradiation to Al<sub>2</sub>O<sub>3</sub> thin films**, Kosei Kamada, Toshifumi Kikuchi, Daisuke Nakamura, Hiroshi Ikenoue, Kyushu Univ. (Japan) . . . . . [11268-71]

**Demonstrating the nonlinearity-independence of resolution in femtosecond laser ablation**, Mario García Lechuga, Olivier P. Utéza, Nicolas Sanner, M. David Grojo, Lab. Lasers, Plasmas et Procédés Photoniques (France) . . . . . [11268-72]

**Metal enhanced fluorescence using nanostructures on silver formed with Ti:Sapphire femtosecond pulsed laser**, Vicente Silva Mattos, Jarbas Caiado de Castro Neto, Instituto de Física de São Carlos (Brazil); Fernanda R. Paolillo, Escola de Engenharia de São Carlos (Brazil); Fatima Maria Mitsue Yasuoka, Marcelo de Assumpção Pereira da Silva, Daniel Cavallini, Instituto de Física de São Carlos (Brazil) . . . . . [11268-73]

**Light-driven bubble printing of nanocomposites with aligned nanocomponents for wearable medical devices**, Jimi Wang, The Univ. of Texas at Austin (USA) . . . . . [11268-74]

**Hot embossing of multifunctional transparent polymers from Cr stamps structured by direct laser interference patterning**, Marcos Soldera, TU Dresden (Germany) and PROBIEN-CONICET, Univ. Nacional del Comahue (Argentina); Yangxi Fu, TU Dresden (Germany); Franco Fortuna, Institut für Fertigungstechnik, Technische Universität Dresden (Germany); Wei Wang, TU Dresden (Germany); Andrés Fabián Lasagni, TU Dresden (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik (Germany) . . . . . [11268-75]

**Dynamic voxel size tuning for direct laser writing**, Titas Tičkūnas, Vytautas Purlys, Vilnius Univ. (Lithuania), Femtika Ltd. (Lithuania) . . . . . [11268-76]

**Laser microprocessing of porous membrane for CO<sub>2</sub> separation**, Kana Fujiwara, Liu Yida, Toshifumi Kikuchi, Kaname Imokawa, Shoma Aki, Yu Hoshino, Yoshiko Miura, Hiroshi Ikenoue, Daisuke Nakamura, Kyushu Univ. (Japan) . . . . . [11268-77]

**Pseudo random micro lens array manufacturing with using two-photon polymerization technology**, Eunsong Oh, YNG Optics, Inc. (Korea, Republic of) . . . . . [11268-78]

**Development of a complex laser processing system for cutting and drilling**, Hyeonchan Park, Kwanghyun Ryu, Seokkyun Lim, Sunwoo Lee, JASTECH Ltd. (Korea, Republic of) . . . . . [11268-79]

**Absorption and photoluminescence of ZnSe quantum dots synthesized by femtosecond laser ablation in microfluidics**, Yuqin Zhang, Chengdu Univ. of Technology (China); Chao Yang, Guoying Feng, Sichuan Univ. (China) . . . . . [11268-80]

## WEDNESDAY 5 FEBRUARY

### SESSION 6

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . WED 8:20 AM TO 10:10 AM

#### Large Area Micro/Nanostructuring Laser Interference Patterning I

Session Chair: **Andrés Fabián Lasagni**, TU Dresden (Germany)

8:20 am: **Fabrication of versatile functional surface properties based on femtosecond laser-induced periodic surface structures (LIPSS)** (*Invited Paper*), Stephan Graef, Clemens Kunz, Frank A. Müller, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11268-26]

8:50 am: **High-throughput direct laser interference patterning: new configurations and applications**, Valentin Lang, TU Dresden (Germany); Aleksander Madelung, Sabri Alamri, Tobias Steege, Benjamin Krupop, Alfredo I. Aguilar, Tim Kunze, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany); Andrés Fabián Lasagni, TU Dresden (Germany) . . . . . [11268-28]

9:10 am: **In-situ laser interference patterning of MBE growth surfaces**, Mark Hopkinson, Yunran Wang, Im Sik Han, Chaoyuan Jin, The Univ. of Sheffield (United Kingdom) . . . . . [11268-29]

9:30 am: **Engineering laser induced periodic surface structures on single crystal diamond**, Ravi Shivaraman, Patrick S. Salter, Univ. of Oxford (United Kingdom) . . . . . [11268-30]

9:50 am: **Surface structuring by high power femtosecond laser for industrial applications**, Gedvinas Nemickas, Femtika UAB (Lithuania) . . . . . [11268-65]

Coffee Break . . . . . Wed 10:10 am to 10:40 am

### SESSION 7

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . WED 10:40 AM TO 12:10 PM

#### Large Area Micro/Nanostructuring Laser Interference Patterning II

Session Chair: **Yongfeng Lu**, Univ. of Nebraska-Lincoln (USA)

10:40 am: **Improvement of metallic surfaces hydrophobicity and corrosion resistance by direct write and combined direct write-DLIP hierarchical micro-nano structuring** (*Invited Paper*), José Luis Ocaña, Daniel Huerta-Murillo, José Tiago Teixeira-Cardoso, Angel García-Beltrán, Francisco Cordovilla, Ignacio Angulo, Univ. Politécnica de Madrid (Spain) . . . . . [11268-32]

11:10 am: **How to improve throughput in direct laser interference patterning: top-hat beam profile and burst mode**, Bogdan Voisiat, Joachim Ströbel, TU Dresden (Germany); Keming Du, EdgeWave GmbH (Germany); Andrés Fabián Lasagni, TU Dresden (Germany) . . . . . [11268-33]

11:30 am: **Maximizing the efficiency of laser-fabricated diffraction gratings on PET using direct laser interference patterning**, Marcos Soldera, TU Dresden (Germany) and PROBIEN-CONICET, Univ. Nacional del Comahue (Argentina); Sabri Alamri, Sebastian Storm, Tim Kunze, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany); Andrés Fabián Lasagni, TU Dresden (Germany) and Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany) . . . . . [11268-34]

11:50 am: **Surface flattening of poly-Si thin films by laser annealing and electrical properties of the LTPS-TFTs**, Fuminobu Hamano, Kaname Imokawa, Daisuke Nakamura, Kyushu Univ. (Japan); Tetsuya Goto, Tohoku Univ. (Japan); Hiroshi Ikenoue, Kyushu Univ. (Japan) . . . . . [11268-35]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:40 pm

### SESSION 8

LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . WED 1:40 PM TO 3:40 PM

#### Direct Write Processing Ablation and Surface Modification I

Session Chair: **Jiyeon Choi**,

Korea Institute of Machinery & Materials (Korea, Republic of)

1:40 pm: **Ultrafast time-resolved microscopy during femtosecond laser structuring** (*Invited Paper*), Jan Siegel, Instituto de Óptica "Daza de Valdés" (Spain); Mario García-Lechuga, Lab. Lasers, Plasmas et Procédés Photoniques (France); Yasser Fuentes-Edfuf, Instituto de Óptica "Daza de Valdés" (Spain); Noemi Casquero, Consejo Superior de Investigaciones Científicas (Spain); Javier Solis, Ctr. de Física "Miguel Antonio Catalán" (Spain) . . . . . [11268-36]

2:10 pm: **Biomechanical metamaterials fabricated through multiphoton lithography by tailoring 3D buckling** (*Invited Paper*), Costas P. Grigoropoulos, Zacharias Vangelatos, Univ. of California, Berkeley (USA); Maria Farsari, Foundation for Research and Technology-Hellas (Greece); Grace Gu, Univ. of California, Berkeley (USA); Zhen Ma, Syracuse Biomaterials Institute (USA); Kyriakos Komvopoulos, Univ. of California, Berkeley (USA). . . . . [11268-37]

2:40 pm: **Superior microstructures for advanced package integration**, Ralph F. Delmdahl, Rainer Pätzel, Jan Brune, Coherent LaserSystems GmbH & Co. KG (Germany); Dirk Mueller, Coherent, Inc. (USA). . . . . [11268-38]

3:00 pm: **Laser processing of battery materials: Process up-scaling and strategies for tuning of materials properties**, Wilhelm Pfleging, Peter Smyrek, Penghui Zhu, Karlsruher Institut für Technologie (Germany); Xiaopeng Cheng, Yuefei Zhang, Beijing Univ. of Technology (China); Yijing Zheng, Karlsruher Institut für Technologie (Germany). . . . . [11268-39]

3:20 pm: **Laser-induced breakdown spectroscopy: A versatile tool for quality-controlled development of Li-based battery systems**, Peter Smyrek, Karlsruhe Nano Micro Facility, Karlsruher Institut für Technologie (Germany); Yijing Zheng, Hans Jürgen Seifert, Karlsruher Institut für Technologie (Germany); Wilhelm Pfleging, Karlsruhe Nano Micro Facility, Karlsruher Institut für Technologie (Germany). . . . . [11268-40]

Coffee Break. . . . . Wed 3:40 pm to 4:10 pm

**SESSION 9**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . WED 4:10 PM TO 5:40 PM**

**Direct Write Processing Ablation and Surface Modification II**

Session Chair: **Ya Cheng**, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences (China)

4:10 pm: **Laser processing of plasmonic metal oxides and phase change materials** (*Invited Paper*), Heungsoo Kim, Nicholas A. Charipar, Raymond C. Y. Auyeung, Kristin M. Charipar, Alberto Piqué, U.S. Naval Research Lab. (USA). . . . . [11268-41]

4:40 pm: **Formation of graphene hybrid structures by laser direct writing and sensor applications**, Akira Watanabe, Ashiqur Rahman, Tohoku Univ. (Japan); Jinguang Cai, China Academy of Engineering Physics (China); Mohammod Aminuzzaman, Univ. Tunku Abdul Rahman (UTAR) (Malaysia). . . . . [11268-42]

5:00 pm: **Impact of laser texturing parameters and processing environment in the anti-wetting transition of nanosecond laser generated textures**, Juan Pedro Godoy Vilar, The Manufacturing Technology Ctr. Ltd. (United Kingdom) and Heriot-Watt Univ. (United Kingdom); Tian Long See, The Manufacturing Technology Ctr. Ltd. (United Kingdom); Wojciech S. Góra, Duncan P. Hand, Heriot-Watt Univ. (United Kingdom). . . . . [11268-43]

5:20 pm: **Laser-based surface treatment of CFRP and aluminum for adhesively bonded hybrid joints**, Jochen Schanz, Dieter Meinhard, Harald Riegel, Hochschule Aalen - Technik und Wirtschaft (Germany); Anjali De Silva, David K. Harrison, Glasgow Caledonian Univ. (United Kingdom); Volker Knoblauch, Hochschule Aalen - Technik und Wirtschaft (Germany). . . . . [11268-44]

**THURSDAY 6 FEBRUARY**

**SESSION 10**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . THU 8:20 AM TO 9:40 AM**

**Beam Shaping and Propagation for Laser Micro/Nano Processing**

Session Chairs: **Udo Klotzbach**, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany); **Rainer Kling**, ALPhANOV (France)

8:20 am: **Nanograting based birefringent retardation elements in integrated photonic circuits**, Kim Lammers, Friedrich-Schiller-Univ. Jena (Germany) and Abbe Ctr. of Photonics (Germany); Malte P. Siems, Friedrich-Schiller-Univ. Jena (Germany); Max Ehrhardt, Univ. Rostock (Germany); Alessandro Alberucci, Abbe Ctr. of Photonics (Germany); Alexander Szameit, Univ. Rostock (Germany); Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Abbe Ctr. of Photonics (Germany). . . . . [11268-46]

8:40 am: **Laser induced periodic surface structures generation by femtosecond laser and multi-plane light conversion beam shaping**, Clément Jacquard, CAILabs (France); Girolamo Mincuzzi, Marc Faucon, Aurélien Sikora, Rainer Kling, ALPhANOV (France); Gwenn Pallier, Nicolas Laurenchet, Pu Jian, Olivier Pinel, Guillaume Labroille, CAILabs (France). . . . . [11268-47]

9:00 am: **Efficiency improvement of multilayer lab-on-a-chip production by dynamic beam shaping**, Frank Sonntag, Thomas H. Kuntze, Volker Franke, Patrick Schöps, Florian Schmieder, Udo Klotzbach, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany). . . . . [11268-48]

9:20 am: **Realization of higher order vector Bessel beams for transparent material processing applications**, Justas Baltrukonis, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Sergej Orlov, Ctr. for Physical Sciences and Technology (Lithuania); Orestas Ulcinas, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Pavel Gotovski, Vytautas Jukna, Ctr. for Physical Sciences and Technology (Lithuania). . . . . [11268-50]

Coffee Break. . . . . Thu 9:40 am to 10:10 am

**SESSION 11**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . THU 10:10 AM TO 11:30 AM**

**High Speed Laser Beam Engineering Systems**

Session Chair: **Wilhelm Pfleging**, Karlsruher Institut für Technologie (Germany)

10:10 am: **High throughput CO<sub>2</sub> laser via drilling enhanced by advanced AOD technologies**, Ruolin Chen, MKS Instruments, Inc. (USA); Geoffrey Lott, Christopher Ryder, Nicolas Falletto, ESI, Inc. (USA). . . . . [11268-51]

10:30 am: **Pulse to pulse control in micromachining with femtosecond lasers**, Girolamo Mincuzzi, Alice Rebière, Hugo Laborie, Marc Faucon, ALPhANOV (France); Martin Delaigue, Konstantin Mishchik, Clemens Hönninger, Eric Audouard, Amplitude Systèmes (France); Rainer Kling, ALPhANOV (France). . . . . [11268-52]

10:50 am: **Divide-and-conquer laser beam deflection system: Fast, wide-ranging, and flexible**, Peter Jäschke, Patrick Taschner, Jan F. Düsing, Arndt Hohnholz, Jürgen Koch, Stefan Kaierle, Ludger Overmeyer, Laser Zentrum Hannover e.V. (Germany). . . . . [11268-53]

11:10 am: **Pump-probe imaging for process control and optimization in high-speed laser micro machining**, Joerg Schille, Hochschule Mittweida (Germany). . . . . [11268-54]

Lunch/Exhibition Break . . . . . Thu 11:30 am to 1:00 pm

**SESSION 12**

**LOCATION: ROOM 153 (UPPER MEZZANINE SOUTH) . . . THU 1:00 PM TO 3:00 PM**

**Direct Write Processing Ablation and Surface Modification III**

Session Chair: **Arkadiusz J. Antonczak**, Wroclaw Univ. of Science and Technology (Poland)

1:00 pm: **Investigation of magnetic-field assisted laser ablation of silicon by using short and ultrashort laser pulses**, Mareike Schäfer, Falicenne Gnintedem Keabou, Garik Torosyan, Yiyun Kang, Hicham Deroch, Photonik-Zentrum Kaiserslautern e.V. (Germany); Baerbel Rethfeld, Technische Univ. Kaiserslautern (Germany); Johannes A. L'huillier, Photonik-Zentrum Kaiserslautern e.V. (Germany); Pavel Terekhin, Technische Univ. Kaiserslautern (Germany). . . . . [11268-55]

1:20 pm: **The analysis of harmonic generation during ultrashort IR pulses filamentation in polymer**, Bogusz D. Stepak, Wroclaw Univ. of Science and Technology (Poland); Aleksander Budnicki, TRUMPF Laser GmbH (Germany); Arkadiusz J. Antonczak, Wroclaw Univ. of Science and Technology (Poland). . . . . [11268-56]

1:40 pm: **Investigation of the influence of 3D electrode architectures on lithium distribution in anode materials by laser-induced breakdown spectroscopy**, Yijing Zheng, Karlsruhe Nano Micro Facility, Karlsruher Institut für Technologie (Germany); Lisa Pfäffl, Karlsruher Institut für Technologie (Germany); Peter Smyrek, Karlsruhe Nano Micro Facility, Karlsruher Institut für Technologie (Germany); Hans Jürgen Seifert, Karlsruher Institut für Technologie (Germany); Wilhelm Pfleging, Karlsruhe Nano Micro Facility, Karlsruher Institut für Technologie (Germany). . . . . [11268-57]

2:00 pm: **Internal micro structuring of transparent optical polymers by fs laser**, Gian-Luca Roth, Hochschule Aschaffenburg (Germany); Cemal Esen, Ruhr-Univ. Bochum (Germany); Ralf Hellmann, Hochschule Aschaffenburg (Germany). . . . . [11268-58]

2:20 pm: **Advanced sensors: Industry 4.0 for the laser microjet technology**, Falk Braunmüller, Jérémie Diboine, Gregoire Laporte, Amédée Zryd, Bernold Richerzhagen, Synova S.A. (Switzerland). . . . . [11268-59]

2:40 pm: **Fabrication of side-firing fiber components using CO<sub>2</sub> laser ablation**, Wenxin Zheng, AFL (USA). . . . . [11268-60]

LASE

# CONFERENCE 11269

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY)

Saturday–Tuesday 1–4 February 2020 • Proceedings of SPIE Vol. 11269

# Synthesis and Photonics of Nanoscale Materials XVII

*Conference Chairs:* **Jan J. Dubowski**, Univ. de Sherbrooke (Canada); **David B. Geohegan**, Oak Ridge National Lab. (USA); **Andrei V. Kabashin**, Aix-Marseille Univ. (France)

*Program Committee:* **Maria Farsari**, Foundation for Research and Technology-Hellas (Greece); **Bilal Gökce**, Univ. Duisburg-Essen (Germany); **Anderson S. L. Gomes**, Univ. Federal de Pernambuco (Brazil); **Tatiana E. Itina**, Lab. Hubert Curien (France); **Hiroshi Kumagai**, Kitasato Univ. (Japan); **Anton V. Malko**, The Univ. of Texas at Dallas (USA); **Katarzyna Matczyszyn**, Wrocław Univ. of Science and Technology (Poland); **Igor V. Meglinski**, Univ. of Oulu (Finland); **Xianfan Xu**, Purdue Univ. (USA); **Vladislav V. Yakovlev**, Texas A&M Univ. (USA); **Irina N. Zavestovskaya**, NRNU MEPhI (Russian Federation)

## SATURDAY 1 FEBRUARY

### SESSION 1

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . SAT 1:30 PM TO 2:55 PM

#### Photonic Nanomaterials for Biomedical Applications I

Session Chair: **Jan J. Dubowski**, Univ. de Sherbrooke (Canada)

1:30 pm: **Nanoparticle-enabled deep-penetrating photodynamic therapy** (*Keynote Presentation*), Sergey M. Deyev, Russian Academy of Sciences (Russian Federation) . . . . . [11269-1]

2:15 pm: **Laser-ablative synthesis of novel functional nanoformulations for biomedical applications**, Andrei V. Kabashin, Aix-Marseille Univ. (France) . . . . . [11269-2]

2:35 pm: **Laser-ablative synthesis of titanium nitride nanoparticles for biomedical applications**, Andrei V. Kabashin, Anton Popov, Gleb I. Tselikov, Noé Dumas, Charlotte Berard, Khaled Metwally, Nicola Jones, Ahmed Al-Kattan, Aix-Marseille Univ. (France); Benoit Larrat, Institut d'Imagerie Biomédicale (France); Diane Braguer, Serge Mensah, Anabela Da Silva, Marie-Anne Estève, Aix-Marseille Univ. (France) . . . . . [11269-3]

Coffee Break. . . . . Sat 2:55 pm to 3:25 pm

### SESSION 2

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . SAT 3:25 PM TO 4:25 PM

#### Photonic Nanomaterials for Biomedical Applications II

Session Chair: **David B. Geohegan**, Oak Ridge National Lab. (USA)

3:25 pm: **Gelatin-based biosensor for molecular screening of aspirin and paracetamol via surface enhanced Raman spectroscopy**, Setumo Lebogang Thobakgale, Sello L. Manoto, Saturnin S. Ombinda-Lemboumba, Patience T. Mthunzi-Kufa, CSIR National Laser Ctr. (South Africa) . . . . [11269-4]

3:45 pm: **Two-dimensional hybrid plasmonic metamaterials for biosensing applications**, Gleb I. Tselikov, Moscow Institute of Physics and Technology (Russian Federation) . . . . . [11269-5]

4:05 pm: **Renewable functionalization of digital photocorrosion biosensor with stacks of GaAs/AlGaAs nanoheterostructures**, René St-Onge, Walid M. Hassen, Jan J. Dubowski, Univ. de Sherbrooke (Canada) . . . [11269-7]

## SUNDAY 2 FEBRUARY

### SESSION 3

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 8:30 AM TO 10:10 AM

#### Synthesis and Diagnostics of Nanoscale Materials I

Session Chair: **Anton V. Malko**, The Univ. of Texas at Dallas (USA)

8:30 am: **Femtosecond laser nanostructuring of metal and semiconductor surfaces** (*Invited Paper*), Camilo Florian Baron, Jörg Krüger, Jörn Bonse, Bundesanstalt für Materialforschung und -prüfung (Germany) . . . . . [11269-8]

9:00 am: **Second order nonlinearities in nanomaterials** (*Invited Paper*), Pierre-François Brevet, Zacharie Behel, Isabelle Russier-Antoine, Emmanuel Benichou, Christian Jonin, Institut Lumière Matière (France) . . . . . [11269-9]

9:30 am: **High LIDT photosensitive organic-inorganic hybrid materials for nanoimprint lithography**, Maria Farsari, Areti Mourka, Vasileia Melissinaki, Dimitris G. Papazoglou, Foundation for Research and Technology-Hellas (Greece); Theodoros Tachtsidis, Nanotypos (Greece); Andrius Melninkaitis, Vilnius Univ. (Lithuania) . . . . . [11269-10]

9:50 am: **Testing trichomes designs of 3D microstructures using multiphoton polymerization: Toward hydrophobic surfaces**, Areti Mourka, Dimitra Ladika, Foundation for Research and Technology-Hellas (Greece); Lampros Papoutsakis, Maria Vamvakaki, Spiros H. Anastasiadis, Foundation for Research and Technology-Hellas (Greece) and Univ. of Crete (Greece); Maria Farsari, Foundation for Research and Technology-Hellas (Greece) . . . . . [11269-11]

Coffee Break. . . . . Sun 10:10 am to 10:40 am

### SESSION 4

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 10:40 AM TO 12:00 PM

#### Synthesis and Diagnostics of Nanoscale Materials II

Session Chair: **Andrei V. Kabashin**, Aix-Marseille Univ. (France)

10:40 am: **Perovskite nanocrystals with different dimensionalities: From synthesis and full characterization to light applications** (*Invited Paper*), Omar F. Mohammed, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11269-12]

11:10 am: **Enhanced photoluminescence properties and increased long-term stability of zero-dimensional cesium lead bromide nanocrystals via gas-phase alumina oxide encapsulation**, Anton V. Malko, The Univ. of Texas at Dallas (USA) . . . . . [11269-13]

11:30 am: **Shaped optical wave packets for photonics applications** (*Invited Paper*), Dimitrios G. Papazoglou, Foundation for Research and Technology-Hellas (Greece) and Univ. of Crete (Greece) . . . . . [11269-14]

Lunch/BiOS Expo Break . . . . . Sun 12:00 pm to 1:30 pm

TUESDAY 4 FEBRUARY

POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Tuesday 10:00 AM– 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Core-shell type alkali quantum dots**, Hal S. Gokturk, Ecoken (USA)[11269-25]

**SERS activity of Ag/ZnO nanocomposites produced by combined surface modification techniques**, Mihaela E. Koleva, Nikolay N. Nedyalkov, Institute of Electronics (Bulgaria); Vladimir I. Nuzhdin, Valery Valeev, Kazan E. K. Zavoisky Physical-Technical Institute (Russian Federation); A. M. Rogov, Kazan Federal Univ. (Russian Federation); Andrey L. Stepanov, Kazan E. K. Zavoisky Physical-Technical Institute (Russian Federation) . . . . . [11269-26]

**High accuracy inverse design in nanophotonics by convolutional neural network**, Ronghui Lin, Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11269-27]

**Widely tunable cw Optical Parametric Oscillators: Mastering the challenges posed in quantum technology research**, Korbinian Hens, Jaroslav Sperling, HÜBNER GmbH & Co. KG (Germany); Niklas Waasem, HÜBNER GmbH & Co KG (Germany); Ronja Gärtner, HÜBNER GmbH & Co. KG (Germany); Gunnar Elgcrona, Cobolt AB (Sweden) . . . . . [11269-28]

**Minimal three-dimensional dark spot shaped near the focal point toward laser processing to create a new nano-scale structure**, Hiroshi Kumagai, Kitasato Univ. (Japan); Yoshinori Iketaki, Olympus Corp. (Japan); Koumei Nagai, NTT Advanced Technology Corp. (Japan); Nandor Bokor, Budapest Univ. of Technology and Economics (Hungary) . . . . . [11269-29]

**Preparation of flexible super pseudocapacitors based on laser induced graphene**, Zhiru Yang, Jiangsu Univ. (China) . . . . . [11269-30]

**Preparation and corrosion resistance of superhydrophobic texture with micro-nano hierarchical structure on magnesium alloy surface**, Zhiru Yang, Jiangsu Univ. (China) . . . . . [11269-31]

**Preparation and wear resistance of superhydrophobic surface of magnesium alloy based on laser ablation in liquid process**, Zhiru Yang, Jiangsu Univ. (China) . . . . . [11269-32]

**Structural and electronic properties of ultrathin LaCoO3 films grown by pulsed laser deposition**, Ksenia Maksimova, Immanuel Kant Baltic Federal Univ. (Russian Federation) and Deutsches Elektronen-Synchrotron (Germany); Anatoly Kozlov, Olga Dikaya, Immanuel Kant Baltic Federal Univ. (Russian Federation); Andrey Hloskovsky, Deutsches Elektronen-Synchrotron (Germany); Aleksandr Goikhman, Immanuel Kant Baltic Federal Univ. (Russian Federation) . . . . . [11269-33]

**Pulsed laser deposition cells for in-situ and in-vacuo experiments on neutron and synchrotron facilities**, Aleksandr Goikhman, Pavel Prokopovich, Immanuel Kant Baltic Federal Univ. (Russian Federation) and Nanomaterials and Devices LLC (Russian Federation); Ksenia Maksimova, Deutsches Elektronen-Synchrotron (Germany) and Immanuel Kant Baltic Federal Univ. (Russian Federation) . . . . . [11269-34]

SESSION 5

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 1:30 PM TO 3:00 PM

Synthesis and Diagnostics of Nanoscale Materials III

Session Chair: Pierre-François Brevet, Institut Lumière Matière (France)

1:30 pm: **Direct printing of gold nanoparticles by solid-state dewetting**, Jae-Hyuck Yoo, Nathan J. Ray, Hoang T. Nguyen, Michael A. Johnson, Salmaan H. Baxamusa, Selim Elhadj, Manyalibo J. Matthews, Eyal Feigenbaum, Lawrence Livermore National Lab. (USA) . . . . . [11269-15]

1:50 pm: **Aerosol generation from laser-ablation-synthesized nanoparticles**, Genny A. Pang, Matthias Bauer, Christoph Haisch, Technische Univ. München (Germany) . . . . . [11269-16]

2:10 pm: **Nanoscale light management with 3D scanning near-field optical microscopy for optoelectronics material design (Invited Paper)**, Giovanni Fanchini, Western Univ. (Canada) . . . . . [11269-17]

2:40 pm: **Highly resolved, on-demand LIFT of graphene and 2D materials and computational modelling of transfer enabling conditions**, Mado Logotheti, Symeon Papazoglou, Dimitris Kaltsas, Filimon Zacharatos, Leonidas Tsetseris, Ioanna Zergioti, National Technical Univ. of Athens (Greece) . . . . . [11269-18]

Coffee Break. . . . . Sun 3:00 pm to 3:30 pm

SESSION 6

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 3:30 PM TO 5:40 PM

Synthesis and Diagnostics of Nanoscale Materials IV

Session Chair: Giovanni Fanchini, Western Univ. (Canada)

3:30 pm: **Nanomaterial synthesis and surface nanostructuring by femtosecond laser ablation in liquids (Invited Paper)**, Dongshi Zhang, Koji Sugioka, RIKEN (Japan) . . . . . [11269-19]

4:00 pm: **Preparation of patterned graphene from natural polymeric compound by laser induced process**, Zhiru Yang, Jiangsu Univ. (China) . . . . . [11269-20]

4:20 pm: **Microfabricated bolometer based on a vertically aligned carbon nanotube absorber**, Anna Vaskuri, Michelle S. Stephens, Nathan A. Tomlin, Christopher S. Yung, Andrew J. Walowitz, National Institute of Standards and Technology (USA); Cameron J. Straatsma, Univ. of Colorado (USA); David M. Harber, Lab. for Atmospheric and Space Physics (USA); John H. Lehman, National Institute of Standards and Technology (USA) . . . . . [11269-21]

4:40 pm: **High-efficiency generation of nanomaterials via laser ablation synthesis in solution with in-situ diagnostics for closed-loop control**, Ronan McCann, I-Form Advanced Manufacturing Ctr. (Ireland) and Dublin City Univ. (Ireland) and National Ctr. for Plasma Science and Technology (Ireland); Brian Freeland, I-Form Advanced Manufacturing Ctr. (Ireland) and Dublin City Univ. (Ireland); Greg Foley, Dublin City Univ. (Ireland); Dermot Brabazon, I-Form Advanced Manufacturing Ctr. (Ireland) and Dublin City Univ. (Ireland) and National Ctr. for Plasma Science and Technology (Ireland) . . . . . [11269-22]

5:00 pm: **Phase-responsive Fourier nanotransducers for probing 2D materials and functional interfaces**, Andrei V. Kabashin, Aix-Marseille Univ. (France); Vasyi Kravets, Fan Wu, Shinji Imaizumi, The Univ. of Manchester (United Kingdom); Victoria Shipunova, Sergey Deyev, Shemyakin-Ovchinnikov Institute of Biorganic Chemistry (Russian Federation); Alexander Grigorenko, The Univ. of Manchester (United Kingdom) . . . . . [11269-23]

5:20 pm: **In situ diagnostic control of pulsed laser deposition for the synthesis and conversion of atomically thin two-dimensional crystals**, David B. Geohegan, Yu-Chuan Lin, Yiling Yu, Alexander Puretzky, Christopher Rouleau, Kai Xiao, Oak Ridge National Lab. (USA); Chenze Liu, The Univ. of Tennessee Knoxville (USA); Gerd Duscher, Mina Yoon, Eva Zarkadoulas, Oak Ridge National Lab. (USA) . . . . . [11269-24]

LASE

**BiOS Expo Industry Stage**

Saturday – Sunday • Hall DE

Keynotes and panels on the latest developments, open to all attendees.

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# CONFERENCE 11270

LOCATION: SATURDAY-SUNDAY: ROOM 104 (LEVEL 1 SOUTH LOBBY) /  
MONDAY: ROOM 154 (UPPER MEZZANINE SOUTH)

Saturday–Tuesday 1–4 February 2020 • Proceedings of SPIE Vol. 11270

## Frontiers in Ultrafast Optics: Biomedical, Scientific, and Industrial Applications XX

Conference Chairs: **Peter R. Herman**, Univ. of Toronto (Canada); **Michel Meunier**, Ecole Polytechnique de Montréal (Canada); **Roberto Osellame**, CNR- Istituto di Fotonica e Nanotecnologie (Italy)

Program Committee: **Craig B. Arnold**, Princeton Univ. (USA); **Yves Bellouard**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Adela Ben-Yakar**, The Univ. of Texas at Austin (USA); **Alexander Heisterkamp**, Leibniz Univ. Hannover (Germany); **Denise M. Krol**, Univ. of California, Davis (USA); **Eric Mazur**, Harvard Univ. (USA); **Eric P. Mottay**, Amplitude Systèmes (France); **Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland); **Stefan Nolte**, Friedrich-Schiller-Univ. Jena (Germany); **Aleks Ovsianikov**, Technische Univ. Wien (Austria); **Christopher B. Schaffer**, Cornell Univ. (USA); **Jan Siegel**, Instituto de Optica “Daza de Valdés” (Spain); **Koji Sugioka**, RIKEN (Japan); **Mitsuhiko Terakawa**, Keio Univ. (Japan); **Alfred Vogel**, Univ. zu Lübeck (Germany); **Sascha Weiler**, TRUMPF Inc. (USA); **Dvir Yelin**, Technion-Israel Institute of Technology (Israel)

Conference Co-Sponsors:



### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . SAT 8:10 AM TO 10:00 AM

#### Biomedical Applications for Ultrafast Lasers

Session Chair: **Michel Meunier**, Polytechnique Montréal (Canada)

8:10 am: **Laser induced forward transfer as a tool for precise bioprinting** (*Invited Paper*), Marianneza Chatzipetrou, Valentina Leva, National Technical Univ. of Athens (Greece); George Tsekenis, Biomedical Research Foundation, Academy of Athens (Greece); Ioanna Zergioti, National Technical Univ. of Athens (Greece) . . . . . [11270-1]

8:40 am: **Aluminum oxide membrane as a functional element for filtering nanoparticles in micro hydraulic devices**, Yatin K. Patel, Arvydas Palevičius, Giedrius Janušas, Vytenis Naginevicius, Kaunas Univ. of Technology (Lithuania); Judita Liaudanskaitė, JSC Kauno stakles (Lithuania) . . . . . [11270-2]

9:00 am: **Increase in efficacy of near-infrared LIRC in corneal tissue with sodium fluorescein and riboflavin: comparison of two repetition rates**, Sara M. Campaign, Wayne H. Knox, Univ. of Rochester (USA) . . . . . [11270-3]

9:20 am: **Er:ZBLAN power amplifier design for minimally invasive laser osteotomy**, Ferda Canbaz, Lina M. Beltran Bernal, Univ. Basel (Switzerland); Georg Rauter, University of Basel (Switzerland); Philippe C. Cattin, Azhar Zam, Univ. Basel (Switzerland) . . . . . [11270-4]

9:40 am: **Scattering properties and femtosecond laser ablation thresholds of human and canine vocal folds**, Liam P. Andrus, Adela Ben-Yakar, The Univ. of Texas at Austin (USA); Ted Mau M.D., The Univ. of Texas Southwestern Medical Ctr. at Dallas (USA) . . . . . [11270-5]

Coffee Break. . . . . Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . SAT 10:30 AM TO 12:00 PM

#### Ultrafast Lasers for the Manipulation of Cells

Session Chair: **Ioanna Zergioti**, National Technical Univ. of Athens (Greece)

10:30 am: **Nanofluidics fabricated by femtosecond laser 3D processing for mechanism study of cancer cell metastasis** (*Invited Paper*), Koji Sugioka, RIKEN Ctr. for Advanced Photonics (Japan); Felix Sima, Institutul National pentru Fizica Laserilor, Plasmei si Radiatiei (Romania); Hiroyuki Kawano, Atsushi Miyawaki, RIKEN Ctr. for Brain Science (Japan) . . . . . [11270-6]

11:00 am: **Femtosecond laser induced densification within cell-laden hydrogels results in cellular alignment**, Zheng Xiong, Haiyan Li, Puscak Kunwar, Yin Zhu, Rafael Ramos, Shannon McLoughlin, Tackla Winston, Zhen Ma, Pranav Soman, Syracuse Biomaterials Institute (USA) . . . . . [11270-7]

11:20 am: **Controlled plasmonic cell fusion and its implications on the actin cytoskeleton**, Julia Belansky, Limor Minai, Dvir Yelin, Technion-Israel Institute of Technology (Israel) . . . . . [11270-8]

11:40 am: **Targeted siRNA delivery with gold nanostars-assisted optoporation using a supercontinuum pulsed picosecond laser**, Morteza Hasanzadeh Kafshgari, Sergiy Patskovsky, Michel Meunier, Jacynthe Francoeur, Polytechnique Montréal (Canada) . . . . . [11270-9]

Lunch/BiOS Expo Break . . . . . Sat 12:00 pm to 1:30 pm

#### SESSION 3

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . SAT 1:30 PM TO 3:30 PM

#### Ultrafast Laser-Matter Interaction

Session Chair: **Koji Sugioka**, RIKEN Ctr. for Advanced Photonics (Japan)

1:30 pm: **Uncovering the mechanism of the ultrafast UV-energy dissipation in the eumelanin pigment**, Aleksandra Iliina, Karen E. Thorn, Paul A. Hume, Justin M. Hodgkiss, Victoria Univ. of Wellington (New Zealand) . . . . . [11270-10]

1:50 pm: **Role of wavelength on femtosecond laser ablation of dielectrics: From 258 nm to 2 μm**, Mario Garcia Lechuga, Oliver Utéza, Nicolas Sanner, M. David Grojo, Lab. Lasers, Plasmas et Procédés Photoniques (France) . . . . . [11270-11]

2:10 pm: **Processing bulk silicon with femtosecond laser pulses at 2-μm wavelength**, Maxime Chambonneau, Markus Blothe, Friedrich-Schiller-Univ. Jena (Germany); Vladimir Yu Fedorov, Texas A&M Univ. at Qatar (Qatar) and P. N. Lebedev Physical Institute (Russian Federation); Tobias Heuermann, Gabor Matthäus, Friedrich-Schiller-Univ. Jena (Germany); Alessandro Alberucci, Abbe Ctr. of Photonics (Germany); Jens Limpert, Friedrich-Schiller-Univ. Jena (Germany) and Helmholtz-Institute Jena (Germany) and Fraunhofer Institute for Applied Optics and Precision Engineering (Germany); Stylianos Tzortzakis, Texas A&M Univ. at Qatar (Qatar) and Foundation for Research and Technology-Hellas (Greece) and Univ. of Crete (Greece); Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) . . . . . [11270-12]

2:30 pm: **Investigation of laser-matter interaction in transparent multilayer thin films**, Ruben Ricca, Yves Bellouard, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11270-13]

2:50 pm: **Synergistic effects of ultrashort optical pulses and nanosecond pulsed electric fields on the material's breakdown**, Vladislav V. Yakovlev, Zachary Coker, Texas A&M Univ. (USA) . . . . . [11270-14]

3:10 pm: **Lasing without population inversion in singly ionized nitrogen molecules**, Rostyslav Danylo, Ecole Polytechnique (France) . . . . . [11270-15]

Coffee Break. . . . . Sat 3:30 pm to 4:00 pm

**SESSION 4**

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . SAT 4:00 PM TO 5:40 PM

**Ultrafast Laser Imaging and Diagnostics**

Session Chair: **Yves Bellouard**,

Ecole Polytechnique Fédérale de Lausanne (Switzerland)

- 4:00 pm: **SOA-based picosecond fiber laser for nonlinear imaging**, Seung Won Jun, Chang-Seok Kim, Hansol Jang, Gyeong Hun Kim, Pusan National Univ. (Korea, Republic of) . . . . . [11270-17]
- 4:20 pm: **Vacuum compatible diagnostic bench for far field and wavefront characterization and correction**, Xavier Levecq, Guillaume Beaugrand, Thomas Lebrun, Lionel Nicolas, Imagine Optic SA (France) . . . . . [11270-18]
- 4:40 pm: **Full-vectorial characterization of complex femtosecond laser pulses**, Tiancheng Huo, Li Qi, Yusi Miao, Yan Li, Zhongping Chen, Beckman Laser Institute and Medical Clinic (USA) . . . . . [11270-19]
- 5:00 pm: **Ultrafast pulse metrology for industrial applications**, Marcos Dantus, Benjamin M. Farris, Michigan State Univ. (USA) . . . . . [11270-20]
- 5:20 pm: **Very high-speed single-shot ultrafast pulse measurement**, Andrei B. Vakhtin, Daniel J. Kane, Mesa Photonics, LLC (USA) . . . . . [11270-21]

**SUNDAY 2 FEBRUARY**

**SESSION 5**

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 8:00 AM TO 9:50 AM

**Ultrafast Laser Micro/Nano-machining**

Session Chair: **Roberto Osellame**,

CNR-Istituto di Fotonica e Nanotecnologie (Italy)

- 8:00 am: **Enhancing the confinement of energy deposition in ultrafast Bessel beam processing of glass** (*Invited Paper*), François Courvoisier, Rémi Meyer, FEMTO-ST (France); Jesus Hoyo, Remo Giust, FEMTO-ST (France) . . . . . [11270-22]
- 8:30 am: **Laser fabrication inside birefringent crystals with aberration correction**, Patrick S. Salter, Martin J. Booth, Univ. of Oxford (United Kingdom) . . . . . [11270-23]
- 8:50 am: **Non-contact fine positioning of optical components and circuits using femtosecond lasers**, Saood Ibbi Nazir, Yves Bellouard, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11270-24]
- 9:10 am: **Versatile fully reflective three by three beam splitter for high throughput surface texturing with high power femtosecond laser**, Ivan Gusachenko, Clément Jacquard, Gwenn Pallier, Nicolas Laurencet, Pu Jian, Olivier Pinel, Guillaume Labroille, CAILabs (France) . . . . . [11270-25]
- 9:30 am: **Enhanced efficacy in refractive corrections of rabbit corneas with low repetition rate blue femtosecond laser pulses**, Ruiting Huang, Dan Yu, Wayne H. Knox, Univ. of Rochester (USA) . . . . . [11270-26]
- Coffee Break . . . . . Sun 9:50 am to 10:20 am

**SESSION 6**

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 10:20 AM TO 12:30 PM

**Ultrafast Laser Writing of Integrated Photonic Devices**

Session Chair: **Peter R. Herman**, Univ. of Toronto (Canada)

- 10:20 am: **Direct inscription of near-surface waveguides in crystals, glasses, and polymers** (*Invited Paper*), Jean-Philippe Bérubé, Clément Frayssinous, Jérôme Lapointe, Albert Dupont, Réal Vallée, Ctr. d'optique, photonique et laser (Canada) . . . . . [11270-27]
- 10:50 am: **Femtosecond laser writing of 3D polarization insensitive integrated devices for astrophotonics**, Simone Piacentini, Politecnico di Milano (Italy) and CNR-Istituto di Fotonica e Nanotecnologie (Italy); Giacomo Corrielli, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Abani Shankar Nayak, Leibniz-Institut für Astrophysik Potsdam (Germany); Tarun Kumar Sharma, Univ. zu Köln (Germany); Kalaga V. Madhav, Leibniz-Institut für Astrophysik Potsdam (Germany); Andrea Adami, Politecnico di Milano (Italy); Ettore Pedretti, STFC Rutherford Appleton Lab. (United Kingdom); Stefano Minardi, Leibniz-Institut für Astrophysik Potsdam (Germany); Lucas Labadie, Univ. zu Köln (Germany); Roberto Osellame, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . . . [11270-28]

11:10 am: **Pioneer demonstration of femtosecond laser inscription of silver-based waveguide Bragg gratings for the VIS/near-IR range**, Yannick G. Petit, Romain Laberdesque, Univ. de Bordeaux (France) and Ctr. Lasers Intenses et Applications, CNRS (France); Théo Guérou, Univ. de Bordeaux (France) and CNRS (France); Laura Loi, Univ. de Bordeaux (France) and Ctr. Lasers Intenses et Applications, Ctr. National de la Recherche Scientifique (France); Alain Abou Khalil, Univ. de Bordeaux (France) and Ctr. Lasers Intenses et Applications, CNRS (France); Sylvain Danto, Univ. de Bordeaux (France) and CNRS (France); Inka B. Manek-Hönniger, Univ. de Bordeaux (France) and Ctr. Lasers Intenses et Applications, CNRS (France); Thierry Cardinal, Univ. de Bordeaux (France) and CNRS (France); Lionel Canioni, Univ. de Bordeaux (France) and Ctr. Lasers Intenses et Applications, CNRS (France) . . . . . [11270-29]

11:30 am: **Low-power reconfigurable photonic integrated circuits fabricated by femtosecond laser micromachining**, Francesco Ceccarelli, Consiglio Nazionale delle Ricerche (Italy) and Politecnico di Milano (Italy); Simone Atzeni, Consiglio Nazionale delle Ricerche (Italy) and Politecnico di Milano (Italy); Francesco Pellegatta, Simone Piacentini, Consiglio Nazionale delle Ricerche (Italy) and Politecnico di Milano (Italy); Andrea Crespi, Roberto Osellame, Consiglio Nazionale delle Ricerche (Italy) and Politecnico di Milano (Italy) . . . . . [11270-30]

11:50 am: **High contrast ultrashort pulse written transmission filter based on Moiré-fiber Bragg grating**, Ria G. Krämer, Friedrich-Schiller- Univ. Jena (Germany); Bennet Fischer, Institut National de la Recherche Scientifique (Canada); Christian Matzdorf, Thorsten A. Goebel, Daniel Richter, Friedrich-Schiller- Univ. Jena (Germany); Roberto Morandotti, Institut National de la Recherche Scientifique (Canada) and Univ. of Electronic Science and Technology of China (China) and ITMO Univ. (Russian Federation); Stefan Nolte, Friedrich-Schiller- Univ. Jena (Germany) . . . . . [11270-31]

12:10 pm: **Ultra-compact 'Spectrometer-in-Fiber' based on chirped filament-array gratings**, Abdullah Rahnama, Keivan Mahmoud Aghdami, Young Hwan Kim, Erden Ertorer, Peter R. Herman, Univ. of Toronto (Canada) . . . . . [11270-32]

Lunch/BiOS Expo Break . . . . . Sun 12:30 pm to 1:40 pm

**SESSION 7**

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 1:40 PM TO 3:50 PM

**Advanced Ultrafast Laser Processing Techniques**

Session Chair: **François Courvoisier**, Institut Franche-Comte Electronique Mecanique Thermique et Optique (France)

1:40 pm: **Ultrafast laser welding of ceramics: The interplay between material properties and laser parameters** (*Invited Paper*), Elias Penilla, Univ. of California, San Diego (USA); Luis Felipe Devia-Cruz, Univ. of California, San Diego (USA) and Univ. of California, Riverside (USA); Andrew T. Wieg, Yasuhiro Kodera, Univ. of California, San Diego (USA); Guillermo Aguilar, Univ. of California, Riverside (USA); Javier E. Garay, Univ. of California, San Diego (USA) . . . . . [11270-33]

2:10 pm: **Generalized non-diffracting beams for ultrafast materials processing**, Daniel Flamm, Keyou Chen, Michael Jenne, Marcel Schäfer, Daniel G. Grossmann, Malte Kumkar, TRUMPF Laser- und Systemtechnik GmbH (Germany) . . . . . [11270-34]

2:30 pm: **Comparative study between laser processing using optimized simultaneous spatial and temporal focusing and standard focusing**, John Czerski, Jeffrey A. Squier, Colorado School of Mines (USA); Yves Bellouard, Arunkrishnan Radhakrishnan, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11270-35]

2:50 pm: **Spatio-temporal simulation of ultrashort phenomena in different optical systems**, Site Zhang, LightTrans International UG (Germany); Christian Hellmann, Wyrowski Photonics GmbH (Germany); Frank Wyrowski, Friedrich-Schiller- Univ. Jena (Germany) . . . . . [11270-36]

3:10 pm: **Picosecond laser-induced shock waves patterning on shape memory alloys**, Bektur Abdisatarov, Ilhom Saidjafarzoda, Ali Oguz Er, Western Kentucky Univ. (USA); Haluk E. Karaca, Univ. of Kentucky (USA) . . . . . [11270-37]

3:30 pm: **Hollow-core-fiber laser-light-cable on TruMirco Series 2000 for easy system integration**, Stefan Baumbach, TRUMPF Laser GmbH (Germany); Felix Zimmermann, Ulf Quentin, Florian Kanal, TRUMPF Laser- und Systemtechnik GmbH (Germany); Aleksander Budnicki, Dirk H. Sutter, Sebastian Pricking, TRUMPF Laser GmbH (Germany) . . . . . [11270-38]

Coffee Break . . . . . Sun 3:50 pm to 4:20 pm

# CONFERENCE 11270

## SESSION 8

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . SUN 4:20 PM TO 6:00 PM

### Novel Ultrafast Laser Sources

Session Chair: **Bo Gu**, Bos Photonics (USA)

4:20 pm: **Versatile industrial high-power femtosecond laser platform for smart process control**, Clemens Hönninger, Jorge Sanabria, Martin Delaigue, Florent Basin, Guillaume Bonamis, Julien Pouysegur, Benoit Trophe, Eric Audouard, Eric P. Mottay, Amplitude Systèmes (France) . . . . . [11270-39]

4:40 pm: **Yb-fiber-based femtosecond source tunable between 770-1180 nm for two-photon-fluorescence microscopy**, Lu-Ting Chou, Dong-Lin Zhong, Yu-Cheng Liu, National Yang-Ming Univ. (Taiwan); Jye-Chang Lee, National Taiwan Univ. (Taiwan); Yi-Syuan Chen, Shih-Hsuan Chia, National Yang-Ming Univ. (Taiwan) . . . . . [11270-40]

5:00 pm: **High repetition rate CEP-stable Yb-doped fiber amplifier**, Florent Guichard, Amplitude Laser Group (France); Anna Golinelli, Lab. Charles Fabry (France); Florent Guichard, Amplitude Laser Group (France); Marc Hanna, Lab. Charles Fabry (France); Yoann Zaouter, Amplitude Laser Group (France); Patrick Georges, Lab. Charles Fabry (France) . . . . . [11270-41]

5:20 pm: **Ultra-low-noise ultrafast lasers for metrology and fast-electronics applications**, Florian Emaury, Benjamin Rudin, Menhir Photonics AG (Switzerland) . . . . . [11270-42]

5:40 pm: **Robust, high repetition-rate, milliwatt-class XUV source**, Michele Natile, Amplitude Systèmes (France); Aura Ines Gonzalez, Amplitude Technologies (France); Sandra Beauvarlet, Ctr. Lasers Intenses et Applications (France); Dominique Descamps, Stéphane Petit, Ctr. Lasers Intenses et Applications (France); Yoann Zaouter, Amplitude Systèmes (France); Yann Mairesse, Antoine Comby, Ctr. Lasers Intenses et Applications (France) . . . . . [11270-43]

## MONDAY 3 FEBRUARY

### SESSION 9

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . MON 8:00 AM TO 10:10 AM

### 3D Ultrafast Laser Microfabrication

Session Chair: **Stefan Nolte**, Friedrich-Schiller-Univ. Jena (Germany)

8:00 am: **3D focal field engineering for rapid femtosecond laser microfabrication (Invited Paper)**, Yan Li, Dong Yang, Qian Zhang, Meng Li, Hong Yang, Qihuang Gong, Peking Univ. (China) . . . . . [11270-44]

8:30 am: **Resonant micro-opto-mechanical modulators fabricated by femtosecond laser micromachining**, Michele Spagnolo, Politecnico di Milano (Italy); Roberto Memeo, Politecnico di Milano (Italy) and CNR-Istituto di Fotonica e Nanotecnologie (Italy); Francesco Pellegatta, Riccardo Motta, Politecnico di Milano (Italy); Andrea Crespi, Politecnico di Milano (Italy) and CNR-Istituto di Fotonica e Nanotecnologie (Italy); Roberto Osellame, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Politecnico di Milano (Italy) . . . . . [11270-45]

8:50 am: **Femtosecond written volume Bragg gratings in multicomponent fluoride glasses**, Lauris Talbot, Univ. Laval (Canada); Daniel Richter, Maximilian Heck, Friedrich-Schiller-Univ. Jena (Germany); Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Friedrich-Schiller-Univ. Jena (Germany); Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Martin Bernier, Univ. Laval (Canada) . . . . . [11270-46]

9:10 am: **Femtosecond laser micro-structuring of air-glass dielectric stacks for enabling interferometric resonant Brewster-angle polarization**, Gligor Djogo, Univ. of Toronto (Canada); Diogo P. Lopes, Politecnico di Milano (Italy); Priyash Singh, Alex Vitkin, Univ. of Toronto (Canada); Roberto Osellame, Politecnico di Milano (Italy); Peter R. Herman, Univ. of Toronto (Canada) . . . . . [11270-47]

9:30 am: **All laser-based fabrication of optical elements**, Simon Schwarz, Stefan Rung, Hochschule Aschaffenburg (Germany); Cemal Esen, Ruhr-Univ. Bochum (Germany); Ralf Hellmann, Hochschule Aschaffenburg (Germany) . . . . . [11270-48]

9:50 am: **Laser welding of silica glass fibre: Enabling robust Bragg grating sensing for high temperature environment**, Oleg Vorobyev, Peter R. Herman, Jianzhao Li, Univ. of Toronto (Canada); Michael Bakaic, Nicholas Burgwin, FIBOS (Canada) . . . . . [11270-49]

Coffee Break . . . . . Mon 10:10 am to 10:30 am

## FRONTIERS IN ULTRAFAST OPTICS BEST STUDENT PAPER COMPETITION AND AWARDS CEREMONY

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . 10:30 AM TO 11:50 AM

Competition . . . . . 10:30 am to 11:30 am

Judging & Award Ceremony . . . . . 11:30 am to 11:50 am

We are pleased to announce that a cash prize will be awarded to the best student presentation in this conference (both poster and oral papers considered).

Papers submitted and presented by graduate and undergraduate students are eligible. In order to ensure a fair evaluation, the conference chairs and the program committee will judge the students during a special student competition session held during the conference. Here the students present a brief 5-minute summary of their original talk or poster presented at the conference.

Following the student competition, the judges will meet and decide on the winner. The winner and runner-up will be announced during the award ceremony and awarded a cash prize.

AWARD SPONSORS:



Lunch Break . . . . . Mon 11:50 am to 1:20 pm

## SESSION 10

LOCATION: ROOM 154 (UPPER MEZZANINE SOUTH) . . . . . MON 1:20 PM TO 3:10 PM

### Ultrafast Laser-induced Modifications in Transparent Materials

Joint Session with 11267 and 11270

#### NOTE ROOM CHANGE

Session Chair: **Roberto Osellame**,

CNR-Istituto di Fotonica e Nanotecnologie (Italy)

1:20 pm: **On the use of femtosecond laser for tuning materials properties (Invited Paper)**, Yves Bellouard, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11267-8]

1:50 pm: **Digital tools for laser parameters optimization in femtosecond processing**, Eric Audouard, Pierre Constant, Amelie Letan, Konstantin Mishchik, Clemens Hönninger, Eric P. Mottay, Amplitude Systèmes (France) . . . . . [11270-50]

2:10 pm: **Femtosecond laser micromachining in hydrophobic intraocular lenses: Efficacy and material effects**, Dan Yu, Ruiting Huang, Wayne H. Knox, Univ. of Rochester (USA) . . . . . [11270-51]

2:30 pm: **Laser induced modifications in transparent materials using azimuthally modulated axicon beams**, Paulius Slevas, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Sergej Orlov, Ctr. for Physical Sciences and Technology (Lithuania); Ernestas Naciuis, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Orestas Ulcinas, Workshop of Photonics (Lithuania); Pavel Gotovski, Ctr. for Physical Sciences and Technology (Lithuania); Justas Baltrukonis, Ctr. for Physical Sciences and Technology (Lithuania) and Workshop of Photonics (Lithuania); Vytautas Jukna, Ctr. for Physical Sciences and Technology (Lithuania) . . . . . [11267-9]

2:50 pm: **High quality Bessel beam generation through reflective axicon for femtosecond laser glass microprocessing**, Antonin Billaud, CAILabs (France); Maik Steinbach, Patrick Taschner, Arndt Hohnholz, Laser Zentrum Hannover e.V. (Germany); Gwenn Pallier, Sami Laroui, Pu Jian, Olivier Pinel, CAILabs (France); Jürgen Koch, Laser Zentrum Hannover e.V. (Germany); Guillaume Labroille, CAILabs (France) . . . . . [11267-10]

Coffee Break . . . . . Mon 3:10 pm to 3:30 pm

**LASE PLENARY SESSION**

**LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . . MON 3:30 PM TO 5:40 PM**

- 3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)
- 3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)
- 3:40 pm: **VCSEL: Born Small and Grown Big (Plenary)**  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)
- 4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources (Plenary)**  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)
- 5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science (Plenary)**  
**Robert L. Byer**, Stanford Univ. (USA)

**TUESDAY 4 FEBRUARY**

**POSTERS-TUESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Tuesday 10:00 AM– 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Bulk MAS ballistic glass optical waveguides fabricated by focused femtosecond laser pulses**, Paulo Henrique D. Ferreira, Débora Cristina N. Fabris, Mariana de Oliveira C. Villas Boas, Univ. Federal de São Carlos (Brazil); Ítalo G. Bezerra, Univ Federal de São Carlos (Brazil); Cleber R. Mendonça, Instituto de Física de São Carlos (Brazil); Edgar D. Zanotto, Univ. Federal de São Carlos (Brazil) . . . . . [11270-52]

**Delay control in laser-assisted photoionization of water molecules by attopulses**, Lara Martini, Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina); Diego I. R. Boll, Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina) and Univ. Autónoma de Madrid (Spain); Omar A. Fojón, Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina) and Univ. de Buenos Aires (Argentina) . . . . . [11270-53]

**Metal microstructure in hydrogel fabricated by multiphoton photoreduction for light-stimulated shrinkage**, Kosuke Mizuguchi, Yo Nagano, Hiroaki Onoe, Mitsuhiro Terakawa, Keio Univ. (Japan) . . . [11270-54]





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# CONFERENCE 11271

LOCATION: TUESDAY AM: ROOM 213 (LEVEL 2 SOUTH);  
TUESDAY PM-THURSDAY: ROOM 207 (LEVEL 2 SOUTH)

Tuesday-Thursday 4-6 February 2020 • Proceedings of SPIE Vol. 11271

## Laser 3D Manufacturing VII

Conference Chairs: **Bo Gu**, Bos Photonics (USA); **Hongqiang Chen**, GE Global Research (USA)

Conference Co-Chair: **Henry Helvajian**, The Aerospace Corp. (USA)

Program Committee: **Corey M. Dnsky**, Aeos Consulting, Inc. (USA); **John T. Fourkas**, Univ. of Maryland, College Park (USA); **Youping Gao**, Aerojet Rocketdyne (USA); **Andreas Heinrich**, Hochschule Aalen (Germany); **Weidong Huang**, Northwestern Polytechnical Univ. (China); **Linas Jonušauskas**, Femtika UAB (Lithuania); **Edward C. Kinzel**, Missouri Univ. of Science and Technology (USA); **Christoph Leyens**, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany); **Jian Liu**, PolarOnyx, Inc. (USA); **Shuang Liu**, Miller Electric Manufacturing Co. (USA); **Henry Peng**, Soochow Univ. (China); **Alberto Piqué**, U.S. Naval Research Lab. (USA); **Yuji Sano**, Institute for Molecular Science (Japan); **Michael Thiel**, Nanoscribe GmbH (Germany); **Andrea Toulouse**, Institut für Technische Optik (Germany); **Paul S. Unwin**, Stanmore Implants (United Kingdom); **Augustine M. Urbas**, Air Force Research Lab. (USA); **Martin Wegener**, Karlsruher Institut für Technologie (Germany)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... TUE 8:20 AM TO 10:10 AM

#### DLW: Microoptics and Metals

Joint Session with Conferences 11271 and 11292

Session Chair: **Georg von Freymann**,  
Technische Univ. Kaiserslautern (Germany)

8:20 am: **3D printed micro-optics: Millimeter size, multiple materials, and combining refractive and diffractive imaging leads to novel functionalities** (*Invited Paper*), Harald Giessen, Univ. Stuttgart (Germany) ..... [11292-34]

8:50 am: **3D printing of transparent glass**, Frederik Kotz, Bastian E. Rapp, Dorothea Helmer, Univ. of Freiburg (Germany) ..... [11271-1]

9:10 am: **Fabrication and characterization of 3D silver micro-structures**, Erik Hagen Waller, Technische Univ. Kaiserslautern (Germany); Georg von Freymann, Technische Univ. Kaiserslautern (Germany) and Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ..... [11292-35]

9:30 am: **High-throughput fabrication of right-angle prism mirrors with selective metalization by two-step 3D printing and computer vision alignment**, Andrea Bertocini, King Abdullah Univ. of Science and Technology (Saudi Arabia); Gheorghe Cojoc, TU Dresden (Germany); Jochen Guck, Max-Planck-Institut für Lichtwissenschaft (Germany) and TU Dresden (Germany); Carlo Liberale, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11292-36]

9:50 am: **Space-variant quarter- and half-wave plates fabricated by combining 3D laser direct writing and electroplating**, Stefan Belle, Hochschule Aschaffenburg (Germany); Stefan F. Helfert, FernUniv. in Hagen (Germany); Ralf Hellmann, Hochschule Aschaffenburg (Germany); Jürgen Jahns, FernUniv. in Hagen (Germany) ..... [11292-37]

Coffee Break ..... Tue 10:10 am to 10:40 am

#### SESSION 2

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... TUE 10:40 AM TO 12:30 PM

#### DLW: High Speed Printing

Joint Session with Conferences 11271 and 11292

Session Chair: **Harald Giessen**, Univ. Stuttgart (Germany)

10:40 am: **Rapid multi-focus multi-photon three-dimensional laser micro-printing** (*Invited Paper*), Vincent Hahn, Jingyuan Qu, Tobias Frenzel, Pascal M. Kiefer, Patrick Ziemke, Karlsruher Institut für Technologie (Germany); Peter Gumbsch, Karlsruher Institute für Technologie (Germany) and Fraunhofer-Institut für Werkstoffmechanik IWM (Germany); Eva Blasco, Karlsruher Institut für Technologie (Germany); Christopher Barner-Kowollik, Queensland Univ. of Technology (Australia) and Karlsruher Institut für Technologie (Germany); Martin Wegener, Karlsruher Institut für Technologie (Germany) ..... [11271-2]

11:10 am: **Two-photon grayscale lithography**, Michael Thiel, Yann Tanguy, Nicole Lindenmann, Alok Tungal, Roman Reiner, Matthias Blaicher, Jörg Hoffmann, Thomas Sauter, Fabian Niesler, Timo Gissibl, André Radke, Nanoscribe GmbH (Germany) ..... [11292-38]

11:30 am: **Dynamic holographic two-photon polymerization method for processing microtube array and its application**, Shengyun Ji, Yanlei Hu, Jiawen Li, Dong Wu, Univ. of Science and Technology of China (China) ..... [11271-3]

11:50 am: **Impact of massive parallelization on two-photon absorption micro- and nanofabrication**, Fabian Hilbert, Jonas Wiedenmann, Benedikt Stender, Multiphoton Optics GmbH (Germany); Quentin Carlier, Luis A. Perez Covarrubias, Kevin Heggarty, IMT Atlantique Bretagne-Pays de la Loire (France); Caroline Arnoux, Cyrille Monnerieu, Patrice Baldeck, Ecole Normale Supérieure de Lyon (France); Ruth Houbertz, Multiphoton Optics GmbH (Germany) ..... [11271-4]

12:10 pm: **High-speed single-photon 3D nanolithography by controlling polymerization inhibition**, Shih-Hsin Hsu, Teng Chi, Paul Somers, Bryan W. Boudouris, Xianfan Xu, Liang Pan, Purdue Univ. (USA) ..... [11271-5]

Lunch/Exhibition Break ..... Tue 12:30 pm to 2:00 pm

#### SESSION 3

LOCATION: ROOM 207 (LEVEL 2 SOUTH) ..... TUE 2:00 PM TO 3:50 PM

#### NOTE ROOM CHANGE

#### 3D Micro-Nano Printing I: Multi-Photon Polymerization

Session Chair: **Hongqiang Chen**, GE Global Research (USA)

2:00 pm: **Industrial use of high precision 3D printing** (*Invited Paper*), Benedikt Stender, Fabian Gumpert, Jonas Wiedenmann, Willi Mantel, Yannick Dupuis, Alexander Krupp, Fabian Hilbert, Ruth Houbertz, Multiphoton Optics GmbH (Germany) ..... [11271-6]

2:30 pm: **Towards the improvement of axial resolution: 4Pi multiphoton polymerization**, Titas Tl?k?nas, Vilnius Univ. (Lithuania) and Femtika UAB (Lithuania); Domas Paipulas, Vilnius Univ. (Lithuania); Vytautas Purlys, Vilnius Univ. (Lithuania) and Femtika UAB (Lithuania) ..... [11271-7]

2:50 pm: **Using optical tweezers and two-photon polymerization to assemble microspheres**, Samira Chizari, Miles P. Lim, Amin Farzaneh, Lucas A. Shaw, Sydney Austin, Jonathan B. Hopkins, Univ. of California, Los Angeles (USA) ..... [11271-8]

3:10 pm: **Machine Learning predicts printing parameters for multi-photon polymerization three-dimensional direct laser writing (3D-DLW)**, Areti Mourka, Foundation for Research and Technology-Hellas (Greece); Georgios D. Barmparis, Dimitra Ladika, Foundation for Research and Technology-Hellas (Greece) and Univ. of Crete (Greece); Vasileia Melissinaki, David Gray, Maria Farsari, Foundation for Research and Technology-Hellas (Greece) ..... [11271-9]

3:30 pm: **Projection two-photon lithography for rapid 3D nanoprinting**, Paul Somers, Yining Wang, Liang Pan, Xianfan Xu, Purdue Univ. (USA) ..... [11271-10]

Coffee Break ..... Tue 3:50 pm to 4:20 pm

**SESSION 4**

LOCATION: ROOM 207 (LEVEL 2 SOUTH) ..... TUE 4:20 PM TO 5:30 PM

**3D Micro-Nano Printing II: Forward Transfer**

Session Chair: **Kristin M. Charipar**, U.S. Naval Research Lab. (USA)

4:20 pm: **High throughput LIFT printing of electric circuitry** (*Invited Paper*), Sharona Cohen, Itay Peled, Oleg Ermak, Zvi Kotler, Orbotech Ltd. (Israel) ..... [11271-11]

4:50 pm: **Microscale deposition of 2D materials via laser induced backwards transfer**, Matthew F. Praeger, Robert W. Eason, Ben Mills, Optoelectronics Research Ctr. (United Kingdom) ..... [11271-12]

5:10 pm: **Laser direct synthesis and patterning process for fabricating 3D circuits**, Ming-Tsang Lee, National Tsing Hua Univ. (Taiwan) ..... [11271-13]

**POSTERS-TUESDAY**

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

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Poster Setup: Tuesday 10:00 AM– 5:00 PM

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**Model of dielectric constant of pure copper on laser welding**, Susumu Kato, National Institute of Advanced Industrial Science and Technology (Japan); Atsushi Sunahara, Center for Materials Under eXtreme Environment, School of Nuclear Engineering, Purdue University (USA); Kento Morimoto, Yuji Sato, Masahiro Tsukamoto, Joining and Welding Research Institute (JWRI), Osaka University (Japan) ..... [11271-40]

**Development of blue diode laser for additive manufacturing**, Ritsuko Higashino, Masahiro Tsukamoto, Nobuyuki Abe, Shin-Ichiro Masuno, Osaka Univ. (Japan); Yuji Sato, Japan Atomic Energy Agency (Japan); Yoshinori Funada, Industrial Research Institute of Ishikawa (Japan) . . [11271-41]

**Rapid fabrication of cylinder structures via a novel ring-shaped beam with high uniformity and high energy utilization**, Chenchu Zhang, Hefei Univ. of Technology (China) ..... [11271-42]

**Fabrication of tunable and wearable strain sensor for adjusting photopolymerization**, Tae Seung Hwang, Heejung Kong, Suwon Hwang, Junyeob Yeo, Kyungpook National Univ. (Korea, Republic of) . . . . . [11271-43]

**Forming of pure copper rod by LMD method with blue direct diode lasers**, Kazuhiro Ono, Masahiro Tsukamoto, Osaka Univ. (Japan); Yuji Sato, Japan Atomic Energy Agency (Japan); Ritsuko Higashino, Takahiro Hara, Osaka Univ. (Japan); Yoshinori Funada, Industrial Research Institute of Ishikawa (Japan); Nobuyuki Abe, Osaka Univ. (Japan) ..... [11271-44]

**Meso-optical elements printed via 3D laser lithography**, Dovile Andrijev, Femtika UAB (Lithuania) and Vilnius Univ. (Lithuania); Tomas Baravykas, Femtika UAB (Lithuania); Linas Jonuskauskas, Femtika UAB (Lithuania) and Vilnius Univ. (Lithuania) ..... [11271-45]

**WEDNESDAY 5 FEBRUARY**

**SESSION 5**

LOCATION: ROOM 207 (LEVEL 2 SOUTH) ..... WED 8:30 AM TO 10:00 AM

**Powder-Bed SLM Metal Printing I**

Session Chair: **Hongqiang Chen**, GE Global Research (USA)

8:30 am: **Additive manufacturing for innovative products: from aerospace to medical applications** (*Invited Paper*), Christoph Leyens, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany) and TU Dresden (Germany); Frank Brückner, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany) and Luleå Univ. of Technology (Sweden); Elena Lopez, Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS (Germany) ..... [11271-14]

9:00 am: **Metal 3D printing: Process validation for high-requirement applications**, Eric Utley, Protolabs (USA) ..... [11271-15]

9:20 am: **Multi-laser fusion process with pre-heating for additive manufacturing**, Philipp Wagenblast, Jeroen Risse, Sven Schweikert, Jörg Zaiss, TRUMPF Laser- und Systemtechnik GmbH (Germany) . . [11271-17]

9:40 am: **Process development for laser powder bed fusion of pure copper**, Thomas Stoll, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) ..... [11271-46]

Coffee Break .....Wed 10:00 am to 10:30 am

**SESSION 6**

LOCATION: ROOM 207 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 12:10 PM

**Powder-Bed SLM Metal Printing II**

Session Chair: **Henry Helvajian**, The Aerospace Corp. (USA)

10:30 am: **Additive manufacturing with green disk lasers** (*Invited Paper*), Philipp Wagenblast, Anne Myrell, Michael Thielmann, Tobias Scherbaum, TRUMPF Laser- und Systemtechnik GmbH (Germany) ..... [11271-18]

11:00 am: **Laser power controlling in SLM: Key point for non-conventional alloy fabrication**, Mehdi Dadras, CSEM SA (Switzerland) and Univ. de Neuchâtel (Switzerland) ..... [11271-19]

11:20 am: **Measurement of energy transfer and balance in a scanned laser-induced melt pool** (*Invited Paper*), David Deisenroth, Sergey Mekhontsev, Brandon Lane, National Institute of Standards and Technology (USA) [11271-20]

11:50 am: **Laser assisted powder bed fusion of hypereutectic Al-Si using ultra-short laser pulses at different pulse durations**, Tobias Ullsperger, Gabor Matthäus, Lisa Kaden, Brian Seyfarth, Dongmei Liu, Markus Rettenmayr, Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11271-21]

Lunch/Exhibition Break .....Wed 12:10 pm to 1:40 pm

**SESSION 7**

LOCATION: ROOM 207 (LEVEL 2 SOUTH) .....WED 1:40 PM TO 3:40 PM

**Multi-Material Printing and Laser Cladding**

Session Chair: **Shuang Liu**, Miller Electric Manufacturing Co. (USA)

1:40 pm: **Hybrid laser platform for printing 3D multiscale multi-material hydrogel structures** (*Invited Paper*), Zheng Xiong, Pusal Kunwar, Yin Zhu, Alex Filip, Haiyan Li, Pranav Soman, Syracuse Biomaterials Institute, Syracuse Univ. (USA) ..... [11271-22]

2:10 pm: **OCT sensor for layer height control in DED using SINUMERIK® controller** (*Invited Paper*), Markus Kogel-Hollacher, Matthias Strebler, Precitec GmbH & Co. KG (Germany) ..... [11271-23]

2:40 pm: **Substrate influence in laser blown powder of nickel superalloys**, Adrien Mouchard, David Tanner, Michael Pomeroy, Jeremy Robinson, Univ. of Limerick (Ireland); Bryan McAuliffe, Lufthansa Technik Turbine Shannon (Ireland); Simon Donovan, Rolls-Royce plc (United Kingdom) . . . . . [11271-24]

3:00 pm: **Numerical simulation and experimental validation of deposition geometry and TiC dissolution in functionally graded Ti-Al composite coatings fabricated with laser metal deposition**, Eytayo Olatunde Olakanmi, Botswana International Univ. of Science & Technology (BIUST) (Botswana); Monnamme Tlotleng, Sisa Pityana, Council for Scientific and Industrial Research (South Africa); Subas Rao, Botswana International Univ. of Science & Technology (BIUST) (Botswana); Maxim M. D. Khomenko, Fikret F.Kh Mirzade, Institute of Laser and Information Technologies (Russian Federation); Shaik S. Hoosain, Council for Scientific and Industrial Research (South Africa) ..... [11271-25]

3:20 pm: **Oxidation resistance of tungsten carbide reinforced stellite 6 matrix composite coating fabricated with laser cladding at elevated temperature**, Eytayo Olatunde Olakanmi, Botswana International Univ. of Science & Technology (BIUST) (Botswana); Monnamme Tlotleng, Sisa Pityana, Shaik S. Hoosain, Council for Scientific and Industrial Research (South Africa) ..... [11271-26]

Coffee Break .....Wed 3:40 pm to 4:10 pm

LASE

# CONFERENCE 11271

## SESSION 8

LOCATION: ROOM 207 (LEVEL 2 SOUTH) ..... WED 4:10 PM TO 5:40 PM

### Glass 3D Printing

Session Chair: **Linas Jonušauskas**, Femtika UAB (Lithuania)

4:10 pm: **Application of 3D printing of fused silica glass using direct laser melting for fabrication of photonic sensors** (*Invited Paper*), Qi Zhang, Jincheng Lei, Yizheng Chen, Yongji Wu, Jianan Tang, Liwei Hua, Hai Xiao, Clemson Univ. (USA) ..... [11271-27]

4:40 pm: **Laser powder bed fusion of glass: a comparative study between CO<sub>2</sub> lasers and ultrashort laser pulses**, Brian Seyfarth, Lisa Schade, Gabor Matthäus, Tobias Ullsperger, Friedrich-Schiller-Univ. Jena (Germany); Nils Heidler, Enrico Hilpert, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Stefan Nolte, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11271-28]

5:00 pm: **Optical fibers fabricated from 3D printed silica preforms**, Angeles L. Camacho Rosales, Martin A. Núñez Velázquez, Optoelectronics Research Ctr. (United Kingdom); Xiao Zhao, Univ. of Southampton (United Kingdom); Jayanta K. Sahu, Optoelectronics Research Ctr. (United Kingdom) ..... [11271-29]

5:20 pm: **Laser-based drawing method for posture-free objects by photochromic active marking with high-speed coaxial gaze control**, Yuri Mikawa, Tomohiro Sueishi, Tomohiko Hayakawa, Masatoshi Ishikawa, The Univ. of Tokyo (Japan) ..... [11271-30]

## THURSDAY 6 FEBRUARY

## SESSION 9

LOCATION: ROOM 207 (LEVEL 2 SOUTH) ..... THU 8:50 AM TO 10:00 AM

### Novel Devices and Biosensor Printing

Session Chair: **Andrea Toulouse**, Institut für Technische Optik (Germany)

8:50 am: **Hybrid additive-subtractive femtosecond laser 3D fabrication of medical microdevices** (*Invited Paper*), Linas Jonušauskas, Dovile Andrijev, Femtika UAB (Lithuania), Vilnius Univ. (Lithuania); Tomas Baravykas, Femtika UAB (Lithuania); Agne Butkute, Titas Tičkūnas, Femtika UAB (Lithuania), Vilnius Univ. (Lithuania); Tomas Gadišauskas, Femtika UAB (Lithuania); Vytautas Purlys, Femtika UAB (Lithuania), Vilnius Univ. (Lithuania) ..... [11271-31]

9:20 am: **Manufacturing of molds by multiphoton polymerization for micro-replication of optically enhanced surfaces**, Nerea Otero, Francisco Gontad, Sara Vidal, Tamara Delgado, Félix Ares, Pablo Romero, AIMEN - Asociación de Investigación Metalúrgica del Noroeste (Spain) ..... [11271-34]

9:40 am: **Weaving versatile microstructures using femtosecond laser self-accelerating beams fabrication and self-assembly technique**, Ze Cai, Yanlei Hu, Jiawen Li, Dong Wu, Univ. of Science and Technology of China (China) ..... [11271-35]

Coffee Break. .... Thu 10:00 am to 10:30 am

## SESSION 10

LOCATION: ROOM 207 (LEVEL 2 SOUTH) ..... THU 10:30 AM TO 12:00 PM

### Biostructure 3D Printing

Session Chair: **Martin Wegener**, Karlsruher Institut für Technologie (Germany)

10:30 am: **3D auxetic metamaterials as scaffolds for cell growth** (*Invited Paper*), Maria Farsari, George Flamourakis, Ioannis Spanos, Vasileia Melissinaki, Foundation for Research and Technology-Hellas (Greece); Zacharias Vangelatos, Costas P. Grigoropoulos, Univ. of California, Berkeley (USA); Anthi Ranella, Foundation for Research and Technology-Hellas (Greece) ..... [11271-36]

11:00 am: **Stimuli-responsive 3D micro-scaffolds for single cell actuation**, Marc Hippler, Kai Weißenbruch, Enrico Lemma, Eva Blasco, Karlsruher Institut für Technologie (Germany); Motomu Tanaka, Ruprecht-Karls-Univ. Heidelberg (Germany); Christopher Barner-Kowollik, Queensland University of Technology (Australia); Martin Bastmeyer, Martin Wegener, Karlsruher Institut für Technologie (Germany) ..... [11271-37]

11:20 am: **Fabrication of 3D fibre scaffolds for tumor-immune system interactions by two photon polymerisation**, Tibor Teplicky, Comenius Univ. in Bratislava (Slovakia); Anton Mateasik, International Laser Ctr. (Slovakia); Beata Cunderlikova, Comenius Univ. in Bratislava (Slovakia) ..... [11271-38]

11:40 am: **Bacterial cellulose growth in 3D hybrid scaffolds sculpted via multiphoton polymerization**, Adriano J. G. Otuka, Instituto de Física de São Carlos, Univ. de São Paulo (Brazil); Rafael R. Domeneguetti, Univ. Estadual Paulista "Júlio de Mesquita Filho" (Brazil); Debora T. Balogh, Instituto de Física de São Carlos, Univ. de São Paulo (Brazil); Sidney J. L. Ribeiro, Univ. Estadual Paulista "Júlio de Mesquita Filho" (Brazil); Cleber R. Mendonça, Instituto de Física de São Carlos, Univ. de São Paulo (Brazil) ..... [11271-39]

## Photonics West Industry Stage

Tuesday - Thursday • Hall DE

Keynotes and panels open to all attendees

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# CONFERENCE 11272

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH)

Monday–Tuesday 3–4 February 2020 • Proceedings of SPIE Vol. 11272

# Free-Space Laser Communications XXXII

Conference Chairs: **Hamid Hemmati**, ViaSat, Inc. (USA); **Don M. Boroson**, MIT Lincoln Lab. (USA)

Program Committee: **Abhijit Biswas**, Jet Propulsion Lab. (USA); **Donald M. Cornwell Jr.**, NASA Goddard Space Flight Ctr. (USA); **Baris I. Erkmén**, X (USA); **Frank F. Heine**, Tesat-Spacecom GmbH & Co. KG (Germany); **William S. Rabinovich**, U.S. Naval Research Lab. (USA); **Zoran Sodnik**, European Space Research and Technology Ctr. (Netherlands); **Linda M. Thomas**, U.S. Naval Research Lab. (USA); **Morio Toyoshima**, National Institute of Information and Communications Technology (Japan)

## MONDAY 3 FEBRUARY

### OPENING REMARKS

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . . . 8:30 AM TO 8:35 AM

**Hamid Hemmati**, ViaSat, Inc. (USA) and  
**Don M. Boroson**, MIT Lincoln Lab. (USA)

### SESSION 1

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . MON 8:35 AM TO 11:55 AM

#### Lasercom Systems I

Session Chair: **Hamid Hemmati**, ViaSat, Inc. (USA)

8:35 am: **An Australia/New Zealand optical communications ground station network for next generation satellite communications**, Francis H. Bennet, The Australian National Univ. (Australia); Ken Grant, Defence Science and Technology Group (Australia); Ed Kruzins, Commonwealth Scientific and Industrial Research Organisation (Australia); Nicholas Rattenbury, The Univ. of Auckland (New Zealand); Sascha Schediwy, International Ctr. for Radio Astronomy Research, The Univ. of Western Australia (Australia) [11272-1]

8:50 am: **Optical inter-satellite link terminals for next generation satellite constellations**, Carlos Carrizo, Markus Knapek, Joachim Horwath, Mynaric Lasercom GmbH (Germany) . . . . . [11272-2]

9:05 am: **Status of Tesat laser communication activities (Invited Paper)**, Frank F. Heine, Patricia Martin-Pimentel, Alicia Sánchez-Tercero, Nils Höpcke, David Hasler, Herwig Zech, Thomas Marynowski, Tesat-Spacecom GmbH & Co. KG (Germany) . . . . . [11272-3]

9:30 am: **Multi-mission capable 1550 nm lasercom terminal for space applications**, Aaron P. Freeman, General Atomics (USA) . . . . . [11272-4]

9:45 am: **Hybrid FSO/RF communications system for high-availability, high-capacity networks**, Katherine Newell, Michelle O'Toole, James Riggins, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Raef Yousef, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [11272-5]

Coffee Break. . . . . Mon 10:00 am to 10:30 am

10:30 am: **A capacity analysis for a 100 Gbps next generation optical communications relay**, Jade P. Wang, Curt Schieler, Don Boroson, Bryan Robinson, MIT Lincoln Lab. (USA) . . . . . [11272-6]

10:45 am: **Position and time information via free space optical communications**, John Garnham, Paul Shubert, Jim McNally, Applied Technology Associates (USA) . . . . . [11272-7]

11:00 am: **Reciprocity-enhanced transmitter diversity for lasercom**, Jeffrey M. Roth, Alexander A. Knoedler, Ronald R. Parenti, Shankararaman Ramakrishnan, Jeffrey R. Minch, John D. Moores, MIT Lincoln Lab. (USA) . . . . . [11272-8]

11:15 am: **Advanced digital waveforms for low-Earth-orbit (LEO) FSO links**, Mike S. Ferraro, William S. Rabinovich, James L. Murphy, Rita Mahon, James L. Dexter, U.S. Naval Research Lab. (USA) . . . . . [11272-9]

11:30 am: **HydRON: High throughput Optical Network (Invited Paper)**, Josep Perdigues, Harald Hauschildt, Carlo Elia, Hermann Moeller, European Space Agency (Netherlands); Wael El-Dali, Tomas Navarro, European Space Agency (United Kingdom); Maria Guta, Silvia Mezzasoma, European Space Agency (Netherlands) . . . . . [11272-10]

Lunch Break . . . . . Mon 11:55 am to 1:30 pm

### SESSION 2

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . MON 1:30 PM TO 2:45 PM

#### Lasercom Systems II

Session Chair: **Frank F. Heine**,  
Tesat-Spacecom GmbH & Co. KG (Germany)

1:30 pm: **In-orbit experimental architecture design of bi-directional communication with a small optical communication terminal attached on ISS and an optical ground station**, Hiromitsu Komatsu, Shinji Ohta, Hiroaki Yamazoe, Yasushi Kubo, Takashi Nakao, Sony Computer Science Labs., Inc. (Japan); Daiki Koda, Hirotaka Sawada, Japan Aerospace Exploration Agency (Japan); Taiji Ito, Sony Computer Science Labs., Inc. (Japan); Morio Toyoshima, National Institute of Information and Communications Technology (Japan); Toshitami Ikeda, Japan Aerospace Exploration Agency (Japan); Yasushi Munemasa, National Institute of Information and Communications Technology (Japan); Kyohei Iwamoto, Sony Computer Science Labs., Inc. (Japan); Hiroo Kunimori, Toshihiro Kubooka, National Institute of Information and Communications Technology (Japan) . . . . . [11272-11]

1:45 pm: **Free space optical communications and networking using adaptive waveforms for low earth orbit satellites**, William S. Rabinovich, Mike S. Ferraro, Joseph P. Macker, Jeffrey Weston, U.S. Naval Research Lab. (USA); Wade T. Freeman, Smart Logic, Inc. (USA) . . . . . [11272-12]

2:00 pm: **ILLUMA-T experiments: A LEO terminal user of LCRD**, Jade P. Wang, MIT Lincoln Lab. (USA); David J. Israel, NASA Goddard Space Flight Ctr. (USA); Don Boroson, MIT Lincoln Lab. (USA); Kevin Carmack, Zachary Gonnsen, NASA Goddard Space Flight Ctr. (USA); Farzana Khatri, Bryan Robinson, MIT Lincoln Lab. (USA); Antonios Seas, NASA Goddard Space Flight Ctr. (USA); Timothy Yarnall, MIT Lincoln Lab. (USA) . . . . . [11272-13]

2:15 pm: **C-RED 3: A SWIR camera for FSO applications**, Jean-Luc Gach, David Boutolleau, Cecile Brun, Thomas Carmignani, Fabien Clop, Philippe Feautrier, Stephane Lemarchand, Eric Stadler, Yann Wanwanscappel, First Light Imaging S.A.S. (France) . . . . . [11272-14]

2:30 pm: **Comprehensive radiation testing of uncooled, free space coupled, InGaAs quad photoreceivers**, Abhay M. Joshi, Shubhashish Datta, Nilesh Soni, Matthew D'Angiolillo, Jeff Mertz, Discovery Semiconductors, Inc. (USA); Michael Sivertz, Adam Rusek, NASA Space Radiation Lab. (USA); James Jardine, Brookhaven National Lab. (USA); Jeff Livas, NASA Goddard Space Flight Ctr. (USA) . . . . . [11272-15]

Coffee Break. . . . . Mon 2:45 pm to 3:30 pm

### LASE PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . . MON 3:30 PM TO 5:40 PM

3:30 pm: **Welcome and Opening Remarks**  
**Beat Neuenschwander**, Berner Fachhochschule Technik und Informatik (Switzerland) and **Xianfan Xu**, Purdue Univ. (USA)

3:35 pm: **Announcement of the 3D Printing, Fabrication, and Manufacturing Best Paper Award**  
**Henry Helvajian**, The Aerospace Corp. (USA)

3:40 pm: **VCSEL: Born Small and Grown Big (Plenary)**  
**Kenichi Iga**, Tokyo Institute of Technology (Japan)

4:20 pm: **Compact Terahertz Driven Electron and X-ray Sources (Plenary)**  
**Franz X. Kärtner**, Deutsches Elektronen-Synchrotron (Germany) and Univ. Hamburg (Germany)

5:00 pm: **Accelerators on a Chip: A Path to Attosecond Science (Plenary)**  
**Robert L. Byer**, Stanford Univ. (USA)

LASE

# CONFERENCE 11272

## TUESDAY 4 FEBRUARY

### OPENING REMARKS

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . TUE 8:30 AM TO 8:35 AM

Hamid Hemmati, ViaSat, Inc. (USA) and  
Don M. Boroson, MIT Lincoln Lab. (USA)

### SESSION 3

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . TUE 8:35 AM TO 9:50 AM

#### Terminal Designs

Session Chair: **Linda M. Thomas**, U.S. Naval Research Lab. (USA)

8:35 am: **Deep space optical communications (DSOC) beam expander design and engineering**, David Driscoll, Brian Zellers, Cheryl Secora-Pearl, L3Harris Technologies, Inc. (USA); William T. Roberts, Daniel MacDonald, Jet Propulsion Lab. (USA); Jason Schomacker, James Guregian, L3Harris Technologies, Inc. (USA); William Klipstein, Jet Propulsion Lab. (USA) . . . [11272-16]

8:50 am: **Design of space laser communication optical module**, Ezra Milby, Tim Rodrigues, Jino Jo, Jay Schwartz, Dave Driscoll, Paul Cucchiario, L3Harris Technologies, Inc. (USA); Edward Colozzo, L3Harris Technologies, Inc. (USA) . . . [11272-17]

9:05 am: **Design approach for athermal laser communications collimator for reduced system complexity**, Andrew Cline, Pablo Reyes, Paul Shubert, Chase McNiel, Applied Technology Associates (USA) . . . [11272-18]

9:20 am: **Minimizing Sun-Earth-Probe angle for RF / optical hybrid telescope**, Makan Mohageg, Mary C. Lorio, Daniel J. Hoppe, John N. Huleis, Alexander Abramovici, Sang K Chung, Jet Propulsion Lab. (USA) . . . [11272-19]

9:35 am: **A system overview of a small form factor free space optical communication prototype**, Taylor A. Page, Andrew J. Menas, Jonathan W. Rabinovich, Mike S. Ferraro, Rita Mahon, William S. Rabinovich, U.S. Naval Research Lab. (USA); Wade T. Freeman, Smart Logic, Inc. (USA) . . . [11272-20]

Coffee Break . . . . . Tue 9:50 am to 10:30 am

### SESSION 4

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . TUE 10:30 AM TO 11:10 AM

#### Quantum Communications

Session Chair: **William S. Rabinovich**, U.S. Naval Research Lab. (USA)

10:30 am: **The SAGA mission concept: GEO based quantum key distribution services using entangled photons**, Eric Wille, Harald Hauschildt, Clemens Heese, Zoran Sodnik, Carlo Elia, European Space Agency (Netherlands) . . . [11272-21]

10:45 am: **High alphabet quantum communication (Invited Paper)**, Rupert Ursin, Österreichische Akademie der Wissenschaften (Austria) . . . [11272-22]

### SESSION 5

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . TUE 11:10 AM TO 11:55 AM

#### Receiver Technologies I

Session Chair: **Baris I. Erkmen**, X (USA)

11:10 am: **FPGA implementation of scintillation tolerant adaptive DSP for 4 Gbps coherent reception**, Keisuke Matsuda, Shota Koshikawa, Tsuyoshi Yoshida, Naoki Suzuki, Toshiyuki Ando, Mitsubishi Electric Corp. (Japan) . . . [11272-23]

11:25 am: **Neural network-based photon counting of summed single photon receivers**, Nicholas C. Lantz, Jennifer N. Downey, Brian E. Vyhnaelek, Sarah A. Tedder, NASA Glenn Research Ctr. (USA) . . . [11272-24]

11:40 am: **Alternative passive fiber coupling system based on multi-plane light conversion for satellite-to-ground communications**, Ramon Mata Calvo, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); David Allieux, CAILabs (France); Andrew Reeves, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Antonin Billaud, CAILabs (France); Juraj Poliak, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Olivier Pinel, CAILabs (France); Helawae Friew Kelemu, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Guillaume Labroille, CAILabs (France) . . . [11272-25]

Lunch/Exhibition Break . . . . . Tue 11:55 am to 1:30 pm

### SESSION 6

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . TUE 1:30 PM TO 2:30 PM

#### Receiver Technologies II

Session Chair: **Zoran Sodnik**,  
European Space Research and Technology Ctr. (Netherlands)

1:30 pm: **Detector channel combining performance for high photon efficiency optical communications links**, Jennifer N. Downey, Brian E. Vyhnaelek, Sarah A. Tedder, Nicholas C. Lantz, NASA Glenn Research Ctr. (USA) . . . [11272-26]

1:45 pm: **Extension of matched optical filtering to scalable multi-channel high-sensitivity photon-counting applications**, Katia Shtyrkova, Igor Gaschits, MIT Lincoln Lab. (USA); David O. Caplan, MIT Lincoln Lab (USA) . . . [11272-27]

2:00 pm: **A novel ground-based receiver for EDRS**, Donatas Miklusis, European Space Agency (Netherlands); Zoran Sodnik, European Space Research and Technology Ctr., European Space Agency (Netherlands) . . . [11272-28]

2:15 pm: **Measurements of Few-mode fiber photonic lanterns in emulated atmospheric conditions for space to ground optical communication receiver applications**, Sarah A. Tedder, Evan Katz, Brian E. Vyhnaelek, Bertram Floyd, NASA Glenn Research Ctr. (USA) . . . [11272-29]

### SESSION 7

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . TUE 2:30 PM TO 5:15 PM

#### Transmitter Technologies

Session Chair: **Don M. Boroson**, MIT Lincoln Lab. (USA)

2:30 pm: **50W, 1.5µm, 8 WDM (25nm) channels PPM downlink Tx and 5kW, 1µm, uplink PPM Tx for deep space lasercom**, Doruk Engin, Slava Litvinovitch, Zach Bush, David Pachowics, Jacob Hwang, Chad Gilman, Mark Long, Selma Tint, Mark Storm, Keith Petrillo, Fibertek, Inc. (USA); Malcolm W. Wright, Jet Propulsion Lab. (USA) and Caltech (USA) . . . [11272-30]

2:45 pm: **Coupled radiation and temperature effects on Erbium-doped fiber amplifiers**, Marine Aubry, Lab. Hubert Curien, iXblue SAS (France) and Ctr. National d'Études Spatiales (France) and Politecnico di Bari (Italy); Arnaud Laurent, Thierry Robin, iXblue SAS (France); Luciano Mescia, Politecnico di Bari (Italy); Julien Mekki, Ctr. National d'Études Spatiales (France); Emmanuel Marin, Youcef Ouerdane, Aziz Boukenter, Sylvain Girard, Lab. Hubert Curien (France) . . . [11272-31]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

3:30 pm: **Space validation of rad-hard optical fibre amplifiers at 1.55 µm for high power application**, Matthew Welch, James Edmunds, Jonathan Crabb, Elliot Prowse, Karen Hall, Marios Kechagias, Ross Elliott, Efstathios Kehayas, Gooch & Housego PLC (United Kingdom) . . . [11272-32]

3:45 pm: **Optimal coherent beam combining based on Multi-Plane Light Conversion for high throughput optical feeder links**, Antonin Billaud, Fausto Gomez, David Allieux, Nicolas Laurechet, Pu Jian, Olivier Pinel, Guillaume Labroille, CAILabs (France) . . . [11272-33]

4:00 pm: **Design of RGB laser diode drivers for smart lighting and Li-Fi using MATLAB GUI**, Sarah Bahanshal, Hibatallah Alwazani, Mohammed Abdulmajid, Effat Univ. (Saudi Arabia) . . . [11272-34]

4:15 pm: **Development of coherent light source with wavelength of 1.5 micron for optical satellite communication**, Toshiyuki Ando, Eisuke Haraguchi, Yoshiya Sato, Kiyotomo Hasegawa, Yuta Takemoto, Keisuke Matsuda, Yuza Yajima, Mitsubishi Electric Corp. (Japan) . . . [11272-35]

4:30 pm: **High speed and long-range performance of navigation Doppler lidar**, Aram Gragossian, Coherent Applications, Inc. (USA); Bruce W. Barnes, NASA Langley Research Ctr. (USA); Jay Estes, NASA Johnson Space Ctr. (USA); Diego F. Pierrrottet, Coherent Applications, Inc. (USA); Farzin Amzajerdian, Glenn D. Hines, NASA Langley Research Ctr. (USA) . . . [11272-36]

4:45 pm: **Erbium-doped fibers for radiation tolerant, high power space laser communications**, E. Joseph Friebele, KeyW Corp., U.S. Naval Research Lab. (USA); Colin C. Baker, U.S. Naval Research Lab. (USA); Ashley Burdett, Univ. Research Foundation (USA); Jashbinder S. Sanghera, U.S. Naval Research Lab. (USA); Michael J. LuValle, Stephanos G. Logothetis, Rutgers, The State Univ. of New Jersey (USA) . . . [11272-37]

5:00 pm: **Beam multiplexing for satellite communication optical feeder links**, Fabrizio Silvestri, Federico Pettazzi, Jeroen J. Boschma, Jochem B. Lutgerink, Remco den Breeje, Cristina M. Duque, Niek J. Doelman, TNO (Netherlands) . . . [11272-38]

**POSTERS-TUESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Tuesday 10:00 AM– 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Free-space optical communication for CubeSats in low lunar orbit (LLO),** Peter M. Goojrian, NASA Ames Research Ctr. (USA) . . . . . [11272-39]

**Beam propagation through atmospheric turbulence using an altitude-dependent structure profile with non-uniformly distributed phase screens,** Yousef Chahine, Sarah A. Tedder, Brian E. Vyhnaek, NASA Glenn Research Ctr. (USA) . . . . . [11272-40]

**Maintenance of a laser-based 2D full duplex link between autonomous mobile vehicles,** A. F. M. Saniul Haq, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Isaiah Williams, Univ. of Central Florida (USA); Murat Yuksel, Univ. of Central Florida (USA) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11272-42]

**A method of determining the maximum data rate that can be achieved with a fluorescent concentrator,** Amna Riaz, Grahame Faulkner, Univ. of Oxford (United Kingdom); Hyunchoe Chun, Incheon National Univ. (Korea, Republic of); Dominic O'Brien, Steve Collins, Univ. of Oxford (United Kingdom) . . . . . [11272-43]

**Lens design-based optimization of path loss in a high data-rate indoor visible light communication link,** Faheem Ahmad, Sathisha Ramachandrapura, Jyothisna KM, Rabindra Biswas, Varun Raghunathan, Indian Institute of Science (India) . . . . . [11272-44]

**Acousto-optic modulator for emulating atmospheric fade in free-space optical communication systems,** Evan J. Katz, Yousef K. Chahine, Brian E. Vyhnaek, Sarah A. Tedder, NASA Glenn Research Ctr. (USA) [11272-45]

**Single-photon counting detector scalability for high photon efficiency optical communications links,** Brian E. Vyhnaek, Jennifer N. Downey, Sarah A. Tedder, NASA Glenn Research Ctr. (USA) . . . . . [11272-46]

**Role of fade slope over FSO link under fog condition,** Kapal Dev, Politecnico di Milano (Italy) . . . . . [11272-47]

**Investigate the performance of real-time adaptive optics correction in a turbulent high-dimensional quantum communication channel,** Jiapeng Zhao, Yiyu Zhou, The Institute of Optics, Univ. of Rochester (USA); Boris Braverman, Univ. of Ottawa (Canada); Cong Liu, Kai Pang, The Univ. of Southern California (USA); Nicholas Steinhoff, Glenn Tyler, the Optical Sciences Co. (USA); Alan Willner, The Univ. of Southern California (USA); Robert Boyd, Univ. of Ottawa (Canada) and The Institute of Optics, Univ. of Rochester (USA) . . . . . [11272-48]

**Formation of a crypto key by a turbulent air flow in coupled transmitting laser communication systems,** Vadim V. Dudorov, Valerii P. Aksenov, V. E. Zuev Institute of Atmospheric Optics (Russian Federation); Valeriy V. Kolosov, V. E. Zuev Institute of Atmospheric Optics (Russian Federation) and Tomsk Scientific Ctr. (Russian Federation); Mikhail E. Levitsky, TOPAZ (Russian Federation); Cheslav E. Pogutsa, V. E. Zuev Institute of Atmospheric Optics (Russian Federation) . . . . . [11272-49]

**Optical wireless power transmission to moving object using Galvano mirror,** Alexander William Setiawan Putra, Hirotaka Kato, Kanazawa Univ. (Japan); Hendra Adinanta, Research Center for Physics, Indonesian Institute of Sciences (LIPI) (Indonesia); Takeo Maruyama, Kanazawa Univ. (Japan) . . . . . [11272-50]

**Stable and tunable performance of ultra-narrow bandpass and high edge slope dichroic optical filters,** Thomas D. Rahmlow Jr., Markus Fredell, Robert Mann, Robert Johnson Jr., Omega Optical, Inc. (USA) . . . . . [11272-51]

**1.5 kHz adaptive optical system for free-space communication tasks,** Julia V. Sheldakova, Alexey Rukosuev, Institute of Dynamics of Geospheres (Russian Federation); Vadim Belousov, LyraTech Ltd. (Russian Federation); Ilya Galaktionov, Alexander Nikitin, Vadim Samarkin, Institute of Dynamics of Geospheres (Russian Federation); Alexis Kudryashov, Institute of Dynamics of Geospheres (Russian Federation) and Moscow Polytechnic Univ. (Russian Federation) . . . . . [11272-52]

**Dual-stage control of tip-tilt mirrors for optical communication telescope,** Tao Tang, Bo Qi, Ge Ren, Yongmei Huang, Institute of Optics and Electronics (China) . . . . . [11272-53]

**Communication, acquisition and tracking with recursive adaptive limited frame integration,** Michael K. Rafailov, Univ. of Alberta (Canada) . . . [11272-54]

**Effects of combinatorial sensing on tracking algorithms for FSO systems,** Jonathan Rabinovich, Mike S. Ferraro, Taylor A. Page, Rita Mahon, William S. Rabinovich, U.S. Naval Research Lab. (USA) . . . . . [11272-55]

**Characterization of fast-steering mirrors at both high and low temperatures,** Lindsey Willstatter, Rita Mahon, Joseph Ghorzi, Ethan Kramer, Linda Thomas, U.S. Naval Research Lab. (USA) . . . . . [11272-56]

**Acquisition, tracking, and pointing for reconfigurable free space optical communication systems in RF challenged environments,** Jianan Zhang, Timothy J. Kane, The Pennsylvania State Univ. (USA) . . . . . [11272-57]

**Characterization of the optical channel between a low earth orbit (LEO) platform and a ground station located at sea level,** Carlos O. Font, Lindsey Willstatter, Christopher Moore, U.S. Naval Research Lab. (USA) . . . . . [11272-58]

**Quasi sensorless adaptive optics correction with adaptive lenses,** Martino Quintavalla, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Jacopo Mocchi, Univ. degli Studi di Verona (Italy); Paolo Spanò, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Officina Stellare S.p.A. (Italy); Michele Ippolito, Officina Stellare S.p.A. (Italy); Riccardo Muradore, Univ. degli Studi di Verona (Italy); Giovanni Dal Lago, Officina Stellare S.p.A. (Italy); Stefano Bonora, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . [11272-59]

**Telescope with a secondary deformable mirror: Characterization and tests,** Martino Quintavalla, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Jacopo Mocchi, Univ. degli Studi di Verona (Italy); Paolo Spanò, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Officina Stellare S.p.A. (Italy); Michele Ippolito, Officina Stellare S.p.A. (Italy); Riccardo Muradore, Univ. degli Studi di Verona (Italy); Giovanni Dal Lago, Stefano Bonora, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . . . [11272-60]

**Optical downlink and intersatellite illumination experiments with low-earth orbiting CubeSats,** Todd S. Rose, Darren W. Rowen, Christopher M. Coffman, G. Kinum, Stephen D. LaLumondiere, Nicolette I. Werner, Josef M. Wicker, Geoffrey A. Maul, Alexander C. Utter, Richard P. Welle, The Aerospace Corp. (USA) . . . . . [11272-61]

**A revolutionary optical hyper data center,** Ohad Harlev, LyteLoop (USA); Paul F. McManamon, Exciting Technology, LLC (USA); Armand Vedadi, LyteLoop (USA); Alan E. Willner, The Univ. of Southern California (USA); Dipayan Choudhary, LyteLoop (USA) . . . . . [11272-62]

**LASER COMMUNICATIONS**

**LOCATION: INTERCONTINENTAL HOTEL, INTERCONTINENTAL C (5TH FLOOR)  
7:30 PM TO 9:00 PM**

Chairs: **Hamid Hemmati**, ViaSat, Inc. (USA) and **Don Boroson**, MIT Lincoln Lab. (USA)

This technical event on Laser Communications will hold its informal annual meeting in conjunction with the Free-Space Laser Communications conference. All professionals involved in theory and applications of free-space laser communications, remote sensing and supporting technologies are invited to participate in an open discussion on a variety of topics related to the challenges and advancement of the field. Attendees are invited to bring suggestions for discussion topics.

LASE

# CONFERENCE 11273

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH)

Tuesday–Wednesday 4–5 February 2020 • Proceedings of SPIE Vol. 11273

# High-Power Laser Materials Processing: Applications, Diagnostics, and Systems IX

Conference Chairs: **Stefan Kaierle**, Laser Zentrum Hannover e.V. (Germany); **Stefan W. Heinemann**, TRUMPF Photonics (USA)

Program Committee: **Bo Gu**, Bos Photonics (USA); **Klaus R. Kleine**, Coherent, Inc. (USA); **Wolfgang Knapp**, Univ. de Nantes (France); **Markus Kogel-Hollacher**, Precitec GmbH & Co. KG (Germany); **Henrikki Pantsar**, TRUMPF Inc. (USA); **Stephan Roth**, BLZ Bayerisches Laserzentrum GmbH (Germany); **Masahiro Tsukamoto**, Osaka Univ. (Japan); **Stefaan Vandendriessche**, Edmund Optics Inc. (USA); **Verena Wippo**, Laser Zentrum Hannover e.V. (Germany)

## TUESDAY 4 FEBRUARY

### POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . TUE 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the LASE poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Tuesday 10:00 AM– 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Reflection-type diffractive optical element employing SiC and Si for application to high-power laser material processing.** Sohan Kawamura, Shin Toyota, Oka Soichi, Nippon Telegraph and Telephone Corp. (Japan) . . . . . [11273-18]

**High peak power DUV laser processing.** Yasuhiro Kamba, Hironori Igarashi, Takashi Onose, Taisuke Miura, Ryoichi Nohdomi, Hiroaki Oizumi, Yoshihiko Murakami, Atsushi Fuchimukai, Chen Qu, Yuki Tamaru, Yohei Tanaka, Yuujiro Sasaki, Junichi Fujimoto, Hakaru Mizoguchi, Gigaphoton Inc. (Japan) . . . . . [11273-19]

**CaliBend: A flexible, cost-effective laser module for thermal-assisted bending of high-strength steels.** Eduard Carbonell Sanromà, MONOCROM S.L. (Spain); Florian Schmidt, Fraunhofer-Institut für Produktionstechnologie IPT (Germany); Daniel Panick, Franz Pauli GmbH & Co. KG (Germany); Joan J. Montiel i Ponsoda, MONOCROM S.L. (Spain); Markus Eckert, Fraunhofer-Institut für Produktionstechnologie IPT (Germany); Christian Melchers, Franz Pauli GmbH & Co. KG (Germany) . . . . . [11273-20]

**Pulsed CO<sub>2</sub> laser induced discharge plasma between metal conical and water electrodes.** Xingbing Wang, Qin Sun Sr., Dongsheng Xiong, Duluo Zuo Sr., Huazhong Univ. of Science and Technology (China) . . . . . [11273-21]

## WEDNESDAY 5 FEBRUARY

### SESSION 1

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . WED 8:00 AM TO 10:00 AM

### Surface Treatment

Session Chair: **Claus Schnitzler**, AMPHOS GmbH (Germany)

8:00 am: **Microhardness and microabrasion behaviour of NiTi shape memory alloy after femtosecond laser shock peening without coating in air.** Hao Wang, Evgeny Gurevich, Andreas Ostendorf, Ruhr-Univ. Bochum (Germany) . . . . . [11273-1]

8:20 am: **Ultrashort-pulse laser machining of hard tool materials.** Sundar Marimuthu, Bethan Smith, Tian Long See, The Manufacturing Technology Ctr. Ltd. (United Kingdom) . . . . . [11273-2]

8:40 am: **Development of high-power laser ablation process for polycrystalline diamond polishing: Part 2. Upscaling of PCD ultra-short pulsed laser ablation to high power.** William Scalbert, Element Six Ltd. (Ireland) . . . . . [11273-3]

9:00 am: **Upscaling laser polishing of large 3D surfaces.** Florent Husson, Mathieu Valentin, Rainer Kling, Kamil Aouati, ALPhANOV (France) . . . . . [11273-4]

9:20 am: **Scaling laser shock peening process towards high repetition rates: A demonstration on industrial grade Al2024-T351.** Guillaume LaFoy, Julien Bergon, Kamil Aouati, Rainer Kling, ALPhANOV (France) . . . . . [11273-5]

9:40 am: **Nanosecond pulse shaping allowing 500 mJ injection in a single core multimode fiber for laser shock peening applications.** Guillaume Gorju, Nadezda Varkentina, Adam Ayeb, Xavier Levecq, Imagine Optic SA (France) . . . . . [11273-6]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . WED 10:30 AM TO 11:50 AM

### Sensing and Control

Session Chair: **Klaus R. Kleine**, Coherent, Inc. (USA)

10:30 am: **Direct, real-time, high-resolution beam profiler for high-power laser.** Masaki Tsunekane, Koji Sato, Tetsuo Takahashi, Seiichi Yoshino, Naoki Yoshimori, Junichiro Ohno, Canare Electric Co., Ltd. (Japan) . . . [11273-7]

10:50 am: **Coupled membrane free optical microphone and optical coherence tomography keyhole measurements to setup welding laser parameters.** Nicolas Authier, CEA (France); Vincent Bruyere, Patrick Namy, SIMTEC (France) . . . . . [11273-8]

11:10 am: **Short-range supercontinuum-based lidar for combustion diagnostics.** Abba Saleh, Valmet Technologies Oy (Finland) and Tampere University (Finland); Piotr Ryczkowski, Goery Genty, Juha Toivonen, Tampere Univ. (Finland) . . . . . [11273-9]

11:30 am: **Material characterization of production additively manufactured SiC for multifunction application.** Jonathan W. Arenberg, Northrop Grumman Aerospace Systems (USA); John T. Vayda, Jeffrey L. Cavaco, Northrop Grumman AOA Xinetics (USA) . . . . . [11273-10]

Lunch/Exhibition Break . . . . . Wed 11:50 am to 1:20 pm

**SESSION 3**

**LOCATION: ROOM 156 (UPPER MEZZANINE SOUTH) . . . WED 1:20 PM TO 3:50 PM**

**Welding**

Session Chair: **Masahiro Tsukamoto**, Osaka Univ. (Japan)

- 1:20 pm: **Dissimilar material combination in laser beam welding: Reduction of distortion and residual stress** (*Invited Paper*), Simon Olschok, Fatma Akyel, Uwe Reisgen, RWTH Aachen Univ. (Germany). . . . . [11273-11]
- 1:50 pm: **Welding strategies for joining copper and aluminum by fast oscillating, high quality laser beam**, Evangelos Papastathopoulos, TRUMPF Laser- und Systemtechnik GmbH (Germany); Elke Kaiser, TRUMPF Laser GmbH (Germany); Guenter Ambrosy, TRUMPF Laser- und Systemtechnik GmbH (Germany) . . . . . [11273-12]
- 2:10 pm: **Copper welding applications with a 2 kW cw laser in the green wavelength regime**, Eva-Maria Dold, Elke Kaiser, Sebastian Pricking, Alexander Killi, TRUMPF Laser GmbH (Germany); Stefanie Bisch, Frank Baumann, Sebastian Zaske, Rüdiger Brockmann, TRUMPF Laser- und Systemtechnik GmbH (Germany) . . . . . [11273-13]
- 2:30 pm: **Bead-on-plate welding of pure copper sheet with 200 W high intensity blue diode laser**, Kento Morimoto, Osaka Univ. (Japan); Masahiro Tsukamoto, Yuji Sato, Shin-Ichiro Masuno, Nobuyuki Abe, Joining and Welding Research Institute, Osaka Univ. (Japan); Kazuyuki Azumi, Yoshihiko Hayashi, OSAKA FUJI Corp. (Japan) . . . . . [11273-14]
- 2:50 pm: **Joining steel and aluminum parts combining additive manufacturing process and laser welding**, Wolfgang Knapp, Univ. de Nantes (France); Pascal Paillard, Univ de Nantes (France); Laurent Couturier, Univ. de Nantes (France); Emilie Aubignat, Ouest Coating (France). . . . . [11273-15]
- 3:10 pm: **Laser based repair of CFRP for the aerospace industry**, Verena Wippo, Simon Hirt, Hagen Dittmar, Peter Jaeschke, Stefan Kaierle, Ludger Overmeyer, Laser Zentrum Hannover e.V. (Germany). . . . . [11273-16]
- 3:30 pm: **Fully reflective annular laser beam shaping for 1.03µm ultra-high throughput laser beam welding**, Matthieu Meunier, CAILabs (France); David Lemaitre, Institut Maupertuis (France); Antonin Billaud, Antoine Queffelec, CAILabs (France); Romain Cornee, Institut Maupertuis (France); Gwenn Pallier, Olivier Pinel, CAILabs (France); Eric Laurensot, Institut Maupertuis (France); Guillaume Labroille, CAILabs (France) . . . . . [11273-17]



**Startup Challenge**

**Wednesday • Moscone West Level 2**  
 Hear pitches for the “best of the best” new photonics businesses; open to all attendees  
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# OPTO 2020 BEST PAPER AWARDS

## Ultrafast Phenomena and Nanophotonics Best Student Paper Award

### ULTRAFAST PHENOMENA AND NANOPHOTONICS (CONF. 11278)

Join us as we announce the Ultrafast Phenomena and Nanophotonics Best Student Paper Award.

#### AWARD PRESENTATION

Tuesday 4 February 2020 • 3:05 PM - 3:15 PM

Location: Room 308 (Level 3 South)

All contributed papers from conference 11278 given by a young scientist (PhD student or postdoc within the first two years after graduation) were eligible for the award (contributed papers only). To facilitate handing out the award during the meeting, applications were collected prior to the meeting.

AWARD SPONSOR:



## Innovation Awards in Quantum Sensing, Nano Electronics, and Photonics

### QUANTUM SENSING AND NANO ELECTRONICS AND PHOTONICS (CONF. 11288)

SPIE announces the Innovation Award in Quantum Sensing and Nano Electronics and Photonics at SPIE Photonics West OPTO 2020 initiated by Prof Manijeh Razeghi.

#### AWARD PRESENTATION

Tuesday 4 February 2020 • 7:30 PM - 9:00 PM

Location: InterContinental Hotel, InterContinental A (5th Floor)

These awards will recognize the outstanding scientific contribution of students and outstanding scientists who present the most notable recent discoveries with broad impact in the areas of quantum sensing and nano electronics and photonics. These discoveries should be innovative in that they represent a new paradigm or way of thinking which will have a broad impact in their respective field. Participants will be required to give a 15-minute presentation. The winners will be announced at the end of the Tuesday evening event.

## Optical Communications Best Paper Awards

### BROADBAND ACCESS COMMUNICATION TECHNOLOGIES (CONF. 11307)

### METRO AND DATA CENTER OPTICAL NETWORKS AND SHORT-REACH LINKS (CONF. 11308)

### NEXT-GENERATION OPTICAL COMMUNICATION: COMPONENTS, SUB-SYSTEMS, AND SYSTEMS (CONF. 11309)

We are pleased to announce Best Paper Awards in Optical Communications.

#### AWARD PRESENTATION

Wednesday 5 February 2020 • 10:30 AM - 10:40 AM

Room 102 (Level 1 South Lobby)

These awards will recognize the outstanding work of students and professionals who present the most notable recent results with broad impact in the area of optical communications. Qualifying papers have been evaluated by the awards committee, and manuscripts judged based on technical merit, impact, and clarity. The winners will be announced immediately following the Optical Communications Joint Keynote Session, and the presenting authors will be awarded a certificate and cash prize.

AWARD SPONSORS:



## Advanced Fabrication Technologies Best Paper Award and Best Student Paper Award

### ADVANCED FABRICATION TECHNOLOGIES FOR MICRO/NANO OPTICS AND PHOTONICS (CONF. 11292)

Location: Announced in session they present in

We are pleased to announce that a cash prize, sponsored by Nanoscribe GmbH, will be awarded to the best paper and best student paper in this conference. Qualifying papers will be evaluated by the awards committee. Manuscripts will be judged based on scientific merit, impact, and clarity. The winners will be announced during the conference and the presenting authors will be awarded a cash prize.

AWARD SPONSOR:



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## **MOEMS and Miniaturized Systems Best Paper Award and Best Student Paper Award**

### **MOEMS AND MINIATURIZED SYSTEMS (CONF. 11293)**

We are pleased to announce that a cash prize, sponsored by Mirrorcle Technologies, Inc., will be awarded to the best paper and best student paper in MOEMS and Miniaturized Systems. Qualifying papers will be evaluated by the awards committee. Manuscripts will be judged based on scientific merit, impact, and clarity. The winners will be announced during the conference and the presenting authors will be awarded a cash prize.

AWARD SPONSOR:



## **Emerging DMD Best Paper Award and Best Student Paper Award**

### **EMERGING DIGITAL MICROMIRROR DEVICE BASED SYSTEMS AND APPLICATIONS (CONF. 11294)**

We are pleased to announce that a cash prize, sponsored by Texas Instruments DLP Products, will be awarded to the best paper and best student paper in Emerging Digital Micromirror Device Based Systems and Applications. Qualifying papers will be evaluated by the awards committee. Manuscripts will be judged based on scientific merit, impact, and clarity. The winners will be announced during the conference and the presenting authors will be awarded a cash prize.

AWARD SPONSOR:



# CONFERENCE DAILY SCHEDULE

SATURDAY 1 February	SUNDAY 2 February	MONDAY 3 February	TUESDAY 4 February	WEDNESDAY 5 February	THURSDAY 6 February
	Neurotechnologies Plenary Session, 3:30 PM - 5:30 PM	OPTO Plenary Session, 8:00 AM - 10:05 AM			
				OPTO Poster Session 6:00 PM - 8:00 PM	
<b>OPTOELECTRONIC MATERIALS AND DEVICES</b>					
Program Track Chairs: James G. Grote, Air Force Research Lab. (USA); Shubin Jiang, AdValue Photonics, Inc. (USA)					
		11274 <b>Physics and Simulation of Optoelectronic Devices XXVIII</b> (Witzigmann, Osirski, Arakawa) p. 339			
			11275 <b>Physics, Simulation, and Photonic Engineering of Photovoltaic Devices IX</b> (Freundlich, Sugiyama, Collin) p. 343		
			11276 <b>Optical Components and Materials XVII</b> (Jiang, Digonnet) p. 346		
				11277 <b>Organic Photonic Materials and Devices XXII</b> (Tabor, Kajzar, Kaino) p. 349	
	11278 <b>Ultrafast Phenomena and Nanophotonics XXIV</b> (Betz, Elezzabi) p. 352				
		11279 <b>Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XIII</b> (Sadwick, Yang) p. 355			
			11280 <b>Gallium Nitride Materials and Devices XV</b> (Fujioka, Morkoç, Schwarz) p. 360		
		11281 <b>Oxide-based Materials and Devices XI</b> (Rogers, Look, Teherani) p. 363			
				11282 <b>2D Photonic Materials and Devices III</b> (Majumdar, Torres, Deng) p. 3680	
<b>PHOTONIC INTEGRATION</b>					
Program Track Chairs: Yakov Sidorin, Quarles & Brady LLP (USA); Jean-Emmanuel Broquin, IMEP-LAHC (France)					
		11283 <b>Integrated Optics: Devices, Materials, and Technologies XXIV</b> (García-Blanco, Cheben) p. 370			
		11284 <b>Smart Photonic and Optoelectronic Integrated Circuits XXII</b> (He, Vivien) p. 374			
		11285 <b>Silicon Photonics XV</b> (Reed, Knights) p. 378			
			11286 <b>Optical Interconnects XX</b> (Schröder, Chen) p. 382		
			11287 <b>Photonic Instrumentation Engineering VII</b> (Soskind, Busse) p. 385		
		11279 <b>Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XIII</b> (Sadwick, Yang) p. 355			
<b>NANOTECHNOLOGIES IN PHOTONICS</b>					
Program Track Chair: Ali Adibi, Georgia Institute of Technology (USA)					
	11288 <b>Quantum Sensing and Nano Electronics and Photonics XVII</b> (Razeghi) p. 388				
		11289 <b>Photonic and Phononic Properties of Engineered Nanostructures X</b> (Adibi, Lin, Scherer) p. 394			
		11290 <b>High Contrast Metastructures IX</b> (Chang-Hasnain, Faraon, Zhou) p. 398			
				11291 <b>Quantum Dots, Nanostructures, and Quantum Materials: Growth, Characterization, and Modeling XVII</b> (Huffaker, Eisele) p. 402	
	11292 <b>Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII</b> (von Freymann, Blasco, Chanda) p. 404				

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	<b>Neurotechnologies Plenary Session,</b> 3:30 PM - 5:30 PM	<b>OPTO Plenary Session,</b> 8:00 AM - 10:05 AM			
				<b>OPTO Poster Session</b> 6:00 PM - 8:00 PM	
<b>MOEMS-MEMS IN PHOTONICS</b> Program Track Chairs: <b>Holger Becker</b> , microfluidic ChipShop GmbH (Germany); <b>Georg von Freymann</b> , Technische Univ. Kaiserslautern (Germany)					
	11292 <b>Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII</b> (von Freymann, Blasco, Chanda) p. 404				
	11293 <b>MOEMS and Miniaturized Systems XIX</b> (Piyawattanametha, Park, Zappe) p. 408	11294 <b>Emerging Digital Micromirror Device Based Systems and Applications XII</b> (Ehmke, Lee) p. 411			
	11235 <b>Microfluidics, BioMEMS, and Medical Microsystems XVIII</b> (Gray, Becker) p. 203				
	11248 <b>Adaptive Optics and Wavefront Control for Biological Systems VI</b> (Bifano, Gigan, Ji) p. 247				
<b>ADVANCED QUANTUM AND OPTOELECTRONIC APPLICATIONS</b> Program Track Chair: <b>David L. Andrews</b> , Univ. of East Anglia (United Kingdom)					
			11295 <b>Advanced Optical Techniques for Quantum Information, Sensing, and Metrology</b> (Hemmer, Migdall, Hasan) p. 414		
	11296 <b>Optical, Opto-Atomic, and Entanglement-Enhanced Precision Metrology II</b> (Shahriar, Scheuer) p. 416				
			11297 <b>Complex Light and Optical Forces XIV</b> (Andrews, Galvez, Rubinsztein-Dunlop) p. 424		
				11298 <b>Photonic Heat Engines: Science and Applications II</b> (Seletskiy, Epstein, Sheik-Bahae) p. 426	
			11299 <b>AI and Optical Data Sciences</b> (Jalali, Kitayama) p. 428		
	11288 <b>Quantum Sensing and Nano Electronics and Photonics XVII</b> (Razeghi) p. 388				
				11291 <b>Quantum Dots, Nanostructures, and Quantum Materials: Growth, Characterization, and Modeling XVII</b> (Huffaker, Eisele) p. 402	
<b>SEMICONDUCTOR LASERS, LEDS, AND APPLICATIONS</b> Program Track Chair: <b>Klaus P. Streubel</b> , OSRAM GmbH (USA)					
				11300 <b>Vertical-Cavity Surface-Emitting Lasers XXIV</b> (Graham, Lei) p. 430	
		11301 <b>Novel In-Plane Semiconductor Lasers XIX</b> (Belyanin, Smowton) p. 432			
		11302 <b>Light-Emitting Devices, Materials, and Applications XXIV</b> (Kim, Krames, Strassburg) p. 436			
		11274 <b>Physics and Simulation of Optoelectronic Devices XXVIII</b> (Witzigmann, Osinski, Arakawa) p. 339			

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				OPTO Poster Session 6:00 PM - 8:00 PM	
			11280 Gallium Nitride Materials and Devices XV (Fujioka, Morkoç, Schwarz) p. 360		
<b>DISPLAYS AND HOLOGRAPHY</b> Program Track Chair: Liang-Chy Chien, Kent State Univ. (USA)					
		11303 Emerging Liquid Crystal Technologies XV (Chien, Broer, Mušević) p. 440			
				11304 Advances in Display Technologies X (Lee, Wang, Yoon) p. 442	
		11305 Ultra-High-Definition Imaging Systems III (Miyata, Yatagai, Koike) p. 445			
				11306 Practical Holography XXXIV: Displays, Materials, and Applications (Bjelkhagen) p. 447	
<b>OPTICAL COMMUNICATIONS: DEVICES TO SYSTEMS</b> Program Track Chair: Benjamin Dingel, Nasfinc Photonics, Inc. (USA)					
			11307 Broadband Access Communication Technologies XIV (Dingel, Tsukamoto, Mikroulis) p. 449		
				11308 Metro and Data Center Optical Networks and Short-Reach Links III (Srivastava, Glick, Akasaka) p. 451	
				11309 Next-Generation Optical Communication: Components, Sub-Systems, and Systems IX (Li, Zhou) p. 453	
11272 Free-Space Laser Communications XXXII (Hemmati, Boroson) p. 327		11279 Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XIII (Sadwick, Yang) p. 355			
		11285 Silicon Photonics XV (Reed, Knights) p. 378			
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# CONFERENCE 11274

LOCATION: ROOM 311 (LEVEL 3 SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11274

# Physics and Simulation of Optoelectronic Devices XXVIII

*Conference Chairs:* **Bernd Witzigmann**, Univ. Kassel (Germany); **Marek Osirski**, The Univ. of New Mexico (USA); **Yasuhiko Arakawa**, The Univ. of Tokyo (Japan)

*Program Committee:* **Hiroshi Amano**, Nagoya Univ. (Japan); **Toshihiko Baba**, Yokohama National Univ. (Japan); **Jing Bai**, Univ. of Minnesota, Duluth (USA); **Enrico Bellotti**, Boston Univ. (USA); **Guillermo Carpintero**, Univ. Carlos III de Madrid (Spain); **Weng W. Chow**, Sandia National Labs. (USA); **Alexandre Freundlich**, Univ. of Houston (USA); **Michael D. Gerhold**, U.S. Army Research Office (USA); **Frédéric Grillot**, Télécom ParisTech (France); **Ortwin Hess**, Imperial College London (United Kingdom); **Stephan W. Koch**, Philipps-Universität Marburg (Germany); **Kathy Lüdge**, Technische Univ. Berlin (Germany); **Cun-Zheng Ning**, Arizona State Univ. (USA); **Joachim Piprek**, NUSOD Institute LLC (USA); **Marc Sciamanna**, CentraleSupélec (France); **Ikuo Suemune**, Hokkaido Univ. (Japan); **Kaikai Xu**, Univ. of Electronic Science and Technology of China (China)

## MONDAY 3 FEBRUARY

### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

### SESSION 1

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . MON 10:30 AM TO 12:00 PM

#### Electromagnetics/Plasmonics I

Session Chair: **Bryan Kelleher**, Univ. College Cork (Ireland)

- 10:30 am: **Multiphysics simulations of parabolic antenna-coupled thermoelectric converters (Invited Paper)**, Gergo P. Szakmany, Gary H. Bernstein, Edward C. Kinzel, Alexei O. Orlov, Wolfgang Porod, Univ. of Notre Dame (USA) . . . . . [11274-1]
- 11:00 am: **Broadband infrared metamaterial absorber with raindrop-shaped nanodisk array**, Wei Jia, Jing Bai, Univ. of Minnesota Duluth (USA); Kevin Robert, Univ. of Minnesota, Twin Cities (USA); David Gosztola, Gary Wiederrecht, Argonne National Lab. (USA); Debao Zhou, Univ. of Minnesota Duluth (USA) . . . . . [11274-2]
- 11:20 am: **Linear Schrödinger equation for front-induced transitions close to the band edge**, Mahmoud Abdel Aziz Gaafar, Hagen Renner, Alexander Petrov, Manfred Eich, Technische Univ. Hamburg-Harburg (Germany) [11274-3]
- 11:40 am: **Graphene-based c-shaped metasurface broadband solar absorber**, Mayurkumar Ladumor, Marwadi Univ. (India); Shreyas Charola, Shobhit Patel, Marwadi Univ. (India) . . . . . [11274-4]
- Lunch Break . . . . . Mon 12:00 pm to 1:20 pm

### SESSION 2

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . MON 1:20 PM TO 3:30 PM

#### Active Materials for Optoelectronics

Session Chair: **Stefan Schulz**, Tyndall National Institute (Ireland)

- 1:20 pm: **Understanding and mitigating the efficiency challenges of light emitters with atomistic calculations (Invited Paper)**, Emmanouil Kioupakis, Univ. of Michigan (USA) . . . . . [11274-5]

- 1:50 pm: **Multiscale modelling of group-IV semiconductor alloys: localisation, hybridisation, and implications for device applications**, Christopher A. Broderick, Edmond J. O'Halloran, Amy C. Kirwan, Michael D. Dunne, Daniel S. P. Tanner, Stefan Schulz, Eoin P. O'Reilly, Tyndall National Institute (Ireland) . . . . . [11274-6]
- 2:10 pm: **InAs/InAsSb type 2 superlattices band parameters determination via magnetoabsorption and k.p modeling**, Gauthier Krizman, Ecole Normale Supérieure (France); Francesca Carosella, Ecole Normale Supérieure (France) and Univ. de Paris (France); Philippe Alwin, Louis-Anne De Vaultchier, Gérald Bastard, Ecole Normale Supérieure (France); Jean-Baptiste Rodriguez, Jean-Philippe Perez, Philippe Christol, Univ. de Montpellier (France); Yves Guldner, Robson Ferreira, Ecole Normale Supérieure (France) . . [11274-7]
- 2:30 pm: **Advanced 2D material optoelectronic devices**, Volker J. Sorger, The George Washington Univ. (USA) . . . . . [11274-8]
- 2:50 pm: **Role of point-defect charging dynamics in quantum-well transport**, Danhong Huang, Air Force Research Lab. (USA); Andrii Iurov, The Univ. of New Mexico (USA); Godfrey Gumbs, Hunter College (USA); Fei Gao, Univ. of Michigan (USA) . . . . . [11274-9]
- 3:10 pm: **Hot carriers generation and resistive switching induced by electric and light pulses in the Mott insulator GaTa<sub>4</sub>Se<sub>8</sub>**, Danylo P. Babich, Benoît Corraze, Institut des Matériaux Jean Rouxel (France); Maciej Lorenc, Roman Bertoni, Marco Cammarata, Céline Mariette, Marina Servol, Hervé Cailleau, Institut de Physique de Rennes (France); Etienne Janod, Laurent Cario, Julien Tranchant, Institut des Matériaux Jean Rouxel (France). [11274-93]
- Coffee Break. . . . . Mon 3:30 pm to 4:00 pm

### SESSION 3

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . MON 4:00 PM TO 6:00 PM

#### Minisymposium on Neuromorphic Computing with Optical Devices

Session Chair: **Bernd Witzigmann**, Univ. Kassel (Germany)

- 4:00 pm: **Size scalable integration of photonic neural networks (Invited Paper)**, Jhonny Moughames, Javier Porte, FEMTO-ST (France); Michael Thiel, Nanoscribe GmbH (Germany); Muamer Kadic, Daniel Brunner, FEMTO-ST (France) . . . . . [11274-10]
- 4:30 pm: **Integrated photonic delay-lasers for reservoir computing (Invited Paper)**, Guy Van der Sande, Krishan Harkhoe, Vrije Univ. Brussel (Belgium); Andrew Katumba, Peter Bienstman, Photonics Research Group (Belgium); Guy Verschaffelt, Vrije Univ. Brussel (Belgium) . . . . . [11274-11]
- 5:00 pm: **Automatic classification of video using a scalable photonic neuro-inspired architecture (Invited Paper)**, Damien Rontani, Piotr Antonik, Nicolas Marsal, CentraleSupélec (France); Daniel Brunner, FEMTO-ST (France) and Univ. Bourgogne Franche-Comté (France) . . . . . [11274-12]
- 5:30 pm: **Electro- and all-optical photonic neural networks: towards real-time processors (Invited Paper)**, Volker J. Sorger, The George Washington Univ. (USA) . . . . . [11274-13]

OPTO

# CONFERENCE 11274

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... TUE 8:20 AM TO 10:10 AM

#### Semiconductor Lasers: Numerical Modeling

Session Chair: **Takasumi Tanabe**, Keio Univ. (Japan)

8:20 am: **Optical feedback effects in semiconductor Fano lasers** (*Invited Paper*), Jesper Mørk, Thorsten S. Rasmussen, Technical Univ. of Denmark (Denmark) ..... [11274-14]

8:50 am: **Traveling wave model-based analysis of tapered broad-area lasers**, Jan-Philipp Koester, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany); Mindaugas Radziunas, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); Anissa Zeghuzi, Ferdinand-Braun-Institut (Germany); Hans Wenzel, Andrea Knigge, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany) [11274-15]

9:10 am: **Impact of dislocations in monolithic III-V lasers on silicon: a theoretical approach**, Constanze Hantschmann, Univ. of Cambridge (United Kingdom); Zizhuo Liu, Mingchu Tang, Alwyn Seeds, Huiyun Liu, Univ. College London (United Kingdom); Ian White, Univ. of Bath (United Kingdom) and Univ. of Cambridge (United Kingdom); Richard Penty, Univ. of Cambridge (United Kingdom) ..... [11274-16]

9:30 am: **Energy balance model of high-power semiconductor lasers at high-pumping current**, Sergey O. Slipchenko, Olga Soboleva, Yulia Bobretsova, Polina Gavrina, Natalia Rudova, Peter Kop'ev, Ioffe Institute (Russian Federation) ..... [11274-17]

9:50 am: **Turn on transient in a long cavity laser**, Svetlana Slepneva, Institut de Physique de Nice, CNRS (France) and Cork Institute of Technology (Ireland) and Tyndall National Institute (Ireland); Uday Munivenkatappa, Cork Institute of Technology (Ireland); Alexander Pimenov, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); Amy Roche, Cork Institute of Technology (Ireland); Evgeny A. Viktorov, ITMO Univ. (Russian Federation); Massimo Giudici, Institut de Physique de Nice (France); Andrei G. Vladimirov, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany); Guillaume Huyet, CNRS (France) ..... [11274-18]

Coffee Break ..... Tue 10:10 am to 10:40 am

### SESSION 5

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... TUE 10:40 AM TO 12:00 PM

#### Signal Encryption and Nonlinear Optical Systems

Session Chair: **Volker J. Sorger**, The George Washington Univ. (USA)

10:40 am: **Experimental and numerical demonstration of tunable octave-wide four-wave mixing in dispersion engineered microresonators** (*Invited Paper*), Shun Fujii, Takasumi Tanabe, Keio Univ. (Japan) ..... [11274-19]

11:10 am: **Photonic physical unclonable functions: from the concept to fully functional device operating in the field** (*Invited Paper*), Dimitris Syvridis, National and Kapodistrian Univ. of Athens (Greece); Alexandros Fragkos, Eulambia Advanced Technologies Ltd. (Greece) ..... [11274-20]

11:40 am: **Generating chirp-free pulses using transistor lasers**, Chien-Ting Tung, National Taiwan Univ. (Taiwan); Hao-Yu Lan, Shu-Wei Chang, Academia Sinica (Taiwan); Chao-Hsin Wu, National Taiwan Univ. (Taiwan) ..... [11274-22]

Lunch/Exhibition Break ..... Tue 12:00 pm to 1:30 pm

### SESSION 6

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... TUE 1:30 PM TO 3:00 PM

#### Quantum Dot Emitters

Session Chairs: **Thorsten S. Rasmussen**, Technical Univ. of Denmark (Denmark); **Jesper Mørk**, Technical Univ. of Denmark (Denmark)

1:30 pm: **Square wave excitability in optically injected quantum-dot lasers** (*Invited Paper*), Bryan Kelleher, Univ. College Cork (Ireland) ..... [11274-23]

2:00 pm: **Strain spectrally-tunable single-photon source based on a quantum dot in microcavity**, Magdalena Moczala-Dusanowska, Lukasz Dusanowski, Stefan Gerhardt, Julius-Maximilians-Univ. Würzburg (Germany); Yu Ming He, Univ. of Science and Technology of China (China); Marcus Reindl, Armando Rastelli, Institut für Halbleiter- und Festkörperphysik, Johannes Kepler Univ. Linz (Austria); Rinaldo Trotta, Institut für Halbleiter- und Festkörperphysik, Johannes Kepler Univ. Linz (Austria) and Sapienza Univ. di Roma (Italy); Niels Gregersen, Technical Univ. of Denmark (Denmark); Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany) and Univ. of St. Andrews (United Kingdom); Christian Schneider, Julius-Maximilians-Univ. Würzburg (Germany) ..... [11274-52]

2:20 pm: **Small-signal dynamic response of quantum-dot lasers with asymmetric barrier layers**, Levon V. Asryan, John L. Monk, Virginia Polytechnic Institute and State Univ. (USA) ..... [11274-25]

2:40 pm: **Multimode dynamics of long-cavity Fabry-Pérot quantum-dot lasers**, Benjamin Lingnau, Univ. College Cork (Ireland) and Tyndall National Institute (Ireland); Bryan Kelleher, Univ. College Cork (Ireland) ..... [11274-26]

Coffee Break ..... Tue 3:00 pm to 3:30 pm

### SESSION 7

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... TUE 3:30 PM TO 5:50 PM

#### Photodetection

Session Chair: **Dimitris Syvridis**, National and Kapodistrian Univ. of Athens (Greece)

3:30 pm: **Fundamental considerations for integrating silicon photomultipliers in frequency domain diffuse optical spectroscopy**, Vincent Kitsmiller, Thomas D. O'Sullivan, Univ. of Notre Dame (USA) ..... [11274-27]

3:50 pm: **Monte Carlo solution to high field hole transport processes in avalanche amorphous selenium**, Atreyo Mukherjee, Stony Brook Univ. (USA); Dragica Vasilevka, Arizona State Univ. (USA); Richard Akis, Stony Brook Univ. (USA); Amirhossein H. Goldan, Stony Brook Univ. (USA) ..... [11274-28]

4:10 pm: **Spectral analysis of surface band bending in organic-inorganic lead halide perovskites**, Hye Ri Jung, William Jo, Ewha Womans Univ. (Korea, Republic of) ..... [11274-29]

4:30 pm: **Advances in MUTC technology**, Madison Woodson, Steven Estrella, Kenneth Hay, Daniel Renner, Milan Mashanovitch, Freedom Photonics, LLC (USA) ..... [11274-30]

4:50 pm: **Prediction of optically-triggered amplification in phototransistor with SPICE circuit simulators**, Chiara Rossi, Jean-Michel Sallese, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11274-31]

5:10 pm: **Gate-controlled time-dependent photocurrent in a biologically inspired optoelectronics**, Fabienne Michelini, Institut Matériaux Microélectronique Nanosciences de Provence (France); Katawoura Beltako, Okinawa Institute of Science and Technology Graduate Univ. (Japan); Dmitry Cherepanov, Victor Nadochenko, N.N. Semenov Institute of Chemical Physics (Russian Federation) ..... [11274-37]

5:30 pm: **NIR optical properties of SWCNTs based on ab-initio calculations and the transfer matrix method**, Ahmed Saeed, Electronics Research Institute (Egypt); Yasser M. Sabry, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt); H. A. Shawkey, Electronics Research Institute (Egypt); Diaa Khalil, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt) .. [11274-32]

WEDNESDAY 5 FEBRUARY

SESSION 8

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... WED 9:00 AM TO 10:10 AM

Nonlinear Photonics in Micro- and Nanostructures

Session Chair: **Damien Rontani**, CentraleSupélec (France)

9:00 am: **Dynamical chaos in silicon micro-cavity optomechanics for physically-enhanced information processing** (*Invited Paper*), Jia-Gui Wu, Univ. of California, Los Angeles (USA) ..... [11274-33]

9:30 am: **Synchronization of coupled monolithic ring laser frequency combs**, Marco Piccardo, Dmitry Kazakov, Shantanu Jha, Harvard Univ. (USA); Maximilian Beiser, Benedikt Schwarz, Technische Univ. Wien (Austria); Federico Capasso, Harvard Univ. (USA) ..... [11274-34]

9:50 am: **Generating optical frequency combs via nanoscale photonic structures**, Chaoyuan Jin, Zhejiang Univ. (China) and The Univ. of Sheffield (United Kingdom); Henry Francis, The Univ. of Sheffield (United Kingdom); Xiaodong Zhang, Zhejiang Univ. (China); Si Chen, The Univ. of Sheffield (United Kingdom); Kai-Jun Che, Xiamen Univ. (China); Mark Hopkinson, The Univ. of Sheffield (United Kingdom) ..... [11274-36]

Coffee Break ..... Wed 10:10 am to 10:40 am

SESSION 9

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... WED 10:40 AM TO 11:40 AM

Plasmonic Sensing

Session Chair: **Jia-Gui Wu**, Univ. of California, Los Angeles (USA)

10:40 am: **Observation of plasmonic exceptional points and attomolar immuno-assay nanosensing**, Junhee Park, Univ. of California, San Diego (USA) and Univ. of California, Berkeley (USA); Abdoulaye Ndao, Boubacar Kanté, Univ. of California, Berkeley (USA) ..... [11274-38]

11:00 am: **Design and analysis of trench-based novel structure for high-sensitive surface plasmon resonance sensor**, Manish Kumar, Indian Institute of Technology (Indian School of Mines), Dhanbad (India); Ajay Kumar, National Institute of Technology, Jamshedpur (India); Sanjeev Kumar Raghuvanshi, Shamsul Hassan, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) ..... [11274-39]

11:20 am: **Surface plasmon resonance sensing structure**, Paulo Lourenço, Univ. Nova de Lisboa (Portugal); Alessandro Fantoni, João Costa, Instituto Superior de Engenharia de Lisboa (Portugal); Manuela Vieira, Instituto Superior de Engenharia de Lisboa (Portugal) and Univ. Nova de Lisboa (Portugal) ..... [11274-40]

Lunch/Exhibition Break ..... Wed 11:40 am to 1:10 pm

SESSION 10

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... WED 1:10 PM TO 3:00 PM

III-Nitride-based Lasers and LEDs

Session Chair: **Emmanouil Kioupakis**, Univ. of Michigan (USA)

1:10 pm: **Multi-scale modeling of electronic, optical, and transport properties of III-N alloys and heterostructures** (*Invited Paper*), Stefan Schulz, Tyndall National Institute (Ireland) ..... [11274-41]

1:40 pm: **High-performance UV LED with an undoped BAIN EBL**, Wen Gu, King Abdullah Univ. of Science and Technology (Saudi Arabia); Yi Lu, Institute of Semiconductors (China); Rongyu Lin, Wenzhe Guo, King Abdullah Univ. of Science and Technology (Saudi Arabia); Jianchang Yan, Junxi Wang, Jinmin Li, Institute of Semiconductors (China); Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11274-42]

2:00 pm: **III-nitride-based AlInN/GaN digital alloys for deep-ultraviolet applications**, Damir Borovac, Wei Sun, Hanlin Fu, Renbo Song, Nelson Tansu, Lehigh Univ. (USA) ..... [11274-43]

2:20 pm: **Low resistance UV-LED tunnel junction design based on machine learning**, Rongyu Lin, Peng Han, Yue Wang, Chenxin Xiong, Yi Lu, Xiangliang Zhang, Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11274-44]

2:40 pm: **Investigation of intersubband phonon-polariton transitions in hBN/GaN heterostructure**, Catherine O'Hearn, Jeremy Dawson, West Virginia Univ. (USA) ..... [11274-45]

Coffee Break ..... Wed 3:00 pm to 3:30 pm

SESSION 11

LOCATION: ROOM 311 (LEVEL 3 SOUTH) ..... WED 3:30 PM TO 5:20 PM

Electromagnetics/Plasmonics II

Session Chair: **Gergo P. Szakmany**, Univ. of Notre Dame (USA)

3:30 pm: **Topological waveguides and nanocavities using semiconductor photonic crystals** (*Invited Paper*), Satoshi Iwamoto, Yasutomo Ota, Takuto Yamaguchi, Hironobu Yoshimi, Yasuhiko Arakawa, The Univ. of Tokyo (Japan) ..... [11274-46]

4:00 pm: **A k-domain method for fast propagation of electromagnetic field through graded-index media**, Huiying Zhong, Friedrich-Schiller-Univ. Jena (Germany); Site Zhang, LightTrans Hannover International UG (Germany); Rui Shi, Friedrich-Schiller-Univ. Jena (Germany); Christian Hellmann, Wyrowski Photonics GmbH (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) ..... [11274-47]

4:20 pm: **A finite-difference time-domain formalism for second-order nonlinear effects**, Brett N. Carnio, Univ. of Alberta (Canada) ..... [11274-48]

4:40 pm: **Optothermal simulation framework for the investigation of phosphor materials in laser-based lighting systems**, Elisavet Chatziziryli, Andreas Wienke, Laser Zentrum Hannover e.V. (Germany); Roland Lachmayer, Leibniz Univ. Hannover (Germany); Jörg Neumann, Dietmar Kracht, Laser Zentrum Hannover e.V. (Germany) ..... [11274-49]

5:00 pm: **Liquid crystal tunable dielectric metasurfaces via inverse design**, Haejun Chung, Owen Miller, Yale Univ. (USA) ..... [11274-50]

POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Electron plasma parameter ferroelectric TGS**, Nadezhda P. Netesova, M.V. Lomonosov Moscow State Univ. (Russian Federation) ..... [11274-59]

**Frequency characteristics of a semi-closed structure in a guided-wave optical pressure sensor for detection of tsunami formation: investigation based on numerical simulations and experiments**, Taiju Triyama, Hana Ono, Naoto Takaoka, Masashi Ohkawa, Niigata Univ. (Japan) ..... [11274-60]

**Design of Si-photonics-based logic gates using micro-ring resonator structures**, Dias Azhigulov, Ikechi Augustine Ukaegbu, Nazarbayev Univ. (Kazakhstan) ..... [11274-61]

**Effect of corner radius on a single corner nanostructure for investigating SERS based chemical sensors**, Nivedita Pandey, Abhishek Kumar, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) ..... [11274-62]

**Structural, electronic, and optical properties of type II heterostructure based on WS<sub>2</sub>/black phosphorene**, Abhishek Kumar, Nivedita Pandey, Suryansh Dongre, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) ..... [11274-63]

**Modelling and optimization of different plasmonic nanostructures for application in infrared region**, Nivedita Pandey, Abhishek Kumar, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) ..... [11274-64]

**Tuning the electronic and optical properties of graphene sheet by functionalization: an ab-initio study**, Abhishek Kumar, Nivedita Pandey, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) ..... [11274-65]

**Wayfinding in complex buildings using visible light communication**, Manuela Vieira, Manuela Vieira, Paula Louro, Instituto Superior de Engenharia de Lisboa (Portugal) and CTS-UNINOVA (Portugal); Pedro Vieira, Instituto Superior de Engenharia de Lisboa (Portugal) and Instituto de Telecomunicações (Portugal) ..... [11274-66]

**Femtosecond simulated electro-optics of electrochemically synthesized CdS particles of different morphology**, Katarzyna Ozga, Institute of Optoelectronics and Measuring Systems, Czestochowa Univ. of Technology (Poland); Iwan V. Kityk, Czestochowa Univ. of Technology (Poland); Oleksandr M. Yanchuk, Oleg V. Marchuk, Lesya Ukrainka Eastern European National Univ. (Ukraine); Iryna A. Moroz, Lutsk National Technical Univ. (Ukraine); Ahmed M. El-Naggar, Ahmed A. Albassam, King Saud Univ. (Saudi Arabia) ..... [11274-67]

OPTO

# CONFERENCE 11274

**Laser-operated optical anisotropy of novel rare-earth-doped  $\text{TeO}_2\text{-P}_2\text{O}_5\text{-ZnO-MxOy-PbF}_2$  glasses**, Iwan V. Kityk, Katarzyna Ozga, Czestochowa Univ. of Technology (Poland); Manuela Reben, AGH Univ. of Science and Technology (Poland); E. Yousef, King Khalid Univ. (Saudi Arabia); Marian Kubliha, Ondrej Bosak, Slovak Technical Univ. in Bratislava (Slovakia) . . . . . [11274-68]

**Carrier lifetime of black silicon as a photoconductor**, Shengkun Zhang, Borough of Manhattan Community College (USA); Robert Alfano, The City College of New York (USA) . . . . . [11274-69]

**Enhancing light-extraction efficiency of UVC LEDs by applying a reflective layer on etched side walls**, Feras AlQatari, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11274-70]

**Investigation of excitonic behavior in halide perovskite for optoelectronic applications**, Hye Ri Jung, William Jo, Ewha Womans Univ. (Korea, Republic of) . . . . . [11274-71]

**An optical pulse generation technique using two optical phase modulators and a Fabry-Perot etalon**, Ibrahim Akkaya, Izmir Biomedicine and Genome Ctr. (Turkey); Serhat Tozburun, Izmir Biomedicine and Genome Ctr. (Turkey) and Dokuz Eylul Univ. (Turkey) . . . . . [11274-72]

**Sub-threshold linewidth broadening factor of a  $3.4\mu\text{m}$  interband cascade laser operated at room temperature**, Yu Deng, Cheng Wang, ShanghaiTech Univ. (China) . . . . . [11274-73]

**Towards cavity-enhanced photodetection in Al-doped BP Integrated with 2D photonic crystal and waveguide for mid-IR wavelengths**, Asif Bilal, Osama Jalil, Abdullah Nafis Khan, Usman Younis, Shahzad Ahmad, Information Technology Univ. of the Punjab (Pakistan) . . . . . [11274-74]

**Performance of infrared endoscope systems for laparoscopic surgery**, Alexandra Bobe, Anna O. Voznesenskaya, ITMO Univ. (Russian Federation) . . . . . [11274-75]

**Effect of different plasmonic metals on sensing performance of a flat fiber**, Moutusi De, Vinod Kumar Singh, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . . . [11274-76]

**Research of aberration control in human-eye inspired vari-focal liquid lens**, Joo ho Lee, Junoh Kim, Yong Hyub Won, KAIST (Korea, Republic of) . . . . . [11274-77]

**Stable pulse propagation in a Kerr-Quintic nonlinear composite**, Gerardo Castelan Rico, Ana L. Merino-Diaz, Benemérita Univ. Autónoma de Puebla (Mexico); Erwin A. Martí Panameño, Benemérita Univ. Autónoma de Puebla (Mexico) and Lab. Nacional de Supercómputo del Sureste de México (Mexico) . . . . . [11274-78]

**Simulation of the transversal mode structure in a monolithic diode laser array**, Fernando C. Romano, Niklaus U. Wetter, Instituto de Pesquisas Energéticas e Nucleares (Brazil) . . . . . [11274-79]

**Analysis of characteristics concerning volume phase gratings of which refractive index distributions are continuously changeable graded types and trapezoid types**, Kaoru Nakajima, Japan Women's Univ. (Japan) [11274-80]

**A highly coherent multi-section semiconductor swept source OCT laser**, Svetlana Slepneva, Institut de Physique de Nice, Univ. Côte d'Azur, CNRS (France) and Cork Institute of Technology (Ireland) and Tyndall National Institute (Ireland); Anton V. Kovalev, ITMO Univ. (Russian Federation); Alexis Verschelde, CNRS (France); Aritra Roy, Tyndall National Institute (Ireland); Patrice Camelin, CNRS (France); Natalia Rebrova, Amy Roche, Cork Institute of Technology (Ireland); Mathias Marconi, CNRS (France); Konstantin Grigorenko, ITMO Univ. (Russian Federation); Massimo Giudici, Institut de Physique de Nice (France); Saroj Kanta Patra, Tyndall National Institute (Ireland); Evgeny A. Viktorov, ITMO Univ. (Russian Federation); Tomasz Piwowski, Tyndall National Institute (Ireland); Guillaume Huyet, CNRS (France) . . . . . [11274-81]

**Simulation of a parallel waveguide array structure suitable for interrogation scheme in a plasmonic biosensor**, João Costa, Alessandro Fantoni, Instituto Superior de Engenharia de Lisboa (Portugal) and CTS-UNINOVA (Portugal); Paulo Lourenço, CTS-UNINOVA (Portugal); Manuela Vieira, Instituto Superior de Engenharia de Lisboa (Portugal) and CTS-UNINOVA (Portugal) . . . . . [11274-83]

**Single-mode AlGaAs/InGaAs/GaAs lasers with a ultra narrow waveguide heterostructure**, Sergey O. Slipchenko, Ilya Shashkin, Viktor Shamakhov, Dmitry Nikolaev, Dmitrii Veselov, Yulia Bobretsova, Andrei Lyutetskiy, Nikita Pikhin, Peter Kop'ev, Ioffe Institute (Russian Federation) . . . . . [11274-84]

**Analysis of sensing properties of bending in optical fiber for highly sensitive applications**, Kartikeya Anand, Vellore Institute of Technology (India); Manish Kumar, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . . . [11274-85]

**High-aperture systems design for agriculture observation**, Helen A. Tsyganok, Anastasiya D. Kozhina, ITMO Univ. (Russian Federation) . . [11274-86]

**Performance modeling of III-V antimonide-based barrier infrared detectors**, Malgorzata Kopytko, Emilia Gomółka, Military Univ. of Technology (Poland); Tetjana Manyk, Wojskowa Akademia Techniczna im. Jaroslawa Dabrowskiego (Poland); Piotr Martyniuk, Jaroslaw Rutkowski, Military Univ. of Technology (Poland) . . . . . [11274-87]

**Hybrid plasmonic directional coupler modulator**, Sherif Mohamed, Lamees Shahada, Qatar Univ. (Qatar); Mohamed Swillam, The American Univ. in Cairo (Egypt) . . . . . [11274-88]

**LWIR range-gate vision system based on a  $\text{CO}_2$  laser**, Yahor V. Lebiadok, Dzmitry M. Kabanau, Vadim A. Gorobets, SSPA "Optics, Optoelectronics, and Laser Technology" NASB (Belarus); Raman Y. Mikulich, SSPA "Optics, Optoelectronics, and Laser Technology" NASB (Belarus) . . . . . [11274-89]

**A highly compact silicon-on-insulator strip-to-slot mode converter for mid-infrared applications**, Mohamed El Rayany, Mohamed Swillam, The American Univ. in Cairo (Egypt) . . . . . [11274-90]

**Photoluminescence and time-resolved photoluminescence study of  $\text{GaSe}_{1-x}\text{S}_x$  mixed crystal**, Phoebe Nicole Perez, Wen-Ching Chao, Li-Wei Tu, National Sun Yat-sen Univ. (Taiwan); Ching-Hwa Ho, National Taiwan Univ. of Science and Technology (Taiwan); Meng-En Lee, National Kaohsiung Normal Univ. (Taiwan); Emmanuel A. Florido, Univ. of the Philippines Los Baños (Philippines); Der-Jun Jang, National Sun Yat-sen Univ. (Taiwan) . . . . [11274-91]

**Design of performance test system for ultraviolet ICCD detector**, YaFeng Qiu, Nanjing Univ. of Science and Technology (China); YiTao Cao, Shanghai Institute of Mechanical and Electrical Engineering (China); Tianyuan Xia, Nanjing Univ. of Science and Technology (China); Hongjin Shuai, Taizhou jingtai road street water station (China) . . . . . [11274-92]

## THURSDAY 6 FEBRUARY

### SESSION 12

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . THU 8:30 AM TO 9:50 AM

### Semiconductor Lasers and Nano Emitters

Session Chair: **Satoshi Iwamoto**, The Univ. of Tokyo (Japan)

8:30 am: **Reviewing the laser transition in high-beta nanolasers with extended gain media**, Christopher Gies, Univ. Bremen (Germany); Paul Gartner, National Institute of Materials Physics (Romania); Frederik Lohof, Roy Barzel, Univ. Bremen (Germany) . . . . . [11274-51]

8:50 am: **Refractory period of optically injected dual-state excitable quantum-dot laser**, Michael Dillane, Univ. College Cork (Ireland) and Tyndall National Institute (Ireland); Benjamin Lingnau, Univ. College Cork (Ireland) and Tyndall National Institute (Ireland); Ilya Dubinkin, Nikita Fedorov, ITMO Univ. (Russian Federation); Bryan Kelleher, Univ. College Cork (Ireland) and Tyndall National Institute (Ireland); Evgeny A. Viktorov, ITMO Univ. (Ireland) . . [11274-24]

9:10 am: **Rate equation analysis of digital pulse modulation in strongly injection-locked semiconductor microring lasers**, Gennady A. Smolyakov, Marek Osinski, The Univ. of New Mexico (USA) . . . . . [11274-53]

9:30 am: **Spectral linewidth narrowing of a quantum cascade laser by strong optical feedback**, Binbin Zhao, XingGuang Wang, Cheng Wang, ShanghaiTech Univ. (China) . . . . . [11274-54]

Coffee Break. . . . . Thu 9:50 am to 10:20 am

### SESSION 13

LOCATION: ROOM 311 (LEVEL 3 SOUTH) . . . . . THU 10:20 AM TO 12:20 PM

### Integrated Ultra Lasers

Session Chair: **Guillermo Carpintero**, Univ. Carlos III de Madrid (Spain)

10:20 am: **High-performance mode-locked lasers on silicon (Invited Paper)**, Songtao Liu, Xinru Wu, Justin Norman, Daehwan Jung, Arthur C. Gossard, John Bowers, Univ. of California, Santa Barbara (USA) . . . . . [11274-55]

10:50 am: **Hybrid integrated silicon nitride lasers (Invited Paper)**, Arne Leinse, Ruud Oldenbeuving, Jörn P. Epping, René Heideman, Dimitri Gekus, Douwe H. Geuzebroek, Lionix International BV (Netherlands) . . . . . [11274-56]

11:20 am: **Polymer-based tunable lasers for a wide range of applications: from telecom to sensing and spectroscopy (Invited Paper)**, David de Felipe Mesquida, Martin Kresse, Hauke Conradi, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany); Matthias Reggentin, Hendrick Thiem, eagleyard Photonics GmbH (Germany); Moritz Kleinert, Madeleine Nuck, Crispin Zawadzki, Anja Scheu, Walter Brinker, Wolfgang Rehbein, Martin Moehle, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany); Guillermo Carpintero, Univ. Carlos III de Madrid (Spain); Norbert Keil, Martin Schell, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany) . . . . . [11274-57]

11:50 am: **Monolithically integrated laser sources for applications beyond telecommunications (Invited Paper)**, Sylwester Latkowski, Erwin A.J. M. Bente, Kevin A. Williams, Technische Univ. Eindhoven (Netherlands) . [11274-58]

# CONFERENCE 11275

LOCATION: ROOM 312 (LEVEL 3 SOUTH)

Tuesday–Thursday 4–6 February 2020 • Proceedings of SPIE Vol. 11275

## Physics, Simulation, and Photonic Engineering of Photovoltaic Devices IX

*Conference Chairs:* **Alexandre Freundlich**, Univ. of Houston (USA); **Masakazu Sugiyama**, The Univ. of Tokyo (Japan); **Stéphane Collin**, Ctr. de Nanosciences et de Nanotechnologies (France)

*Program Committee:* **Urs Aeberhard**, FLUXiM AG (Switzerland); **Kylie R. Catchpole**, The Australian National Univ. (Australia); **Gavin C. Conibeer**, The Univ. of New South Wales (Australia); **Olivier Durand**, Fonctions Optiques pour les Technologies de l'information (France); **Jean-François Guillemoles**, Institut Photovoltaïque d'Ile-de-France (France), NextPV LIA (Japan); **Karin Hinzer**, Univ. of Ottawa (Canada); **Seth M. Hubbard**, Rochester Institute of Technology (USA); **Marina S. Leite**, Univ. of Maryland, College Park (USA); **Laurent Lombez**, Institut Photovoltaïque d'Ile-de-France (France), NextPV LIA (Japan); **Marek Osiński**, The Univ. of New Mexico (USA); **Ian R. Sellers**, The Univ. of Oklahoma (USA); **Samuel D. Stranks**, Univ. of Cambridge (United Kingdom); **Robert J. Walters**, Packet Digital (USA); **Peichen Yu**, National Chiao Tung Univ. (Taiwan)

### TUESDAY 4 FEBRUARY

#### WELCOME AND OPENING REMARKS

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... TUE 1:20 PM TO 1:30 PM

**Alexandre Freundlich**, Univ. of Houston (USA); **Masakazu Sugiyama**, The Univ. of Tokyo (Japan); **Stéphane Collin**, Ctr. de Nanosciences et de Nanotechnologies (France)

#### SESSION 1

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... TUE 1:30 PM TO 3:10 PM

#### Advances in Photonic Designs and Material Developments for High Efficiency Tandems

Session Chairs: **Alexandre Freundlich**, Univ. of Houston (USA); **Stéphane Collin**, Ctr. de Nanosciences et de Nanotechnologies (France)

1:30 pm: **Modeling and realization of photonic structures for silicon-based tandem solar cells** (*Invited Paper*), Oliver Höhn, Hubert Hauser, Nico Tucher, Ralph Müller, Benedikt Bläsi, Fraunhofer-Institut für Solare Energiesysteme ISE (Germany) ..... [11275-1]

2:00 pm: **Towards cost effective III-V photovoltaics with advanced substrate engineering** (*Invited Paper*), Abderraouf Boucherif, Univ. de Sherbrooke (Canada) ..... [11275-2]

2:30 pm: **Design, modeling, and experimental results for CPV arrays built using heterogeneously integrated III-V micro-cells**, Matthew P. Lumb, The George Washington Univ. (USA) and U.S. Naval Research Lab. (USA); Kenneth J. Schmieder, U.S. Naval Research Lab. (USA); Thomas C. Mood, David Balwin, Wolfgang Wagner, Consultant (USA); James E. Moore, The George Washington Univ. (USA); Laura B. Ruppalt, Nicole Kotulak, Jill A. Nolde, U.S. Naval Research Lab. (USA); Eric A. Armour, Ziggy Pulwin, Veeco Instruments Inc. (USA); Matthew Meitl, Brent R. Fisher, Jim Carter, Scott Burroughs, Semprius, Inc. (USA) ..... [11275-3]

2:50 pm: **CIGS growth on a GaP/Si(001) platform: towards CIGS/Si tandem solar cells**, Olivier Durand, Antoine Létoublon, Charles Cornet, Ang Zhou, Fonctions Optiques pour les Technologies de l'information (France) and Institut National des Sciences Appliquées de Rennes (France); Nicolas Barreau, Eric Gautron, Univ. de Nantes (France) and Institut des Matériaux Jean Rouxel, CNRS (France); Matteo Balestrieri, Damien Coutancier, Lincot Daniel, CNRS (France) and Institut Photovoltaïque d'Ile-de-France (France) ..... [11275-4]

Coffee Break. .... Tue 3:10 pm to 3:40 pm

#### SESSION 2

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... TUE 3:40 PM TO 5:30 PM

#### Hot Carrier Solar Cells

Session Chairs: **Masakazu Sugiyama**, The Univ. of Tokyo (Japan); **Seth M. Hubbard**, Rochester Institute of Technology (USA)

3:40 pm: **Simulation of nonequilibrium electron and phonon dynamics in advanced concept photovoltaic devices** (*Invited Paper*), Stephen M. Goodnick, Yongjie Zou, Raghuraj Hathwar, Arizona State Univ. (USA) ..... [11275-5]

4:10 pm: **Designing better absorbers for hot-carrier solar cells**, Maxime Giteau, Kentaroh Watanabe, Naoya Miyashita, Hassanet Sodabanlu, The Univ. of Tokyo (Japan); Daniel Suchet, Institut Photovoltaïque d'Ile-de-France (France); Stéphane Collin, Ctr. de Nanosciences et de Nanotechnologies (France); Jean-François Guillemoles, Institut Photovoltaïque d'Ile-de-France (France); Yoshitaka Okada, The Univ. of Tokyo (Japan) ..... [11275-6]

4:30 pm: **Valley photovoltaics: Experimental evidence for a route to the realization of practical hot carrier solar cells**, Ian R. Sellers, Hamidreza M. Esmailpour, Vincent R. Whiteside, Kyle R. Dorman, Tetsuya D. Mishima, Michael B. Santos, The Univ. of Oklahoma (USA); David K. Ferry, Arizona State Univ. (USA) ..... [11275-7]

4:50 pm: **Microscopic simulation of hot carrier effects in quantum well solar cells**, Urs Aeberhard, FLUXiM AG (Switzerland) ..... [11275-8]

5:10 pm: **Advanced analysis for hot-carriers photoluminescence spectrum**, Hamidreza M. Esmailpour, Institut Photovoltaïque d'Ile-de-France (France); Maxime Giteau, Research Ctr. for Advanced Science and Technology (Japan); Amaury Delamarre, Ctr. de Nanosciences et de Nanotechnologies (France); François Gibelli, Dac Trung Nguyen, Institut Photovoltaïque d'Ile-de-France (France); Nicolas Cavassilas, Aix-Marseille Univ. (France) and Univ. de Toulon (France) and Institut Matériaux Microélectronique Nanosciences de Provence, CNRS (France); Yoshitaka Okada, Research Ctr. for Advanced Science and Technology (Japan); Jean-François Guillemoles, Laurent Lombez, Institut Photovoltaïque d'Ile-de-France (France); Daniel Suchet, Research Ctr. for Advanced Science and Technology (Japan) and Institut Photovoltaïque d'Ile-de-France (France) and Ecole Polytechnique (France) ..... [11275-9]

OPTO

# CONFERENCE 11275

## WEDNESDAY 5 FEBRUARY

### SESSION 3

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... WED 8:30 AM TO 10:00 AM

#### Design and Simulation of Perovskites PV

Session Chairs: **Philip Schulz**, National Renewable Energy Lab. (USA); **Peichen Yu**, National Chiao Tung Univ. (Taiwan)

8:30 am: **Computational device optimization and parameter extraction for perovskite-based solar cells** (*Invited Paper*), Urs Aeberhard, FLUXiM AG (Switzerland); Martin T. Neukom, Andreas Schiller, Simon Zuefle, FLUXiM AG (Switzerland) and Zürcher Hochschule für Angewandte Wissenschaften (Switzerland); Sandra Jenatsch, Balthasar Blülle, Stéphane Altazin, Lidia Stepanova, FLUXiM AG (Switzerland); Evelyne Knapp, Christoph Kirsch, Zürcher Hochschule für Angewandte Wissenschaften (Switzerland); Beat Ruhstaller, FLUXiM AG (Switzerland) and Zürcher Hochschule für Angewandte Wissenschaften (Switzerland) ..... [11275-10]

9:00 am: **Optical modelling and analysis of semi-transparent triple cation perovskite solar cells for tandem applications**, Emilie Raoult, Electricité de France (France) and Institut Photovoltaïque d'Ile-de-France (France) and Ctr. de Nanosciences et de Nanotechnologies, Ctr. National de la Recherche Scientifique (France); Romain Bodeux, Sébastien Jutteau, Samuel Rives, Armelle Yaiche, Jean Rousset, Electricité de France (France) and Institut Photovoltaïque d'Ile-de-France (France); Stéphane Collin, Ctr. de Nanosciences et de Nanotechnologies (France) and Institut Photovoltaïque d'Ile-de-France (France) ..... [11275-11]

9:20 am: **Exploiting localized charge accumulation regions in alloyed hybrid perovskites for highly efficient luminescence**, Sascha Feldmann, Stuart Macpherson, Satyaprasad P. Senanayak, Mojtaba Abdi-Jalebi, Jasmine P. H. Rivett, Univ. of Cambridge (United Kingdom); Guangjun Nan, Univ. de Mons (Belgium); Gregory D Tainter, Tiarnan A. S. Doherty, Kyle Frohna, Emilie Ringe, Richard H. Friend, Henning Sirringhaus, Univ. of Cambridge (United Kingdom); Michael Saliba, Univ. de Fribourg (Switzerland); David Beljonne, Univ. de Mons (Belgium); Samuel D. Stranks, Felix Deschler, Univ. of Cambridge (United Kingdom) ..... [11275-12]

9:40 am: **Impact of PL reabsorption and surface passivation on the internal quantum efficiency of perovskite solar cells**, Mingcong Wang, Kai Wang, Yajun Gao, Jafar I. Khan, Dalia Al Nakdali, Erkki Alarousu, Stefaan De Wolf, King Abdullah Univ. of Science and Technology (Saudi Arabia); Denis Andrienko, Max-Planck-Institut für Polymerforschung (Germany); Frederic Laquai, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11275-13]

Coffee Break ..... Wed 10:00 am to 11:00 am

### SESSION 4

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... WED 11:00 AM TO 12:10 PM

#### Perovskites and Emerging Photovoltaics

Session Chair: **Marko Topic**, Univ. of Ljubljana (Slovenia)

11:00 am: **Interfaces design for halide perovskite solar cells** (*Invited Paper*), Philip Schulz, Institut Photovoltaïque d'Ile-de-France (France) ..... [11275-14]

11:30 am: **Modelling photoluminescence decay of perovskite PV device from TR-FLIM**, Jean-Baptiste Puel, Institut Photovoltaïque d'Ile-de-France (France) and Electricité de France (France); Guillaume Vidon, Institut Photovoltaïque d'Ile-de-France (France); Adrien Bercegol, Institut de Recherche et Développement sur l'Energie Photovoltaïque (France) and Electricité de France (France); Olivier Fournier, Institut Photovoltaïque d'Ile-de-France (France) and Electricité de France (France); Daniel Suchet, Institut Photovoltaïque d'Ile-de-France (France) and Ecole Polytechnique (France) and CNRS (France); Daniel Ory, Institut Photovoltaïque d'Ile-de-France (France) and Electricité de France (France); Laurent Lombez, Jean-François Guillemoles, Institut Photovoltaïque d'Ile-de-France (France) and Ecole Polytechnique (France) and CNRS (France) ..... [11275-15]

11:50 am: **Controlling crystal growth of non-toxic Bismuth iodide (BiI<sub>3</sub>) semiconducting material for efficient photovoltaics**, Maryam Masroor Shalmani, Pratap M. Rao, Worcester Polytechnic Institute (USA) ..... [11275-16]

Lunch/Exhibition Break ..... Wed 12:10 pm to 1:30 pm

### SESSION 5

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... WED 1:30 PM TO 3:30 PM

#### Characterization of Solar Cells

Session Chairs: **Jean-François Guillemoles**, Institut Photovoltaïque d'Ile-de-France (France); **Karin Hinzer**, Univ. of Ottawa (Canada)

1:30 pm: **Application of the generalised Planck equation for the characterisation of photovoltaic materials and devices** (*Invited Paper*), Thorsten Trupke, BT Imaging Pty Ltd. (Australia) ..... [11275-17]

2:00 pm: **Non-contacting optical probing of photovoltaic device performance** (*Invited Paper*), Nikolas J. Podraza, Prakash Uprety, Indra Subedi, Maxwell Junda, Biwas Subedi, Dipendra Adhikari, Kiran Ghimire, Prakash Koirala, Robert W. Collins, Yanfa Yan, The Univ. of Toledo (USA) ..... [11275-18]

2:30 pm: **Analysis of perimeter recombination on multijunction solar cells using luminescence imaging**, Hao Xu, Hassanet Sodabanlu, The Univ. of Tokyo (Japan); Matthew M. Wilkins, Univ. of Ottawa (Canada); Amaury Delamarre, Ctr. de Nanosciences et de Nanotechnologies (France); Theodoros J. Wijaya, Kentaroh Watanabe, Yoshiaki Nakano, Masakazu Sugiyama, The Univ. of Tokyo (Japan) ..... [11275-19]

2:50 pm: **A comparison of the optoelectronic properties of high-efficiency polycrystalline and epitaxial Cu(In,Ga)Se<sub>2</sub> photovoltaic films**, Harvey L. Guthrey IV, National Renewable Energy Lab. (USA); Jiro Nishinaga, National Institute of Advanced Industrial Science and Technology (Japan); Andrew Norman, National Renewable Energy Lab. (USA); Hajime Shibata, National Institute of Advanced Industrial Science and Technology (Japan); Mowafak M. Al-Jassim, National Renewable Energy Lab. (USA); Shogo Ishizuka, National Institute of Advanced Industrial Science and Technology (Japan) ..... [11275-20]

3:10 pm: **Electron-beam-induced current characterization of solid state dye-sensitized solar cell**, Camila Faccini De Lima, Emerson Kohlrusch, Marcos A.Z. Vasconcellos, Macos Leite, Univ. Federal do Rio Grande do Sul (Brazil) ..... [11275-21]

Coffee Break ..... Wed 3:30 pm to 4:00 pm

### SESSION 6

LOCATION: ROOM 312 (LEVEL 3 SOUTH) ..... WED 4:00 PM TO 5:50 PM

#### Carrier Transport in Quantum/Nano-Engineered Solar Cells

Session Chairs: **Urs Aeberhard**, FLUXiM AG (Switzerland); **Matthew P. Lumb**, U.S. Naval Research Lab. (USA)

4:00 pm: **The role of intervalley phonons in hot carrier transfer and extraction in InAs/AlAsSb quantum well solar cells** (*Invited Paper*), Ian R. Sellers, Michael B. Santos, Vincent R. Whiteside, Tetsuya D. Mishima, Hamidreza M. Esmaielpour, Kyle R. Dorman, The Univ. of Oklahoma (USA); David K. Ferry, Arizona State Univ. (USA) ..... [11275-22]

4:30 pm: **Quantum well solar cells incorporating thin barriers for improved efficiency**, Stephen J. Polly, Rochester Institute of Technology (USA); Roger E. Welsler, Magnolia Optical Technologies, Inc. (USA); Mitsul Kacharia, Anastasiia Fedorenko, Rochester Institute of Technology (USA); Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); Seth M. Hubbard, Rochester Institute of Technology (USA) ..... [11275-23]

4:50 pm: **p-i-p structure for time-of-flight measurements of effective carrier mobility in multi-quantum-well structures**, Matthew M. Wilkins, Univ. of Ottawa (Canada); Meita Asami, Hsiang-Hung Huang, The Univ. of Tokyo (Japan); Karin Hinzer, Univ. of Ottawa (Canada); Masakazu Sugiyama, The Univ. of Tokyo (Japan) ..... [11275-24]

5:10 pm: **Trade-off study on the radiative efficiency and carrier transport of multiple-quantum-well solar cells**, Hsiang-Hung Huang, Kasidit Toprasertpong, The Univ. of Tokyo (Japan); Matthew M. Wilkins, Karin Hinzer, Univ. of Ottawa (Canada); Masakazu Sugiyama, Yoshiaki Nakano, The Univ. of Tokyo (Japan) ..... [11275-25]

5:30 pm: **Dynamical view of charge transport and separation in nanojunctions**, Fabienne Michelini, Institut Matériaux Microélectronique Nanosciences de Provence (France); Katawoura Beltako, Okinawa Institute of Science and Technology Graduate Univ. (Japan); Nicolas Cavassilas, Michel Lannoo, Institut Matériaux Microélectronique Nanosciences de Provence (France) ..... [11275-26]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Propagation of the blackbody radiation in a periodic metamaterial,** Peter B. Lerner, Device Physics Consultants, LLC (USA) . . . . . [11275-40]

**Solar cell requirements for UAV applications,** Aaron J. Danner, National Univ. of Singapore (Singapore) . . . . . [11275-41]

**Optimization of solar-cell packing models for flexible surfaces,** Rahul Chowdhury, The City College of New York (USA); Malgorzata Marciniak, LaGuardia Community College (USA) . . . . . [11275-42]

**Solar panels for the Lunar Base,** Malgorzata Marciniak, The City Univ. of New York (USA) and LaGuardia Community College (USA); Leylaye Maskal, The City Univ. of New York (USA) and LaGuardia Community College (USA) and NASA Goddard Institute for Space Studies (USA); Christian Singleton, Ali Taha, The City Univ. of New York (USA) and LaGuardia Community College (USA); Delfino Enriquez-Torres, The City College of New York (USA); Ahmed Aboudiwan, College of Staten Island (USA) . . . . . [11275-43]

**Performance enhancement of a thermo-photovoltaic (TH-PV) hybrid system using a plasmonic IR absorber,** Ahmed M. Hassanen, Samar Akef, Mohamed A. Swillam, The American Univ. in Cairo (Egypt) . . . . . [11275-44]

**FDTD study of anti-reflective properties of photonic crystal slabs in silicon,** Thomas M. Mercier, Chirenjeevi Krishnan, Martin D. B. Charlton, Univ. of Southampton (United Kingdom) . . . . . [11275-45]

**Enhancement of silicon nanowire micro-TEG using a plasmonic mid-IR absorber,** Samar Akef, Ahmed M. Hassanen, Mohamed A. Swillam, The American Univ. in Cairo (Egypt) . . . . . [11275-46]

**TCAD modeling of microcrystalline silicon ( $\mu\text{-Si}$ ) based thin-film solar cell with multi-grain boundaries,** Muzaffar Imam, Syed Sadique Anwer Askari, Mukul K. Das, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . . . [11275-47]

**Impact of silver nanostructures in the characteristics of perovskite solar cells,** Hussein Badran, Kuwait Univ. (Kuwait); Ishac Lamei Nagiub Kandas, Alexandria Univ. (Egypt); Nader Shehata, Kuwait College of Science and Technology (Egypt) and Alexandria Univ. (Egypt); Ali Hajjiah, Kuwait Univ. (Kuwait) . . . . . [11275-48]

**Plasmonic nanostructures for enhanced performance of microcrystalline silicon solar cells,** Uttam K. Kumawat, Kamal Kumar, Abhijit K. Das, Akanksha Ninawe, Anuj Dhawan, Indian Institute of Technology Delhi (India) . . . . . [11275-49]

**Investigation the absorption efficiency of InGaP nanowire solar cells,** Farah Amer, Erbil Polytechnic Univ. (Iraq) . . . . . [11275-50]

**THURSDAY 6 FEBRUARY**

**SESSION 7**

**LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . THU 8:30 AM TO 10:20 AM**

**Advanced Light Management in Solar Cells**

Session Chair: **Thorsten Trupke**, BT Imaging Pty Ltd. (Australia)

8:30 am: **Nanostructures and design challenges in photovoltaic devices** (*Invited Paper*), Marko Topic, Univ. of Ljubljana (Slovenia); Marko Jost, Univ. of Ljubljana (Slovenia) and Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); Milan Kovacic, Benjamin Lipovšek, Franc Smole, Janez Krc, Univ. of Ljubljana (Slovenia) . . . . . [11275-27]

9:00 am: **Design of photonic light-trapping structures for ultra-thin solar cells,** Phoebe Pearce, Imperial College London (United Kingdom); Larkin Sayre, Louise Hirst, Univ. of Cambridge (United Kingdom); Nicholas J. Ekins-Daukes, The Univ. of New South Wales (Australia) . . . . . [11275-28]

9:20 am: **Benefits of Lambertian Light Distribution Across Widely Deployed Photovoltaic Materials,** Nicholas P. Irvin, Sean J. Babcock, Eric Y. Chen, Richard R. King, Christiana B. Honsberg, Arizona State Univ. (USA) . . . . . [11275-29]

9:40 am: **Proof of concept: ARC-free black interdigitated back contact module with wide acceptance angle,** Pablo Ortega, Univ. Politècnica de Catalunya (Spain); Toni P. Pasanen, Aalto Univ. (Finland); Moises Garin, Univ. Politècnica de Catalunya (Spain) and Univ. de Vic (Spain); Guillaume von Gastrow, Aalto Univ. (Finland) and Univ. of California, San Diego (USA); Tuukka Savisalo, Valoe Oyj (Finland); Antti Tolvanen, Henri Vahlman, Endeas Oy (Finland); Ville Vähänissi, Aalto Univ. (Finland); David Carrió, Ramón Alcobilla, Univ. Politècnica de Catalunya (Spain); Hele I. Savin, Aalto Univ. (Finland) . . . . . [11275-30]

10:00 am: **Impact of bifacial photovoltaic cell characteristics on module energy yield in high-latitude locations,** Mandy R. Lewis, Univ. of Ottawa (Canada) and Arizona State Univ. (USA); Annie C. J. Russell, Erin M. Tonita, Christopher E. Valdivia, Univ. of Ottawa (Canada); Joan E. Haysom, J.L. Richards & Associates Ltd. (Canada); Mariana I. Bertoni, Arizona State Univ. (USA); Karin Hinzer, Univ. of Ottawa (Canada) . . . . . [11275-31]  
Coffee Break . . . . . Thu 10:20 am to 10:50 am

**SESSION 8**

**LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . THU 10:50 AM TO 12:20 PM**

**IBSC and QD Solar Cells**

Session Chairs: **Stephen M. Goodnick**, Arizona State Univ. (USA); **Ian R. Sellers**, The Univ. of Oklahoma (USA)

10:50 am: **Quasi-Fermi level splitting in InAs quantum-dot solar cells from photoluminescence measurements** (*Invited Paper*), Ryo Tamaki, Research Ctr. for Advanced Science and Technology (Japan); Yasushi Shoji, National Institute of Advanced Industrial Science and Technology (Japan); Laurent Lombez, Jean-François Guillemoles, Institut Photovoltaïque d'Ile-de-France (France) and CNRS (France); Yoshitaka Okada, Research Ctr. for Advanced Science and Technology (Japan) . . . . . [11275-32]

11:20 am: **Physics of the inter-subband transition in quantum-dot intermediate-band solar cell,** Nicolas Cavassilas, Institut Matériaux Microélectronique Nanosciences de Provence (France); Daniel Suchet, Ecole Polytechnique (France) and Institut Photovoltaïque d'Ile-de-France (France); Amaury Delamarre, Ctr. de Nanosciences et de Nanotechnologies (France); Jean-François Guillemoles, Institut Photovoltaïque d'Ile-de-France (France); Marc Bescond, Institute of Industrial Science, The Univ. of Tokyo (Japan); Fabienne Michelini, Michel Lannoo, Institut Matériaux Microélectronique Nanosciences de Provence (France) . . . . . [11275-33]

11:40 am: **Device modeling lessons for intermediate-band solar cells,** Matthew M. Wilkins, Emily Z. Zhang, Eduard C. Dumitrescu, Jacob J. Krich, Univ. of Ottawa (Canada) . . . . . [11275-34]

12:00 pm: **Quantum-dot enhanced photonic quasi crystal silicon solar cell,** Thomas M. Mercier, Chirenjeevi Krishnan, Tasmiat Rahman, Stuart A. Boden, Martin D. B. Charlton, Pavlos G. Lagoudakis, Univ. of Southampton (United Kingdom) . . . . . [11275-35]

Lunch/Exhibition Break . . . . . Thu 12:20 pm to 1:50 pm

**SESSION 9**

**LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . THU 1:50 PM TO 3:10 PM**

**TPV and Other Emerging PV Devices**

Session Chairs: **Olivier Durand**, Fonctions Optiques pour les Technologies de l'information (France); **Ryo Tamaki**, Research Ctr. for Advanced Science and Technology (Japan)

1:50 pm: **Efficiencies and limiting factors of narrow bandgap thermophotovoltaic cells,** Wenxiang Huang, Rui Q. Yang, The Univ. of Oklahoma (USA) . . . . . [11275-36]

2:10 pm: **Designing a high-voltage photonic power converter for extended-reach power-over-fiber systems,** Meghan N. Beattie, Daiki Xia, Christopher E. Valdivia, Marziyeh Zamiri, Univ. of Ottawa (Canada); Man Chun A. Tam, Zbigniew R. Wasilewski, Univ. of Waterloo (Canada); Jacob J. Krich, Karin Hinzer, Univ. of Ottawa (Canada) . . . . . [11275-37]

2:30 pm: **Photo-controlled solid-state negative hydrogen ion source,** Sara Kandil, Dan F. Sievenpiper, Prabhakar Bandaru, Univ. of California, San Diego (USA); Anna Alexander, Nathan A. Moody, Los Alamos National Lab. (USA) . . . . . [11275-38]

2:50 pm: **Improving conversion efficiency of GaSb thermophotovoltaic diodes using metallic photonic crystals and distributed Bragg reflectors,** Emily S. Carlson, John H. McElearney, Minsu Oh, Dante F. DeMeo, Thomas E. Vandervelde, Tufts Univ. (USA) . . . . . [11275-39]

**CLOSING REMARKS**

**LOCATION: ROOM 312 (LEVEL 3 SOUTH) . . . . . 3:10 PM TO 3:20 PM**

**Alexandre Freundlich**, Univ. of Houston (USA); **Masakazu Sugiyama**, The Univ. of Tokyo (Japan); **Stéphane Collin**, Ctr. de Nanosciences et de Nanotechnologies (France)

# CONFERENCE 11276

LOCATION: ROOM 313 (LEVEL 3 SOUTH)

Tuesday-Thursday 4-6 February 2020 • Proceedings of SPIE Vol. 11276

## Optical Components and Materials XVII

Conference Chairs: **Shibin Jiang**, AdValue Photonics, Inc. (USA); **Michel J. F. Digonnet**, Stanford Univ. (USA)

Program Committee: **Jean-Luc Adam**, Univ. de Rennes 1 (France); **Joel Bagwell**, Edmund Optics Inc. (USA); **Rolindes Balda**, Univ. del País Vasco (Spain); **Robert P. Dahlgren**, NASA Ames Research Ctr. (USA); **Angel Flores**, Air Force Research Lab. (USA); **Jesse A. Frantz**, U.S. Naval Research Lab. (USA); **Leonid B. Glebov**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Seppo K. Honkanen**, Univ. of Eastern Finland (Finland); **Microsoft HoloLens** (Finland); **Jacques Lucas**, Univ. de Rennes 1 (France); **Yasutake Ohishi**, Toyota Technological Institute (Japan); **Aydogan Ozcan**, Univ. of California, Los Angeles (USA); **Giancarlo C. Righini**, Istituto di Fisica Applicata "Nello Carrara" (Italy); **Setsuhisa Tanabe**, Kyoto Univ. (Japan); **John M. Zavada**, Polytechnic Institute of New York Univ. (USA); **Jun Zhang**, U.S. Army Research Lab. (USA)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... TUE 8:30 AM TO 10:00 AM

#### Optical Switches

Session Chair: **Shibin Jiang**, AdValue Photonics, Inc. (USA)

8:30 am: **GST integrated silicon photonics** (*Invited Paper*), Arka Majumdar, Univ. of Washington (USA) ..... [11276-1]

9:00 am: **Integrated electroholographic photorefractive wavelength selective switches with sustained longevity produced by LED illumination**, Aharon J. Agranat, Sagi Frishman, Yehudit Garcia, Daniel Rosenthal, The Hebrew Univ. of Jerusalem (Israel) ..... [11276-2]

9:20 am: **Figure of merit of phase change materials for Mach-Zehnder interferometer-based and directional-coupler-based optical switches**, Kenta Sakamoto, Keio Univ. (Japan); Masashi Kuwahara, National Institute of Advanced Industrial Science and Technology (Japan); Hiroyuki Tsuda, Keio Univ. (Japan) ..... [11276-3]

9:40 am: **KTN-based electro-optic beam controller**, Shizhuo Yin, The Pennsylvania State Univ. (USA) ..... [11276-4]

Coffee Break ..... Tue 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... TUE 10:30 AM TO 11:50 AM

#### Optical Modulators

Session Chair: **John M. Zavada**, Polytechnic Institute of New York Univ. (USA)

10:30 am: **Franz-Keldysh modulation in GeSn-based heterostructures**, Mathieu Bertrand, Lara Casiez, Andréa Quintero, CEA-LETI (France); Quang Minh Thai, CEA-DRF (France); Jérémie Chrétien, CEA-LETI (France); Nicolas Pauc, CEA-DRF (France); Rami Khazaka, Philippe Rodriguez, Jean-Michel Hartmann, Alexei Tcheinokov, CEA-LETI (France); Vincent Calvo, CEA-LETI-DOPT (France); Vincent Reboud, CEA-LETI (France) ..... [11276-5]

10:50 am: **Free-spectral-range-free microring-based coupling modulator with integrated contra-directional-couplers**, Ajay Mistry, Mustafa Hammood, Hossam Shoman, Stephen Lin, Lukas Chrostowski, Nicolas A. F. Jaeger, The Univ. of British Columbia (Canada) ..... [11276-6]

11:10 am: **Composite material hollow core anti-resonant fiber electromodulators: exploring the optical FET response**, Adam H. Lewis, Francesco De Lucia, Univ. of Southampton (United Kingdom); Walter Belardi, Lab. de Physique des Lasers, Atomes et Molécules (France); Chung-Che Huang, John R. Hayes, Francesco Poletti, Daniel W. Hewak, Pier J. A. Sazio, Univ. of Southampton (United Kingdom) ..... [11276-7]

11:30 am: **Fiber-based interferometer for optical field reconstruction**, Aaron M. Katzenmeyer, Sandia National Labs. (USA) ..... [11276-8]

Lunch/Exhibition Break ..... Tue 11:50 am to 1:30 pm

#### SESSION 3

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... TUE 1:30 PM TO 3:00 PM

#### Plasmonic Devices and Technologies

Session Chair: **Michel J. F. Digonnet**, Stanford Univ. (USA)

1:30 pm: **Thermal-emission engineering with dynamically tunable materials** (*Invited Paper*), Mikhail A. Kats, Univ. of Wisconsin-Madison (USA) ..... [11276-9]

2:00 pm: **Dynamically tunable gap plasmon resonance modulated by M13 phage**, Hyuk Jeong, Pusan National Univ. (Korea, Republic of); Vasanthan Devaraj, Chungnam National Univ. (Korea, Republic of); Jong-Min Lee, Thanh Mien Nguyen, Won-Geun Kim, Jin-Woo Oh, Pusan National Univ. (Korea, Republic of) ..... [11276-10]

2:20 pm: **Active tunable filters based on GeSbTe phase-change materials and surface plasmon resonance**, Hyun Jung Kim, National Institute of Aerospace (USA); Matthew Julian, Univ. of Virginia (USA); Calum Williams, Univ. of Cambridge (United Kingdom); Scott M. Bartram, David G. MacDonnell, NASA Langley Research Ctr. (USA) ..... [11276-11]

2:40 pm: **Optical and structural properties of 3D-printed plasmonic nanowires with dynamically tunable nano-gap size**, Jong-Min Lee, Won-Geun Kim, Vasanthan Devaraj, Thanh Mien Nguyen, Hyuk Jeong, Pusan National Univ. (Korea, Republic of); Ji Tae Kim, The Univ. of Hong Kong (Hong Kong, China); Jin-Woo Oh, Pusan National Univ. (Korea, Republic of) [11276-12]

Coffee Break ..... Tue 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... TUE 3:30 PM TO 5:40 PM

#### Photodetectors

Session Chair: **Seppo K. Honkanen**, Univ. of Eastern Finland (Finland)

3:30 pm: **High-performance AlAs<sub>0.56</sub>Sb<sub>0.44</sub> avalanche photodiodes** (*Invited Paper*), Xin Yi, The Univ. of Sheffield (United Kingdom); Shiyu Xie, Cardiff Univ. (United Kingdom); Baolai L. Liang, Univ. of California, Los Angeles (USA); Leh W. Lim, The Univ. of Sheffield (United Kingdom); Mukul C. Debnath, Univ. of California, Los Angeles (USA); Diana L. Huffaker, Cardiff Univ. (United Kingdom); Chee Hing Tan, John P. R. David, The Univ. of Sheffield (United Kingdom) ..... [11276-13]

4:00 pm: **Nanostructured germanium for near-infrared sensors with >99 % absorption up to 1600-nm wavelength**, Toni P. Pasanen, Joonas Isometsä, Aalto Univ. (Finland); Moises Garin, Aalto Univ. (Finland) and Univ. de Vic (Spain) and Univ. Politècnica de Catalunya (Spain); Kexun Chen, Ville Vähänissi, Caterina Soldano, Hele I. Savin, Aalto Univ. (Finland) ..... [11276-14]

4:20 pm: **High-sensitivity NIR photodiodes using black silicon**, Juha Heinonen, Antti Haarahiltunen, Michael Dov Serue, EIfys Oy (Finland); Ville Vähänissi, Toni P. Pasanen, Aalto Univ. (Finland); Mikko A. Juntunen, EIfys Oy (Finland); Hele I. Savin, Aalto Univ. (Finland); Lutz Werner, Physikalisch Technische Bundesanstalt (Germany) ..... [11276-15]

4:40 pm: **Dilute nitride photodetector arrays for sensing applications**, Sabeur Siala, Array Photonics, Inc. (USA) ..... [11276-16]

5:00 pm: **Broadband PureGaB Ge-on-Si photodiodes responsive in ultraviolet to near-infrared range**, Tihomir Knežević, Univ. of Zagreb (Croatia) and Univ. of Twente (Netherlands); Max Krakkers, Lis K. Nanver, Univ. of Twente (Netherlands) ..... [11276-17]

5:20 pm: **Characterization of HOT MWIR InAs/InAsSb T<sub>2</sub>SL discrete photodetectors**, Jongwoo Kim, Henry Yuan, Andrey Rummyantsev, Phillip Bey, David Bond, Joseph Kimchi, Mary Grace DeForest, Teledyne Judson Technologies (USA) ..... [11276-60]

WEDNESDAY 5 FEBRUARY

SESSION 5

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... WED 8:30 AM TO 10:00 AM

Rare-Earth-Doped Lasers

Session Chair: **Rolindes Balda**, Univ. del Pais Vasco (Spain)

- 8:30 am: **Modeling and parameter recovering of rare-earth-doped/co-doped glass and glass ceramics optical devices** (*Invited Paper*), Mario Christian Falconi, Dario Laneve, Politecnico di Bari (Italy); Lam Thi Ngoc Tran, Ho Chi Minh City Univ. of Technology and Education (Viet Nam); Lidia Zur, Alessandro Chiasera, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Fondazione Bruno Kessler (Italy); Rolindas Balda, Univ. del Pais Vasco (Spain); Joaquín Fernández, Donostia International Physics Ctr. (Spain); Pawel Gluchowski, Anna Lukowiak, Institute of Low Temperature and Structure Research PAN (Poland); Maurizio Ferrari, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Fondazione Bruno Kessler (Italy); Francesco Prudeniano, Politecnico di Bari (Italy) ..... [11276-18]
- 9:00 am: **Low NA large-mode-area neodymium-doped fiber fabricated by SPCVD for efficient laser operation near 900nm**, Alexandre Barnini, iXblue SAS (France); Kilian Le Corre, iXblue SAS (France) and Ctr. de Recherche sur les Ions, les Matériaux et la Photonique (France); Mathieu Laroche, Ctr. de Recherche sur les Ions, les Matériaux et la Photonique (France); Louanne Kervella, Pascal Guittton, Thierry Robin, iXblue SAS (France) ..... [11276-19]
- 9:20 am: **Double line neodymium-doped GeO<sub>2</sub>-PbO waveguide amplifier for the second telecom window**, Diego S. da Silva, Faculdade de Tecnologia de São Paulo (Brazil); Niklaus U. Wetter, Wagner de Rossi, Instituto de Pesquisas Energéticas e Nucleares (Brazil); Luciana Reyes P. Kassab, Faculdade de Tecnologia de São Paulo (Brazil) ..... [11276-20]
- 9:40 am: **Polydispersed Nd<sup>3+</sup>:YVO<sub>4</sub>/SiO<sub>2</sub> powders for highly efficient random lasers**, Niklaus U. Wetter, Ernesto Jiménez Villar, Danilo A. A. da Silva, Jéssica Dipold, Instituto de Pesquisas Energéticas e Nucleares (Brazil) ..... [11276-21]
- Coffee Break ..... Wed 10:00 am to 10:30 am

SESSION 6

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... WED 10:30 AM TO 11:50 AM

Optical Properties of Materials

Session Chair: **Michel J. F. Digonnet**, Stanford Univ. (USA)

- 10:30 am: **Thermal annealing behavior of arsenic selenide thin films**, Anthony R. Clabeau, Univ. Research Foundation (USA); Jason D. Myers, Jesse A. Frantz, U.S. Naval Research Lab. (USA); Robel Y. Bekele, Univ. Research Foundation (USA); Vinh Q. Nguyen, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA) ..... [11276-22]
- 10:50 am: **Graphene material characterisation for optofluidic applications**, Michelle Del Rosso, Univ. of Guelph (Canada) ..... [11276-23]
- 11:10 am: **Magneto-optical properties of diamagnetic glasses and paramagnetic glasses in the 2µm region**, Masoud Mollaei, The Univ. of Arizona (USA) and NP Photonics, Inc. (USA); Xiushan Zhu, Pierre Lucas, The Univ. of Arizona (USA); Nick O'Brien, NP Photonics, Inc. (USA); Michal L. Lukowski, Julien Ari, Nasser N. Peyghambarian, The Univ. of Arizona (USA) ..... [11276-24]
- 11:30 am: **Breaking the silica ceiling: ZBLAN-based opportunities for photonics applications**, Ioana Cozmuta, G-Space Inc. (USA); Solenn Cozic, Marcel Poulain, Samuel Poulain, Le Verre Fluoré (France) ..... [11276-25]
- Lunch/Exhibition Break ..... Wed 11:50 am to 1:20 pm

SESSION 7

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... WED 1:20 PM TO 3:10 PM

Lasers and Amplifiers

Session Chair: **Jesse A. Frantz**, U.S. Naval Research Lab. (USA)

- 1:20 pm: **Reconsidering nanoparticles in optical fibers** (*Invited Paper*), Wilfried Blanc, Zhuorui Lu, Institut de Physique de Nice (France); Manuel Vermillac, Ecole Centrale de Nantes (France); Jorel Fourmont, Univ. d'Angers (France); Isabelle Martin, Hugues François Saint-Cyr, CAMECA Instruments, Inc. (USA); Carlo Molardi, Daniele Tosi, Nazarbayev Univ. (Kazakhstan); Andrea Piarresteguy, Institut Charles Gerhardt Montpellier (France); Franck Mady, Mourad Benabdesselam, Institut de Physique de Nice (France); Franck Pigeonneau, MINES ParisTech (France); Stéphane Chaussement, Univ. d'Angers (France); Christelle Guillermier, Carl Zeiss SMT Inc. (USA) ..... [11276-26]
- 1:50 pm: **Active materials and components for fiber lasers: results from COST MP1401 European network activities**, Lidia Zur, Fondazione Bruno Kessler (Italy) and CNR-Istituto di Fotonica e Nanotecnologie (Italy); Hrvoje Gebavi, Institut Ruder Boškovic (Croatia); Kay Schuster, Leibniz-Institut für Photonische Technologien e.V. (Germany); Maurizio Ferrari, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Virginie Nazabal, Univ. de Rennes 1 (France); Stefano Taccheo, Swansea Univ. (United Kingdom) ..... [11276-27]
- 2:10 pm: **Mode suppression in graphene oxide-doped microcavities fabricated by two-photon polymerization**, Nathália B. Tomazio, Kelly Tasso, Franciele R. Henrique, Ruben D. Fonseca Rodriguez, Instituto de Física de São Carlos, Univ. de São Paulo (Brazil); Miguel V. Andrés, Univ. de València (Spain); Cleber R. Mendonça, Instituto de Física de São Carlos, Univ. de São Paulo (Brazil) ..... [11276-28]
- 2:30 pm: **Continuous linewidth tuning of a laser source from single frequency to over 30GHz using phase modulation amplification using cascaded four-wave mixing**, B. S. Vikram, Roopa Prakash, V. R. Supradeepa, Indian Institute of Science (India) ..... [11276-29]
- 2:50 pm: **Hundreds of meter-long low-loss silicon-core optical fiber**, Laurent Bigot, Maryna Kudinova, Rémi Habert, Karen Baudelle, Rémy Bernard, Bertrand Chazallon, Andy Cassez, Hicham El Hamzaoui, Olivier Vanvincq, CNRS (France) and Univ. de Lille (France); Johann Troles, CNRS (France) and Univ. de Rennes 1 (France); Géraud Bouwmans, CNRS (France) and Univ. de Lille (France) ..... [11276-30]
- Coffee Break ..... Wed 3:10 pm to 3:30 pm

SESSION 8

LOCATION: ROOM 313 (LEVEL 3 SOUTH) ..... WED 3:30 PM TO 6:00 PM

Sensors

Session Chair: **Shibin Jiang**, AdValue Photonics, Inc. (USA)

- 3:30 pm: **A high-beam-quality high-pulse-energy picosecond laser system for high-precision ultra-remote laser ranging** (*Invited Paper*), Jie Li, Academy of Opto-Electronics (China); Zhongwei Fan, Academy of Opto-Electronics, Chinese Academy of Sciences (China); Yutao Huang, Xiaochao Yan, Guoguang Yan, Zhenao Bai, Academy of Opto-Electronics (China); Jianguo He, Academy of Opto-Electronics, Chinese Academy of Sciences (China); Tianzhuo Zhao, Hongbo Zhang, Academy of Opto-Electronics (China) ..... [11276-31]
- 4:00 pm: **High-temperature enhanced Rayleigh scattering optical fiber sensor for borehole applications**, Hongchao Wu, Kenneth S. Feder, Andrei A. Stolov, Scott D. Shenk, Eric M. Monberg, Debra A. Simoff, OFS Fitel, LLC (USA) ..... [11276-32]
- 4:20 pm: **High-sensitivity refractive index sensing using an Axicon lens structure**, Manar Abdel-Galil, Ain Shams Univ. (Egypt); Mohamed A. Swillam, Yehea Ismail, The American Univ. in Cairo (Egypt); Diaa Khalil, Ain Shams Univ. (Egypt) ..... [11276-33]
- 4:40 pm: **Suspended InGaAs membrane waveguide devices with subwavelength gratings and photonic crystal structures for ammonia sensing at λ=6.15µm**, Kyoung Min Yoo, Jason Midkiff, Ali Rostamian, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA) ..... [11276-34]
- 5:00 pm: **Enhanced modal interference in negative curvature fiber and its application to curvature sensing**, Charu Goel, Seongwoo Yoo, Nanyang Technological Univ. (Singapore) ..... [11276-35]
- 5:20 pm: **Synthetic diamond lenses for IR and multispectral imaging**, Frederick Faulkner, Alexander Muhr, Element Six Technologies U.S. Corp. (USA) ..... [11276-36]
- 5:40 pm: **OCT measurement of aspheric polymer lenses for adaptive assembly of micro optical imaging objectives**, Max Riediger, Marvin Berger, Maximilian Hoeren, Niels König, Daniel Zontar, Christian Brecher, Robert H. Schmitt, Fraunhofer-Institut für Produktionstechnologie IPT (Germany) ..... [11276-37]

OPTO

# CONFERENCE 11276

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Investigation of phosphate glasses for white-light emission,** Mersaydes Goodson, Bommareddi Rami Reddy, Alabama A&M Univ. (USA) . . . . . [11276-45]

**Parity-time symmetry laser with nanocolloidal gain medium,** Darayas Patel, Sharon Parkins, Kaiana Lewis, Sean Walker, Dedrian Barrett, Andrew Dholicand, Morgan Narain, Oakwood Univ. (USA); Sergey S. Sarkisov, SSS Optical Technologies, LLC (USA); Abdalla M. Darwish, Dillard Univ. (USA) . . . . . [11276-46]

**Chromium-doped luminescent borate glass and glass-ceramics for optoelectronic devices,** Anastasiia N. Babkina, ITMO Univ. (Russian Federation); Damir Valiev, National Research Tomsk Polytechnic Univ. (Russian Federation); Ksenia Zyryanova, Rustam Nuryev, Daria Agafonova, ITMO Univ. (Russian Federation); Andrei Afonyushkin, Laser Ctr. (Russian Federation) . . . . . [11276-47]

**Materials development and IR emission properties of Dy-doped TIPb<sub>2</sub>Br<sub>5</sub> and CsPbCl<sub>3</sub>,** Uwe H. Hömmerich, Daniel Hart, Hampton Univ. (USA); Clayton S. C. Yang, Sudhir B. Trivedi, Brimrose Technology Corp. (USA); Al Amin Kabir, Hampton Univ. (USA) . . . . . [11276-48]

**Characterization of a Sagnac-loop mirror-based hybrid passive variable optical coupler/attenuator,** Simeon Bikorimana, The City College of New York (USA); Muhammad A. Ummayy, New York City College of Technology (USA); Abdullah Hossain, The City College of New York (USA); Richard Lin, New York City College of Technology (USA); Roger Dorsinville, The City College of New York (USA) . . . . . [11276-49]

**Fabrication of a tellurite hollow-core optical fiber for mid-infrared transmission,** Hoang Tuan Tong, Nobuhiko Nishiharaguchi, Takenobu Suzuki, Yasutake Ohishi, Toyota Technological Institute (Japan) . . . . . [11276-50]

**Optical properties of a tapered optical fiber with liquid-crystal cladding doped gold nanoparticles,** Joanna E. Mos, Karol A. Stasiewicz, Katarzyna Garbat, Leszek R. Jaroszewicz, Wojskowa Akademia Techniczna im. Jaroslawa Dabrowskiego (Poland) . . . . . [11276-51]

**Observation of second-order reflection band from cholesteric liquid-crystal using wideband wavelength-swept laser,** Soyeon Ahn, Myeong Ock Ko, Jong-Hyun Kim, Min Yong Jeon, Chungnam National Univ. (Korea, Republic of) . . . . . [11276-52]

**Compact passive photonic filter using an MZI,** Muhammad Favad Qadir, Fahad Malik, Aftab Hussain, Muhammad Zakwan, Air Univ. (Pakistan) [11276-53]

**Fabrication and gain evaluation for polymer waveguide optical amplifier incorporated with europium-aluminum polymer composite,** Toshifumi Horie, Takaaki Ishigure, Keio Univ. (Japan) . . . . . [11276-54]

**Optimally designed narrow-band guided-mode resonance transmittance filters for label-free optical biosensor,** Phuc Toan Dang, Chonbuk National Univ. (Korea, Republic of); Khai Quang Le, Truong Khang Nguyen, Ton Duc Thang Univ. (Viet Nam); Ji-Hoon Lee, Chonbuk National Univ. (Korea, Republic of) . . . . . [11276-55]

**Custom high-sensitivity CCD and sCMOS detectors for high-harmonic generation, x-ray absorption spectroscopy, and soft x-ray microscopy/tomography,** Adam J. Wise, Justin T. Cooper, Andor Technology Ltd. (USA) . . . . . [11276-56]

**Ultrathin Cu/Au alloy as broad spectral infrared absorber,** Niklas Luhmann, Markus Piller, Miao-Hsuan Chien, Silvan Schmid, Technische Univ. Wien (Austria) . . . . . [11276-57]

**Direct laser writing of unidirectional upconversion signal emitters,** Abhishek K. Kottaram Amrithanath, Sridhar Krishnaswamy, Northwestern Univ. (USA) . . . . . [11276-58]

**Persistent luminescence features in hexagonal Sr<sub>1-x/2</sub>Al<sub>2-x</sub>Si<sub>x</sub>O<sub>4</sub>:Eu<sup>2+</sup>, Dy<sup>3+</sup> phosphors,** Victor Castaing, École Nationale Supérieure de Chimie de Paris (France); Charlotte Monteiro, Conditions Extrêmes et Matériaux: Haute température et Irradiation, CNRS (France) and Univ. d'Orléans (France); Mathieu Allix, Univ. d'Orléans (France) and Conditions Extrêmes et Matériaux: Haute température et Irradiation, CNRS (France); Bruno Viana, École Nationale Supérieure de Chimie de Paris (France) . . . . . [11276-59]

**High-temperature thermal stability of AlInN alloys nearly lattice-matched to GaN/sapphire grown via MOVPE,** Damir Borovac, Wei Sun, Renbo Song, Jonathan J. Wierer Jr., Nelson Tansu, Lehigh Univ. (USA) . . . . . [11276-61]

**Monitoring the refractive index mismatch of muscle tissue under pressure by total internal reflection microscopy,** Zhichao Deng, Jin Wang, Shike Liu, Jianchun Mei, Qing Ye, Jianguo Tian, Nankai Univ. (China) [11276-62]

**Scale law of far-field thermal radiation from plasmonic metasurfaces,** Jiayu Li, Bowen Yu, Sheng Shen, Carnegie Mellon Univ. (USA) . . . . . [11276-63]

**Degenerate quasi-normal mode theory for near-field radiation between plasmonic structures,** Jiayu Li, Sheng Shen, Carnegie Mellon Univ. (USA) . . . . . [11276-64]

## THURSDAY 6 FEBRUARY

### SESSION 9

LOCATION: ROOM 313 (LEVEL 3 SOUTH) . . . . . THU 9:00 AM TO 10:00 AM

### Nanoparticles

Session Chair: **Michel J. F. Digonnet**, Stanford Univ. (USA)

9:00 am: **Photonic glass ceramics based on SnO<sub>2</sub> nanocrystals: advances and perspectives** (*Invited Paper*), Lam Thi Ngoc Tran, HCMC Univ. of Technology and Education (Viet Nam); Cristina Armellini, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Rolindas Balda, Univ. del Pais Vasco (Spain) and Ctr. de Fisica de Materiales (Spain); Mourad Benabdesselam, Institut de Physique de Nice (France); Simone Berneschi, Istituto di Fisica Applicata "Nello Carrara" (Italy); Wilfried Blanc, Institut de Physique de Nice (France); Brigitte Boulard, Institut des Molécules et Matéria (France); Alessandro Carpentiero, Andrea Chiappini, Alessandro Chiasera, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Paola Dentella, Politecnico di Milano (Italy); Dominik Dorosz, AGH Univ. of Science and Technology (Poland); Shane Eaton, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Politecnico di Milano (Italy); Mario Christian Falconi, Politecnico di Bari (Italy); Joaquin Fernández, Donostia International Physics Ctr. (Spain); Maurizio Ferrari, CNR-Istituto di Fotonica e Nanotecnologie (Italy); James Gates, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom); Pawel Gluchowski, Institute of Low Temperature and Structure Research PAN (Poland); Gloria Ischia, Univ. degli Studi di Trento (Italy); Anna Lukowiak, Institute of Low Temperature and Structure Research PAN (Poland); Franck Mady, Institut de Physique de Nice, Ctr. National de la Recherche Scientifique (France) and Univ. Côte d'Azur (France); Damiano Massella, Univ. de Vigo (Spain); Gualtiero Nunzi Conti, Istituto di Fisica Applicata "Nello Carrara" (Italy); Francesco Prudeniano, Politecnico di Bari (Italy); Barbara Rossi, Elettra-Sincrotrone Trieste S.C.p.A. (Italy); Roberta Ramponi, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Giancarlo C. Righini, Museo Storico della Fisica e Ctr. Studi e Ricerche "Enrico Fermi" (Italy); Pier-John Sazio, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom); Giorgio Speranza, Fondazione Bruno Kessler (Italy); Stefano Varas, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Fondazione Bruno Kessler (Italy); Daniele Zonta, Univ. degli Studi di Trento (Italy) and Univ. of Strathclyde (United Kingdom) and CNR-Istituto di Fotonica e Nanotecnologie (Italy); Lidia Zur, CNR-Istituto di Fotonica e Nanotecnologie (Italy) and Fondazione Bruno Kessler (Italy) . . . . . [11276-38]

9:20 am: **Continuous-wave pumped biexciton emission in copper-doped colloidal quantum wells,** Junhong Yu, Manoj Sharma, Mingjie Li, Pedro Hernández-Martínez, Savas Delikanli, Ashma Sharma, Nanyang Technological Univ. (Singapore); Yemilhi Altintas, Bilkent Univ. (Turkey); Chaturanga Hettiarachchi, TzeChien Sum, Hilmi Demir, Cuong H. Dang, Nanyang Technological Univ. (Singapore) . . . . . [11276-39]

9:40 am: **Augmentation of magnetic-field-induced birefringence and chain formation in a magnetic fluid by the addition of silica nanoparticles,** Urveshkumar Soni, Rucha Desai, Nidhi Ruparelia, Charotar Univ. of Science and Technology (CHARUSAT) (India) . . . . . [11276-40]

Coffee Break. . . . . Thu 10:00 am to 10:30 am

### SESSION 10

LOCATION: ROOM 313 (LEVEL 3 SOUTH) . . . . . THU 10:30 AM TO 11:40 AM

### Nanostructures

Session Chair: **Michel J. F. Digonnet**, Stanford Univ. (USA)

10:30 am: **3D printing of chalcogenide glasses: an original way for the elaboration of microstructured preforms and optical fibers** (*Invited Paper*), Johann Troles, Julie Carcreff, Francois Chevre, Elodie Galdó, Ronan Lebullenger, Antoine Gautier, Jean-Luc Adam, Univ. de Rennes 1 (France) and Institut des Sciences Chimiques de Rennes, Ctr. National de la Recherche Scientifique (France); Laurent Brilland, SelenOptics (France); Gilles Renversez, Aix-Marseille Univ. (France) . . . . . [11276-41]

11:00 am: **Back and forth Förster resonance energy transfer in a binary nanomaterial complex,** Junhong Yu, Manoj Sharma, Savas Delikanli, Muhammad Birowosuto, Hilmi Demir, Cuong H. Dang, Nanyang Technological Univ. (Singapore) . . . . . [11276-43]

11:20 am: **Optical scattering measurements of random anti-reflection subwavelength surface structures on binary gratings,** Praneeth Gadamsetti, Karteek Kunal, Menelaos K. Poutous, The Univ. of North Carolina at Charlotte (USA) . . . . . [11276-44]

# CONFERENCE 11277

LOCATION: ROOM 305 (LEVEL 3 SOUTH)

Wednesday–Thursday 5–6 February 2020 • Proceedings of SPIE Vol. 11277

## Organic Photonic Materials and Devices XXII

Conference Chairs: **Christopher E. Tabor**, Air Force Research Lab. (USA); **François Kajzar**, Univ. Politehnica of Bucharest (Romania); **Toshikuni Kaino**, Tohoku Univ. (Japan)

Conference Co-Chair: **Okihiro Sugihara**, Utsunomiya Univ. (Japan)

Program Committee: **Chantal Andraud**, Ecole Normale Supérieure de Lyon (France); **Werner J. Blau**, Trinity College Dublin (Ireland); **Ken Caster**, Air Force Office of Scientific Research (USA); **Fabrice Charra**, CEA (France); **Beata J. Derkowska-Zielinska**, Nicolaus Copernicus Univ. (Poland); **Raluca Dinu**, GigPeak, Inc. (USA); **Manfred Eich**, Technische Univ. Hamburg-Harburg (Germany); **James G. Grote**, Air Force Research Lab. (USA); **Alex K. Y. Jen**, Univ. of Washington (USA); **Michael H. C. Jin**, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); **Eunyoung Kim**, Yonsei Univ. (Korea, Republic of); **Jang-Joo Kim**, Seoul National Univ. (Korea, Republic of); **Junya Kobayashi**, NTT Advanced Technology Corp. (Japan); **Yasuhiro Koike**, Keio Univ. (Japan); **Isabelle Ledoux-Rak**, Lab. de Photonique Quantique et Moléculaire (France); **Kwang-Sup Lee**, Hannam Univ. (Korea, Republic of); **Misoon Y. Mah**, Asian Office of Aerospace Research and Development (Japan); **Seth R. Marder**, Georgia Institute of Technology (USA); **Antoni C. Mitus**, Wrocław Univ. of Science and Technology (Poland); **Jaroslav Mysliwiec**, Wrocław Univ. of Science and Technology (Poland); **Robert A. Norwood**, College of Optical Sciences, The Univ. of Arizona (USA); **Jean-Michel Nunzi**, Queen's Univ. (Canada); **Shuji Okada**, Yamagata Univ. (Japan); **Akira Otomo**, National Institute of Information and Communications Technology (Japan); **Lada N. Puntus**, Kotelnikov Institute of Radio Engineering and Electronics of RAS (Russian Federation); **Ileana Rau**, Univ. Politehnica of Bucharest (Romania); **Niyazi Serdar Sariciftci**, Johannes Kepler Univ. Linz (Austria); **Devanand K. Shenoy**, U.S. Dept. of Energy (USA); **William M. Shensky III**, U.S. Army Research Lab. (USA); **Kenneth D. Singer**, Case Western Reserve Univ. (USA); **Rebecca E. Taylor**, Lockheed Martin Space Systems Co. (USA); **Jeong-Weon Wu**, Ewha Womans Univ. (Korea, Republic of); **Shiyoshi Yokoyama**, Kyushu Univ. (Japan); **Roberto Zamboni**, Istituto per la Sintesi Organica e la Fotoreattività (Italy); **Wei Zhou**, Virginia Polytechnic Institute and State Univ. (USA)

### WEDNESDAY 5 FEBRUARY

#### SESSION 1

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... WED 8:00 AM TO 9:25 AM

#### 3D Printing

Session Chair: **Christopher E. Tabor**, Air Force Research Lab. (USA)

8:00 am: **3D-printed multi-layered soft actuators with embedded photo-responsive molecules** (*Invited Paper*), Alberto Portone, Istituto Nanoscienze (Italy); Chiara De Donno, Stefania Marconi, Giulia Scalet, Univ. degli Studi di Pavia (Italy); Luana Persano, Istituto Nanoscienze (Italy); Ferdinando Auricchio, Univ. degli Studi di Pavia (Italy); Dario Pisignano, Univ. di Pisa (Italy); Andrea Camposeo, Istituto Nanoscienze (Italy) ..... [11277-1]

8:25 am: **Additive manufacturing of a ceramic micro-tool by two-photon polymerization of a low-shrinkage pre-ceramic polymer**, Georgia Konstantinou, Eirini Kakkava, Lorenz Hagelüken, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Pradeep Vallachira Warriam, EMPA (Switzerland); Jieping Wang, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Malgorzata Grazyna Makowska, Paul Scherrer Institut (Switzerland); Giulia Panusa, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Jakob Kübler, EMPA (Switzerland); Helena Moens Van Swyghoven, Paul Scherrer Institut (Switzerland); Jürgen Brugger, Demetri Psaltis, Christophe Moser, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11277-2]

8:45 am: **Can one 3D print a laser?**, Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany) ..... [11277-3]

9:05 am: **Additive manufactured organic light-emitting diodes**, Christian Eder, Andreas Heinrich, Manuel Rank, Zentrum für Optische Technologien, Hochschule Aalen - Technik und Wirtschaft (Germany) ..... [11277-4]

#### SESSION 2

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... WED 9:25 AM TO 10:25 AM

#### Photo Excitations

Session Chair: **Francois Hache**, Lab. d'Optique et Biosciences (France)

9:25 am: **Optical analysis of a 3D-printed photoluminescent chip**, Sangeetha Suresh Nair, Lisa Maria Batha, Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany) ..... [11277-5]

9:45 am: **Rewritable luminescent tags using room-temperature phosphorescence (RTP)**, Max Gmelch, Heidi Thomas, Felix Fries, Tim Achenbach, Sebastian Reineke, TU Dresden (Germany) ..... [11277-6]

10:05 am: **The importance of statistics for photoluminescence quantum yield measurements**, Felix Fries, Heidi Thomas, Max Gmelch, Tim Achenbach, Sebastian Reineke, TU Dresden (Germany) ..... [11277-7]

Coffee Break. .... Wed 10:25 am to 10:55 am

#### SESSION 3

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... WED 10:55 AM TO 12:10 PM

#### Nano Materials

Session Chair: **Kwang-Sup Lee**, Hannam Univ. (Korea, Republic of)

10:55 am: **Nanophase separation as a new method to prepare hierarchically ordered polymer films** (*Invited Paper*), Jun Matsui, Yamagata Univ. (Japan) ..... [11277-8]

11:20 am: **Continuous roll imprinting of moth-eye antireflection surface using anodic porous alumina and multi-functionalities on the moth-eye surface** (*Invited Paper*), Yoshihiro Uozu, Mitsubishi Chemical Corp. (Japan) ..... [11277-9]

11:45 am: **Photonic networks and lasers made of organic and nanocomposite nanowires** (*Invited Paper*), Alberto Portone, Francesca Martino, Andrea Camposeo, Luana Persano, Istituto Nanoscienze (Italy); Dario Pisignano, Univ. di Pisa (Italy) and Istituto Nanoscienze, CNR (Italy) ..... [11277-10]

Lunch/Exhibition Break ..... Wed 12:10 pm to 1:40 pm

#### SESSION 4

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... WED 1:40 PM TO 3:25 PM

#### New Materials

Session Chair: **Okihiro Sugihara**, Utsunomiya Univ. (Japan)

1:40 pm: **Organics, polymers, and organic-inorganic hybrid materials with optoelectronic functions: a personal journey from fundamentals to applications** (*Keynote Presentation*), Kwang-Sup Lee, Hannam Univ. (Korea, Republic of) ..... [11277-11]

2:20 pm: **Plasmonic organic-inorganic nanocomposite particles for on-demand SERS sensing** (*Invited Paper*), Hiroshi Yabu, Tohoku Univ. (Japan) ..... [11277-12]

2:45 pm: **Controlling energy transfer routes in dye-sensitized lanthanide-based luminescent nanoparticles**, Flavia Artizzu, Rik Van Deun, Pieter Geiregat, Univ. Gent (Belgium); Luca Pilia, Univ. degli Studi di Cagliari (Italy); Jing Liu, Univ. Gent (Belgium) ..... [11277-13]

3:05 pm: **Transparent photothermal heaters using NIR absorbing dyes**, Minsu Han, Hwandong Jang, Eunyoung Kim, Yonsei Univ. (Korea, Republic of) ..... [11277-14]

Coffee Break. .... Wed 3:25 pm to 4:00 pm

# CONFERENCE 11277

## SESSION 5

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... WED 4:00 PM TO 5:45 PM

### EO Materials and Devices

Session Chair: **James G. Grote**, Air Force Research Lab. (USA)

4:00 pm: **2D supramolecular self-assembly strategies towards functional graphene-based surfaces for (nano)photonics** (*Invited Paper*), Sylvain LeLiepvre, Fabrice Charra, CEA (France); Ping Du, Imad Arfaoui, Céline Paris, Sorbonne Univ. (France); Cheolyun Cho, Byeongwan Kim, Eunkyong Kim, Yonsei Univ. (Korea, Republic of); André-Jean Attias, CNRS (France) and Sorbonne Univ. (France) and Yonsei Univ. (Japan) ..... [11277-15]

4:25 pm: **Development of EO polymer/Si hybrid optical modulators for O-band datacom applications**, Akira Otomo, Isao Aoki, Chiyumi Yamada, Hideo Yokohama, Toshiaki Yamada, National Institute of Information and Communications Technology (Japan); Hidehisa Tazawa, Yasunori Murakami, Sumitomo Electric Industries, Ltd. (Japan) ..... [11277-17]

4:45 pm: **High-thermal stable poly(norbornene-dicarboximide) for electro-optic polymer modulator**, Alisa Bannaron, Andrew Spring, Shiyoshi Yokoyama, Kyushu Univ. (Japan) ..... [11277-18]

5:05 pm: **Continuous-wave terahertz detectors using electro-optic polymer waveguides and gold antenna arrays**, Takahiro Kaji, Isao Morohashi, Yukihiko Tominari, Yoh Ogawa, Norihiko Sekine, Toshiaki Yamada, Akira Otomo, National Institute of Information and Communications Technology (Japan) ..... [11277-19]

5:25 pm: **Surface plasmon enhanced switching kinetics of organic photochromic films on holey electrodes for optoelectronic applications**, Bohdan Lenyk, Forschungszentrum Jülich GmbH (Germany) and Univ. Konstanz (Germany); Johannes Boneberg, Mikhail Kabdulov, Elke Scheer, Thomas Huhn, Univ. Konstanz (Germany); Andreas Offenhausser, Dirk Mayer, Forschungszentrum Jülich GmbH (Germany) ..... [11277-52]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

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**A beam modulation in the multilayer parabolic bio-nanostructures of the eye of the firefly**, Cheng-Hao Ko, KueiJen Lee, Graduate Institute of Automation and Control, National Taiwan Univ. of Science and Technology (Taiwan) ..... [11277-40]

**Development of IOT mechanical device for fabrication of tapers and gratings using CO<sub>2</sub> IR laser**, Carlota Bujanos Buenrostro, José Valentín Guzmán-González, Mauricio Axel Rodríguez Alvarado, Arturo Castillo, Romeo de Jesús Selvas, Daniel Toral Acosta, Univ. Autónoma de Nuevo León (Mexico) ..... [11277-41]

**Tandem structure consisting of phthalocyanine on inorganic films**, Hal S. Gokturk, Ecoken (USA) ..... [11277-42]

**An annealing freehole interfacial layer for high-performance inverted perovskite solar cells with long-term air stability**, Binrui Xu, Hyun-Min Jeong, Sae-Wan Kim, Ju-Seong Kim, Jin-Beom Kwon, Shin-Won Kang, Kyungpook National Univ. (Korea, Republic of) ..... [11277-43]

**Development of a new polymer (OSTE+) optical waveguide for evanescent wave absorption-based photonic sensors**, Sonatan Das, Amrit Patnaik, Ctr. for Research in Nanotechnology and Sciences, Indian Institute of Technology Bombay (India); Tapanendu Kundu, Indian Institute of Technology Bombay (India); V. Ramgopal Rao, Indian Institute of Technology Delhi (India) ..... [11277-44]

**Tandem structured 3-color micro-polymer light-emitting diodes ( $\mu$ -PLEDs)**, KeunYeong Choi, Soongsil Univ. (Korea, Republic of); Han Wool Park, Do Hwan Kim, Hanyang Univ. (Korea, Republic of); Hojin Lee, Soongsil Univ. (Korea, Republic of) ..... [11277-45]

**Highly stretchable organic light-emitting diodes using patterned nanomesh electrode**, Tae Hoon Park, Kyung Rock Son, Ho Jin Lee, Wanqi Ren, Tae Geun Kim, Korea Univ. (Korea, Republic of) ..... [11277-47]

**Highly flexible blue TADF OLEDs using IZO/Ag/IZO nanomesh electrodes**, Tae Geun Kim, Ho Jin Lee, Kyung Rock Son, Byeong Ryong Lee, Tae Hoon Lee, Ashkan Vakilipour Takaloo, Korea Univ. (Korea, Republic of) ..... [11277-48]

**Universal strategy for Ohmic charge injection into organic semiconductors**, Naresh Kotadiya, Max-Planck-Institut für Polymerforschung (Germany) ..... [11277-49]

**Preparation of p-doped graphene layer for an organic light-emitting transistor**, Junhyoung Kim, Minsu Han, Eunkyong Kim, Yonsei Univ. (Korea, Republic of) ..... [11277-50]

**Improving the photoresponse of organic polarization-sensitive materials by dimerizing the chromophore component**, Irakli Chaganava, Institute of Cybernetics, Georgian Technical Univ. (Georgia) and Georgian State Univ. of Physical Education and Sport (Georgia); Natia Gogia, Irine Kobulashvili, Institute of Cybernetics, Georgian Technical Univ. (Georgia); Qi-Huo Wei, Southern Univ. of Science and Technology (China) ..... [11277-51]

**Horizontally oriented dipole ratio of organic light-emitting material in top-emitting OLEDs for achieving the same efficiency and color gamut as QD electroluminescent display**, Hyunsu Cho, Chan-mo Kang, Byoung-Hwa Kwon, Sukyung Choi, Chul Woong Joo, Hyunwoo Lee, Electronics and Telecommunications Research Institute (Korea, Republic of) ... [11277-53]

## THURSDAY 6 FEBRUARY

### SESSION 6

LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... THU 8:00 AM TO 10:15 AM

### Nonlinear Optics

Session Chair: **Christoph Bubeck**, Max-Planck-Institut für Polymerforschung (Germany)

8:00 am: **Light amplification and white lasing in tunable multicolor liquid crystalline systems** (*Invited Paper*), Jaroslaw Mysliwiec, Wroclaw Univ. of Science and Technology (Poland); Alina Adamow, Adam Szukalski, Wroclaw Univ. of Science and Technology (Poland) and NEST, Istituto Nanoscienze, Consiglio Nazionale delle Ricerche (Italy); Lech Sznitko, Wroclaw Univ. of Science and Technology (Poland); Luana Persano, NEST, Istituto Nanoscienze, Consiglio Nazionale delle Ricerche (Italy); Dario Pisignano, Univ. di Pisa (Italy) and NEST, Istituto Nanoscienze, Consiglio Nazionale delle Ricerche (Italy); Andrea Camposeo, NEST, Istituto Nanoscienze, Consiglio Nazionale delle Ricerche (Italy) ..... [11277-20]

8:25 am: **Nonlinear optical organic and organometallic dye development** (*Invited Paper*), Joy E. Haley, Air Force Research Lab. (USA); Douglas M. Krein, Air Force Research Lab. (USA) and General Dynamics Information Technology (USA); Jonathan E. Slagle, Matthew J. Dalton, Air Force Research Lab. (USA); Ramamurthi Kannan, Air Force Research Lab. (USA) and UES, Inc. (USA); Tod A. Grusenmeyer, Air Force Research Lab. (USA); Zhenning Yu, Air Force Research Lab. (USA) and UES, Inc. (USA); Christopher L. McCleese, Steven M. Wolf, Air Force Research Lab. (USA) and General Dynamics Information Technology (USA); Loon-Seng Tan, Thomas M. Cooper, Air Force Research Lab. (USA) ..... [11277-21]

8:50 am: **Characterization of the ultrafast nonlinear response of new organic compounds** (*Invited Paper*), David J. Hagan, Salimeh Tofighi, Sepehr A. Benis, Mikhail V. Bondar, Eric W. Van Stryland, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) ..... [11277-22]

9:15 am: **Transmission of 43-Gb/s optical signals through a single-mode polymer waveguide for LAN-WDM**, Satoshi Suda, Takayuki Kurosu, Akihiro Noriki, Takeru Amano, National Institute of Advanced Industrial Science and Technology (Japan) ..... [11277-23]

9:35 am: **Kinetics of energy transfer and acceptor dimerization in a bichromophore system**, Timothy M. Pritchett, Ryan M. O'Donnell, U.S. Army Combat Capabilities Development Command, U.S. Army Research Lab. (USA) ..... [11277-24]

9:55 am: **Aza-BODIPY dyes for optical power limitation in the SWIR: molecular engineering for optimized hybrid materials**, Sylvain David, Ecole Normale Supérieure de Lyon (France) and Thales LAS France SAS (France); Denis Château, Ecole Normale Supérieure de Lyon (France); Hampus Lundén, FOI-Swedish Defence Research Agency (Sweden); Hao-Jung Chang, David J. Hagan, Eric W. Van Stryland, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Denis Jacquemin, CEISAM, Univ. de Nantes (France); Cesar Lopes, FOI-Swedish Defence Research Agency (Sweden); Gérard Berginc, Thales LAS France SAS (France); Stéphane Parola, Olivier Maury, Chantal Andraud, Ecole Normale Supérieure de Lyon (France) ..... [11277-25]

Coffee Break. .... Thu 10:15 am to 10:45 am

**SESSION 7**

**LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... THU 10:45 AM TO 12:15 PM**

**Solar Cells**

Session Chair: **David J. Hagan**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

10:45 am: **Photoluminescence, electroluminescence, and scintillation of halide perovskites** (*Invited Paper*), Cuong H. Dang, Aozhen Xie, Nanyang Technological Univ. (Singapore) and CNRS International-NTU-Thales Research Alliance (Singapore); Chathuranga Hettiarachchi, Nanyang Technological Univ. (Singapore); Francesco Maddalena, Muhammad Danang Birowosuto, Nanyang Technological Univ. (Singapore) and CNRS International-NTU-Thales Research Alliance (Singapore) ..... [11277-26]

11:10 am: **Properties and applications of hybrid organic-inorganic halide perovskites thin films** (*Invited Paper*), Anna Zawadzka, Agnieszka Marjanowska, Przemysław P?óciennik, Andrzej Korcala, Krzysztof Wisniewski, Nicolaus Copernicus Univ. (Poland); Bouchta Sahraoui, LUNAM Univ. (France) ..... [11277-27]

11:35 am: **Investigation of degradation in halide perovskite solar cells using correlative imaging combining the 3D OrbiSIMS and optical imaging**, Lidija Matjacic, Sebastian Wood, Alina Zoladek-Lemanczyk, George Koutsourakis, Filipe Richheimer, Fernando Castro, Rasmus Havelund, National Physical Lab. (United Kingdom); Nicola Beaumont, Oxford PV (United Kingdom); Bernard Wegner, Univ. of Oxford (United Kingdom); Ian Gilmore, National Physical Lab. (United Kingdom) ..... [11277-28]

11:55 am: **Ion-doped two-dimensional perovskite crystals for versatile radiation detection**, Aozhen Xie, Chathuranga Hettiarachchi, Nanyang Technological Univ. (Singapore); Francesco Maddalena, CNRS International NTU THALES Research Alliance (Singapore); Michal Makowski, Marcin E. Witkowski, Winicjusz Drozdowski, Nicolaus Copernicus Univ. (Poland); Arramel Arramel, National Univ. of Singapore (Singapore); Stuart V. Springham, National Institute of Education, Nanyang Technological Univ. (Singapore); Christophe Dujardin, Univ. Claude Bernard Lyon 1 (France); Muhammad Danang Birowosuto, CNRS International NTU THALES Research Alliance (Singapore); Cuong H. Dang, Nanyang Technological Univ. (Singapore) ..... [11277-29]

Lunch/Exhibition Break ..... Thu 12:15 pm to 1:15 pm

**SESSION 8**

**LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... THU 1:15 PM TO 3:05 PM**

**Biophotonics**

Session Chair: **François Kajzar**, Univ. Politehnica din Bucuresti (Romania)

1:15 pm: **Biopolymer charge carrier blocking layers for photonics and electronics** (*Keynote Presentation*), James G. Grote, Photonics and Electronics Engineering Research Consultant (USA); François Kajzar, Polymer Photonics Research Consultant (France) ..... [11277-30]

1:55 pm: **Unveiling excited-state chirality of binaphthols by sub-picosecond circular dichroism and quantum-chemical calculations** (*Invited Paper*), Francois Hache, Pascale Changenet, Lab. d'Optique et Biosciences (France) ..... [11277-31]

2:20 pm: **NIR biphotonic chromophores in the service of bio-imaging** (*Invited Paper*), Chantal Andraud, Ecole Normale Supérieure de Lyon (France) ..... [11277-32]

2:45 pm: **Self-assembled, flexible, and transient biomaterial disk lasers**, Itir Bakis Dogru, Rustamzhon Melikov, Sedat Nizamoglu, Koç Univ. (Turkey) ..... [11277-33]

Coffee Break ..... Thu 3:05 pm to 3:30 pm

**SESSION 9**

**LOCATION: ROOM 305 (LEVEL 3 SOUTH) ..... THU 3:30 PM TO 5:15 PM**

**OLEDs**

Session Chair: **Jaroslav Mysliwicz**, Wroclaw Univ. of Science and Technology (Poland)

3:30 pm: **Control of polymer-aggregate orientation in thin films by molecular weight and solution processing** (*Invited Paper*), Christoph Bubeck, Max-Planck-Institut für Polymerforschung (Germany); Yati Mardiyati, Institute of Technology Bandung (Indonesia) ..... [11277-34]

3:55 pm: **Organic light-emitting diodes for high-brightness operation: self-heating and switched-back regions**, Anton Kirch, Axel Fischer, Sebastian Reineke, Integrated Ctr. for Applied Physics and Photonic Materials, TU Dresden (Germany); Matthias Liero, Jürgen Fuhrmann, Annegret Glitzky, Weierstrass-Institut für Angewandte Analysis und Stochastik (Germany) ..... [11277-35]

4:15 pm: **Elucidate the mechanism of hole injection through molybdenum oxide in organic light-emitting diode**, Zingway Pei, Hsing-Yi Wu, National Chung Hsing Univ. (Taiwan) ..... [11277-37]

4:35 pm: **Optical dispersion study of PPDT2FBT by spectroscopic ellipsometry**, Chandan Q. Howlader, Mehedhi Hasan, Alex Zakhidov, Maggie Chen, Texas State Univ. (USA) ..... [11277-38]

4:55 pm: **Efficient and stable single-layer organic light-emitting diodes based on thermally activated delayed fluorescence**, Naresh Kotadiya, Max-Planck-Institut für Polymerforschung (Germany) ..... [11277-39]



**Photonics West Industry Stage**

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# CONFERENCE 11278

LOCATION: ROOM 308 (LEVEL 3 SOUTH)

Sunday–Tuesday 2–4 February 2020 • Proceedings of SPIE Vol. 11278

# Ultrafast Phenomena and Nanophotonics XXIV

Conference Chairs: **Markus Betz**, Technische Univ. Dortmund (Germany); **Abdulhakem Y. Elezabi**, Univ. of Alberta (Canada)

Program Committee: **Alan D. Bristow**, West Virginia Univ. (USA); **Keshav Dani**, Okinawa Institute of Science and Technology Graduate Univ. (Japan); **Jeff Davis**, Swinburne Univ. of Technology (Australia); **Kimberley C. Hall**, Dalhousie Univ. (Canada); **Rupert Huber**, Univ. Regensburg (Germany); **Robert A. Kaindl**, Lawrence Berkeley National Lab. (USA); **Dai-Sik Kim**, Seoul National Univ. (Korea, Republic of); **Xiaoqin Li**, The Univ. of Texas at Austin (USA); **Christoph Lienau**, Carl von Ossietzky Univ. Oldenburg (Germany); **James Lloyd-Hughes**, The Univ. of Warwick (United Kingdom); **Torsten Meier**, Univ. Paderborn (Germany); **Frank J. Meyer zu Heringdorf**, Univ. Duisburg-Essen (Germany); **Walter Pfeiffer**, Univ. Bielefeld (Germany); **Pascal Ruello**, Le Mans Univ. (France); **Volker J. Sorger**, The George Washington Univ. (USA); **Fabrice Vallee**, Institut Lumière Matière (France); **Kam Sing Wong**, Hong Kong Univ. of Science and Technology (Hong Kong, China)

Conference Co-Sponsor:



## SUNDAY 2 FEBRUARY

### SESSION 1

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... SUN 8:30 AM TO 10:00 AM

#### 2D Materials I

Session Chair: **Markus Betz**, Technische Univ. Dortmund (Germany)

8:30 am: **Ultrafast photocurrents from transient interlayer exciton states in twisted and stacked 2D materials** (*Invited Paper*), Hial Patel, Kyle T. Vogt, Matt W. Graham, Oregon State Univ. (USA) ..... [11278-1]

9:00 am: **Single photons, phonons, and spins in atomically thin WSe<sub>2</sub>** (*Invited Paper*), Ajit Srivastava, Emory Univ. (USA) ..... [11278-2]

9:30 am: **Ultrafast hot-electron transfer in metallic VSe<sub>2</sub>/graphene van der Waals heterostructures**, Tae Gwan Park, KAIST (Korea, Republic of); Byong Ki Choi, The Univ. of Seoul (Korea, Republic of); Junho Park, KAIST (Korea, Republic of); Jungdae Kim, Univ. of Ulsan (Korea, Republic of); Young Jun Chang, The Univ. of Seoul (Korea, Republic of); Fabian Rotermund, KAIST (Korea, Republic of) ..... [11278-3]

9:45 am: **Dominance of Pauli-blocking signals over biexciton formation in monolayer MoS<sub>2</sub> at 4K observed with ultrafast spectroscopy**, Ryan Wood, Lawson T. Lloyd, Fauzia Mujid, Richard J. Mazuski, Lili Wang, Hui Gao, Jiwoong Park, Gregory S. Engel, The Univ. of Chicago (USA) ..... [11278-4]

Coffee Break ..... Sun 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... SUN 10:30 AM TO 12:00 PM

#### Metamaterials

Session Chair: **Matt W. Graham**, Oregon State Univ. (USA)

10:30 am: **Electrically tunable metasurface with independent amplitude and phase control for arbitrary wavefront manipulation** (*Invited Paper*), Junghyun Park, Byung Gil Jeong, Sun Il Kim, Duhyun Lee, Kyoungho Ha, Hyuck Choo, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) ..... [11278-5]

11:00 am: **Highly efficient color routing and focusing in the submicron regime based on metaphotonic phase engineering** (*Invited Paper*), Seokho Yun, Sookyoung Roh, Samsung Advanced Institute of Technology (Korea, Republic of); Hongkyu Park, Samsung Advanced Institute of Technology (Kosovo, Republic of); Minwoo Lim, Hyuck Choo, Samsung Advanced Institute of Technology (Korea, Republic of) ..... [11278-6]

11:30 am: **Epsilon-near-zero metamaterials realized using metal-dielectric stacks as a potential candidate for nonlinear applications at visible wavelength**, Sisira Suresh, Orad Reshef, M. Zahirul Alam, Jeremy Upham, Mohammad Karimi, Univ. of Ottawa (Canada); Robert Boyd, Univ. of Ottawa (Canada) and Univ. of Rochester (USA) ..... [11278-7]

11:45 am: **Anapolar metasurfaces for ultrastrong coupling in Landau polaritons**, Felice Appugliese, Institute for Quantum Electronics, ETH Zurich (Switzerland); Shima Rajabali, Johan Andberger, Josefine Enkner, Mattias Beck, Giacomo Scalari, Jérôme Faist, ETH Zurich (Switzerland) ..... [11278-8]

Lunch Break ..... Sun 12:00 pm to 1:30 pm

### SESSION 3

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... SUN 1:30 PM TO 3:30 PM

#### Photovoltaic Materials

Session Chair: **Sarah Houver**, ETH Zurich (Switzerland)

1:30 pm: **Ultrafast transient absorption spectroscopy studies of new dumbbell-shaped platinum (Pt) systems composed of “weight” and “bar” chromophores** (*Invited Paper*), David Lee Phillips, Lili Du, Wenjuan Xiong, Wai-Kin Chan, Runhui Liang, The Univ. of Hong Kong (Hong Kong, China) ..... [11278-9]

2:00 pm: **Ultrafast coherent dynamics in photovoltaic materials probed by two-dimensional electronic spectroscopy** (*Invited Paper*), Antonietta De Sio, Carl von Ossietzky Univ. Oldenburg (Germany) ..... [11278-10]

2:30 pm: **Charge separation in non-fullerene acceptor solar cells** (*Invited Paper*), Frédéric Laquai, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11278-11]

3:00 pm: **Interferometric 3D tracking of energy carriers in heterogeneous optoelectronic materials at the nanoscale** (*Invited Paper*), Milan Delor, Hannah L. Weaver, James K. Utterback, QinQin Yu, Naomi S. Ginsberg, Univ. of California, Berkeley (USA) ..... [11278-12]

Coffee Break ..... Sun 3:30 pm to 4:00 pm

### SESSION 4

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... SUN 4:00 PM TO 6:15 PM

#### THz Spectroscopy I

Session Chair: **Frederic Laquai**, King Abdullah Univ. of Science and Technology (Saudi Arabia)

4:00 pm: **Ultrafast photocurrents in the Weyl semimetal TaAs** (*Invited Paper*), Nicholas Sirica, Rohit Prasankumar, Dmitry Yarotski, Jianxin Zhu, Los Alamos National Lab. (USA) ..... [11278-13]

4:30 pm: **Terahertz light-wave control of non-equilibrium phases and collective modes in multi-band superconductors** (*Invited Paper*), Martin Mootz, Ilias E. Perakis, The Univ. of Alabama at Birmingham (USA); Jigang Wang, Iowa State Univ. of Science and Technology (USA) and Ames Lab. (USA) ..... [11278-14]

5:00 pm: **Resonators for enhancing THz light-matter interaction at the nanoscale** (*Invited Paper*), Luca Razzari, Institut National de la Recherche Scientifique (Canada) ..... [11278-15]

5:30 pm: **Transient photoconductivity and photo-excited carrier dynamics in (Bi<sub>1-x</sub>In<sub>x</sub>)<sub>2</sub>Se<sub>3</sub> thin films**, Teng Shi, Kateryna Kushnir, Worcester Polytechnic Institute (USA); Zhengtianyue Wang, Stephanie Law, Univ. of Delaware (USA); Lyubov V. Titova, Worcester Polytechnic Institute (USA) ..... [11278-16]

5:45 pm: **Zero-valent Au, Cu and Sn intercalation into GeS nanoribbons: tailoring ultrafast photoconductive response**, Kateryna Kushnir, Teng Shi, Worcester Polytechnic Institute (USA); Leticia Damian, California State Univ., San Marcos (USA); Guangjiang Li, Worcester Polytechnic Institute (USA); Auddy Anilao II, Kristie J. Koski, Univ. of California, Davis (USA); Lyubov V. Titova, Worcester Polytechnic Institute (USA) ..... [11278-17]

6:00 pm: **Subcycle time-resolved study for efficient terahertz high harmonic generation in Dirac semimetal Cd<sub>3</sub>As<sub>2</sub>**, Natsuki Kanda, The Institute for Solid State Physics, The Univ. of Tokyo (Japan); Bing Cheng, The Institute for Quantum Matter, Johns Hopkins Univ. (USA); Tatsuhiko N. Ikeda, Takuya Matsuda, Peiyu Xia, The Institute for Solid State Physics, The Univ. of Tokyo (Japan); Timo Schumann, Susanne Stemmer, Univ. of California, Santa Barbara (USA); Jiro Itatani, The Institute for Solid State Physics, The Univ. of Tokyo (Japan); N. Peter Armitage, The Institute for Quantum Matter, Johns Hopkins Univ. (USA); Ryusuke Matsunaga, The Institute for Solid State Physics, The Univ. of Tokyo (Japan) and PRESTO, Japan Science and Technology Agency (Japan) . . . . . [11278-18]

**MONDAY 3 FEBRUARY**

**OPTO PLENARY SESSION**

**LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM**

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
Erik P. A. M. Bakkers, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break . . . . . Mon 10:05 am to 10:30 am

**SESSION 5**

**LOCATION: ROOM 308 (LEVEL 3 SOUTH) . . . . . MON 10:30 AM TO 12:15 PM**

**THz Spectroscopy II**

Session Chair: **Abdulhakem Y. Elezabi**, Univ. of Alberta (Canada)

- 10:30 am: **Spintronic THz emitters (Invited Paper)**, Rudolf Bratschitsch, Westfälische Wilhelms-Universität Münster (Germany) . . . . . [11278-19]
- 11:00 am: **Ultrafast magnetic recording with terahertz radiation (Invited Paper)**, Ilie Radu, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Mostafa Shalaby, Capital Normal Univ. (China); Martin Hennecke, Dieter Engel, Clemens von Korff Schmising, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Arata Tsukamoto, Nihon Univ. (Japan); Christoph Hauri, Paul Scherrer Institut (Switzerland); Stefan Eisebitt, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) . . . . . [11278-20]
- 11:30 am: **Many-body aspects of lightwave electronics (Invited Paper)**, Mackillo Kira, Univ. of Michigan (USA) . . . . . [11278-21]
- 12:00 pm: **Giant optical nonlinearity interferences in quantum structures**, Sarah Houver, Armand Lebreton, Lab. de Physique de l'ens de Lyon (France); Teldo Pereira, Univ. Federal de Mato Grosso (Brazil); Gangyi Xu, Raffaele Colombelli, Ctr. de Nanosciences et de Nanotechnologies (France); Iman Kundu, Lianhe Li, Edmund Linfield, Giles Davies, Univ. of Leeds (United Kingdom); Juliette Mangeney, Jerome Tignon, Robson Ferreira, Sukhdeep Dhillion, Lab. de Physique Statistique de l'ENS (France) . . . . . [11278-22]
- Lunch Break . . . . . Mon 12:15 pm to 2:00 pm

**SESSION 6**

**LOCATION: ROOM 308 (LEVEL 3 SOUTH) . . . . . MON 2:00 PM TO 3:45 PM**

**Carrier Dynamics in Semiconductors and Nanostructures I**

Session Chair: **Alan D. Bristow**, West Virginia Univ. (USA)

- 2:00 pm: **2D THz spectroscopic investigation of ballistic conduction-band electron dynamics in InSb (Invited Paper)**, Sarah Houver, Lucas Huber, Matteo Savoini, Elsa Abreu, Steven L. Johnson, ETH Zurich (Switzerland) . . . . . [11278-23]
- 2:30 pm: **Surface recombination in ultrafast carrier dynamics of complex oxide thin films (Invited Paper)**, Mikel Holcomb, Saeed Yousefi, Alan D. Bristow, Aldo H. Romero, West Virginia Univ. (USA) . . . . . [11278-24]

3:00 pm: **Dominant recombination processes into surface defects on cuprous oxide photoelectrodes**, Lisa Grad, Univ. Zürich (Switzerland); Zbynek Novotny, Univ. Zürich (Switzerland) and Paul Scherrer Institute (Switzerland); Matthias Hengsberger, Jürg Osterwalder, Univ. Zürich (Switzerland) . . . . . [11278-25]

3:15 pm: **Pump-probe study of ultrafast response of GaAs photocathodes grown by MOCVD and MBE**, Hemang P. Jani, Rui Zhou, The Univ. of Alabama in Huntsville (USA); Yijun Zhang, Yunsheng Qian, Nanjing Univ. of Science and Technology (China); Lingze Duan, The Univ. of Alabama in Huntsville (USA) . . . . . [11278-26]

3:30 pm: **Microscopic simulations of the nonlinear optical properties of direct-gap semiconductors including transition dipole moment phases**, Wolf-Rüdiger Hannes, Torsten Meier, Univ. Paderborn (Germany) . . . [11278-27]

Coffee Break . . . . . Mon 3:45 pm to 4:15 pm

**SESSION 7**

**LOCATION: ROOM 308 (LEVEL 3 SOUTH) . . . . . MON 4:15 PM TO 6:15 PM**

**Carrier Dynamics in Semiconductors and Nanostructures II**

Session Chair: **Rudolf Bratschitsch**, Westfälische Wilhelms-Universität Münster (Germany)

4:15 pm: **Polarization-dependent absolute-phase-corrected multidimensional coherent spectra of excitons and polaritons**, Jared K. Wahlstrand, National Institute of Standards and Technology (USA); Jagannath Paul, Alan D. Bristow, West Virginia Univ. (USA) and National Institute of Standards and Technology (USA) . . . . . [11278-28]

4:30 pm: **Thermal free ultrafast luminescence due to nonlocal light-matter interaction**, Masayoshi Ichimiya, Univ. of Shiga Prefecture (Japan) and Osaka Univ. (Japan); Takuya Matsuda, Osaka Prefecture Univ. (Japan); Hajime Ishihara, Osaka Univ. (Japan) and Osaka Prefecture Univ. (Japan); Masaaki Ashida, Osaka Univ. (Japan) . . . . . [11278-29]

4:45 pm: **Dynamical formation and active modulation of a persistent spin helix**, Markus Betz, Technische Univ. Dortmund (Germany) . . . . . [11278-30]

5:00 pm: **Resonance fluorescence of GaAs quantum dots with near-unity photon indistinguishability**, Lukas Hanschke, Walter Schottky Institut (Germany); Eva Schöll, Lucas Schweickert, Katharina D. Zeuner, KTH Royal Institute of Technology (Sweden); Marcus Reindl, Saimon Filipe Covre da Silva, Johannes Kepler Univ. Linz (Austria); Thomas Lettner, KTH Royal Institute of Technology (Sweden); Rinaldo Trotta, Sapienza Univ. di Roma (Italy); Jonathan J. Finley, Kai Müller, Walter Schottky Institut (Germany); Armando Rastelli, Johannes Kepler Univ. Linz (Austria); Val Zwiller, Klaus D. Jöns, KTH Royal Institute of Technology (Sweden) . . . . . [11278-31]

5:15 pm: **Generation of entangled photon pairs at gigahertz repetition rates via an ultrafast LED**, Jonathan Müller, Toshiba Research Europe Ltd. (United Kingdom) and The Univ. of Sheffield (United Kingdom); R. Mark Stevenson, Joanna Skiba-Szymanska, Toshiba Research Europe Ltd. (United Kingdom); Ginny Shooter, Toshiba Research Europe Ltd. (United Kingdom) and Univ. of Cambridge (United Kingdom); Ian Farrer, The Univ. of Sheffield (United Kingdom); David A. Ritchie, Univ. of Cambridge (United Kingdom); Andrew J. Shields, Toshiba Research Europe Ltd. (United Kingdom) . . . . . [11278-32]

5:30 pm: **Ultrafast dynamics of Ga(In)As-Al(Ga)As based nanowire lasers**, Andreas Thurn, Benedikt Mayer, Thomas Stettner, Jochen Bissinger, Franz Langrieger, Daniel Ruhstorfer, Michael Kaniber, Walter Schottky Institut (Germany); Benjamin Lingnau, Kathy Lüdge, Institut für Theoretische Physik, Technische Univ. Berlin (Germany); Gregor Koblmüller, Jonathan J. Finley, Walter Schottky Institut (Germany) . . . . . [11278-33]

5:45 pm: **Decoherence dynamics of hole spin qubits in self-assembled quantum dots**, Tobias Simmet, Friedrich Sbresny, William Rauhaus, Malte Kremser, Walter Schottky Institut (Germany); Fuxiang Li, Nikolai A. Sinitsyn, Los Alamos National Lab. (USA); Lukasz Cywinski, Institute of Physics, Polish Academy of Sciences (Poland); Kai Müller, Jonathan J. Finley, Walter Schottky Institut (Germany) . . . . . [11278-34]

6:00 pm: **Measurement of optical nonlinear properties of CdSe/ZnS quantum dots by time-resolved inline digital holography**, Nikolay V. Petrov, Ekaterina P. Kolesova, Sergey S. Nalegaev, Andrey V. Belashov, Igor A. Shevkunov, Sergey E. Putilin, ITMO Univ. (Russian Federation); Chau-Jern Cheng, National Taiwan Normal Univ. (Taiwan); Anna O. Orlova, ITMO Univ. (Russian Federation) . . . . . [11278-35]

**OPTO**

# CONFERENCE 11278

## TUESDAY 4 FEBRUARY

### SESSION 8

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... TUE 8:00 AM TO 10:00 AM

#### Plasmonics

Session Chair: **Simon Thibault**, Univ. Laval (Canada)

8:00 am: **Investigating ultrafast system dynamics at the nanoscale by photoemission electron microscopy** (*Invited Paper*), Matthias Hensen, Julius-Maximilians-Univ. Würzburg (Germany) ..... [11278-36]

8:30 am: **Plasmon drag effect pinning and molecule adsorption** (*Invited Paper*), Maxim Durach, Georgia Southern Univ. (USA) ..... [11278-37]

9:00 am: **Harmonic generation in bilayer nanoparticle films enhanced by plasmon-plasmon coupling**, Nathan Spear, Kent Hallman, Vanderbilt Univ. (USA); Amanda Wistuba, Northwest Missouri State Univ. (USA); Wenzhe Tan, Janet Macdonald, Richard F. Haglund Jr., Vanderbilt Univ. (USA) . . . [11278-38]

9:15 am: **Generalized two-temperature fitting algorithm for ultrashort laser heating of metal film and nanoparticles**, Paul Bresson, Lab. Nanotechnologies Nanosystemes (LN2) (Canada) and Lab. Charles Fabry (France); Jean-François Bryche, Lab. Nanotechnologies Nanosystemes (LN2) (Canada); Julien Moreau, Lab. Charles Fabry (France); Paul-Ludovic Karsenti, Univ. de Sherbrooke (Canada); Mondher Besbes, Lab. Charles Fabry (France); Denis Morris, Paul Charette, Michael Canva, Lab. Nanotechnologies Nanosystemes (LN2) (Canada) . . . [11278-39]

9:30 am: **Resonance-enhanced transmission of surface plasmon polariton wave-packets through metal-insulator-metal nanocavities**, Naoki Ichiji, Atsushi Kubo, Univ. of Tsukuba (Japan) ..... [11278-40]

9:45 am: **Giant Rabi splitting observed in colloidal quantum wells interacting with silver nanocube**, Junhong Yu, Songyan Hou, Manoj Sharma, Landobasa Tobing, Zhigang Song, Savas Delikanli, Chathuranga Hettiarachchi, Dao-Hua Zhang, Weijun Fan, Muhammad Birowosuto, Hong Wang, Hilmi Demir, Cuong Dang, Nanyang Technological Univ. (Singapore) ..... [11278-41]

Coffee Break. . . . . Tue 10:00 am to 10:30 am

### SESSION 9

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... TUE 10:30 AM TO 12:15 PM

#### Ultrafast Optical Techniques

Session Chair: **Giulio N. Cerullo**, Politecnico di Milano (Italy)

10:30 am: **Ultrafast mode-locked frequency microcombs: fundamentals and precision metrology** (*Invited Paper*), Chee Wei Wong, Wenting Wang, Jinghui Yang, Shu-Wei Huang, Baicheng Yao, Abhinav Kumar Vinod, Hao Liu, James F. McMillan, Xinghe Jiang, Jiagui Wu, Yoon-Soo Jang, Univ. of California, Los Angeles (USA) ..... [11278-42]

11:00 am: **Cavity-enhanced high-harmonic generation for XUV time-resolved ARPES: quantitative determination electron-phonon coupling in the time domain** (*Invited Paper*), Andrea Damascelli, David J. Jones, The Univ. of British Columbia (Canada) . . . [11278-43]

11:30 am: **Ultrafast optical pulse from non-paraxial beam-shaping to optical metrology** (*Invited Paper*), Simon Thibault, Charles Pichette, Univ. Laval (Canada); Pierre Marquet, CERVO Brain Research Ctr. (Canada); Michel Piché, Univ. Laval (Canada) . . . [11278-44]

12:00 pm: **Femtosecond OPCPAs from UV to short-wave-IR wavelengths for ultrafast dynamics experiments on condensed matter to atoms, molecules, and clusters**, Jan Buss, Ivanka Grguras, Torsten Golz, Mark J. Prandolini, Michael Schulz, Robert Riedel, Class 5 Photonics GmbH (Germany) ..... [11278-45]

Lunch/Exhibition Break. . . . . Tue 12:15 pm to 1:35 pm

### SESSION 10

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... TUE 1:35 PM TO 3:05 PM

#### 2D Materials II

Session Chair: **Alexander Steinhoff**, Univ. Bremen (Germany)

1:35 pm: **Ultrafast charge transfer in heterostructures of 2D materials** (*Invited Paper*), Stefano Dal Conte, Chiara Trovatiello, Zilong Wang, Giulio N. Cerullo, Politecnico di Milano (Italy) ..... [11278-46]

2:05 pm: **Coherent dynamics and mapping of exciton states in WSe<sub>2</sub> and MoSe<sub>2</sub> monolayers at the homogeneous limit** (*Invited Paper*), Tomasz Jakubczyk, Univ. of Basel (Switzerland); Caroline Boule, Ctr. National de la Recherche Scientifique (France); Diana Vaclavkova, Miroslav Bartos, Karol Nogajewski, Lukas Zdrzil, CNRS (France); Kenji Watanabe, Takashi Taniguchi, National Institute for Materials Science (Japan); Marek Potemski, Jacek Kasprzak, CNRS (France) ..... [11278-47]

2:35 pm: **Pulse duration effects on Valley-selective Floquet-Bloch states in monolayer transition metal dichalcogenides**, Stuart Earl, Mitchell Conway, Jack Muir, Jonathan Tollerud, Jeffrey Davis, Swinburne Univ. of Technology (Australia) ..... [11278-48]

2:50 pm: **Interferometric frequency-resolved optical gating for measurement of band-nested dark excitons in two-dimensional materials**, Brian Squires, Arup Neogi, Univ. of North Texas (USA) ..... [11278-49]

### BEST STUDENT PAPER AWARD

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... 3:05 PM TO 3:15 PM

Join us as we announce the Ultrafast Phenomena and Nanophotonics Best Student Paper Award. All contributed papers from conference 11278 given by a young scientist (PhD student or postdoc within the first two years after graduation) were eligible for the award (contributed papers only). To facilitate handing out the award during the meeting, applications were collected prior to the meeting (**Due 10 January 2020**). See the OPTO Awards Page for more details.

Coffee Break. . . . . Tue 3:15 pm to 3:40 pm

### SESSION 11

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... TUE 3:40 PM TO 5:55 PM

#### Perovskites

Session Chair: **Tomasz Jakubczyk**, Univ. of Basel (Switzerland)

3:40 pm: **Extreme lattice response to charge localization in lead halide perovskites** (*Invited Paper*), Sebastian Maehrlein, Prakriti P. Joshi, Feifan Wang, Columbia Univ. (USA); Dominik M. Juraschek, ETH Zürich (Switzerland) and Harvard Univ. (USA); Marie Cherasse, Ctr. National de la Recherche Scientifique (France); Xiaoyang Zhu, Columbia Univ. (USA) . . . . . [11278-58]

4:10 pm: **Optical properties and carrier dynamics in transition metal dichalcogenides and halide perovskites** (*Invited Paper*), Alexander Steinhoff, Frank Jahne, Matthias Florian, Univ. Bremen (Germany); Christoph Lienau, Antonietta De Sio, Xuan Trung Nguyen, Carl von Ossietzky Univ. Oldenburg (Germany) . . . . . [11278-50]

4:40 pm: **Ultrafast energy funneling and lasing kinetics in multiphase hybrid perovskites** (*Invited Paper*), Kenan Gundogdu, North Carolina State Univ. (USA) . . . . . [11278-51]

5:10 pm: **Surface effects in ultrafast optical phenomena of perovskite oxide thin films**, Saeed Yousefi Sarraf, West Virginia Univ. (USA); Sobhit Singh, Rutgers Univ. (USA) and West Virginia Univ. (USA); Andrés Camilo Garcia-Castro, Univ. Industrial de Santander (Colombia); Robbyn Trappen, Navid Mottaghi, Guerau Cabrera, Chih-Yeh Huang, Shalini Kumari, Ghadendra Bhandari, Alan D. Bristow, Aldo H. Romero, Mikel Holcomb, West Virginia Univ. (USA) . . . . . [11278-52]

5:25 pm: **Probing carrier extraction from lead halide perovskite to charge transport layers by ultrafast spectroscopy**, Jafar I. Khan, Esma Ugur, Furkan Isikgor, Erkan Aydin, Mindaugas Kirkus, Marios Neophytou, Stefaan De Wolf, Iain McCulloch, Frédéric Laquai, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11278-53]

5:40 pm: **Revealing the impact of cesium/rubidium incorporation on the photophysics of multiple-cation lead halide perovskites**, Yajun Gao, Kai Wang, Mingcong Wang, Jafar I. Khan, Ahmed Balawi, Stefaan De Wolf, Frédéric Laquai, King Abdullah Univ. of Science and Technology Solar Ctr. (Saudi Arabia) . . . . . [11278-54]

### POSTERS-TUESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... TUE 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the poster session on Tuesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Tuesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**An insight into strong many-body interactions in ultrathin anisotropic tin (II) monosulfide**, Aamir Mushtaq, Indian Institute of Technology Mandi (India) . . . . . [11278-55]

**Temperature dependence of interface-state-phonon-assisted carrier relaxation in CdSe quantum dots**, Shengkun Zhang, Borough of Manhattan Community College (USA); Robert Alfano, The City College of New York (USA) . . . . . [11278-56]

# CONFERENCE 11279

LOCATION: ROOM 307 (LEVEL 3 SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11279

# Terahertz, RF, Millimeter, and Submillimeter-Wave Technology and Applications XIII

Conference Chairs: **Laurence P. Sadwick**, InnoSys, Inc. (USA); **Tianxin Yang**, Tianjin Univ. (China)

Program Committee: **René Beigang**, Technische Univ. Kaiserslautern (Germany); **Jianji Dong**, Huazhong Univ. of Science and Technology (China); **Frank Ellrich**, Technische Hochschule Bingen (Germany); **Fabian Friederich**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); **Robert H. Giles**, Univ. of Massachusetts Lowell (USA); **R. Jennifer Hwu**, InnoSys, Inc. (USA); **Mona Jarrahi**, Univ. of California, Los Angeles (USA); **Daniel Molter**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); **J. Anthony Murphy**, National Univ. of Ireland, Maynooth (Ireland); **Créidhe O’Sullivan**, National Univ. of Ireland, Maynooth (Ireland); **Kyung Hyun Park**, Electronics and Telecommunications Research Institute (Korea, Republic of); **Alessia Portieri**, TeraView Ltd. (United Kingdom); **Marco Rahm**, Technische Univ. Kaiserslautern (Germany); **Jinghua Teng**, Institute of Materials Research and Engineering (Singapore); **Michael Weibel**, Joint Research and Development, Inc. (USA); **Jiangfeng Zhou**, Univ. of South Florida (USA)

## MONDAY 3 FEBRUARY

### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

### SESSION 1

LOCATION: ROOM 307 (LEVEL 3 SOUTH) . . . . . MON 10:30 AM TO 12:00 PM

#### Terahertz and Sub-Terahertz Devices

Session Chairs: **Laurence P. Sadwick**, InnoSys, Inc. (USA); **Tianxin Yang**, Tianjin Univ. (China)

- 10:30 am: **Development of InGaAs Schottky barrier diode for industry applications**, Dong Woo Park, Jun-Hwan Shin, Eui Su Lee, Dong Hun Lee, Mugeon Kim, Kiwon Moon, Hyun-Soo Kim, Il-Min Lee, Kyung Hyun Park, Electronics and Telecommunications Research Institute (Korea, Republic of). . . . . [11279-1]
- 10:50 am: **Si, SiGe, InP, III-N and p-diamond field effect and heterostructure bipolar transistors for sub-terahertz and terahertz applications (Invited Paper)**, Michael S. Shur, Rensselaer Polytechnic Institute (USA). . . . . [11279-2]
- 11:20 am: **1THz one-sided directional slot antenna on a chip connected with InAs HEMT**, Haruichi Kanaya, Ryo Takigawa, Kohei Tasaki, Kazutoshi Kato, Tanemasa Asano, Kyushu Univ. (Japan). . . . . [11279-3]
- 11:40 am: **Sub-terahertz detection by fin-shaped GaN/AlGaIn transistors**, Pavlo Sai, Dmytro B. But, Grzegorz Cywinski, Maksym Dub, Maciej Sakowicz, Pawel Prystawko, Sergey Rummyantsev, Wojciech Knap, Institute of High Pressure Physics, Polish Academy of Sciences (Poland) . . . . . [11279-4]
- Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

### SESSION 2

LOCATION: ROOM 307 (LEVEL 3 SOUTH) . . . . . MON 1:30 PM TO 3:10 PM

#### Infrared Devices, Technology, and Applications

Session Chairs: **Tianxin Yang**, Tianjin Univ. (China); **Laurence P. Sadwick**, InnoSys, Inc. (USA)

- 1:30 pm: **Spectrometer-based mid-infrared optical coherence tomography operating at multi-kHz line rate speed**, Niels M. Israelsen, Christian R. Petersen, Technical Univ. of Denmark (Denmark) and NORBLIS IVS (Denmark); Peter John L. Rodrigo, Technical Univ. of Denmark (Denmark); Ajanta Barh, ETH Zurich (Switzerland); Deepak Jain, The Univ. of Sydney (Australia); Getinet Woyessa, Mikkel Jensen, Technical Univ. of Denmark (Denmark); Günther Hanneschläger, Research Ctr. for Non Destructive Testing GmbH (Austria); Peter Tidemand-Lichtenberg, Christian Pedersen, Technical Univ. of Denmark (Denmark) and NLIIR (Denmark); Adrian G. H. Podoleanu, Univ. of Kent (United Kingdom); Ole Bang, Technical Univ. of Denmark (Denmark) and NKT Photonics (Denmark) and NORBLIS IVS (Denmark). . . . . [11279-5]
- 1:50 pm: **Performance enhancement of quantum-dot infrared photodetector by periodic pillar array**, Taizo Shibuya, Yuichi Igarashi, Masahiro Kakuda, Yoshihiro Kitagawa, Tetsuro Sato, Akinobu Shibuya, Masayuki Shirane, NEC Corp. (Japan); Yasuhiko Arakawa, The Univ. of Tokyo (Japan). . . . . [11279-6]
- 2:10 pm: **Advanced broadband MEMS infrared emitter based on high-temperature-resistant nanostructured surfaces and packaging solutions for harsh environments**, Steffen Biermann, André Magi, Patrick Sachse, Micro-Hybrid Electronic GmbH (Germany); Karin Wedrich, Lutz Müller, Technische Univ. Ilmenau (Germany); Martin Hoffmann, Ruhr-Univ. Bochum (Germany); Ralf Koppert, Siegert ThinFilm Technology GmbH (Germany); Thomas Ortlepp, CMOS IR GmbH (Germany); Julia Baldauf, CiS Forschungsinstitut für Mikrosensorik GmbH (Germany) . . . . . [11279-7]
- 2:30 pm: **Semiconducting amorphous Y-Ba-Cu-O: an attractive material for fast and sensitive thermal sensing in the NIR to THz range**, Annick F. Dégardin, CentraleSupélec (France) and Lab. Génie électrique et électronique de Paris (France) and Sorbonne Univ. (France); Vishal S. Jagtap, Bergische Univ. Wuppertal (Germany) and CentraleSupélec (France) and Lab. Génie électrique et électronique de Paris (France); Xavier Galiano, Alain J. Kreisler, CentraleSupélec (France) and Lab. Génie électrique et électronique de Paris (France). . . . . [11279-8]
- 2:50 pm: **Long-wavelength interband cascade photodetector with an InAs/GaAsSb superlattice absorber**, Yi Zhou, Xuliang Chai, Min Huang, Zhicheng Xu, Jianxin Chen, Li He, Shanghai Institute of Technical Physics (China) . . . . . [11279-9]
- Coffee Break. . . . . Mon 3:10 pm to 3:40 pm

OPTO

# CONFERENCE 11279

## SESSION 3

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... MON 3:40 PM TO 5:50 PM

### Terahertz Frontiers

Session Chairs: **Laurence P. Sadwick**, InnoSys, Inc. (USA);  
**R. Jennifer Hwu**, InnoSys, Inc. (USA)

3:40 pm: **Terahertz spectral characterization of NIR nanomaterials** (*Invited Paper*), Robert H. Giles, Jillian P. Martin, Emmanouil Gkikas, Cecil S. Joseph, Univ. of Massachusetts Lowell (USA) ..... [11279-10]

4:10 pm: **Out-of-plane electron generation via 3D-printed resonant THz nanocones**, Andrea Rovere, Institut National de la Recherche Scientifique (Canada); Andrea Bertocini, King Abdullah Univ. of Science and Technology (Saudi Arabia); Riccardo Piccoli, Young-Gyun Jeong, Stéphane Payeur, François Vidal, Institut National de la Recherche Scientifique (Canada); O-Pil Kwon, Seung-Heon Lee, Ajou Univ. (Korea, Republic of); Roberto Morandotti, Institut National de la Recherche Scientifique (Canada) and ITMO Univ. (Russian Federation) and Univ. of Electronic Science and Technology of China (China); Carlo Liberale, King Abdullah Univ. of Science and Technology (Saudi Arabia); Luca Razzari, Institut National de la Recherche Scientifique (Canada) ..... [11279-11]

4:30 pm: **Terahertz pulse time-domain holography for broadband optical wavefront sensing**, Nikolay V. Petrov, ITMO Univ. (Russian Federation); Maksim S. Kulya, ITMO Univ. (Russian Federation) and Tampere Univ. (Finland); Andrei A. Gorodetsky, Nikolay S. Balbekin, Sergei A. Kozlov, ITMO Univ. (Russian Federation) ..... [11279-12]

4:50 pm: **Towards quantum sensing in the terahertz frequency range**, Daniel Molter, Mirco Kutas, Björn Haase, Felix Riexinger, Patricia Bickert, Michael Bortz, Georg von Freymann, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ..... [11279-13]

5:10 pm: **Effect of cross-focusing on terahertz generation driven by laser plasma interaction**, Alka Mehta, Niti Kant, Lovely Professional Univ. (India) ..... [11279-14]

5:30 pm: **InAs/GaAsSb type-II superlattice long-wavelength infrared photodetectors**, Min Huang, Jianxin Chen, Zhicheng Xu, Yi Zhou, Fangfang Wang, Jiajia Xu, Zhizhong Bai, Lulu Zheng, Aibo Huang, Ruijun Ding, Li He, Shanghai Institute of Technical Physics (China) ..... [11279-15]

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... TUE 8:00 AM TO 8:40 AM

### THz Imaging and Sampling

Session Chairs: **Robert H. Giles**, Univ. of Massachusetts Lowell (USA);  
**Kyung Hyun Park**, Electronics and Telecommunications Research Institute (Korea, Republic of)

8:00 am: **Frequency noise and phase-locking of a quantum cascade laser-pumped 1.073 terahertz molecular laser using a 1560nm frequency comb**, Stefano Barbieri, Jean-François Lampin, Antoine Pagies, Institut d'Electronique de Microélectronique et de Nanotechnologie, CNRS (France); Giorgio Santarelli, Institut d'Optique Graduate School (France) and CNRS (France); Jeffrey L. Hesler, Virginia Diodes, Inc. (USA); Wolfgang Hänsel, Ronald Holzwarth, Menlo Systems GmbH (Germany) ..... [11279-17]

8:20 am: **Spatial sampling of terahertz fields with subwavelength accuracy via probe beam encoding**, Jiapeng Zhao, Yiwen E., Kaia Williams, Xi-Cheng Zhang, The Institute of Optics, Univ. of Rochester (USA); Robert Boyd, The Institute of Optics, Univ. of Rochester (USA) and Univ. of Ottawa (Canada) ..... [11279-18]

### SESSION 5

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... TUE 8:40 AM TO 10:00 AM

### Terahertz Layer Thickness Evaluation

Session Chairs: **Fabian Friederich**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); **Daniel Molter**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany)

8:40 am: **Simulation of terahertz waves in multilayer coatings for non-contact thickness measurements of top layers**, Imke Busboom, Simon Christmann, Hartmut Haehnel, Volker K. S. Feige, Hochschule Düsseldorf (Germany); Bernd Tibken, Bergische Univ. Wuppertal (Germany) ..... [11279-19]

9:00 am: **Terahertz signal processing algorithm for time-of-flight measurement in humid air**, Jinwoo Lee, Soohyun Kim, KAIST (Korea, Republic of) ..... [11279-20]

9:20 am: **Optical thickness of a plant leaf measured with THz pulses echoes**, Yannick Abautret, Myriam Zerrad, Institut Fresnel (France); Coquillat Dominique, Lab. Charles Coulomb (France); Ryad Bendoula, Institut National de Recherche en Sciences et Technologies Pour l'Environnement et l'Agriculture (France); Gabriel Soriano, Institut Fresnel (France); Heran Daphné, Institut National de Recherche en Sciences et Technologies Pour l'Environnement et l'Agriculture (France); Bruno Grèzes-Besset, Innolea (France); Frédéric Chazallet, euroShaktiware (France); Claude Amra, Institut Fresnel (France) ..... [11279-21]

9:40 am: **FMCW thickness evaluation with a mobile hand-held terahertz system**, Fabian Friederich, Nina S. Schreiner, Andreas Keil, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ..... [11279-22]

Coffee Break ..... Tue 10:00 am to 10:30 am

### SESSION 6

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... TUE 10:30 AM TO 12:10 PM

### Fast-Scanning Terahertz TDS Systems

Session Chairs: **Daniel Molter**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany);  
**Fabian Friederich**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany)

10:30 am: **Ultrafast repetition rate control for pulsed femtosecond lasers** (*Invited Paper*), Ole Peters, Sami Wittmann, Ronald Holzwarth, Menlo Systems GmbH (Germany) ..... [11279-23]

11:00 am: **Fast thickness gauging with an ECOPS-based terahertz time-domain system** (*Invited Paper*), Milad Yahyapour, Angelika Jahn, Katja Dutzi, Thomas Puppe, Patrick Leisching, TOPTICA Photonics AG (Germany); Bernhard Schmauss, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Nico Vieweg, Anselm J. Deninger, TOPTICA Photonics AG (Germany) ..... [11279-24]

11:30 am: **SLAPCOPS: A single-laser engine for terahertz time-domain spectroscopy systems**, Michael Kolano, Daniel Molter, Oliver Boidol, Georg von Freymann, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ..... [11279-25]

11:50 am: **Recording terahertz electric field evolutions in single-shot with high resolution using chirped laser pulses**, Serge Bielawski, Eleonore Roussel, Christophe Szwarz, Clément Evain, Marc Le Parquier, Lab. de Physique des Lasers, Atomes et Molécules (France); Bernd Steffen, European XFEL GmbH (Germany) and Deutsches Elektronen-Synchrotron (Germany); Christopher Gerth, European XFEL GmbH (Germany); Cejo K. Lonappan, Bahram Jalali, Tianwei Jiang, Univ. of California, Los Angeles (USA) ..... [11279-26]

Lunch/Exhibition Break ..... Tue 12:10 pm to 1:40 pm

### SESSION 7

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... TUE 1:40 PM TO 3:00 PM

### Terahertz Cross-Correlation Systems

Session Chairs: **Fabian Friederich**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); **Daniel Molter**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany)

1:40 pm: **Stable THz wave generations using laser chaos** (*Invited Paper*), Fumiyoshi Kuwashima, Takuya Shirao, Fukui Univ. of Technology (Japan); Masahiko Tani, Kazuyoshi Kurihara, Kohji Yamamoto, Univ. of Fukui (Japan); Osamu Morikawa, Japan Coast Guard Academy (Japan); Makoto Nakajima, Osaka Univ. (Japan) ..... [11279-27]

2:10 pm: **Towards ultra-compact broadband photonic terahertz systems enabled by monolithic laser diodes** (*Invited Paper*), Kevin Kolpatzck, Jan C. Balzer, Univ. Duisburg-Essen (Germany) ..... [11279-28]

2:40 pm: **Terahertz cross-correlation spectroscopy using incoherent light sources**, Daniel Molter, Michael Kolano, Georg von Freymann, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ..... [11279-29]

Coffee Break ..... Tue 3:00 pm to 3:30 pm

**SESSION 8**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... TUE 3:30 PM TO 4:50 PM**

**Photonic Terahertz Systems**

Session Chairs: **Daniel Molter**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany);  
**Fabian Friederich**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany)

3:30 pm: **Continuous-wave terahertz spectrometer without active phase modulation**, Björn Globisch, Lars Liebermeister, Simon Nellen, Robert B. Kohlhaas, Martin Schell, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany) ..... [11279-30]

3:50 pm: **Ultra-broadband terahertz time-domain spectroscopy in a compact system with DSTMS organic crystals**, Tobias Bach, Rainbow Photonics AG (Switzerland); Uro? Puc, Vincent Michel, Mojca Jazbinsek, Zürcher Hochschule für Angewandte Wissenschaften (Switzerland); Peter Günter, Carolina C. Medrano, Rainbow Photonics AG (Switzerland) ..... [11279-31]

4:10 pm: **High-dynamic-range time-domain terahertz spectroscopy system operating at 1 μm optical wavelength**, Deniz Turan, Nezi? Tolga Yardimci, Mona Jarrahi, Univ. of California, Los Angeles (USA) ..... [11279-32]

4:30 pm: **Terahertz spectrometer based on widely tunable injection-seeded terahertz parametric generation and detection for identifying pharmaceutical materials**, Mizuki Mohara, Kei Shimura, Kenji Aiko, Touya Ono, Hitachi High-Technologies Corp. (Japan) ..... [11279-33]

**WEDNESDAY 5 FEBRUARY**

**SESSION 9**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... WED 8:00 AM TO 9:00 AM**

**Terahertz Components**

Session Chairs: **Kyung Hyun Park**, Electronics and Telecommunications Research Institute (Korea, Republic of);  
**Robert H. Giles**, Univ. of Massachusetts Lowell (USA)

8:00 am: **Graphene-based highly efficient C-shaped metasurface for terahertz absorber**, Shreyas Charola, Mayurkumar Ladumor, Shobhitkumar Patel, Marwadi Education Foundation (India) ..... [11279-34]

8:20 am: **Hermetically packaged THz detector for industrial systems**, Jun-Hwan Shin, Dong Woo Park, Eui Su Lee, Dong Hun Lee, Mugeon Kim, Kiwon Moon, Hyun-Soo Kim, Il-Min Lee, Kyung Hyun Park, Electronics and Telecommunications Research Institute (Korea, Republic of) ..... [11279-35]

8:40 am: **Generation of a guided mode in a THz semiconductor waveguide using excitation by a tilted optical pulse front**, Qamar Islam, Fanqi Meng, Hartmut G. Roskos, Goethe-Univ. Frankfurt am Main (Germany) ..... [11279-36]

**SESSION 10**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... WED 9:00 AM TO 10:20 AM**

**Terahertz Devices**

Session Chairs: **Daniel Molter**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany);  
**Fabian Friederich**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany)

9:00 am: **Next-generation photo-conductive THz devices for 1550nm excitation**, Björn Globisch, Robert B. Kohlhaas, Steffen Breuer, Lars Liebermeister, Simon Nellen, Martin Schell, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany) ..... [11279-37]

9:20 am: **Design and characterization of a millimeter-long travelling wave THz photomixer**, Fuanki Bavedila, Institut d'Electronique de Microélectronique et de Nanotechnologie, Ctr. National de la Recherche Scientifique (France); Charbel Tannoury, Institut d'Electronique de Microélectronique et de Nanotechnologie, CNRS (France); Vincent Magnin, Institut d'Electronique de Microélectronique et de Nanotechnologie, Ctr. National de la Recherche Scientifique (France); Sylvie Lepilliet, Vanessa Avramovic, David Troadec, Joseph Harrari, Dmitri Yarekha, Jean-François Lampin, Guillaume Ducournau, Emilien Peytavit, Institut d'Electronique de Microélectronique et de Nanotechnologie, CNRS (France) ..... [11279-38]

9:40 am: **Narrowband terahertz radiation produced in a BaGa<sub>4</sub>Se<sub>7</sub> crystal**, Brett N. Carnio, Univ. of Alberta (Canada) ..... [11279-39]

10:00 am: **Room-temperature broadband terahertz detector based on three-dimensional graphene**, Yifan Li, Yating Zhang, Zhiliang Chen, Yu Yu, Lufan Jin, Jianquan Yao, Tianjin Univ. (China) ..... [11279-40]

Coffee Break ..... Wed 10:20 am to 10:50 am

**SESSION 11**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... WED 10:50 AM TO 12:30 PM**

**Terahertz Imaging**

Session Chairs: **Fabian Friederich**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); **Daniel Molter**, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany)

10:50 am: **Terahertz imaging with nonlinear quantum-cascade-laser source**, Atsushi Nakanishi, Kazuo Fujita, Hiroshi Satozono, Hamamatsu Photonics K.K. (Japan) ..... [11279-41]

11:10 am: **A plasmonic photoconductive terahertz focal-plane array**, Xurong Li, Mona Jarrahi, Univ. of California, Los Angeles (USA) ..... [11279-42]

11:30 am: **Rapid nondestructive evaluation of defects in GFRP composites using terahertz line scanner**, Harikrishnan Brajesh Kaimal, Indian Institute of Technology Madras (India); Nirmala Devi, Mercy Latha, CSIR-Central Electronics Engineering Research Institute (India); Prabhu Rajagopal, Krishnan Balasubramaniam, Indian Institute of Technology Madras (India); Bala Pesala, CSIR-Central Electronics Engineering Research Institute (India) ..... [11279-43]

11:50 am: **Resolution enhancement of THz imaging based on free-space spectrum detection**, Hui Yuan, Goethe-Univ. Frankfurt am Main (Germany); Min Wan, Univ. College Dublin (Ireland); Alvydas Lisauskas, Vilnius Univ. (Lithuania) and Institute of High Pressure Physics (Poland); John T. Sheridan, Univ. College Dublin (Ireland); Hartmut G. Roskos, Goethe-Univ. Frankfurt am Main (Germany) ..... [11279-44]

12:10 pm: **Toward industrial applications of CW THz system: cost-effective imaging and sensing**, Eui Su Lee, Mugeon Kim, Kiwon Moon, Il-Min Lee, Dong Woo Park, Hyun-Soo Kim, Kyung Hyun Park, Electronics and Telecommunications Research Institute (Korea, Republic of) ..... [11279-45]

Lunch/Exhibition Break ..... Wed 12:30 pm to 2:00 pm

**SESSION 12**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... WED 2:00 PM TO 3:00 PM**

**Cross Cutting Technologies**

Session Chairs: **Laurence P. Sadwick**, InnoSys, Inc. (USA);  
**R. Jennifer Hwu**, InnoSys, Inc. (USA)

2:00 pm: **Spoof plasmon-based interconnect technology to self-heal random faults**, Soumitra R. Joy, Univ. of Michigan (USA); Md Asaduz Zaman Mamun, Md Zunaid Baten, Bangladesh Univ. of Engineering and Technology (Bangladesh); Pinaki Mazumder, Univ. of Michigan (USA) ..... [11279-46]

2:20 pm: **The principle of measuring instantaneous frequent and dynamic linewidth of frequency swept lightwaves**, Jiewei Yang, Tianxin Yang, Peng Li, Tianjin Univ. (China) ..... [11279-47]

2:40 pm: **Brillouin spectrum engineering for the enhancement of slope-assisted Brillouin dynamic sensing**, Cheng Feng, Technische Univ. Braunschweig (Germany); Xin Lu, Norwegian Research Ctr. AS (Norway); Thomas Schneider, Technische Univ. Braunschweig (Germany) ..... [11279-48]

Coffee Break ..... Wed 3:00 pm to 3:30 pm

OPTO

# CONFERENCE 11279

## SESSION 13

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... WED 3:30 PM TO 5:30 PM

### Fundamental Research in Terahertz Physics

Session Chairs: **Marco Rahm**, Technische Univ. Kaiserslautern (Germany); **Laurence P. Sadwick**, InnoSys, Inc. (USA)

3:30 pm: **THz properties of organic and biological materials** (*Invited Paper*), Jens Neu, Sophia M. Yi, Coleen T. Nemes, Yangqi Gu, Jacob A. Spies, J. Patrick O'Brien, Kevin P. Regan, Vishok Srikanth, Dennis Vu, Charles A. Schmuttenmaer, Nikhil S. Malvankar, Yale Univ. (USA) . . . [11279-49]

4:00 pm: **Ultrafast atomic scale stimuli steering single molecule dynamics** (*Invited Paper*), Carmen Roelcke, Dominik Peller, Lukas Kastner, Thomas Buchner, Jascha Repp, Rupert Huber, Univ. Regensburg (Germany) . [11279-50]

4:30 pm: **Coherent polaron dynamics in the lead halide perovskites** (*Invited Paper*), Yang Lan, Benjamin Dringoli, David Valverde-Chavez, McGill Univ. (Canada); Xixi Tao, McGill Univ. (Canada) and Institute of Solid State Physics, Chinese Academy of Sciences (China) and Univ. of Science and Technology of China (China); Xianghua Kong, McGill Univ. (Canada); Yihui He, Northwestern Univ. (USA); Xiaohong Zheng, Institute of Solid State Physics, Chinese Academy of Sciences (China) and Univ. of Science and Technology of China (China); Mark Sutton, Hong Guo, McGill Univ. (Canada); Mercouri G. Kanatzidis, Northwestern Univ. (USA); David G. Cooke, McGill Univ. (Canada) . . [11279-51]

5:00 pm: **Advances in ultrafast terahertz scanning tunneling microscopy** (*Invited Paper*), Yang Luo, Vedran Jelic, Jesus A. M. Calzada, Peter H. Nguyen, Howe Simpson, Daniel Mildenerger, Yu-Jui Liu, Frank A. Hegmann, Univ. of Alberta (Canada) . . . . . [11279-52]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Complex-domain sparse imaging in terahertz pulse time-domain holography with balance detection**, Maksim S. Kulya, Tampere Univ. (Finland) and ITMO Univ. (Russian Federation); Vladimir Y. Katkovnik, Karen O. Egiptarian, Tampere Univ. (Finland); Nikolay V. Petrov, ITMO Univ. (Russian Federation) . . . . . [11279-16]

**The nonlinear tuning technique of a DFB laser using frequency predistortion procedures**, Tianxin Yang, Peng Li, Jiewei Yang, Tianjin Univ. (China) . . . . . [11279-72]

**THz to microwave photonic**, Ricardo Bustos Ramirez, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11279-73]

**Quasi-linear broadband-frequency swept light source based on a novel spectrum stitching technique**, Wen Lai, Zhaoying Wang, Quan Yuan, Tianxin Yang, Diannan Hu, Jiaqi Qin, Tianjin Univ. (China) . . . . . [11279-74]

**Generation of orbital angular momentum using reflect-array antenna based on liquid crystals at 330GHz**, Fanyi Meng, Chuanhong Zhao, Harbin Institute of Technology (China) . . . . . [11279-75]

**Modeling of plasmonic semiconductor THz antennas in square and hexagonal array arrangements**, Soenke Gruessing, Bernd Witzigmann, Friedhard Römer, Univ. Kassel (Germany); Giovanni Capellini, Carlos C. Alvarado, Wolfgang M. Klesse, Elena Hardt, IHP GmbH (Germany); Jacob Piehler, Changjiang You, Julia Flesch, Univ. Osnabrück (Germany) . . [11279-76]

**Photonic RF frequency conversion using microcombs**, Xingyuan Xu, Mengxi Tan, Jiayang Wu, Swinburne Univ. of Technology (Australia); Thach G. Nguyen, RMIT Univ. (Australia); Sai Tak Chu, City Univ. of Hong Kong (Hong Kong, China); Brent E. Little, Univ. of Chinese Academy of Sciences (China); Roberto Morandotti, Institut National de la Recherche Scientifique (Canada); Arnan Mitchell, RMIT Univ. (Australia); David J. Moss, Swinburne Univ. of Technology (Australia) . . . . . [11279-77]

**RF photonic fractional signal processor based on a 50GHz Kerr microcomb**, Mengxi Tan, Xingyuan Xu, Jiayang Wu, Thach G. Nguyen, Sai Tak Chu, Brent E. Little, Roberto Morandotti, Arnan Mitchell, David J. Moss, Swinburne Univ. of Technology (Australia) . . . . . [11279-78]

**Dispersion dependence of noise characteristics of an electro-optic-modulation comb**, Kenya Hitomi, Tokyo Denki Univ. (Japan); Atsushi Ishizawa, Kenichi Hitachi, Tomoya Akatsuka, NTT Basic Research Labs. (Japan); Tadashi Nishikawa, Tokyo Denki Univ. (Japan); Hideki Gotoh, NTT Basic Research Labs. (Japan) . . . . . [11279-79]

**Sensitive nanomechanical thermal detector for IR measurements at room temperature**, Markus Piller, Miao-Hsuan Chien, Niklas Luhmann, Silvan Schmid, Technische Univ. Wien (Austria) . . . . . [11279-80]

**Coherent Tri-mode FPLD with SCM of 80 Gbit/s OFDM for 75-km long-reach MMWof at 28 GHz**, Huai-Yung Wang, Gong-Ru Lin, National Taiwan Univ. (Taiwan) . . . . . [11279-81]

**High-resolution motorized x-z translation stage to scan 3D objects using terahertz technology**, Rosaura Vallejo-Mendoza, Arturo Olivares-Pérez II, Carlos G. Treviño-Palacios II, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Gaudencio Paz Martánez, Univ. de Salamanca (Spain); Miguel Ángel Briseño Carmona, Joan Manuel Villa-Hernández, Roxana M. Herrán Cuspinera, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . . . [11279-82]

**Characterization of semiconductor in sub-terahertz band**, Min Wan, Univ. College Dublin (Ireland); Yevhen Yashchyshyn, Konrad Godziszewski, Warsaw Univ. of Technology (Poland); John J. Healy, John T. Sheridan, Univ. College Dublin (Ireland) . . . . . [11279-83]

**Sub-pixel motion estimation for terahertz imaging**, Min Wan, Christopher Dugan, John J. Healy, John T. Sheridan, Univ. College Dublin (Ireland) . . . . . [11279-84]

**Long-wave infrared optical materials and filters**, Thomas D. Rahmlow Jr., Omega Optical, Inc. (USA); Nasrat A. Raouf, Brian J. Drouin, Jet Propulsion Lab. (USA); Robert L. Johnson Jr., Omega Optical, Inc. (USA) . . . . . [11279-85]

**Investigation of THz spectra from nematic liquid crystal by applying electric fields**, Myeong Ock Ko, Chungnam National Univ. (Korea, Republic of); Sang-Pil Han, Electronics and Telecommunications Research Institute (Korea, Republic of); Hansol Choi, Soyeon Ahn, Chungnam National Univ. (Korea, Republic of); Zhongping Chen, Univ. of California, Irvine (USA); Min Yong Jeon, Chungnam National Univ. (Korea, Republic of) . . . . . [11279-86]

**Gas detection at 455-m distance with THz ps pulse propagation through the atmosphere**, Tae-In Jeon, Gyeong-Ryul Kim, Korea Maritime and Ocean Univ. (Korea, Republic of); Kiwon Moon, Kyung Hyun Park, Electronics and Telecommunications Research Institute (Korea, Republic of); John F. O'Hara, Daniel R. Grischkowsky, Oklahoma State Univ. (USA) . . . . . [11279-88]

# THURSDAY 6 FEBRUARY

## SESSION 14

LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... THU 8:00 AM TO 10:00 AM

### RF/Microwave/Millimeter-Wave

Session Chairs: **Laurence P. Sadwick**, InnoSys, Inc. (USA); **Tianxin Yang**, Tianjin Univ. (China)

8:00 am: **Detection of millimeter waves using an electro-optic polymer device and a modulator-based optical comb source**, Isao Morohashi, Takahiro Kaji, Yukihiko Tominari, Toshiki Yamada, Akira Otomo, Norihiko Sekine, Akifumi Kasamatsu, Iwao Hosako, National Institute of Information and Communications Technology (Japan) . . . . . [11279-53]

8:20 am: **High-power balanced uni-traveling-carrier photodiodes for high-frequency RF photonic links**, Madison Woodson, Steven Estrella, Kenneth A. Hay, Ronald P. Stahl, Henry Garrett, Keye Sun, Freedom Photonics, LLC (USA); Jesse Morgan, Andreas Beling, Univ. of Virginia (USA); Daniel Renner, Milan L. Mashanovitch, Freedom Photonics, LLC (USA) . . . . . [11279-54]

8:40 am: **Polarization independent flat metasurface lens for millimeter-wave beam focusing**, Wonwoo Lee, Semin Jo, Kanghyeok Lee, Hong Soo Park, Junhyuk Yang, Changkun Park, Sun K. Hong, Hoin Lee, Soongsil Univ. (Korea, Republic of) . . . . . [11279-55]

9:00 am: **Advances in the science and technology of optoelectronic microwave oscillators**, Yanne K. Chembo, Univ. of Maryland, College Park (USA) . . . . . [11279-56]

9:20 am: **90-GHz +15 dBm high-output integrated photoreceiver driven by only photonic power supply**, Toshimasa Umezawa, Atsushi Kanno, Pham T. Dat, Atsushi Matsumoto, Kouichi Akahane, Naokatsu Yamamoto, National Institute of Information and Communications Technology (Japan); Tetsuya Kawanishi, Waseda Univ. (Japan) . . . . . [11279-57]

9:40 am: **Wireless-powered VOC sensor based on wi-fi energy-harvesting metamaterial with i-TPU**, Heejoo Park, Wonwoo Lee, Hyunseung Jung, Soongsil Univ. (Korea, Republic of); So Young Kim, Do Hwan Kim, Hanyang Univ. (Korea, Republic of); Hoin Lee, Soongsil Univ. (Korea, Republic of) . . . . . [11279-58]

Coffee Break. . . . . Thu 10:00 am to 10:30 am

**SESSION 15**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... THU 10:30 AM TO 11:50 AM**

**Terahertz Developments**

Session Chairs: **Tianxin Yang**, Tianjin Univ. (China);  
**Laurence P. Sadwick**, InnoSys, Inc. (USA)

- 10:30 am: **Nanofocusing of the optical wave using staircase-tapered plasmonic waveguide**, Vishal Sorathiya, Mayurkumar Ladumor, Shobhitkumar Patel, Marwadi Education Foundation (India) ..... [11279-59]
- 10:50 am: **Topological phase transition in Sb<sub>2</sub>Te<sub>3</sub> studied using THz spectroscopy and electrical measurements**, Varun S. Kamboj, Angadjit Singh, Lukas Jakob, Univ. of Cambridge (United Kingdom); Gregor Mussler, Forschungszentrum Jülich GmbH (Germany); Satyaprasad P. Senanayak, Adrian Ionescu, Harvey E. Beere, Univ. of Cambridge (United Kingdom); Detlev Grützmacher, Forschungszentrum Jülich GmbH (Germany); Crispin H. W. Barnes, David A. Ritchie, Univ. of Cambridge (United Kingdom) . . . . [11279-60]
- 11:10 am: **Ultra strong light matter coupling with THz nano antennas: towards the few electron systems**, Shima Rajabali, Giacomo Scalari, Felice Appugliese, Josefine Enkner, Mattias Beck, Jérôme Faist, ETH Zurich (Switzerland) ..... [11279-61]
- 11:30 am: **Simulation study and experimental confirmation of a tunable terahertz negative-refractive index metamaterial**, Wei-Chih Wang, Univ. of Washington (USA) and National Tsing Hua Univ. (Taiwan); Han-Hsiang Chen, National Tsing Hua Univ. (Taiwan); Chi-Leung Tsui, Univ. of Washington (USA) ..... [11279-62]
- Lunch/Exhibition Break ..... Thu 11:50 am to 1:20 pm

**SESSION 16**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... THU 1:20 PM TO 3:00 PM**

**Novel Technologies and Approaches**

Session Chairs: **Robert H. Giles**, Univ. of Massachusetts Lowell (USA);  
**Kyung Hyun Park**, Electronics and Telecommunications Research Institute (Korea, Republic of)

- 1:20 pm: **Thin film lithium niobate optical modulators for THz applications**, Seyfollah Toroghi, Payam Rabiei, Partow Technologies LLC (USA) . . [11279-63]
- 1:40 pm: **Hydration studies of nanosilica incorporated cement using mid-infrared and terahertz spectroscopy**, Shaumik Ray, Jyotirmayee Dash, Bala Pesala, CSIR-Central Electronics Engineering Research Institute (India) and Academy of Scientific & Innovative Research (India); Saptarshi Sasmal, CSIR - Structural Engineering Research Ctr. (India) and Academy of Scientific & Innovative Research (India); Nirmala Devi, CSIR-Central Electronics Engineering Research Institute (India) and Academy of Scientific & Innovative Research (India) . . . . . [11279-64]
- 2:00 pm: **Improving the linearity of silicon ring modulators by manipulating the quality factor and operation wavelength**, Qiang Zhang, Hui Yu, Penghui Xia, Jianyi Yang, Zhejiang Univ. (China) ..... [11279-65]
- 2:20 pm: **Microscopic conductivity and ultrafast carrier dynamics in molybdenum-based MXenes: THz spectroscopy study**, Guangjiang Li, Teng Shi, Worcester Polytechnic Institute (USA); Varun Natu, Michel W. Barsoum, Drexel Univ. (USA); Lyubov V. Titova, Worcester Polytechnic Institute (USA) . . . . . [11279-66]
- 2:40 pm: **Generation of kilovolt, picosecond electric pulses by coherent combining in optoelectronic systems**, Sahar Wehbi, Delia Arnaud-Cormos, Philippe Leveque, Philippe Leproux, XLIM (France); Anthony Bertrand, ALPhANOV (France); Vincent Couderc, XLIM (France) . . . . . [11279-67]
- Coffee Break ..... Thu 3:00 pm to 3:30 pm

**SESSION 17**

**LOCATION: ROOM 307 (LEVEL 3 SOUTH) ..... THU 3:30 PM TO 5:10 PM**

**Characterization and Applications**

Session Chairs: **Laurence P. Sadwick**, InnoSys, Inc. (USA);  
**Tianxin Yang**, Tianjin Univ. (China)

- 3:30 pm: **Investigation on the excess noise in the Brillouin optical time domain analysis due to stimulated Brillouin scattering**, Jaffar Kadum, Technische Univ. Braunschweig (Germany) and State Co. for Oil Projects (Iraq); Cheng Feng, Thomas Schneider, Technische Univ. Braunschweig (Germany) ..... [11279-68]
- 3:50 pm: **Degradation effects and origin in H-terminated diamond MESFETs**, Carlo De Santi, Luca Pavanello, Arianna Nardo, Univ. degli Studi di Padova (Italy); Claudio Verona, Gianluca Verona Rinati, Univ. degli Studi di Roma "Tor Vergata" (Italy); Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini, Univ. degli Studi di Padova (Italy) ..... [11279-69]
- 4:10 pm: **Investigation of single-mode anti-resonant hollow-core THz fibers**, Shuai Sun, Wei Shi, Quan Sheng, Guo Zhang, Yao Zhang, Jianquan Yao, Tianjin Univ. (China) ..... [11279-70]
- 4:30 pm: **Low-index sparse dielectric metagratings for sub-terahertz polarization control and extreme beam deflection**, Jierong Cheng, Xipu Dong, Fei Fan, Shengjiang Chang, Nankai Univ. (China) ..... [11279-71]
- 4:50 pm: **Terahertz generation by cross-focused q-Gaussian laser beams in collisional plasmas**, Kumar Sandeep, Naveen Gupta, Lovely Professional Univ. (India) ..... [11279-87]

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# CONFERENCE 11280

LOCATION: ROOM 314 (LEVEL 3 SOUTH)

Tuesday–Thursday 4–6 February 2020 • Proceedings of SPIE Vol. 11280

## Gallium Nitride Materials and Devices XV

*Conference Chairs:* **Hiroshi Fujioka**, Institute of Industrial Science, The Univ. of Tokyo (Japan); **Hadis Morkoç**, Virginia Commonwealth Univ. (USA); **Ulrich T. Schwarz**, Technische Univ. Chemnitz (Germany)

*Program Committee:* **Frank Bertram**, Otto-von-Guericke-Universität Magdeburg (Germany); **Michal Bockowski**, Institute of High Pressure Physics (Poland); **Raffaella Calarco**, Paul-Drude-Institut für Festkörperelektronik (Germany); **Mitch M. C. Chou**, National Sun Yat-Sen Univ. (Taiwan); **Jen-Inn Chyi**, National Central Univ. (Taiwan); **Martin Feneberg**, Otto-von-Guericke-Universität Magdeburg (Germany); **Mitsuru Funato**, Kyoto Univ. (Japan); **Bernard Gil**, Lab. Charles Coulomb (France); **Nicolas Grandjean**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Jung Han**, Yale Univ. (USA); **Hideki Hirayama**, RIKEN (Japan); **Ray-Hua Horng**, National Chiao Tung Univ. (Taiwan); **Chih-Fang Huang**, National Tsing Hua Univ. (Taiwan); **Motoaki Iwaya**, Meiji Univ. (Japan); **Michael Kneissl**, Technische Univ. Berlin (Germany); **Elison Matioli**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Koh Matsumoto**, Taiyo Nippon Sanso Corp. (Japan); **Hideito Miyake**, Mie Univ. (Japan); **Eva Monroy**, CEA-INAAC (France); **Yong-Tae Moon**, LG Electronics Inc. (Korea, Republic of); **Yasushi Nanishi**, Ritsumeikan Univ. (Japan); **Ümit Özgür**, Virginia Commonwealth Univ. (USA); **Piotr Perlin**, Institute of High Pressure Physics (Poland); **Fan Ren**, Univ. of Florida (USA); **Tae-Yeon Seong**, Korea Univ. (Korea, Republic of); **Bo Shen**, Peking Univ. (China); **Jong-In Shim**, Hanyang Univ. (Korea, Republic of); **Maria Tchernycheva**, Ctr. de Nanosciences et de Nanotechnologies (France); **Akio Wakejima**, Nagoya Institute of Technology (Japan); **Chih-Chung Yang**, National Taiwan Univ. (Taiwan); **Euijon Yoon**, Seoul National Univ. (Korea, Republic of)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... TUE 10:30 AM TO 12:30 PM

#### Growth I: Bulk Growth and Epitaxy

Session Chair: **Ulrich T. Schwarz**,  
Technische Univ. Chemnitz (Germany)

10:30 am: **Recent progress of large size and low dislocation bulk GaN growth** (*Invited Paper*), Yutaka Mikawa, Mitsubishi Chemical Holdings Corp. (Japan); Takayuki Ishinabe, Mitsubishi Chemical Corp. (Japan); Yuji Kagamitani, Hirofumi Ikeda, Tae Mochizuki, Satoru Izumisawa, Kenji Iso, Tatsuya Takahashi, Kohei Kubota, Yuuki Enatsu, Yusuke Tsukada, Mitsubishi Chemical Corp. (Japan) ..... [11280-1]

11:00 am: **Electric-field-induced diffusion phenomena of Mg and hydrogen atoms in Mg-doped GaN through annealing** (*Invited Paper*), Tetsuo Narita, Toyota Central R&D Labs., Inc. (Japan) ..... [11280-2]

11:30 am: **Recent progress in bulk GaN growth**, Michal Bockowski, Boleslaw Lucznik, Mikolaj Amilusik, Michal Fijalkowski, Kacper Sierakowski, Slawomir Sakowski, Aneta Sidor, Malgorzata Iwinska, Robert Kucharski, Karolina Grabianska, Tomasz Sochacki, Institute of High Pressure Physics (Poland) ..... [11280-3]

11:45 am: **Optical and crystallinity properties of lattice-matched AlGaN on GaN**, Justin Goodrich, Hanlin Fu, Damir Borovac, Nelson Tansu, Lehigh Univ. (USA) ..... [11280-4]

12:00 pm: **Structural and optical properties of phase-transition cubic III-nitride on patterned silicon (100) substrates**, Richard Liu, Can Bayram, ChangQiang Chen, Univ. of Illinois (USA) ..... [11280-5]

12:15 pm: **Gallium pollution in an AIXTRON close coupled showerhead reactor and its serious effect on the growth process stability of InGaIn layers for optoelectronic applications**, Mrad Mrad, Christophe Licitra, Amelie Dussaigne, Victor Yon, Jerome Richey, Matthieu Lafossas, Joel Kanyandekwe, Guy Feuillet, Matthew Charles, CEA-Grenoble (France) ..... [11280-6]

Lunch/Exhibition Break ..... Tue 12:30 pm to 2:00 pm

#### SESSION 2

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... TUE 2:00 PM TO 3:00 PM

#### Growth II: Characterization and Dislocations

Session Chair: **Shigefusa F. Chichibu**, Tohoku Univ. (Japan)

2:00 pm: **Visualization of defects in nitride semiconductors by electron channeling** (*Invited Paper*), Carol Trager-Cowan, Aeshah Alasamari, William Avis, Jochen Bruckbauer, Paul Edwards, Ben Hourahine, Albes Kotzai, Gunnar Kusch, Robert Martin, Ryan McDermott, G. Naresh-Kumar, M. Nouf-Allahiani, Elena Pascal, David Thomson, Dale Waters, Univ. of Strathclyde (United Kingdom); Peter Parbrook, Tyndall National Institute (Ireland); Arantxa Vilalta-Clemente, Angus Wilkinson, Univ. of Oxford (United Kingdom); Ken Mingard, National Physical Lab. (United Kingdom); Aimo Winkelmann, Laser Zentrum Hannover e.V. (Germany) ..... [11280-7]

2:30 pm: **Dislocation density reduction in (101 1) GaN at a high temperature using tri-halide vapor phase epitaxy**, Kenji Iso, Mitsubishi Chemical Corp. (Japan); Shoma Ohtaki, Erina Miyata, Yuka Kido, Hisashi Murakami, Akinori Koukitu, Tokyo Univ. of Agriculture and Technology (Japan) ..... [11280-8]

2:45 pm: **Growth optimization and characterization of an AlInN-based p-i-n diode**, Damir Borovac, Wei Sun, Matthew R. Peart, Renbo Song, Jonathan J. Wierer Jr., Nelson Tansu, Lehigh Univ. (USA) ..... [11280-9]

Coffee Break ..... Tue 3:00 pm to 3:30 pm

#### SESSION 3

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... TUE 3:30 PM TO 5:45 PM

#### Material Characterization: Point Defects

Session Chair: **Michal Bockowski**,  
Institute of High Pressure Physics (Poland)

3:30 pm: **Origin and dynamic properties of major intrinsic nonradiative recombination centers in wide bandgap nitride semiconductors** (*Invited Paper*), Shigefusa F. Chichibu, Kohei Shima, Kazunobu Kojima, Tohoku Univ. (Japan); Shoji Ishibashi, National Institute of Advanced Industrial Science and Technology (Japan); Akira Uedono, Univ. of Tsukuba (Japan) ..... [11280-10]

4:00 pm: **Control of vacancy-type defects in Mg implanted GaN studied by positron annihilation spectroscopy** (*Invited Paper*), Akira Uedono, Univ. of Tsukuba (Japan); Werner Egger, Univ. der Bundeswehr München (Germany); Christoph Hugschmidt, Technische Univ. München (Germany); Shoji Ishibashi, National Institute of Advanced Industrial Science and Technology (Japan) ..... [11280-11]

4:30 pm: **Exciton fine structure of aluminum nitride** (*Invited Paper*), Ryota Ishii, Mitsuru Funato, Yoichi Kawakami, Kyoto Univ. (Japan) ..... [11280-12]

5:00 pm: **Degradation and recovery of high-periodicity InGaIn/GaN MQWs under optical stress in short-circuit condition**, Alessandro Caria, Carlo De Santi, Filippo Zamperetti, Univ. degli Studi di Padova (Italy); Xuanqi Huang, Houqiang Fu, Hong Chen, Yuji Zhao, Arizona State Univ. (USA); Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini, Univ. degli Studi di Padova (Italy) ..... [11280-13]

5:15 pm: **Characterizations of BAIN films with various boron contents**, Tinh Binh Tran, Feras AlQatari, Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11280-14]

5:30 pm: **GaN nano-porous structures and arrays of nanolasers made by selective area sublimation**, Benjamin Damilano, Ctr. de recherche sur l'hétéroépitaxie et ses applications (France) ..... [11280-59]

WEDNESDAY 5 FEBRUARY

SESSION 4

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... WED 8:00 AM TO 10:15 AM

VCSEL and RCLED

Session Chair: **Piotr Perlin**, Institute of High Pressure Physics (Poland)

8:00 am: **Polarization-locked blue semipolar (20-2-1) GaN-based vertical-cavity surface-emitting lasers** (*Invited Paper*), Jared Kearns, Joonho Back, Nathan Palmquist, Daniel A. Cohen, Steven P. DenBaars, Shuji Nakamura, Univ. of California, Santa Barbara (USA) ..... [11280-15]

8:30 am: **Nonpolar GaN-based VCSELS with lattice-matched nanoporous distributed Bragg reflector mirrors** (*Invited Paper*), Daniel F. Feezell, Saadat Mishkat-Ul-Masabih, Andrew Aragon, Morteza Monavarian, The Univ. of New Mexico (USA); Ting Luk, Ctr. for Integrated Nanotechnologies, Los Alamos National Lab. (USA) ..... [11280-16]

9:00 am: **Recent progress for blue VCSELS and challenges to move to UV** (*Invited Paper*), Åsa Haglund, Filip Hjort, Chalmers Univ. of Technology (Sweden); Johannes Enslin, Institut für Festkörperphysik, Technische Univ. Berlin (Germany); Munise Cobet, Technische Univ. Berlin (Germany); Michael A. Bergmann, Ehsan Hashemi, Chalmers Univ. of Technology (Sweden); Tim Kolbe, Ferdinand-Braun-Institut (Germany); Johan Gustavsson, Jörgen Bengtsson, Tim Wernicke, Chalmers Univ. of Technology (Sweden); Michael Kneissl, Technische Univ. Berlin (Garon) ..... [11280-17]

9:30 am: **Growth and characterization of III-nitride UV vertical resonant-cavity light-emitting diodes with hybrid air-gap/AlGaIn and dielectric distributed Bragg reflectors**, Russell D. Dupuis, Theeradet Detchprohm, Young-Jae Park, Chuan-Wei Tsou, Karan Mehta, Ping Chen, Hoon Jeong, Minkyu Cho, P. D. Yoder, Shyh-Chiang Shen, Georgia Institute of Technology (USA) ..... [11280-18]

9:45 am: **A 310-nm optically pumped AlGaIn VCSEL with two dielectric distributed Bragg reflectors**, Filip Hjort, Chalmers Univ. of Technology (Sweden); Johannes Enslin, Munise Cobet, Technische Univ. Berlin (Germany); Michael A. Bergmann, Chalmers Univ. of Technology (Sweden); Tim Kolbe, Ferdinand-Braun-Institut (Germany); Johan Gustavsson, Chalmers Univ. of Technology (Sweden); Tim Wernicke, Michael Kneissl, Technische Univ. Berlin (Germany); Åsa Haglund, Chalmers Univ. of Technology (Sweden) ... [11280-19]

10:00 am: **GaN-based vertical-cavity surface-emitting laser incorporating a TiO<sub>2</sub> high-index-contrast grating**, Tsu-Chi Chang, National Chiao Tung Univ. (Taiwan); Ehsan Hashemi, Jörgen Bengtsson, Johan Gustavsson, Åsa Haglund, Chalmers Univ. of Technology (Sweden); Tien-Chang Lu, National Chiao Tung Univ. (Taiwan) ..... [11280-20]

Coffee Break. .... Wed 10:15 am to 10:45 am

SESSION 5

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... WED 10:45 AM TO 12:15 PM

LED: Light Extraction and Efficiency

Session Chair: **Daniel F. Feezell**, The Univ. of New Mexico (USA)

10:45 am: **Light extraction from LEDs: a long battle** (*Invited Paper*), Claude Weisbuch, Leah Y. Kuritzky, James S. Speck, Univ. of California, Santa Barbara (USA) ..... [11280-21]

11:15 am: **PECVD grown Si<sub>3</sub>N<sub>4</sub> photonic crystal micro-domes for the light extraction enhancement of GaN LEDs**, Muhammet Genc, Sabanci Univ. (Turkey); Volodymyr Sheremet, Mustafa Elci, Bilkent Univ. (Turkey); Ismail Altuntas, Ilkay Demir, Cumhuriyet Üniv. (Turkey); Emre Gur, Atatürk Univ. (Turkey); Sezai Elagoz, Cumhuriyet Üniv. (Turkey); Oguz Gulseren, Bilkent Univ. (Turkey); Atila Aydinli, Uludag Univ. (Turkey) ..... [11280-22]

11:30 am: **Efficiency of InGaIn LEDs: revisiting the role of disorder and localization** (*Invited Paper*), Aurelien David, Soraa, Inc. (USA) ..... [11280-23]

12:00 pm: **Determination of carrier concentration and quantum efficiency in InGaIn/GaN quantum wells using photomodulated reflectivity**, Matthew P. Halsall, Iain Crowe, The Univ. of Manchester (United Kingdom); Rachel Oliver, Menno J. Kappers, Colin J. Humphreys, Univ. of Cambridge (United Kingdom) ..... [11280-24]

Lunch/Exhibition Break ..... Wed 12:15 pm to 1:45 pm

SESSION 6

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... WED 1:45 PM TO 3:15 PM

In-Plane Laser Diodes and Nonlinear Optics

Session Chair: **Åsa Haglund**, Chalmers Univ. of Technology (Sweden)

1:45 pm: **Towards 2D fully integrated array of InGaIn laser diodes** (*Invited Paper*), Piotr Perlin, Anna Kafar, Kiran Saba, Krzysztof Gibasiewicz, Agata Bojarska, Institute of High Pressure Physics (Poland); Dario Schiavon, TopGaN Ltd. (Poland) ..... [11280-25]

2:15 pm: **Blue and green InGaIn semiconductor lasers as light sources for displays**, Yoshitaka Nakatsu, Yoji Nagao, Tsuyoshi Hirao, Yoshihiro Hara, Shingo Masui, Tomoya Yanamoto, Shin-ichi Nagahama, Nichia Corp. (Japan) ..... [11280-26]

2:30 pm: **(Al,In)GaIn laser diodes angular resolved far-field dynamics**, Ulrich T. Schwarz, Hassan S. Banayem, Matthias Damm, Yijie Mu, Technische Univ. Chemnitz (Germany); Soenke Tautz, Harald Koenig, Georg Bruederl, OSRAM Opto Semiconductors GmbH (Germany) ..... [11280-27]

2:45 pm: **Looking for the causes of degradation of ultraviolet laser diodes**, Lucja Marona, Szymon Grzanka, Dario Schiavon, Piotr Perlin, Institute of High Pressure Physics (Poland) ..... [11280-28]

3:00 pm: **Second harmonic generation devices with transverse quasi-phase-matched polarity-inverted stacked AlN waveguide**, Asahi Yamauchi, Tenta Komatsu, Kazuhisa Ikeda, Osaka Univ. (Japan); Kenjiro Uesugi, Kanako Shojiki, Hideto Miyake, Mie Univ. (Japan); Toshiaki Hikosaka, Shinya Nunoue, Toshiba Corp. (Japan); Takaya Morikawa, Yasufumi Fujiwara, Masahiro Uemukai, Tomoyuki Tanikawa, Ryuji Katayama, Osaka Univ. (Japan) ..... [11280-29]

Coffee Break. .... Wed 3:15 pm to 3:45 pm

SESSION 7

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... WED 3:45 PM TO 5:45 PM

In-Plane Laser Diodes: Visible and UV

Session Chair: **Lucja Marona**, Institute of High Pressure Physics (Poland)

3:45 pm: **Toward the realization of AlGaIn-based UVB laser diodes on high-quality thick AlGaIn films** (*Invited Paper*), Motoaki Iwaya, Meijo Univ. (Japan); Kosuke Sato, Asahi Kasei Corp. (Japan) and Meijo Univ. (Japan); Sho Iwayama, Tetsuya Takeuchi, Satoshi Kamiyama, Meijo Univ. (Japan); Isamu Akasaki, Meijo Univ. (Japan) and Nagoya Univ. (Japan); Hideto Miyake, Mie Univ. (Japan) ..... [11280-30]

4:15 pm: **InGaIn frequency stabilized high-power devices for atom-cooling and trapping enabling quantum technology**, Ludwig Prade, John Macarthur, Loyd McKnight, Fraunhofer Ctr. for Applied Photonics (United Kingdom); William Dorward, Opticap Ltd. (United Kingdom); John Sharp, Helia Photonics Ltd. (United Kingdom); Stephen Najda, Piotr Perlin, Tadeusz Suski, Lucja Marona, Szymon Stanczyk, Przemek Wisniewski, Szymon Grzanka, Dario Schiavon, Michal Leszczyński, TopGaN Ltd. (Poland) ..... [11280-31]

4:30 pm: **Critical discussion of the determination of internal losses in state-of-the-art (Al,In)GaIn laser diodes**, Ulrich T. Schwarz, Dominic J. Kunzmann, Raphael Kohlstedt, Tino Uhlig, Technische Univ. Chemnitz (Germany) ..... [11280-32]

4:45 pm: **Degradation mechanisms of 1.6 W blue semiconductor lasers: effect on subthreshold optical power and power spectral density**, Francesco Piva, Carlo De Santi, Matteo Buffolo, Mattia Taffarel, Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini, Univ. degli Studi di Padova (Italy) ..... [11280-33]

5:00 pm: **Monolithically p-down nitride laser diodes and LEDs obtained by MBE using buried tunnel junction design**, Henryk Turski, Institute of High Pressure Physics (Poland); Shyam Bharadwaj, Cornell Univ. (USA); Marcin Siekacz, Grzegorz Muziol, Mikolaj Chlipala, Mikolaj Zak, Mateusz Hajdel, Krzesimir Nowakowski-Szkudlarek, Szymon Stanczyk, Institute of High Pressure Physics (Poland); Grace Xing, Debdeep Jena, Cornell Univ. (USA); Czeslaw Skierbiszewski, Institute of High Pressure Physics (Poland) ..... [11280-34]

5:15 pm: **Micro-LED displays: monolithic approach for full color** (*Invited Paper*), Kei-May Lau, Hong Kong Univ. of Science and Technology (Hong Kong, China) ..... [11280-35]

OPTO

# CONFERENCE 11280

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Low leakage and high fmax RF AlInGa/GaN HEMT on low-resistivity silicon substrate by i-Line stepper optical lithography**, Jian-Min Li, Jen-Inn Chyi, Indraneel Sanyal, Yi-Zhen Liu, National Central Univ. (Taiwan) . [11280-53]

**The improving resolution for dislocation analysis in GaN by three-photon microscopy**, Eiji Hase, Takeshi Yasui, Tokushima Univ. (Japan); Hideki Hirayama, Tokushima Univ. (Japan) and RIKEN (Japan); Kentaro Nagamatsu, Tokushima Univ. (Japan) ..... [11280-56]

**Improvement in photoelectrochemical water splitting characteristics of GaN nanowires using tungsten sulfide nanostructures**, Sangmoon Han, Siyun Noh, Chonbuk National Univ. (Korea, Republic of); Ganpurev Adilbish, Chonbuk National Univ. (Korea, Republic of); Yeontae Yu, Chonbuk National Univ. (Korea, Republic of); Seoung-Ki Lee, Applied Quantum Composites Research Ctr., Korea Institute of Science and Technology (Korea, Republic of); Mee-Yi Ryu, Kangwon National Univ. (Korea, Republic of); Jin Soo Kim, Chonbuk National Univ. (Korea, Republic of) ..... [11280-57]

**Tunneling mechanism and photocurrent properties dependence on internal electric field in InGaN/pseudo-AlInGaN multi-quantum-wells**, Woong-Ki Kim, Byung-Guon Park, Reddeppa Maddaka, Moon-Deock Kim, Chungnam National Univ. (Korea, Republic of) ..... [11280-58]

## THURSDAY 6 FEBRUARY

### SESSION 8

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... THU 8:00 AM TO 10:45 AM

#### UV LED

Session Chair: **Andreas Waag**, Technische Univ. Braunschweig (Germany)

8:00 am: **Deep-UV photonic devices using extreme quantum confinement** (*Invited Paper*), Debdeep Jena, Cornell Univ. (USA) ..... [11280-36]

8:30 am: **AlGaIn-based quantum structures for high-efficiency light emitters** (*Invited Paper*), Zlatko Sitar, Ramon Collazo, Ronny Kirste, Seiji Mita, North Carolina State Univ. (USA) ..... [11280-37]

9:00 am: **Strain relaxation caused by defects in InGaIn-based multiple-quantum-well near-ultraviolet light-emitting diodes investigated by macroscopic characterization**, A. B. M. Hamidul Islam, Suncheon National Univ. (Korea, Republic of); Dong-Soo Shin, Hanyang Univ. (Korea, Republic of); Joon Seop Kwak, Suncheon National Univ. (Korea, Republic of); Jong-In Shim, Hanyang Univ. (Korea, Republic of) ..... [11280-38]

9:15 am: **Role of defects in the mid-term degradation of UV-B LEDs investigated by optical and DLTS measurements**, Francesco Piva, Carlo De Santi, Univ. degli Studi di Padova (Italy); Manato Deki, Manato Deki, Maki Kushimoto, Hiroshi Amano, Institute of Materials and Systems for Sustainability, Nagoya Univ. (Japan); Hidemasa Tomozawa, Naoki Shibata, Nikkiso Giken Co., Ltd. (Japan); Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini, Univ. degli Studi di Padova (Italy) ..... [11280-39]

9:30 am: **High performances of AlGaIn-based UVC and UVB LEDs with relaxed buffer layer as well as using p-type graded multi-quantum-barrier electron-blocking layer** (*Invited Paper*), Muhammad Ajml Khan, RIKEN Ctr. for Advanced Photonics (Japan) and RIKEN (Japan); Noritoshi Maeda, Masafumi Jo, RIKEN (Japan); Yukio Kashima, Marubun Corp. (Japan); Hideki Hirayama, RIKEN (Japan) ..... [11280-40]

10:00 am: **Prospects and challenges for UV LEDs and UV lasers with tunnel junctions** (*Invited Paper*), Tim Wernicke, Luca Sulmoni, Martin Guttman, Norman Susilo, Eviathar Ziffer, Christian Kuhn, Frank Mehnke, Anton Muhin, Technische Univ. Berlin (Germany); Filip Hjort, Chalmers Univ. of Technology (Sweden); Johannes Enslin, Technische Univ. Berlin (Germany); Munise Cobet, Technische Univ. Berlin (Germany) and Johannes Kepler Univ. Linz (Austria); Michael A. Bergmann, Chalmers Univ. of Technology (Sweden); Martin Martens, Technische Univ. Berlin (Germany); Johan Gustavsson, Åsa Haglund, Chalmers Univ. of Technology (Sweden); Michael Kneissl, Technische Univ. Berlin (Germany) and Ferdinand-Braun-Institut (Germany) ..... [11280-41]

10:30 am: **Enhancement of light extraction efficiency of 280-nm deep-UV LEDs using SiO<sub>2</sub> microsphere and microlens arrays**, Bryan Melanson, Jing Zhang, Cheng Liu, Rochester Institute of Technology (USA) ..... [11280-42]

Coffee Break ..... Thu 10:45 am to 11:15 am

### SESSION 9

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... THU 11:15 AM TO 12:30 PM

#### MicroLED and Nanostructured Devices I

Session Chair: **Martin D. Dawson**, Fraunhofer UK Research Ltd. (United Kingdom)

11:15 am: **3D GaN microstructures with high aspect ratio: from material properties to devices** (*Invited Paper*), Andreas Waag, Lab. for Emerging Nanometrology, Technische Univ. Braunschweig (Germany) and Epitaxy Competence Ctr. ec2 (Germany); Jana Hartmann, Christoph Margenfeld, Irene Mangano Clavero, Technische Univ. Braunschweig (Germany) and Epitaxy Competence Ctr. ec2 (Germany); Hendrik Spende, Lab. for Emerging Nanometrology, Technische Univ. Braunschweig (Germany) and Epitaxy Competence Ctr. ec2 (Germany); Klaas Stempel, Hergo-Heinrich Wehmann, Technische Univ. Braunschweig (Germany) and Epitaxy Competence Ctr. ec2 (Germany); Adrian Avramescu, Martin Strassburg, Hans-Jürgen Lugauer, OSRAM Opto Semiconductors GmbH (Germany) ..... [11280-43]

11:45 am: **Local emission properties of micro-fin LED structures**, Jonas Quatuor, Mursal A. Baggash, Technische Univ. Chemnitz (Germany); Irene Mangano Clavero, Andreas Waag, Technische Univ. Braunschweig (Germany); Ulrich T. Schwarz, Technische Univ. Chemnitz (Germany) [11280-44]

12:00 pm: **Beta-phase gallium oxide nanodevices for (opto)electronic applications**, Jihyun Kim, Korea Univ. (Korea, Republic of) ..... [11280-45]

12:15 pm: **X-ray photoelectron spectroscopy analysis of InGaIn surfaces after chemical treatments and atomic layer deposition of Al<sub>2</sub>O<sub>3</sub> thin films: application to  $\mu$ LED**, Corentin Le Maout, David Vaufray, François Martin, Eugénie Martinez, Emmanuel Nolot, CEA-LETI, Univ. Grenoble Alpes (France); Stéphane Cadot, Univ. Grenoble Alpes (France); Etienne Gheeraert, Institut Néel, Univ. Grenoble Alpes, CNRS (France) and Grenoble INP (France) ..... [11280-46]

Lunch/Exhibition Break ..... Thu 12:30 pm to 2:00 pm

### SESSION 10

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... THU 2:00 PM TO 3:30 PM

#### MicroLED and Nanostructured Devices II

Session Chair: **Zlatko Sitar**, North Carolina State Univ. (USA)

2:00 pm: **Novel micro-LED devices for visible and ultraviolet wireless optical communications** (*Invited Paper*), Martin D. Dawson, Fraunhofer UK Research Ltd. (United Kingdom) ..... [11280-47]

2:30 pm: **Application of porous GaN for microLED** (*Invited Paper*), Chen Chen, Jie Song, Joo Won Choi, Saphlux Inc. (USA) ..... [11280-48]

3:00 pm: **The photonic properties of micro/mini LED arrays with different substrate thickness** (*Invited Paper*), Yen-Hsiang Fang, Industrial Technology Research Institute (Taiwan) ..... [11280-49]

Coffee Break ..... Thu 3:30 pm to 4:00 pm

### SESSION 11

LOCATION: ROOM 314 (LEVEL 3 SOUTH) ..... THU 4:00 PM TO 5:45 PM

#### Electronic Devices

Session Chair: **Hiroshi Fujioka**, Institute of Industrial Science, The Univ. of Tokyo (Japan)

4:00 pm: **Towards a Si foundry-compatible GaN-on-Si MMIC process on 200mm Si with Cu damascene BEOL** (*Invited Paper*), Jeffrey LaRoche, Raytheon Integrated Defense Systems (USA) ..... [11280-50]

4:30 pm: **Prospect of vertical GaN U MOS-FET by Mg ion implantation** (*Invited Paper*), Tetsuo Kachi, Hideki Sakurai, Nagoya Univ. (Japan); Tetsuo Narita, Keita Kataoka, Toyota Central R&D Labs., Inc. (Japan); Jun Suda, Nagoya Univ. (Japan) ..... [11280-51]

5:00 pm: **Out-diffusion of Pd as a potential degradation mechanism in GaN HEMTs with Ni-Pd-Au Schottky contacts and electrical characteristics of irradiated GaN HEMTs with protons and heavy ions**, Yongkun Sin, Dmitry Veksler, Miles Brodie, Jeremy Bonsall, Scott Sitzman, Zachary Lingley, The Aerospace Corp. (USA) ..... [11280-52]

5:15 pm: **AlGaIn/GaN heterostructure field-effect transistor with BAIN interlayer**, Rongyu Lin, Xinwei Liu, Kaikai Liu, Yi Lu, King Abdullah Univ. of Science and Technology (Saudi Arabia); Xinke Liu, Changchun Institute of Optics (China); Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11280-54]

5:30 pm: **Exploration of process techniques and diode designs for Ga<sub>2</sub>O<sub>3</sub>-based diodes**, Fan Ren, Minghan Xiao, Patrick Carey IV, Chaker Fares, Stephen Pearton, Univ. of Florida (USA); Marko Tadjer, U.S. Naval Research Lab. (USA) ..... [11280-55]

# CONFERENCE 11281

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11281

## Oxide-based Materials and Devices XI

Conference Chairs: **David J. Rogers**, Nanovation (France); **David C. Look**, Wright State Univ. (USA); **Ferechteh H. Teherani**, Nanovation (France)

Program Committee: **Vitaliy Avrutin**, Virginia Commonwealth Univ. (USA); **Philippe Bove**, Nanovation (France); **Ekaterine Chikoidze**, Univ. de Versailles Saint-Quentin-en Yvelines (France); **Jean-Jacques Delaunay**, The Univ. of Tokyo (Japan); **Aleksandra B. Djurić**, The Univ. of Hong Kong (Hong Kong, China); **Michael D. Gerhold**, U.S. Army Research Office (USA); **Michael A. Harper**, CIV USN ONR GLOBAL (USA); **Adrián Hierro**, Univ. Politécnica de Madrid (Spain); **Axel Hoffmann**, Technische Univ. Berlin (Germany); **Na Lu**, Purdue Univ. (USA); **Bianchi Méndez**, Univ. Complutense de Madrid (Spain); **Norbert H. Nickel**, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); **Tatsuo Okada**, OPERA Ctr. for Organic Photonics and Electronics Research (Japan); **Ümit Özgür**, Virginia Commonwealth Univ. (USA); **Seong-Ju Park**, Gwangju Institute of Science and Technology (Korea, Republic of); **Manijeh Razeghi**, Northwestern Univ. (USA); **Federico Rosei**, Univ. du Québec (Canada); **Vinod Eric Sandana**, Nanovation (France); **Michael L. Schuette**, Air Force Research Lab. (USA); **Chris G. Van de Walle**, Univ. of California, Santa Barbara (USA); **Bruno Viana**, Ecole Nationale Supérieure de Chimie de Paris (France); **Markus R. Wagner**, Technische Univ. Berlin (Germany); **Magnus Willander**, Linköping Univ. (Sweden); **Hideki Yamamoto**, NTT Basic Research Labs. (Japan)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . MON 10:30 AM TO 12:10 PM

##### Ga<sub>2</sub>O<sub>3</sub>: Defects, Doping and Density of States I

Session Chairs: **Chris G. Van de Walle**, Univ. of California, Santa Barbara (USA); **David C. Look**, Wright State Univ. (USA)

- 10:30 am: **First-principles studies of defects, doping, and diffusion in gallium oxide (Invited Paper)**, **Chris G. Van de Walle**, Univ. of California, Santa Barbara (USA). . . . . [11281-1]
- 10:55 am: **Hydrogen density-of-states in β-Ga<sub>2</sub>O<sub>3</sub> (Invited Paper)**, **Norbert H. Nickel**, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany); **Encarnacion G. Villora**, Kiyoshi Shimamura, National Institute for Materials Science (Japan); **Jörg Rappich**, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) . . . . . [11281-2]
- 11:20 am: **Electron-phonon coupling and electron mobility in degenerately doped oxides from first-principles (Invited Paper)**, **Marco D. Santia**, Air Force Research Lab. (USA) and National Research Council (USA); **David C. Look**, Wright State Univ. (USA); **Stefan C. Badescu**, Air Force Research Lab. (USA) . . . . . [11281-3]
- 11:45 am: **Exploration of doping in gallium oxide and related alloys (Invited Paper)**, **Joel B. Varley**, Lawrence Livermore National Lab. (USA) . . . . [11281-75]
- Lunch Break . . . . . Mon 12:10 pm to 1:10 pm

#### SESSION 2

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . MON 1:10 PM TO 2:25 PM

##### Ga<sub>2</sub>O<sub>3</sub>: Defects, Doping and Density of States II

Session Chairs: **David C. Look**, Wright State Univ. (USA); **Chris G. Van de Walle**, Univ. of California, Santa Barbara (USA)

- 1:10 pm: **Can we make In<sub>2</sub>O<sub>3</sub> and Ga<sub>2</sub>O<sub>3</sub> p-type? (Invited Paper)**, **Anderson Janotti**, Univ. of Delaware (USA). . . . . [11281-4]
- 1:35 pm: **Optical absorption in gallium and indium oxide (Invited Paper)**, **Hartwin Peelaers**, The Univ. of Kansas (USA). . . . . [11281-5]
- 2:00 pm: **Atomic scale microscopy of point defects and their complexes in β-Ga<sub>2</sub>O<sub>3</sub> (Invited Paper)**, **Jinwoo Hwang**, **Jared M. Johnson**, The Ohio State Univ. (USA); **Joel B. Varley**, Lawrence Livermore National Lab. (USA); **Aaron Arehart**, **Steven A. Ringel**, The Ohio State Univ. (USA); **Chris G. Van de Walle**, Univ. of California, Santa Barbara (USA) . . . . . [11281-6]

#### SESSION 3

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . MON 2:25 PM TO 6:30 PM

##### Ga<sub>2</sub>O<sub>3</sub>: Material Engineering

Session Chairs: **Masataka Higashiwaki**, National Institute of Information and Communications Technology (Japan); **David J. Rogers**, Nanovation (France)

- 2:25 pm: **Ga<sub>2</sub>O<sub>3</sub> phase control and heterojunctions using plasma-enhanced atomic layer epitaxy (Invited Paper)**, **Virginia D. Wheeler**, **Neeraj Nepal**, **David Boris**, **Scott Walton**, **Syed Noor Qadri**, **Jason Avila**, **Brian Downey**, **Vikrant J. Gokhale**, U.S. Naval Research Lab. (USA); **Luke Nyakiti**, Texas A&M Univ. (USA); **Andrew D. Koehler**, **Geoffrey Foster**, U.S. Naval Research Lab. (USA); **Mark S. Goorsky**, Univ. of California, Los Angeles (USA); **Charles R. Eddy**, **David Meyer**, **Marko Tadjer**, U.S. Naval Research Lab. (USA) . . . . . [11281-7]
- 2:50 pm: **Tin-assisted growth of κ-(Al<sub>x</sub>Ga<sub>1-x</sub>)<sub>2</sub>O<sub>3</sub>/κ-(In<sub>x</sub>Ga<sub>1-x</sub>)<sub>2</sub>O<sub>3</sub> superlattice heterostructures by pulsed laser deposition employing radially-segmented targets (Invited Paper)**, **Max Kneiss**, **Philipp Storm**, **Anna Hassa**, **Daniel Splith**, **Holger von Wenckstern**, **Michael Lorenz**, **Marius Grundmann**, Univ. Leipzig (Germany) . . . . . [11281-8]
- 3:15 pm: **Recent progress in the MOCVD growth of device quality β-Ga<sub>2</sub>O<sub>3</sub> films (Invited Paper)**, **Fikadu Alema**, **Andrei V. Osinsky**, **Agnitron Technology, Inc.** (USA); **Yuewei Zhang**, **Akhil Mauze**, **James S. Speck**, Univ. of California, Santa Barbara (USA) . . . . . [11281-76]
- Coffee Break. . . . . Mon 3:40 pm to 4:10 pm

OPTO

# CONFERENCE 11281

4:10 pm: **MOCVD epitaxy and doping for  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> and (Al<sub>x</sub>Ga<sub>1-x</sub>)<sub>2</sub>O<sub>3</sub>** (*Invited Paper*), Hongping Zhao, The Ohio State Univ. (USA) . . . . . [11281-9]

4:35 pm: **Investigation of the (Ga,In)<sub>2</sub>O<sub>3</sub> and (Ga,Al)<sub>2</sub>O<sub>3</sub> alloy systems on thin films grown by continuous composition spread pulsed laser deposition** (*Invited Paper*), Daniel Splith, Anna Hassa, Max Kneiss, Chris Sturm, Philipp Storm, Catharina Krömmelbein, Holger von Wenckstern, Marius Grundmann, Univ. Leipzig (Germany) . . . . . [11281-10]

5:00 pm: **Current status of halide vapor phase epitaxy of Ga<sub>2</sub>O<sub>3</sub> and related sesquioxides** (*Invited Paper*), Ken Goto, Nao Takekawa, Hisashi Murakami, Tokyo Univ. of Agriculture and Technology (Japan); Akito Kuramata, Novel Crystal Technology, Inc. (Japan); Shigenobu Yamakoshi, Tamura Corp. (Japan); Bo Monemar, Linköping Univ. (Sweden); Masataka Higashiwaki, National Institute of Information and Communications Technology (Japan); Yoshinao Kumagai, Tokyo Univ. of Agriculture and Technology (Japan) [11281-11]

5:25 pm: **HVPE growth of  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> films for devices on bulk and thermally enhanced  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> composite substrates** (*Invited Paper*), Jacob H. Leach, T. Hess, H. Splawn, Kyma Technologies, Inc. (USA); Sukwon Choi, The Pennsylvania State Univ. (USA); Craig McGray, Modern Microsystems (USA) and National Institute of Standards and Technology (USA) . . . . . [11281-12]

5:50 pm: **Epitaxial growth of  $\beta$ -Ga<sub>2</sub>O<sub>3</sub>/ $\epsilon$ -Ga<sub>2</sub>O<sub>3</sub> polymorphic heterostructures on c-plane sapphire for deep-ultraviolet optoelectronics**, Nasir A. Alfaraj, Kuang-Hui Li, Chun Hong Kang, Laurentiu V. Braic, Tien Khee Ng, Boon S. Ooi, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11281-13]

6:05 pm: **Ga<sub>2</sub>O<sub>3</sub> economics and the wide bandgap market** (*Invited Paper*), Samantha Reese, Andriy Zakutayev, National Renewable Energy Lab. (USA) . . . . . [11281-87]

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . TUE 8:00 AM TO 9:45 AM

### Ga<sub>2</sub>O<sub>3</sub> for Power Applications

Session Chairs: **Andriy Zakutayev**, National Renewable Energy Lab. (USA); **Philippe Bove**, Nanovation (France)

8:00 am: **Vertical Ga<sub>2</sub>O<sub>3</sub> transistors based on ion implantation doping technology** (*Invited Paper*), Man Hoi Wong, Univ. of Massachusetts Lowell (USA); Ken Goto, Hisashi Murakami, Yoshinao Kumagai, Tokyo Univ. of Agriculture and Technology (Japan); Masataka Higashiwaki, National Institute of Information and Communications Technology (Japan) . . . . . [11281-14]

8:25 am: **High-voltage high-current vertical-geometry gallium-oxide rectifiers** (*Invited Paper*), Minghan Xiao, Chaker Fares, Patrick Carey IV, Fan Ren, Univ. of Florida (USA); Marko J. Tadjer, U.S. Naval Research Lab. (USA); Yu-Te Liao, National Chiao Tung Univ. (Taiwan); Chin Wei Chang, Jenshan Lin, Ribhu Sharma, Mark Law, Univ. of Florida (USA); Peter Raad, Southern Methodist Univ. (USA); Pavel Komarov, TMX Scientific, Inc. (USA); Zahabul Islam, Aman M. Haque, The Pennsylvania State Univ. (USA); Akito Kuramata, Novel Crystal Technology, Inc. (Japan); Stephen J. Pearton, Univ. of Florida (USA) . . . . . [11281-15]

8:50 am: **Modeling of oxide semiconductors for power electronic devices** (*Invited Paper*), Andriy Zakutayev, National Renewable Energy Lab. (USA) . . . . . [11281-16]

9:15 am: **Charge trapping and degradation of Ga<sub>2</sub>O<sub>3</sub> isolation structures for power electronics**, Carlo De Santi, Arianna Nardo, Univ. degli Studi di Padova (Italy); Man Hoi Wong, National Institute of Information and Communications Technology (Japan); Ken Goto, Tokyo Univ. of Agriculture and Technology (Japan); Akito Kuramata, Novel Crystal Technology, Inc. (Japan); Shigenobu Yamakoshi, Tamura Corp. (Japan); Hisashi Murakami, Yoshinao Kumagai, Tokyo Univ. of Agriculture and Technology (Japan); Masataka Higashiwaki, National Institute of Information and Communications Technology (Japan); Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini, Univ. degli Studi di Padova (Italy) . . . . . [11281-17]

9:30 am: **AlN/ $\beta$ -Ga<sub>2</sub>O<sub>3</sub>-based HEMT for high-power devices**, Yi Lu, Hsin-Hung Yao, Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11281-18]

Coffee Break . . . . . Tue 9:45 am to 10:10 am

### SESSION 5

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . TUE 10:10 AM TO 11:30 AM

### Ga<sub>2</sub>O<sub>3</sub>: Applications Driven Material Structuring

Session Chairs: **Philippe Bove**, Nanovation (France); **Virginia D. Wheeler**, U.S. Naval Research Lab. (USA)

10:10 am: **Elemental device technologies developed for lateral Ga<sub>2</sub>O<sub>3</sub> metal-oxide-semiconductor field-effect transistors** (*Invited Paper*), Masataka Higashiwaki, Takafumi Kamimura, Yoshiaki Nakata, National Institute of Information and Communications Technology (Japan) . . . . . [11281-19]

10:35 am: **Unique material modifications of Ga<sub>2</sub>O<sub>3</sub> enabled by ultrafast laser irradiation** (*Invited Paper*), Minhyung Ahn, Alex Sarracino, Abdul Ansari, Ben R. Torralva, Steven M. Yalisove, Jamie Phillips, Univ. of Michigan (USA) . . . . . [11281-20]

11:00 am:  **$\beta$ -(AlGa)<sub>2</sub>O<sub>3</sub> solar-blind photodetector fabricated by high-temperature driven interdiffusion method**, Che-Hao Liao, Yara Banda, Gaia Da Prato, Kuang-Hui Li, Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11281-21]

11:15 am: **Advanced approaches to critical dimension measurement in high-throughput industrial processing**, John Cruickshank, Jeffrey Witz, Toni Ivanov, Vadim Pinskiy, Matthew Putman, Nanotronics (USA) . . . [11281-22]

Lunch/Exhibition Break . . . . . Tue 11:30 am to 12:30 pm

### SESSION 6

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . TUE 12:30 PM TO 3:05 PM

### ZnGa<sub>2</sub>O<sub>4</sub> Based Devices and Properties

Session Chairs: **Zbigniew Galazka**, Leibniz-Institut für Kristallzüchtung (Germany); **David C. Look**, Wright State Univ. (USA)

12:30 pm: **Electron mobility from phonon scattering in degenerate semiconductors: ZnO,  $\beta$ -Ga<sub>2</sub>O<sub>3</sub>, and ZnGa<sub>2</sub>O<sub>4</sub>** (*Invited Paper*), David C. Look, Wright State Univ. (USA); Kevin D. Leedy, Air Force Research Lab. (USA); Ray-Hua Horng, National Chiao Tung Univ. (Taiwan); Stefan C. Badescu, Marco D. Santia, Air Force Research Lab. (USA) . [11281-23]

12:55 pm: **First-principles modeling of native point defects in zinc gallate** (*Invited Paper*), Stefan C. Badescu, Marco D. Santia, Air Force Research Lab. (USA); David C. Look, Wright State Univ. (USA); Kevin D. Leedy, Air Force Research Lab. (USA) . . . . . [11281-24]

1:20 pm: **Quasi-single-crystalline ZnGa<sub>2</sub>O<sub>4</sub> films via solid-phase epitaxy for UV sensing** (*Invited Paper*), Dong-Sing Wu, National Chung Hsing Univ. (Taiwan) . . . . . [11281-25]

1:45 pm: **Bulk ZnGa<sub>2</sub>O<sub>4</sub> single crystals and their physical properties** (*Invited Paper*), Zbigniew Galazka, Leibniz-Institut für Kristallzüchtung (Germany) . . . . . [11281-26]

2:10 pm: **Investigation of the surface electronic structure of bulk ZnGa<sub>2</sub>O<sub>4</sub>**, Felix Reichmann, Jaroslaw Dabrowski, IHP GmbH (Germany); Zbigniew Galazka, Leibniz-Institut für Kristallzüchtung (Germany); Wolfgang M. Klesse, IHP GmbH (Germany); Mattia Mulazzi, Humboldt-Univ. zu Berlin (Germany) . . . . . [11281-27]

2:25 pm: **Effect of ZnGa<sub>2</sub>O<sub>4</sub> epilayer qualities on the performance of DUV phototransistors** (*Invited Paper*), Ray-Hua Horng, Peng-Hsuan Huang, Yuan Chu Shen, Chiung-Yi Huang, National Chiao Tung Univ. (Taiwan) . . . . . [11281-28]

2:50 pm: **Improved ultrafast optical nonlinearity in polycrystalline GaZnO nanostructures by selective electron beam irradiation**, Albin Antony, Poornesh P., Manipal Institute of Technology (India); Iwan V. Kityk, Czestochowa Univ. of Technology (Poland); Ganesh Sanjeev, Mangalore Univ. (India); Suresh D. Kulkarni, Manipal Academy of Higher Education (India) . . . . . [11281-29]

Coffee Break . . . . . Tue 3:05 pm to 3:30 pm

**SESSION 7**

**LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . TUE 3:30 PM TO 6:15 PM**

**Nanostructured Growth, Properties and Applications**

Session Chairs: **Bruno Viana**, École Nationale Supérieure de Chimie de Paris (France); **Vinod Eric Sandana**, Nanovation (France)

3:30 pm: **Oxides-based nanophosphors for thermometry at nanoscale** (*Invited Paper*), Estelle Glais, Sorbonne Univ. (France) and Chimie de la Matière Condensée de Paris, CNRS (France); Lise Abiven, Corinne Chaneac, Sorbonne Univ. (France); Bruno Viana, École Nationale Supérieure de Chimie de Paris (France) . . . . . [11281-30]

3:55 pm: **Synthesis and characterization of NiO- and Sn-doped NiO micro and nanostructures** (*Invited Paper*), David Maestre Varea, Ana Cremades Rodriguez, María Taeño González, Julio Ramírez Castellanos, Univ. Complutense de Madrid (Spain) . . . . . [11281-31]

4:20 pm: **The use of deep learning for photometric stereo of noise samples** (*Invited Paper*), Denis Sharoukhov, Tina Narong, Vadim Pinskiy, Matthew Putman, Nanotronics (USA) . . . . . [11281-32]

4:45 pm: **Luminescent properties of powders and pulsed-laser-deposited thin phosphor films and their applications** (*Invited Paper*), Martin Ntwaeaborwa, Univ. of the Witwatersrand, Johannesburg (South Africa) . . . . . [11281-33]

5:10 pm: **Si(O)(C) and ZnO-based nanosystems for energy applications and nanomedicine** (*Invited Paper*), Giancarlo Salviati, Istituto dei Materiali per l'Electronica ed il Magnetismo (Italy) . . . . . [11281-73]

5:35 pm: **Application of Fe<sub>3</sub>O<sub>4</sub> nanoparticles for magnetic hyperthermia** (*Invited Paper*), Francesca Rossi, Istituto dei Materiali per l'Electronica ed il Magnetismo (Italy) . . . . . [11281-74]

6:00 pm: **Role of indium in enhancing CO gas sensing properties of ZnO thin films probed by photoluminescence and Raman spectroscopy**, Aninamol Ani, Poornesh P., Nagaraja K. K., Suresh D. Kulkarni, Manipal Academy of Higher Education (India); Murugaiya S. Ilango, Ctr. for Nano Science and Engineering (CeNSE), Indian Institute of Science (India) [11281-34]

**WEDNESDAY 5 FEBRUARY**

**SESSION 8**

**LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . WED 8:00 AM TO 11:25 AM**

**Plasmonics and Photonics**

Session Chairs: **Vitaliy S. Avrutin**, Virginia Commonwealth Univ. (USA); **Adrián Hierro**, Univ. Politécnica de Madrid (Spain)

8:00 am: **ITO ENZ photonics: from modulators to optical limiters** (*Invited Paper*), Volker J. Sorger, The George Washington Univ. (USA) [11281-35]

8:25 am: **CdZnO/sapphire as a plasmonic metamaterial: surface plasmon-phonon polariton hybridation** (*Invited Paper*), Adrián Hierro, Julien Tamayo-Arriola, Eduardo Martinez Castellano, Miguel Montes Bajo, Univ. Politécnica de Madrid (Spain); Adelaida Huerta-Barbera, Univ. de València (Spain); Elias Muñoz, Univ. Politécnica de Madrid (Spain); Vicente Munoz-San Jose, Univ. de València (Spain) . . . . . [11281-36]

8:50 am: **Transparent conductive oxides for integrated photonics and silicon photonics** (*Invited Paper*), Alan X. Wang, Oregon State Univ. (USA) . . . . . [11281-37]

9:15 am: **Broadband photonic epsilon-near-zero transparent conductive oxide composites made by multi-target multi-beam pulsed laser deposition** (*Invited Paper*), Abdalla M. Darwish, Dillard Univ. (USA); Sergey S. Sarkisov, SSS Optical Technologies, LLC (USA); Kyu C. Cho, Anit K. Giri, U.S. Army Research Lab. (USA); Jamaya Wilson, Dillard Univ. (USA); Avedik S. Sarkisov, Gubkin Russian State Univ. of Oil and Gas (Russian Federation); Brent Koplitz, Xiaodong Zhang, Tulane Univ. (USA) . . . . . [11281-38]

9:40 am: **Low-temperature growth of ZnO-based TCOs by MBE and ALD for plasmonics** (*Invited Paper*), Dhruv Fomra, Kai Ding, Vitaliy S. Avrutin, Natalia Izyumskaya, Nathaniel Kinsey, Ümit Özgür, Hadis Morkoç, Virginia Commonwealth Univ. (USA) . . . . . [11281-39]

Coffee Break . . . . . Wed 10:05 am to 10:20 am

10:20 am: **Gold-nanoparticle incorporated acceptor- and donor-doped strontium titanate for optical-fiber based high-temperature gas sensing** (*Invited Paper*), Jeffrey K. Wuenschell, Youngseok Jee, Paul R. Ohodnicki, National Energy Technology Lab. (USA) . . . . . [11281-40]

10:45 am: **Surface oxide mediated electronic-chemical coupling for sensor applications** (*Invited Paper*), April S. Brown, Duke Univ. (USA) . . . . . [11281-77]

11:10 am: **Ga<sub>2</sub>O<sub>3</sub>:Si grown by pulsed laser deposition for transistor applications**, Vinod Eric Sandana, Nanovation (France) . . . . . [11281-41]

**SESSION 9**

**LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . WED 11:25 AM TO 12:45 PM**

**Electronic Devices**

Session Chairs: **Heidemarie Schmidt**, Leibniz-Institut für Photonische Technologien e.V. (Germany); **Bruno Viana**, École Nationale Supérieure de Chimie de Paris (France)

11:25 am: **Full swing and high-gain inverters based on MESFETs and JFETs with amorphous zinc tin-oxide channels** (*Invited Paper*), Peter Schlupp, Oliver Lahr, Sofie Vogt, Zhipeng Zhang, Holger von Wenckstern, Marius Grundmann, Univ. Leipzig (Germany) . . . . . [11281-42]

11:50 am: **Reconfigurable perovskite memristors: properties and applications** (*Invited Paper*), Heidemarie Schmidt, Leibniz-Institut für Photonische Technologien e.V. (Germany) and Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Elektronische Nanosysteme ENAS (Germany) . . . . . [11281-43]

12:15 pm: **Structure-property relationship in blade-coated amorphous In<sub>2</sub>O<sub>3</sub> thin-film transistors**, Ahmad R. Kirmani, Emily F. Roe, Lee J. Richter, National Institute of Standards and Technology (USA) . . . . . [11281-44]

12:30 pm: **Effect of hydrogen incorporation on sub-gap density of states in amorphous InGaZnO thin-film transistors**, George W. Mattson, Kyle T. Vogt, Chris Malmberg, Paul Cheong, Matt W. Graham, John F. Wager, Oregon State Univ. (USA) . . . . . [11281-45]

Lunch/Exhibition Break . . . . . Wed 12:45 pm to 2:00 pm

**SESSION 10**

**LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . WED 2:00 PM TO 3:40 PM**

**Photodetectors and Sensors**

Session Chairs: **Maria Losurdo**, Istituto di Nanotecnologia (Italy); **Philippe Bove**, Nanovation (France)

2:00 pm: **Zinc oxide for THz quantum-cascade devices** (*Invited Paper*), Jean-Michel Chauveau, Nolwenn Le Biavan, Maxime Hugues, Ctr. de recherche sur l'hétéroépitaxie et ses applications (France); Miguel Montes, Julien Tamayo-Arriola, Instituto de Sistemas Optoelectrónicos y Microtecnología, Univ. Politécnica de Madrid (Spain); Arnaud Jollivet, Ctr. de Nanosciences et de Nanotechnologies (France); Borislav Hinkov, Hanh Thi Hoang, Technische Univ. Wien (Austria); Bo Meng, ETH Zurich (Switzerland); Denis Lefebvre, Ctr. de recherche sur l'hétéroépitaxie et ses applications (France); Maria Tchernycheva, François H. Julien, Ctr. de Nanosciences et de Nanotechnologies (France); Gottfried Strasser, Technische Univ. Wien (Austria); Adrián Hierro, Instituto de Sistemas Optoelectrónicos y Microtecnología, Univ. Politécnica de Madrid (Spain); Jérôme Faist, ETH Zurich (Switzerland) . . . . . [11281-47]

2:25 pm: **Direct studies on nonlinear oxide crystals able to generate mid-infrared parametric light** (*Invited Paper*), Patricia Segonds, Benoit Boulanger, Institut NéEL (France) . . . . . [11281-48]

2:50 pm: **Q-switch using magneto-optical garnet film for holographic application** (*Invited Paper*), Taichi Goto, Shutaro Nakata, Yuichi Nakamura, Hironaga Uchida, Mitsuteru Inoue, Toyohashi Univ. of Technology (Japan) . . . . . [11281-51]

3:15 pm: **Multiple roles of oxides interfacing metal plasmonic nanoparticles: a new way to tailor functionality** (*Invited Paper*), Maria Losurdo, Istituto di Nanotecnologia (Italy); Yael Gutiérrez Vela, Univ. de Cantabria (Spain); Maria Michela Giangregorio, Istituto di Nanotecnologia (Italy); Fernando Moreno, Univ. de Cantabria (Spain); April S. Brown, Duke Univ. (USA) . . . . . [11281-78]

Coffee Break . . . . . Wed 3:40 pm to 4:00 pm



## SESSION 11

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . WED 4:00 PM TO 5:45 PM

### Material Properties

Session Chairs: **Takeyoshi Onuma**, Kogakuin Univ. (Japan);  
**David J. Rogers**, Nanovation (France)

- 4:00 pm: **DUV cathodoluminescence in rocksalt-structured MgZnO films** (*Invited Paper*), Takeyoshi Onuma, Mizuki Ono, Kanta Kudo, Kogakuin Univ. (Japan); Kyohei Ishii, Kentaro Kaneko, Shizuo Fujita, Kyoto Univ. (Japan); Tohru Honda, Kogakuin Univ. (Japan) . . . . . [11281-52]
- 4:25 pm: **Fast optical activation of insulator-to-metal transition in vanadium dioxide (VO<sub>2</sub>) phase-changed materials**, Aurelian Crunteanu-Stanescu, Jean-Christophe Orlianges, Annie Bessaudou, XLIM (France) . . . . . [11281-53]
- 4:40 pm: **Impact of light and ambient gas on the resistance of sputter-deposited non-doped ZnO films** (*Invited Paper*), Yasuhisa Omura, Shingo Sato, Kansai Univ. (Japan) . . . . . [11281-54]
- 5:05 pm: **Laser damage threshold for HfO<sub>2</sub>, Ta<sub>2</sub>O<sub>5</sub>, Nb<sub>2</sub>O<sub>5</sub>, and TiO<sub>2</sub> under manufacturing environments**, Andrew Z. Gao, Yifan Yang, Bojun Zhang, Wenhao Cao, Wenbo Cui, Silicon Valley Optics Technology, Inc. (USA) . . . . . [11281-55]
- 5:20 pm: **Band structure engineering and doping control of transparent conducting materials** (*Invited Paper*), Su-Huai Wei, Beijing Computational Science Research Ctr. (China) . . . . . [11281-71]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

- Ion beam sputtering of HfO<sub>2</sub>/SiO<sub>2</sub> optical coatings for UV applications**, Matthias Falmbigl, Sandeep Kohli, Riju Singhal, Jason M. George, Veeco Instruments Inc. (USA) . . . . . [11281-49]
- Rechargeable Zn<sup>2+</sup>/Al<sup>3+</sup> dual-ion electrochromic device with long lifetime utilizing dimethyl sulfoxide (DMSO)-nanocluster modified hydrogel electrolytes**, Eric Hopmann, Univ. of Alberta (Canada) . . . . . [11281-64]
- An indium-oxide electrode with discontinuous Au layers for plasmonic devices**, Yuri K. Vygranenko, UNINOVA (Portugal); Guilherme Lavareda, Univ. Nova de Lisboa (Portugal); Vânia André, Instituto Superior Técnico (Portugal); Miguel Fernandes, Alessandro Fantoni, Manuela Vieira, Instituto Superior de Engenharia de Lisboa (Portugal) . . . . . [11281-65]
- Tuning material properties of ZnON by Mg<sup>2+</sup> cationic substitution**, Antonia Welk, Anna Reinhardt, Holger von Wenckstern, Peter Schlupp, Marius Grundmann, Univ. Leipzig (Germany) . . . . . [11281-66]
- A comparative study on the effect of UV-ozone annealing on the optical properties of ZnMgO thin films and nanorods**, Md Jawaid Alam, Indian Institute of Technology Bombay (India); Punam A. Murkute, Univ. Grenoble Alpe (France); Sushama Sushama, Indian Institute of Technology Bombay (India); Hemant J. Ghadi, The Ohio State Univ. (USA); Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11281-67]
- Impact of UV-ozone annealing on the optical and structural properties of ZnO thin films and nanorods**, Md Jawaid Alam, Indian Institute of Technology Bombay (India); Punam A. Murkute, Univ. Grenoble Alpes (France); Sushama Sushama, Indian Institute of Technology Bombay (India); Hemant J. Ghadi, The Ohio State Univ. (USA); Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11281-68]
- SrAl<sub>2</sub>O<sub>4</sub>:Eu<sup>2+</sup>, Dy<sup>3+</sup> nanoparticles obtained by pulsed laser ablation in liquid**, Hongli Du, Victor Castaing, École Nationale Supérieure de Chimie de Paris (France); Dongcai Guo, Hunan Univ. (China); Bruno Viana, École Nationale Supérieure de Chimie de Paris (France) . . . . . [11281-69]
- UV nanophotodetector based on a single ZnO: Au nanowire functionalized with Au-nanoparticles**, Vasile Postica, Univ. Technica a Moldovei (Moldova); Thierry Pauporte, Bruno Viana, École Nationale Supérieure de Chimie de Paris (France); H. Cavers, Rainer Adelung, Mathias Hoppe, Christian-Albrechts-Univ. zu Kiel (Germany); Oleg Lupan, Univ. Technica a Moldovei (Moldova) [11281-70]

## THURSDAY 6 FEBRUARY

## SESSION 12

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . THU 8:30 AM TO 9:40 AM

### Thin-Film Growth and Doping

Session Chairs: **Vitaliy S. Avrutin**, Virginia Commonwealth Univ. (USA);  
**Patricia Segonds**, Institut NÉEL (France)

- 8:30 am: **Molecular beam epitaxy of Zn-polar ZnO/BeMgZnO heterostructure field effect transistors on GaN and c-sapphire: a comparative study** (*Invited Paper*), Kai Ding, Vitaliy S. Avrutin, Natalia Izyumskaya, Ümit Özgür, Hadis Morkoç, Virginia Commonwealth Univ. (USA) . . . . . [11281-56]
- 8:55 am: **Structural and electrical properties of MgO on GaN by thermal atomic layer deposition**, Justin Goodrich, Onoriode N. Ogidi-Ekoko, Lehigh Univ. (USA); Thomas Farinha, Univ. of Maryland, College Park (USA); Alexandra Howzen, Animesh Kundu, Jonathan J. Wierer, Nicholas Strandwitz, Nelson Tansu, Lehigh Univ. (USA) . . . . . [11281-57]
- 9:10 am: **Electronic coupling in ZnO asymmetric quantum wells for intersubband cascade devices**, Nolwenn Le Biavan, Univ. Côte d'Azur (France) and Ctr. de recherche sur l'hétéroépitaxie et ses applications, CNRS (France); Maxime Hugues, Univ. Côte d'Azur (France); Bo Meng, ETH Zurich (Switzerland); Miguel Montes Bajo, Julien Tamayo-Arriola, Instituto de Sistemas Optoelectrónicos y Microtecnología, Univ. Politécnica de Madrid (Spain); Arnaud Jollivet, Ctr. de Nanosciences et de Nanotechnologies (France); Borislav Hinkov, Hanh Thi Hoang, Technische Univ. Wien (Austria); Almudena Torres-Pardo, Univ. Complutense de Madrid (Spain); Denis Lefebvre, Yvon Cordier, Borge Vinter, Univ. Côte d'Azur (France); Maria Tchernycheva, François H. Julien, Ctr. de Nanosciences et de Nanotechnologies (France); Gottfried Strasser, Technische Univ. Wien (Austria); Adrián Hierro, Instituto de Sistemas Optoelectrónicos y Microtecnología, Univ. Politécnica de Madrid (Spain); Jérôme Faist, ETH Zurich (Switzerland); Jean-Michel Chauveau, Univ. Côte d'Azur (France) . . . . . [11281-58]
- 9:25 am: **Electro-optic pulse generation at the 2µm wavelength range proximity to the ferroelectric phase transition in KLTN crystals**, Yehuda Vidal, The Hebrew Univ. of Jerusalem (Israel); Salman Noach, Jerusalem College of Technology (Israel); Aharon J. Agranat, The Hebrew Univ. of Jerusalem (Israel) . . . . . [11281-59]
- Coffee Break. . . . . Thu 9:40 am to 10:10 am

## SESSION 13

LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . THU 10:10 AM TO 2:20 PM

### Photovoltaics and Energy Harvesting

Session Chairs: **Vinod Eric Sandana**, Nanovation (France);  
**Can Bayram**, Univ. of Illinois (USA)

- 10:10 am: **Intermediate-band solar cells based on highly mismatched II-VI oxide semiconductors** (*Invited Paper*), Tooru Tanaka, Katsuhiko Saito, Qixin Guo, Saga Univ. (Japan); Kin Man Yu, City Univ. of Hong Kong (Hong Kong, China); Wladek Walukiewicz, Lawrence Berkeley National Lab. (USA) and Univ. of California, Berkeley (USA) . . . . . [11281-60]
- 10:35 am: **Reactively sputtered metal-oxide interlayers for scalable photovoltaic devices**, Morten Madsen, Mehrad Ahmadvour, Univ. of Southern Denmark (Denmark); André L. F. Cauduro, Lawrence Berkeley National Lab. (USA); Jani Lamminaho, Bhushan Ramesh Patil, William Greenbank, Univ. of Southern Denmark (Denmark); Brian Julsgaard, Aarhus Univ. (Denmark); Vida Turkovic, Univ. of Southern Denmark (Denmark); Peter Balling, Aarhus Univ. (Denmark); Horst-Günter Rubahn, Univ. of Southern Denmark (Denmark); Nadine Witkowski, Sorbonne Univ. (France) and Institut des nanosciences de Paris (France); Andreas K. Schmid, Lawrence Berkeley National Lab. (USA) . . . . . [11281-61]
- 10:50 am: **Embedding laser-generated nanocrystals in BiVO<sub>4</sub> photoanode for efficient photoelectrochemical water splitting** (*Invited Paper*), Hongqiang Wang, Northwestern Polytechnical Univ. (China) . . . . . [11281-62]
- 11:15 am: **Multifunctional materials for emerging technologies** (*Invited Paper*), Federico Rosei, Institut National de la Recherche Scientifique (Canada) . . . . . [11281-63]
- 11:40 am: **Solar hydrogen production on oxide semiconductor heterostructures** (*Invited Paper*), Yi-Hsuan Chiu, Ming-Yu Kuo, Ting-Hsuan Lai, Ping-Yen Hsieh, Yung-Jung Hsu, National Chiao Tung Univ. (Taiwan) . . . . . [11281-72]
- Lunch/Exhibition Break . . . . . Thu 12:05 pm to 1:30 pm

1:30 pm: **Modified synthesis of lithium metal oxides for high-performance lithium-ion batteries** (*Invited Paper*), Neslihan Yuca, Enwair Energy Technologies Corp. (Turkey), Maltepe Univ. (Turkey); Büşra Çetin, Enwair Energy Technologies Corp. (Turkey) . . . . . [11281-80]

1:55 pm: **Effect of light-induced lattice expansion in high-efficiency halide perovskites solar cells** (*Invited Paper*), Olivier Durand, Fonctions Optiques pour les Technologies de l'information (France); Hsinhan Tsai, Los Alamos National Lab. (USA) and Rice Univ. (USA); Reza Asadpour, Purdue Univ. (USA); Jean-Christophe Blancon, Los Alamos National Lab. (USA); Constantinos C. Stoumpos, Northwestern Univ. (USA); Joseph Strzalka, Argonne National Lab. (USA); Bo Chen, Rafael Verduzco, Pulickel M. Ajayan, Rice Univ. (USA); Sergei Tretiak, Los Alamos National Lab. (USA); Jacky Even, Fonctions Optiques pour les Technologies de l'information (France); Muhammad Ashraf Alam, Purdue Univ. (USA); Mercouri G. Kanatzidis, Northwestern Univ. (USA); Wanyi Nie, Los Alamos National Lab. (USA); Aditya D. Mohite, Los Alamos National Lab. (USA) and Rice Univ. (USA) . . . . . [11281-84]

**SESSION 14**

**LOCATION: ROOM 152 (UPPER MEZZANINE SOUTH) . . . THU 2:20 PM TO 3:30 PM**

**Oxides-based Devices**

Session Chairs: **David J. Rogers**, Nanovation (France); **Federico Rosei**, Institut National de la Recherche Scientifique (Canada)

2:20 pm: **High-rate lithium-ion batteries via ALD infiltration of aluminium into LiCoO<sub>2</sub> electrodes** (*Invited Paper*), Takashi Teranishi, Yumi Yoshikawa, Mika Yoneda, Akira Kishimoto, Okayama Univ. (Japan); Mircea G. Modreanu, Ian M. Povey, Tyndall National Institute (Ireland) . . . . . [11281-85]

2:45 pm: **Demonstration of large-size vertical Ga<sub>2</sub>O<sub>3</sub> Schottky diodes**, Mi-Hee Ji, Shajjad Chowdhury, Ivan I. Kravchenko, Emre Gurpinar, Pooran C. Joshi, Tolga Aytug, Frederick A. List III, Burak Ozpineci, M. Parans Paranthaman, Oak Ridge National Lab. (USA) . . . . . [11281-79]

3:00 pm: **Broadband high-speed and large-amplitude all-optical switching with cadmium oxide**, Soham Saha, Purdue Univ. (USA); Benjamin T. Diroll, Argonne National Lab. (USA); Joshua Shank, Sandia National Labs. (USA); Zhaxylyk A. Kudyshev, Aweek Dutta, Sarah N. Chowdhury, Purdue Univ. (USA); Ting S. Luk, Salvatore Campione, Sandia National Labs. (USA); Richard D. Shaller, Argonne National Lab. (USA); Vladimir M. Shalaev, Purdue Univ. (USA); Michael G. Wood, Sandia National Labs. (USA); Alexandra Boltasseva, Purdue Univ. (USA) . . . . . [11281-82]

3:15 pm: **Novel approach to lift-off based on oxide templates**, David J. Rogers, Vinod Eric Sandana, Philippe Bove, Ferechteh H. Teherani, Nanovation (France) . . . . . [11281-86]



**Photonics West Industry Stage**

Tuesday – Thursday • Hall DE  
Keynotes and panels open to all attendees  
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# CONFERENCE 11282

LOCATION: ROOM 308 (LEVEL 3 SOUTH)

Wednesday–Thursday 5–6 February 2020 • Proceedings of SPIE Vol. 11282

## 2D Photonic Materials and Devices III

Conference Chairs: **Arka Majumdar**, Univ. of Washington (USA); **Carlos M. Torres Jr.**, Naval Information Warfare Ctr. Pacific (USA); **Hui Deng**, Univ. of Michigan (USA)

Program Committee: **Ritesh Agarwal**, Univ. of Pennsylvania (USA); **Igor Aharonovich**, Univ. of Technology, Sydney (Australia); **Joshua R. Hendrickson**, Air Force Research Lab. (USA); **Maiken H. Mikkelsen**, Duke Univ. (USA); **Nathaniel P. Stern**, Northwestern Univ. (USA); **A. Nick Vamivakas**, Univ. of Rochester (USA); **Feng Wang**, Univ. of California, Berkeley (USA); **Fengnian Xia**, Yale Univ. (USA); **Xiaodong Xu**, Univ. of Washington (USA)

### WEDNESDAY 5 FEBRUARY

#### SESSION 1

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... WED 8:00 AM TO 10:00 AM

#### Atomically Thin Classical and Quantum Light Sources I

Session Chair: **Vinod M. Menon**, The City College of New York (USA)

8:00 am: **Spin-layer locking of interlayer valley excitons trapped in moiré potentials** (*Invited Paper*), Brian D. Gerardot, Heriot-Watt Univ. (United Kingdom) ..... [11282-1]

8:30 am: **Quantum emitters in 2D materials: progress, challenges, and opportunities** (*Invited Paper*), Galan Moody, Univ. of California, Santa Barbara (USA) ..... [11282-2]

9:00 am: **Strain reduced and photoluminescence enhanced of two-dimensional molybdenum disulfide emitters on three-dimensional substrate**, Andrew B. Lee, Chiao-Yun Chang, Hsiang-Ting Lin, Academia Sinica (Taiwan); Ming Sheng Lai, National Chiao Tung Univ. (Taiwan); Cheng-Li Yu, Chong-Rong Wu, Academia Sinica (Taiwan); Shih-Yen Lin, Academia Sinica (Taiwan) and National Taiwan Univ. (Taiwan); He-Chun Chou, National Taiwan Univ. (Taiwan); Chi Chen, Academia Sinica (Taiwan); Min-Hsiung Shih, Academia Sinica (Taiwan) and National Chiao Tung Univ. (Taiwan) . . . . [11282-3]

9:20 am: **Prospects of high-beta nanolasers with transition metal dichalcogenides**, Christopher Gies, Frederik Lohof, Alexander Steinhoff, Matthias Florian, Michael Lorke, Daniel Erben, Frank Jahnke, Univ. Bremen (Germany) ..... [11282-4]

9:40 am: **Deterministic assembly of arrays of van der Waals heterostructures from lithographically defined WS<sub>2</sub> and MoS<sub>2</sub> monolayer arrays obtained directly from multilayer sources**, Vu Nguyen, Hayden K. Taylor, Univ. of California, Berkeley (USA) ..... [11282-5]

Coffee Break. .... Wed 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... WED 10:30 AM TO 12:10 PM

#### Atomically Thin Classical and Quantum Light Sources II

Session Chair: **Carlos M. Torres Jr.**, Naval Information Warfare Ctr. Pacific (USA)

10:30 am: **Hexagonal boron nitride: an emerging platform for nanophotonics** (*Invited Paper*), Trong Toan Tran, Univ. of Technology, Sydney (Australia) ..... [11282-6]

11:00 am: **Discrete interactions between a few interlayer excitons trapped at a MoSe<sub>2</sub>-WSe<sub>2</sub> heterointerface** (*Invited Paper*), Malte Kremser, Walter Schottky Institut (Germany); Mauro Brotons-Gisbert, Heriot-Watt Univ. (United Kingdom); Moritz Meyer, Walter Schottky Institut (Germany); Johannes Knörzer, Max-Planck-Institut für Quantenoptik (Germany); Matteo Barbone, Walter Schottky Institut (Germany); Brian D. Gerardot, Heriot-Watt Univ. (United Kingdom); Jonathan J. Finley, Walter Schottky Institute (Germany); Kai Müller, Walter Schottky Institut (Germany) ..... [11282-7]

11:30 am: **Enhanced electroluminescence from WSe<sub>2</sub> monolayers coupled to gold antenna arrays**, Kevin Han, Geun Ho Ahn, Joy Cho, Seth Fortuna, George Zhang, Ali Javey, Ming C. Wu, Univ. of California, Berkeley (USA) ..... [11282-8]

11:50 am: **Probing the properties of excitons and critical points in van der Waals heterostructures: the important role of dielectric screening**, Xudan Zhu, Junbo He, Rong-Jun Zhang, Yu-Xiang Zheng, Song-You Wang, Haibin Zhao, Liangyao Chen, Fudan Univ. (China) ..... [11282-9]

Lunch/Exhibition Break ..... Wed 12:10 pm to 1:40 pm

#### SESSION 3

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... WED 1:40 PM TO 3:20 PM

#### 2D Material Exciton-Polariton I

Session Chair: **Deep Jariwala**, Univ. of Pennsylvania (USA)

1:40 pm: **Towards two-dimensional exciton arrays in transition metal dichalcogenides** (*Invited Paper*), You Zhou, Giovanni Scuri, Jiho Sung, Ryan Gelly, Trond Anderson, Dominik Wild, Kristiaan De Greve, Andrew Joe, Philip Kim, Mikhail Lukin, Hongkun Park, Harvard Univ. (USA) ..... [11282-10]

2:10 pm: **Spin and valley properties in tunable 2D materials and artificial van der Waals solids** (*Invited Paper*), Ursula Wurstbauer, Westfälische Wilhelms-Universität Münster (Germany) ..... [11282-11]

2:40 pm: **Valley-selective optical Stark effect of exciton-polaritons in a monolayer semiconductor**, Trevor LaMountain, Erik Lenferink, Samuel H. Amsterdam, Mark C. Hersam, Nathaniel P. Stern, Northwestern Univ. (USA) ..... [11282-12]

3:00 pm: **Room-temperature valley coherence in a polaritonic system**, Liangyu Qiu, Chitraleema Chakraborty, Sajal Dhara, Nick Vamivakas, The Institute of Optics, Univ. of Rochester (USA) ..... [11282-13]

Coffee Break. .... Wed 3:20 pm to 3:50 pm

#### SESSION 4

LOCATION: ROOM 308 (LEVEL 3 SOUTH) ..... WED 3:50 PM TO 5:40 PM

#### 2D Material Exciton-Polariton II

Session Chair: **Kai Müller**, Walter Schottky Institut (Germany)

3:50 pm: **Tailoring optical phenomena at the nanoscale by integrating 2D materials with plasmonics and nanophotonics** (*Invited Paper*), Alexander High, The Univ. of Chicago (USA) ..... [11282-14]

4:20 pm: **Strong light-matter coupling in atomically-thin excitonic semiconductors** (*Invited Paper*), Deep Jariwala, Univ. of Pennsylvania (USA) ..... [11282-15]

4:50 pm: **Exciton polaritons and quantum emitters in 2D materials** (*Invited Paper*), Vinod M. Menon, The City College of New York [11282-16]

5:20 pm: **High-precision local transfer of van der Waals materials on nanophotonic structures**, David Rosser, Univ. of Washington (USA) [11282-17]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Graphene as a metal without the negative dielectric constant in the designed monolayer graphene waveguide at a chemical potential of 450meV**, Swetha S. Bobba, City, Univ. of London (United Kingdom) . [11282-32]

**Two-dimensional MoS<sub>2</sub>/InP heterojunction photovoltaic**, Sachin J. Pawar, Donghwan Kim, Yeungnam Univ. (Korea, Republic of); Ansoon Kim, Korea Research Institute of Standards and Science (Korea, Republic of); Joo Hyung Park, Korea Institute of Energy Research (Korea, Republic of); Jae Cheol Shin, Yeungnam Univ. (Korea, Republic of); TaeWan Kim, Chonbuk National Univ. (Korea, Republic of) . . . . . [11282-33]

**Graphene-based broadband and tunable grating reflector for far-infrared frequency**, Juveriya Parmar, Shreyas Charola, Mayurkumar Ladumor, Shobhit Patel, Marwadi Univ. (India) . . . . . [11282-34]

**Modulating the emission directionality of monolayer WS<sub>2</sub> by single hydrogen-doped amorphous silicon nanospheres**, Jie Fang, Mingsong Wang, Yuebing Zheng, The Univ. of Texas at Austin (USA) . . . . . [11282-35]

**Enhancing the nonlinear functionality of step-index silica fibers through the combination of thermal poling and 2D materials**, Francesco De Lucia, Adam H. Lewis, Rex H. S. Bannerman, Optoelectronics Research Ctr. (United Kingdom); Nicolas Englebort, Univ. Libre de Bruxelles (Belgium); Martin Núñez Velázquez, Chung-Che Huang, James C. Gates, Optoelectronics Research Ctr. (United Kingdom); Simon-Pierre Gorza, François Leo, Univ. Libre de Bruxelles (Belgium); Jayanta K. Sahu, Dan W. Hewak, Pier J. A. Sazio, Optoelectronics Research Ctr. (United Kingdom) . . . . . [11282-36]

**Highly efficient broadband graphene absorbers**, Sangin Kim, Hyungjun Heo, Sangjun Lee, Ajou Univ. (Korea, Republic of) . . . . . [11282-38]

**Wavelength- and polarization-dependent second harmonic generations in TMD heterostructure**, Jungcheol Kim, Hyeonsik Cheong, Sogang Univ. (Korea, Republic of) . . . . . [11282-39]

**Quantum molecular dynamics simulations of chemical vapor deposition synthesis of MoS<sub>2</sub> crystal assisted by H<sub>2</sub> partial pressures**, Sungwook Hong, California State Univ., Bakersfield (USA) . . . . . [11282-40]

**Polymer-assisted graphene doping for high-speed optical integrated nanodevice**, Aref Asghari, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Volker J. Sorger, The George Washington Univ. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [11282-41]

**Graphene-like Si<sub>3</sub>N<sub>3</sub> and Si<sub>3</sub>N<sub>4</sub> nanolayers on silicon surface**, Yahor V. Lebiadok, Alena A. Razumets, SSPA “Optics, Optoelectronics, and Laser Technology” NASB (Belarus); Raman Y. Mikulich, SSPA “Optics, Optoelectronics, and Laser Technology” (Belarus) . . . . . [11282-42]

**THURSDAY 6 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 308 (LEVEL 3 SOUTH) . . . . . THU 8:00 AM TO 10:20 AM**

**2D Material Optoelectronics and Integrated Nanophotonics**

Session Chair: **Carlos M. Torres Jr.**, Naval Information Warfare Ctr. Pacific (USA)

8:00 am: **2D material-integrated optoelectronics** (*Invited Paper*), Volker J. Sorger, The George Washington Univ. (USA) . . . . . [11282-18]

8:30 am: **2D material photonics: from devices to systems** (*Invited Paper*), Thomas Mueller, Technische Univ. Wien (Austria) . . . . . [11282-19]

9:00 am: **Novel optoelectronics and nanophotonics based on van der Waals materials** (*Invited Paper*), Chang-Hua Liu, National Tsing Hua Univ. (Taiwan) . . . . . [11282-20]

9:30 am: **Lateral heterostructures in two-dimensional transition metal dichalcogenides** (*Invited Paper*), Hossein Taghinejad, Ali A. Eftekhar, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11282-21]

10:00 am: **Strain-induced waveguide integrated MoTe<sub>2</sub> photodetector at 1550 nm**, Rishi Maiti, Chandraman Patil, Ti Xie, Volker J. Sorger, The George Washington Univ. (USA) . . . . . [11282-22]

Coffee Break . . . . . Thu 10:20 am to 10:50 am

**SESSION 6**

**LOCATION: ROOM 308 (LEVEL 3 SOUTH) . . . . . THU 10:50 AM TO 12:30 PM**

**Emerging 2D Materials including Ferroelectric and Ferromagnetic Materials**

Session Chair: **John Schaibley**, The Univ. of Arizona (USA)

10:50 am: **Chiral interaction between photon angular momentum and surface electrons in topological insulators** (*Invited Paper*), Mo Li, Univ. of Washington (USA); Li He, Univ. of Minnesota, Twin Cities (USA); Seokhyeong Lee, Univ. of Washington (USA) . . . . . [11282-23]

11:20 am: **Valley physics in TMD-ferromagnet heterostructures** (*Invited Paper*), Thomas P. Lyons, The Univ. of Sheffield (United Kingdom) . . . . . [11282-24]

11:50 am: **BiOBr nanoflakes with strong Kerr nonlinearity towards hybrid integrated photonic devices**, Linnan Jia, Swinburne Univ. of Technology (Australia); Dandan Cui, Beihang Univ. (China); Jiayang Wu, Swinburne Univ. of Technology (Australia); Haifeng Feng, Yi Du, Univ. of Wollongong (Australia); Weichang Hao, Beihang Univ. (China); Baohua Jia, David J. Moss, Swinburne Univ. of Technology (Australia) . . . . . [11282-25]

12:10 pm: **Layer-dependent third-harmonic generation in multilayer tin diselenide**, Rabindra Biswas, Medha Dandu, Keshav K. Jha, Sruti Menon, Jyothsna K. M., Kausik Majumdar, Varun Raghunathan, Indian Institute of Science (India) . . . . . [11282-26]

Lunch/Exhibition Break . . . . . Thu 12:30 pm to 2:00 pm

**SESSION 7**

**LOCATION: ROOM 308 (LEVEL 3 SOUTH) . . . . . THU 2:00 PM TO 4:20 PM**

**2D Material Nonlinear Optical Devices and Cavity-Enhanced Nonlinear Optics**

Session Chair: **Volker J. Sorger**, The George Washington Univ. (USA)

2:00 pm: **2D materials: a new playground for nonlinear optics** (*Invited Paper*), Shiwei Wu, Fudan Univ. (China) . . . . . [11282-27]

2:30 pm: **Nonlinear plasmonics with monolayer semiconductor excitons** (*Invited Paper*), John Schaibley, The Univ. of Arizona (USA) . . . . . [11282-28]

3:00 pm: **Integrated polarizers based on graphene oxide in waveguides and ring resonators**, Jiayang Wu, Yunyi Yang, Yuning Zhang, Yang Qu, Xingyuan Xu, Linnan Jia, Yao Liang, Swinburne Univ. of Technology (Australia); Sai Tak Chu, City Univ. of Hong Kong (Hong Kong, China); Brent E. Little, Chinese Academy of Sciences (China); Roberto Morandotti, Institut National de la Recherche Scientifique (Canada); Baohua Jia, David J. Moss, Swinburne Univ. of Technology (Australia) . . . . . [11282-29]

3:20 pm: **Interplay of (non)linear optical responses of WS<sub>2</sub>**, Javier Hernandez Rueda, Marc Nordaam, Irina Komen, Laurens K. Kuipers, Technische Univ. Delft (Netherlands) . . . . . [11282-30]

3:40 pm: **Computationally efficient surface conductivity graphene model for tunable graphene-based devices**, Ludmila J. Prokopenva, Huan Jiang, Alexander V. Kildishev, Di Wang, Sajid Choudhury, Purdue Univ. (USA) . . . . . [11282-31]

4:00 pm: **Towards cavity-enhanced photodetection in Al-doped BP integrated with 2D photonic crystal and waveguide for mid-IR wavelengths**, Asif Bilal, Osama Jalil, Shahzad Ahmad, Abdullah Nafis Khan, Usman Younis, Information Technology Univ. of the Punjab (Pakistan) . . . . . [11282-37]

OPTO

# CONFERENCE 11283

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11283

# Integrated Optics: Devices, Materials, and Technologies XXIV

Conference Chairs: **Sonia M. García-Blanco**, Univ. Twente (Netherlands); **Pavel Cheben**, National Research Council Canada (Canada)

Program Committee: **Pierre Berini**, Univ. of Ottawa (Canada); **Romeo Bernini**, Istituto per il Rilevamento Elettromagnetico dell'Ambiente (Italy); **Andrea Blanco Redondo**, The Univ. of Sydney (Australia); **Alexandra Boltasseva**, Purdue Univ. (USA); **Jean-Emmanuel Broquin**, IMEP-LAHC (France); **Florenta A. Costache**, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany); **Xudong Fan**, Univ. of Michigan (USA); **Robert Halir**, Univ. de Málaga (Spain); **Gualtiero Nunzi Conti**, Istituto di Fisica Applicata Nello Carrara (Italy); **Alessia Pasquazi**, Univ. of Sussex (United Kingdom); **François Royer**, Univ. Jean Monnet Saint-Etienne (France); **Jens H. Schmid**, National Research Council Canada (Canada); **Yakov Sidorin**, Quarles & Brady LLP (USA); **Winnie N. Ye**, Carleton Univ. (Canada); **Avinoam Zadok**, Bar-Ilan Univ. (Israel); **Wei Zhou**, Virginia Polytechnic Institute and State Univ. (USA)

## MONDAY 3 FEBRUARY

### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break . . . . . Mon 10:05 am to 10:30 am

### SESSION 1

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) MON 10:30 AM TO 12:20 PM

#### Inverse Design of Integrated Photonic Circuits I

Session Chair: **Sonia M. García-Blanco**, Univ. of Twente (Netherlands)

10:30 am: **Inverse electromagnetic design for silicon photonic components (Keynote Presentation)**, Andrew S. Michaels, Eli Yablonovitch, Univ. of California, Berkeley (USA) . . . . . [11283-1]

11:10 am: **Adjoint state method for the inverse design of photonic devices (Invited Paper)**, Zongfu Yu, Univ. of Wisconsin-Madison (USA) . . . . . [11283-2]

11:40 am: **Deep-learning assisted on-chip Fourier transform spectrometer**, Lipeng Xia, Aoxue Zhang, Ting Li, Yi Zou, ShanghaiTech Univ. (China) [11283-3]

12:00 pm: **Taming randomness: Inverse design of an on-chip diffusive spectrometer**, Tianran Liu, Andrea Fiore, Technische Univ. Eindhoven (Netherlands) . . . . . [11283-4]

Lunch Break . . . . . Mon 12:20 pm to 1:50 pm

### SESSION 2

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . MON 1:50 PM TO 3:00 PM

#### Inverse Design of Integrated Photonic Circuits II

Session Chair: **Yakov Sidorin**, Quarles & Brady LLP (USA)

1:50 pm: **Deep-learning-enabled generative models for plasmonic metastructures (Invited Paper)**, Wenshan Cai, Georgia Institute of Technology (USA) . . . . . [11283-5]

2:20 pm: **Inverse design and demonstration of on-chip laser-driven particle accelerators**, Neil V. Saprà, Ki Youl Yang, Dries Vercrusysse, Kenneth J. Leedle, Dylan S. Black, Stanford Univ. (USA); Robert J. England, SLAC National Accelerator Lab. (USA); Logan Su, Yu Miao, Olav Solgaard, Robert L. Byer, Jelena Vuckovic, Stanford Univ. (USA) . . . . . [11283-6]

2:40 pm: **Dispersion engineering with inverse design**, Dries Vercrusysse, Neil V. Saprà, Logan Su, Jelena Vuckovic, Stanford Univ. (USA) . . . . . [11283-7]

Coffee Break . . . . . Mon 3:00 pm to 3:30 pm

### SESSION 3

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . MON 3:30 PM TO 5:30 PM

#### Novel Materials and Platforms

Session Chair: **Jean-Emmanuel Broquin**, Institut de Microélectronique Électromagnétisme et Photonique et Lab d'hyperfréquences et Caracté (France)

3:30 pm: **Ultra-low-loss Ta<sub>2</sub>O<sub>5</sub> waveguides for integrated photonics (Invited Paper)**, Daniel Blumenthal, Univ. of California, Santa Barbara (USA) . . . . . [11283-8]

4:00 pm: **Seeing blue: Pushing integrated photonics into the ultraviolet with ALD aluminum oxide (Invited Paper)**, Gavin N. West, Massachusetts Institute of Technology (USA) . . . . . [11283-9]

4:30 pm: **Low-loss TiO<sub>2</sub> channel waveguides**, Ivo Hegeman, Meindert Dijkstra, Sonia M. García-Blanco, Univ. of Twente (Netherlands) . . . . [11283-10]

4:50 pm: **RF-sputtering deposition of rare-earth-ion-doped Al<sub>2</sub>O<sub>3</sub> layers for integrated photonics**, Martijn L. Stok, Sonia M. García-Blanco, Carlijn I. van Emmerik, Ward A. P. M. Hendriks, Michiel de Goede, Lantian Chang, Jinfeng Mu, Meindert Dijkstra, Univ. of Twente (Netherlands) . . . . . [11283-11]

5:10 pm: **Nonreciprocal InSb-based magneto-optic structures**, Pavel Kwiecien, Ivan Richter, Czech Technical Univ. in Prague (Czech Republic); Vladimír Kuzmiak, Jiri Ctyroký, Institute of Photonics and Electronics of the CAS, v.v.i. (Czech Republic) . . . . . [11283-12]

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . TUE 8:30 AM TO 10:30 AM

#### Photonic Integration Technologies

Session Chair: **Rainer Hainberger**, AIT Austrian Institute of Technology GmbH (Austria)

8:30 am: **Strip-loaded photonics for an easier integration (Invited Paper)**, Matthieu Roussey, Ségolène Péliisset, Univ. of Eastern Finland (Finland) . . . . . [11283-13]

9:00 am: **Transfer printing of thin-film single-crystal diamond for integrated photonics (Invited Paper)**, Michael J. Strain, Univ. of Strathclyde (United Kingdom) . . . . . [11283-14]

9:30 am: **InP grating coupler design for vertical coupling of InP and silicon chips**, Yingheng Tang, Mitsubishi Electric Research Labs. (USA) and Purdue Univ. (USA); Keisuke Kojima, Mitsubishi Electric Research Labs. (USA) and Univ. of California, Santa Barbara (USA); Mitsunobu Gotoda, Satoshi Nishikawa, Mitsubishi Electric Corp. (Japan); Toshiaki Koike-Akino, Kieran Parsons, Mitsubishi Electric Research Labs. (USA); Thomas Meissner, Bowen Song, Jonathan Klamkin, Univ. of California, Santa Barbara (USA) . . . . . [11283-15]

9:50 am: **Tuneable laser at 2.6 μm based on GaSb and SiPh chips**, Jukka Viheriälä, Nouman Zia, Samu-Pekka Ojanen, Heidi Tuorila, Eero Koivusalo, Tampere Univ. (Finland); Matteo Cherchi, Timo Aalto, VTT Technical Research Ctr. of Finland Ltd. (Finland); Mircea Guina, Tampere Univ. (Finland) . . . . . [11283-16]

WEDNESDAY 5 FEBRUARY

SESSION 8

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . WED 8:00 AM TO 10:20 AM

Photonic Integrated Circuits

Session Chair: **Pavel Cheben**,  
National Research Council Canada (Canada)

8:00 am: **Recent progress in ultra-long fiber Bragg gratings** (*Invited Paper*), Raman Kashyap, Polytechnique Montréal (Canada) . . . . . [11283-28]

8:30 am: **Scaling-up optical transmission capacity through silicon photonics** (*Invited Paper*), Wei Shi, Univ. Laval (Canada) . . . . . [11283-29]

9:00 am: **Silicon-photonics-enabled low-cost and small-footprint fiber-optic communications** (*Keynote Presentation*), Christopher R. Doerr, Acacia Communications, Inc. (USA) . . . . . [11283-30]

9:40 am: **Silicon photonic phase interrogators for on-chip calibration of optical phased arrays**, Jon Øyvind Kjellman, Sarp Kerman, Benedetto Troia, Hemant Kumar Tyagi, Tangla David Kongnyuy, Aleksandrs Marinins, Mathias Prost, Bruno Figeys, Sarvagya Dwivedi, Marcus S. Dahlem, Philippe Soussan, Xavier Rottenberg, Roelof A. Jansen, imec (Belgium) . . . . . [11283-31]

10:00 am: **28 Gbps silicon-germanium hetero-structure avalanche photodetectors**, Daniel Benedikovic, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Léopold Virost, Univ. Grenoble Alpes (France) and CEA-LETI (France); Guy Aubin, Ctr. de Nanosciences et de Nanotechnologies (France); Jean-Michel Hartmann, Univ. Grenoble Alpes (France) and CEA-LETI (France); Farah Amar, Ctr. de Nanosciences et de Nanotechnologies (France); Bertrand Szelag, CEA-LETI (France) and Univ. Grenoble Alpes (France); Xavier Le Roux, Carlos Alonso-Ramos, Paul Crozat, Eric Cassan, Delphine Marris-Morini, Ctr. de Nanosciences et de Nanotechnologies (France); Charles Baudot, Frédéric Boeuf, STMicroelectronics S.A. (France); Jean-Marc Fédéli, Christophe Kopp, Univ. Grenoble Alpes (France) and CEA-LETI (France); Laurent Vivien, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11283-32]

Coffee Break. . . . . Wed 10:20 am to 10:50 am

SESSION 9

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . WED 10:50 AM TO 12:30 PM

Programmable Integrated Photonics

Session Chair: **Yakov Sidorin**, Quarles & Brady LLP (USA)

10:50 am: **Erasable and tunable devices to facilitate programmable photonic circuits** (*Invited Paper*), Graham T. Reed, Optoelectronics Research Ctr. (United Kingdom) . . . . . [11283-33]

11:20 am: **Dynamically controlling optical beams with programmable silicon photonic meshes** (*Invited Paper*), Francesco Morichetti, Fabio Toso, Francesco Zanetto, Giorgio Ferrari, Marco Sampietro, Andrea Melloni, Politecnico di Milano (Italy); David A. B. Miller, Stanford Univ. (USA) . . . . . [11283-34]

11:50 am: **Low-power reconfigurable photonic integrated circuits fabricated by femtosecond laser micromachining**, Francesco Ceccarelli, Simone Atzeni, Francesco Pellegatta, Ciro Pentangelo, Andrea Crespi, Roberto Osellame, Consiglio Nazionale delle Ricerche (Italy) and Politecnico di Milano (Italy) . . . . . [11283-35]

12:10 pm: **Liquid crystal waveguide switch / variable power splitter for visible and near-infrared wavelengths**, Florenta A. Costache, Boscij Pawlik, Martin Blasl, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany) . . . . . [11283-36]

Lunch/Exhibition Break . . . . . Wed 12:30 pm to 1:30 pm

10:10 am: **Hybrid integration of a polarization independent optical circulator**, Hauke Conradi, David de Felipe Mesquida, Moritz Kleinert, Madeleine Nuck, Martin Kresse, Crispin Zawadzki, Anja Scheu, Norbert Keil, Martin Schell, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany) . . . . . [11283-17]

Coffee Break. . . . . Tue 10:30 am to 11:00 am

SESSION 5

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . TUE 11:00 AM TO 12:10 PM

Optical Sensors I

Session Chair: **Carlos A. Alonso-Ramos**,  
Ctr. de Nanosciences et de Nanotechnologies (France)

11:00 am: **Nanophotonic metasurfaces for biosensing and bioimaging** (*Invited Paper*), Hatice Altug, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11283-18]

11:30 am: **High-order exceptional point based optical sensor**, Yulin Wu, Peiji Zhou, Ting Li, Yi Zou, ShanghaiTech Univ. (China) . . . . . [11283-19]

11:50 am: **Suspended silicon waveguide for mid-infrared gas sensing**, Raghi S. El Shamy, Mohamed A. Swillam, The American Univ. in Cairo (Egypt); Diaa A. M. Khalil, Ain Shams Univ. (Egypt) . . . . . [11283-20]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 2:10 pm

SESSION 6

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . TUE 2:10 PM TO 3:10 PM

Optomechanics

Session Chair: **Florenta A. Costache**, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany)

2:10 pm: **Integrated optomechanical gigahertz oscillator made of piezoelectric III/V semiconductor** (*Invited Paper*), Ines Ghorbel, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France) and Thales Research & Technology (France); Rui Zhu, Giuseppe Modica, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Aude Martin, Sylvain Combré, Alfredo De Rossi, Thales Research & Technology (France); Rémy Braive, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France) . . . . . [11283-21]

2:40 pm: **Electromechanical Brillouin scattering in integrated photonics** (*Invited Paper*), Mo Li, Qiyu Liu, Huan Li, Univ. of Washington (USA) . [11283-22]

Coffee Break. . . . . Tue 3:10 pm to 3:40 pm

SESSION 7

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . TUE 3:40 PM TO 5:40 PM

Optical Sensors II

Session Chair: **Sonia M. García-Blanco**, Univ. of Twente (Netherlands)

3:40 pm: **CMOS-compatible silicon nitride waveguide photonic building blocks and their application for optical coherence tomography and other sensing applications** (*Invited Paper*), Rainer Hainberger, Paul Mueller, Moritz Eggeling, Alejandro Maese-Novo, Stefan Nevlacsil, Jörg Schotter, Florian Vogelbacher, AIT Austrian Institute of Technology GmbH (Austria); Jochen Kraft, Martin Sagmeister, ams AG (Austria); Xue Zhou, Jinhua Huang, Mingzhu Li, Ke-Jian Jiang, Yanlin Song, Institute of Chemistry (China); Dana Seyringer, FH Vorarlberg (Austria); Elisabet Rank, Wolfgang Drexler, Medizinische Univ. Wien (Austria) . . . . . [11283-23]

4:10 pm: **Ultra-sensitive photonic-integrated-circuit-based biosensors for healthcare applications** (*Invited Paper*), Arne Leinse, René Heideman, Douwe Geuzebroek, Erik Schreuder, Floris Falke, LioniX International BV (Netherlands); Ioanna Zergioti, School of Applied Mathematics and Physical Sciences, National Technical University of Athens (Greece) . . . . . [11283-24]

4:40 pm: **Highly sensitive silicon Mach-Zehnder interferometer based ultrasound sensor**, Boling Ouyang, Technische Univ. Delft (Netherlands); Yanlu Li, Photonics Research Group (Belgium) and Ctr. for Nano and Biophotonics, Univ. Gent (Belgium); Marten Kruidhof, Roland Horsten, Technische Univ. Delft (Netherlands); Roel Baets, Photonics Research Group (Belgium) and Ctr. for Nano and Biophotonics, Univ. Gent (Belgium); Koen W. A. van Dongen, Jacob Caro, Technische Univ. Delft (Netherlands) . . . . . [11283-25]

5:00 pm: **Critical coupling condition engineered subwavelength grating waveguide ring resonator for sensitivity enhancement**, Ting Li, Yi Zou, ShanghaiTech Univ. (China) . . . . . [11283-26]

5:20 pm: **Sub-wavelength on-chip optical sources towards multiplex single-molecule detection**, Sara Perotto, Francesco Tantussi, Claudio Biagini, Francesco De Angelis, Istituto Italiano di Tecnologia (Italy) . . . . . [11283-27]

# CONFERENCE 11283

## SESSION 10

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . . WED 1:30 PM TO 3:30 PM

### Artificial Intelligence with Integrated Optics

Session Chair: **Jean-Emmanuel Broquin**,

Institut de Microélectronique Électromagnétisme et Photonique et le Lab d'hyperfréquences et Caracte (France)

1:30 pm: **A chaotic microresonator structure for an optical implementation of an artificial neural network** (*Invited Paper*), Trevor M. Benson, The Univ. of Nottingham (United Kingdom); Peter Bienstman, Univ. Gent (Belgium); Angela B. Seddon, Chris J. Mellor, Sendy Phang, The Univ. of Nottingham (United Kingdom) . . . . . [11283-37]

2:00 pm: **Advances in neuromorphic photonics** (*Invited Paper*), Bhavin J. Shastri, Queen's Univ. (Canada) . . . . . [11283-38]

2:30 pm: **Topological defect states in valley photonic structures** (*Invited Paper*), Yidong Chong, Baile Zhang, Nanyang Technological Univ. (Singapore) . . . . . [11283-39]

3:00 pm: **Photonic recurrent ising sampler (PRIS) for photonic parallel networks** (*Invited Paper*), Yichen Shen, Lightelligence, Inc. (USA) . . . [11283-40]

Coffee Break . . . . . Wed 3:30 pm to 4:00 pm

## SESSION 11

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . WED 4:00 PM TO 6:00 PM

### Nonlinear Photonics

Session Chair: **Jens H. Schmid**,

National Research Council Canada (Canada)

4:00 pm: **Integrated nonlinear optics using hybrid structures beyond Si** (*Invited Paper*), Christelle Monat, Institut des Nanotechnologies de Lyon (France) . . . . . [11283-41]

4:30 pm: **Stabilization of silicon micro-ring resonators for applications in four-wave mixing using intrinsic photocurrent** (*Invited Paper*), Andrew P. Knights, Mengyuan Ye, McMaster Univ. (Canada) . . . . . [11283-42]

5:00 pm: **Enhancement of third-order nonlinearity of thermally evaporated GeSbSe waveguides through annealing**, Michael B. Grayson, Mo Zohrabi, Kyuyoung Bae, Jiangang Zhu, Juliet T. Gopinath, Wounghang Park, Univ. of Colorado Boulder (USA) . . . . . [11283-43]

5:20 pm: **Chalcogenide hybrid inorganic/organic polymers (CHiPs) based optical waveguides for integrated nonlinear photonics applications**, Abhinav Nishant, Masoud Babaeian, Kyung-Jo Kim, Wyant College of Optical Sciences (USA); Tristan S. Kleine, Jordan A. Meise, Jeffrey Pyun, The Univ. of Arizona (USA); Robert A. Norwood, Wyant College of Optical Sciences (USA) . . . . . [11283-44]

5:40 pm: **Low-loss single-mode chalcogenide hybrid inorganic/organic polymer optical waveguides for mid-wave infrared photonic applications**, Julie I. Frish, Sasaan A. Showghi, Laura Anderson, Wyant College of Optical Sciences (USA); Tristan S. Kleine, Masoud Babaeian, Jeffrey Pyun, The Univ. of Arizona (USA); Robert A. Norwood, Wyant College of Optical Sciences (USA) . . . . . [11283-45]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**A fluorescence spectroscopy biosensor for lab-on-a-chip detection of antibiotics in milk**, Rick Bosma, Jasen Devasagayam, Ashutosh Singh, Christopher M. Collier, Univ. of Guelph (Canada) . . . . . [11283-58]

**Techniques to achieve low series resistance, high photon absorption rate, and high quantum efficiency for photonic CMOS field effect transistors**, James Pan, Northrop Grumman Corp. (USA) and Advanced Enterprise and License Co. (USA) . . . . . [11283-59]

**Two-photon absorption of GaN and Al<sub>x</sub>Ga<sub>1-x</sub>N thin films**, Cleber R. Mendonça, Diego Manoel, Jéssica Dipold, Renato Martins, Ruben Fonseca, Instituto de Física de São Carlos (Brazil); Irene Mangano-Clavero, Christoph Margenfeld, Andreas Waag, Tobias Voss, Technische Univ. Braunschweig (Germany); Marcelo Vivas, Instituto de Física de São Carlos (Brazil) . [11283-60]

**On-chip Mach-Zehnder interferometer based interrogator for a ring-resonator ultrasound sensor**, Boling Ouyang, Technische Univ. Delft (Netherlands); Michael Haverdings, Technobis Fibre Technologies BV (Netherlands); Roland Horsten, Marten Kruidhof, Technische Univ. Delft (Netherlands); Pim Kat, Technobis Fibre Technologies BV (Netherlands); Jacob Caro, Technische Univ. Delft (Netherlands) . . . . . [11283-61]

**Generalized model for refractive index of III-V semiconductors**, Daniel H. G. Espinosa, Mfon Odungide, Univ. of Ottawa (Canada); Kashif M. Awan, The Univ. of British Columbia (Canada); Ksenia Dolgaleva, Univ. of Ottawa (Canada) . . . . . [11283-62]

**Waviness of additive manufactured polymer optical waveguides**, Carsten Backhaus, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Gerd A. Hoffmann, Ludger Overmeyer, Leibniz Univ. Hannover (Germany); Thomas Reitberger, Jörg Franke, Norbert Lindlein, Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany) . . . . . [11283-63]

**Optimization of solder reflow processing and part design in thermoplastic optical interconnect components**, Peter Johnson, SABIC (USA); Takamune Sugawara, Norihiko Ohno, SABIC Japan LLC (Japan); Gabriele Hoogland, SABIC (Netherlands) . . . . . [11283-64]

**Integrated high-resolution and broad-bandwidth optical spectrum analyzer**, Arijit Misra, Stefan Preussler, Technische Univ. Braunschweig (Germany); Linjie Zhou, Shanghai Jiao Tong Univ. (China); Thomas Schneider, Technische Univ. Braunschweig (Germany) . . . . . [11283-65]

**Optical microfluidic device for sorting particles with optical whispering gallery modes**, Alexander S. King, Nathan J. Jordan, Gordon College (USA); Yuhe Chang, Kamil Ekinici, Sean B. Andersson, Boston Univ. (USA); Oleksiy Svitelskiy, Gordon College (USA) . . . . . [11283-66]

**Athermal chirp-compensated directly-modulated PIC for uncooled DWDM**, Gaurav Jain, Trinity College Dublin (Ireland) and Pilot Photonics Ltd. (Ireland); Prince M. Anandarajah, Dublin City Univ. (Ireland); Robert McKenna, Trinity College Dublin (Ireland); Deseada Gutierrez-Pascual, Frank Smyth, Jules I. Braddell, Pilot Photonics Ltd. (Ireland); John F. Donegan, Trinity College Dublin (Ireland) . . . . . [11283-67]

**Twin-fano resonator with widely tunable slope for ultra-high-resolution wavelength monitor**, Xiaoqing Guo, Zhejiang Univ. (China) . . . . . [11283-68]

**A scalable fibre-optic sensing architecture for lab-on-a-chip devices**, Isaac Spotts, Camille A. Leclerc, Dima Ismail, Noor Jaffar, Christopher M. Collier, Univ. of Guelph (Canada) . . . . . [11283-69]

**Design and analysis of polarization beam splitter based on cascaded MMI on SOI**, Devendra Chack, Shamsul Hassan, Abhishek Kumar, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . . . [11283-70]

**Restricted mode launching device for MMF composed of graded-index core polymer optical waveguide**, Ryosuke Hatai, Takaaki Ishigure, Keio Univ. (Japan) . . . . . [11283-71]

**Waveguides sensitivity analysis for mid-infrared gas sensing**, Raghī S. El Shamy, Mohamed A. Swillam, The American Univ. in Cairo (Egypt); Diaa A. M. Khalil, Ain Shams Univ. (Egypt) . . . . . [11283-72]

**Fabrication of optical waveguide using a non-contact printing technique**, Geum-Yoon Oh, Hyungchan Kim, Jeong Beom Ko, Choon Keun Park, Korea Institute of Industrial Technology (Korea, Republic of) . . . . . [11283-73]

**Silicon-on-Sapphire subwavelength grating waveguide sensor in mid-infrared regime**, Nourhan H. Rasheed, Arab Academy for Science, Technology & Maritime Transport (Egypt); Mohamed M. Badr, The American Univ. in Cairo (Egypt); Mostafa Fedawy, Arab Academy for Science, Technology & Maritime Transport (Egypt); Mohamed A. Swillam, The American Univ. in Cairo (Egypt) . . . . . [11283-74]

**Gain assisted coupled shifted-core nano-coaxial cavity based refractive index sensor**, Farhat Abbas, Xi Li, Qing Gu, The Univ. of Texas at Dallas (USA) . . . . . [11283-75]

**Al-Al<sub>2</sub>O<sub>3</sub> multilayer plasmonic metamaterial absorber**, Monu Nath Baitha, Jonghyeok Im, Kyoungsik Kim, Yonsei Univ. (Korea, Republic of) . . . . [11283-76]

**The integrated vertically-coupled resistive random-access memory (ReRAM) based microdisk resonator and the relevant performance evaluation**, Ricky W. Chuang, Kuan-Lun Fu, National Cheng Kung Univ. (Taiwan) . . . . . [11283-77]

**The impact of ultraviolet light on the switching characteristics of NiO resistive random access memory (ReRAM) devices**, Ricky W. Chuang, Ming-Cheng Huang, You-Kui Hu, National Cheng Kung Univ. (Taiwan) . . . . . [11283-78]

**Aerosol Jet printed PZT actuated MEMS resonating cantilever scanner**, Wei-Chih Wang, Mingyao Lee, Chuang-Cheng Peng, Univ. of Washington (USA); Ye-Feng Hsu, National Tsinghua University (Taiwan) . . . . . [11283-79]

**Polymer waveguide tunable wavelength filters based on cascaded 2-stage tilted Bragg gratings**, Tae-Hyun Park, Sung-Moon Kim, Kwon-Wook Chun, Min-Cheol Oh, Pusan National Univ. (Korea, Republic of) . . . . [11283-80]

**Coplanar poling of the EO polymer phase modulator to overcome the DC drift effect**, Eunsu Lee, Sung-Moon Kim, Tae-Hyun Park, Kwon-Wook Chun, Pusan National Univ. (Korea, Republic of); Mihye Yi, Korea Research Institute of Chemical Technology (Korea, Republic of); Min-Cheol Oh, Pusan National Univ. (Korea, Republic of) . . . . . [11283-81]

**Overcoming the temperature dependence of integrated-optic current sensor by using an elliptical-core PM fiber**, Sung-Moon Kim, Kwon-Wook Chun, Min-Cheol Oh, Pusan National Univ. (Korea, Republic of) . . . . [11283-82]

**Gold nanostructures engineered on hybrid-plasmonic waveguides for SERS in remote mode**, Nebras E. Al-Attar, Univ. College Dublin (Ireland) and Univ. of Technology Baghdad (Iraq); Rusul M. Al-Shammari, Univ. College Dublin (Ireland); Khalid S. Shibib, Univ. of Technology Baghdad (Iraq); Mohammad Amin Baghban, Katia Gallo, KTH Royal Institute of Technology (Sweden); Aoife A. Gowen, Brian J. Rodriguez, James H. Rice, Univ. College Dublin (Ireland) . . . . . [11283-83]

**Mode control in quantum cascade lasers with PT-symmetry**, Sercan Keskinden, Atilla Aydinli, Uludag Univ. (Turkey) . . . . . [11283-84]

**Foundry-compatible thin-film lithium niobate electro-optic modulators**, Reza Safian, imec USA - Florida (USA); Amirmahdi Honardoost, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Min Teng, Leimeng Zhuang, Swapnajit Chakravarty, imec USA - Florida (USA) . [11283-85]

**Beam finite spot size effect on angle-tolerant optical filters**, Noha Anous, Diaa A. M. Khalil, Ain Shams Univ. (Egypt) . . . . . [11283-86]

**Geometry optimization of unidirectional integrated ring laser**, Giuseppe Giannuzzi, Politecnico di Torino (Italy); Enrico Ghillino, Synopsys, Inc. (USA); Paolo Bardella, Politecnico di Torino (Italy) . . [11283-87]

**Graphene-based broadband and tunable grating reflector for far infrared frequency**, Juveriya Parmar, Mayurkumar Ladumor, Shreyas Charola, Shobhitkumar Patel, Marwadi Univ. (India) . . . . . [11283-88]

**THURSDAY 6 FEBRUARY**

**SESSION 12**

**LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . THU 9:00 AM TO 10:30 AM**

**Optical Sensors III**

Session Chair: **Jean-Emmanuel Broquin**, Institut de Microélectronique Électromagnétisme et Photonique et le Lab d'hyperfréquences et Caracté (France)

9:00 am: **Rigorous modal analysis of light interaction with micro and nano resonators** (*Invited Paper*), Philippe Lalanne, Lab. Photonique, Numérique et Nanosciences (France) . . . . . [11283-46]

9:30 am: **Integrated plasmonic sensing via nanofocusing in hybrid gap plasmonic waveguides**, Nicholas Gusken, Ming Fu, Monica Mota, Imperial College London (United Kingdom); Michael Nielsen, The Univ. of New South Wales (Australia); Rupert Oulton, Imperial College London (United Kingdom); Stefan A. Maier, Ludwig-Maximilians-Univ. München (Germany) . . . . [11283-47]

9:50 am: **Fabrication of multichannel Bloch long-range surface plasmon biosensors integrating counter electrodes for electrochemical sensing**, Maryam Khodami, Zohreh Hirbodvash, Oleksiy Krupin, Anthony Olivieri, Howard Northfield, Ewa Lisicka-Skrzek, Pierre Berini, Univ. of Ottawa (Canada) . . . . . [11283-48]

10:10 am: **Extruded complex optical fiber structures for shape sensing and biomedical applications**, Pierre Lorre, Frédéric Monet, Matthieu Gauthier, Arthur Poiffaut, Anthony Roberge, Samuel Kadoury, Raman Kashyap, Ecole Polytechnique de Montréal (Canada) . . . . . [11283-49]

Coffee Break . . . . . Thu 10:30 am to 11:00 am

**SESSION 13**

**LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . THU 11:00 AM TO 12:20 PM**

**Optical Sensors IV**

Session Chair: **Florenta A. Costache**, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany)

11:00 am: **Optimizing resolution in an integrated blazed chirped Bragg grating spectrometer**, James W. Field, Sam A. Berry, Rex H. S. Bannerman, Corin B. E. Gawith, Peter G. R. Smith, James C. Gates, Univ. of Southampton (United Kingdom) . . . . . [11283-50]

11:20 am: **Thermo-optimally tuned spatial heterodyne Fourier-transform spectrometer**, Miguel Montesinos Ballester, Qiankun Liu, Ctr. de Nanosciences et de Nanotechnologies (France); Vladyslav Vakarin, Nexdot (France); Joan Manel Ramirez, III-V Lab. (France); Carlos Alonso-Ramos, Delphine Marris-Morini, Ctr. de Nanosciences et de Nanotechnologies (France); Giovanni Isella, Politecnico di Milano (Italy); Laurent Vivien, Ctr. de Nanosciences et de Nanotechnologies (France); Jacopo Frigerio, Politecnico di Milano (Italy); Xavier Le Roux, Ctr. de Nanosciences et de Nanotechnologies (France); Andrea Ballabio, Politecnico di Milano (Italy); Lucas Deniel, David Bouville, Ctr. de Nanosciences et de Nanotechnologies (France) . . . [11283-51]

11:40 am: **Silicon nitride waveguide platform for on-chip spectroscopy at visible and NIR wavelengths**, Sushma Gali, Shankar Kumar Selvaraja, Varun Raghunathan, Indian Institute of Science (India) . . . . . [11283-52]

12:00 pm: **Alloy-based wire array metamaterial fibres for super-resolution imaging at MIR frequencies**, Juliano Grigoletto Hayashi, Nicholas M. White, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom); Petr Janicek, Univ. Pardubice (Czech Republic); Francesco Poletti, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom) . . . . . [11283-53]

Lunch/Exhibition Break . . . . . Thu 12:20 pm to 2:00 pm

**SESSION 14**

**LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) . . THU 2:00 PM TO 3:20 PM**

**Photonic Devices**

Session Chair: **Jens H. Schmid**, National Research Council Canada (Canada)

2:00 pm: **Design and fabrication of multilayer GRIN lenses by multi-material additive manufacturing for light coupling applications in planar optoelectronic systems**, Hossein Salmani Rezaei, Gerrit Hohenhoff, Peter Jäschke, Stefan Kaierle, Ludger Overmeyer, Laser Zentrum Hannover e.V. (Germany) . . . . . [11283-54]

2:20 pm: **2D beam steering based on polymer waveguide optical phased array device**, Sung-Moon Kim, Tae-Hyun Park, Eunsu Lee, Jinung Jin, Pusan National Univ. (Korea, Republic of); Chul-Soon Im, Sang-Shin Lee, Kwangwoon Univ. (Korea, Republic of); Taehoon Kim, Agency for Defense Development (Korea, Republic of); Young-Ho Kim, i3system, Inc. (Korea, Republic of); Min-Cheol Oh, Pusan National Univ. (Korea, Republic of) . . . . . [11283-55]

2:40 pm: **Three-dimensional fused silica templates to fabricate integrated photonic platforms**, Abhishek K. Kottaram Amrithanath, Sridhar Krishnaswamy, Northwestern Univ. (USA) . . . . . [11283-56]

3:00 pm: **A scalable glass waveguide-based optofluidic photoreactor for converting CO<sub>2</sub> to fuels**, Xiangkun Cao, Tao Hong, Tingwei Liu, Jessica Akemi, Tobias Hanrath, David Erickson, Cornell Univ. (USA) . [11283-57]



# CONFERENCE 11284

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11284

## Smart Photonic and Optoelectronic Integrated Circuits XXII

*Conference Chairs:* **Sailing He**, KTH Royal Institute of Technology (Sweden), Zhejiang Univ. (China); **Laurent Vivien**, Ctr. for Nanoscience and Nanotechnology, CNRS, Univ. Paris-Sud, Univ. Paris-Saclay (France)

*Program Committee:* **Pavel Cheben**, National Research Council Canada (Canada); **Ray T. Chen**, The Univ. of Texas at Austin (USA); **Louay A. Eldada**, Quanergy Systems, Inc. (USA); **Chennupati Jagadish**, The Australian National Univ. (Australia); **Stefan A. Maier**, Imperial College London (United Kingdom); **Lorenzo Pavesi**, Univ. degli Studi di Trento (Italy); **Joachim Piprek**, NUSOD Institute LLC (USA); **David V. Plant**, McGill Univ. (Canada); **Andrew W. Poon**, Hong Kong Univ. of Science and Technology (Hong Kong, China); **Ali Serpengüzel**, Koç Univ. (Turkey); **Bertrand Szlag**, CEA-LETI (France); **Augustine M. Urbas**, Air Force Research Lab. (USA); **Dries Van Thourhout**, Univ. Gent (Belgium); **Alan X. Wang**, Oregon State Univ. (USA); **Jian Wang**, Huazhong Univ. of Science and Technology (China); **Qian Wang**, Huawei Technologies Co., Ltd. (China); **Michael R. Watts**, Massachusetts Institute of Technology (USA); **Lin Yang**, Institute of Semiconductors, CAS (China); **Rui Q. Yang**, The Univ. of Oklahoma (USA)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . MON 10:30 AM TO 12:10 PM

#### Photonics Based on Artificial Intelligence I

Session Chair: **Alan X. Wang**, Oregon State Univ. (USA)

- 10:30 am: **Optical neural networks: from integrated photonics to free-space solutions (Invited Paper)**, Volker J. Sorger, The George Washington Univ. (USA) . . . . . [11284-1]
- 10:55 am: **Neuromorphic computing through photonic integrated circuits (Invited Paper)**, George Mourgias-Alexandris, Angelina Totovic, Nikolaos Passalis, George Dabos, Anastasios Tefas, Nikos Pleros, Aristotle Univ. of Thessaloniki (Greece) . . . . . [11284-2]
- 11:20 am: **Silicon optical mode switches for on-chip optical interconnects (Invited Paper)**, Lin Yang, Ting Zhou, Hao Jia, Lei Zhang, Xin Fu, Institute of Semiconductors (China) . . . . . [11284-3]
- 11:45 am: **Smart design of photonic structures with artificial intelligence and neural networks (Invited Paper)**, Wenshan Cai, Georgia Institute of Technology (USA) . . . . . [11284-4]
- Lunch Break . . . . . Mon 12:10 pm to 1:10 pm

#### SESSION 2

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . MON 1:10 PM TO 3:15 PM

#### Photonics Based on Artificial Intelligence II

Session Chair: **Lorenzo Pavesi**, Univ. degli Studi di Trento (Italy)

- 1:10 pm: **Integrated photonic processing unit for acceleration of neural network training (Invited Paper)**, Roger Dangel, Folkert Horst, Efe Bueyuekoezer, Yannick Baumgartner, Bert J. Offrein, IBM Research - Zürich (Switzerland) . . . . . [11284-5]
- 1:35 pm: **Artificial neural computing with nanophotonics (Invited Paper)**, Zongfu Yu, Univ. of Wisconsin-Madison (USA) . . . . . [11284-6]
- 2:00 pm: **Artificial photonic neural networks (Invited Paper)**, Wolfram H. P. Pernice, Westfälische Wilhelms-Univ. Münster (Germany) . . . . . [11284-7]
- 2:25 pm: **All-optical deep feed forward network based on nonlinear microresonators for telecom applications (Invited Paper)**, Mattia Mancinelli, Univ. degli Studi di Trento (Italy) . . . . . [11284-8]
- 2:50 pm: **Information photonics empowered by artificial intelligence (Invited Paper)**, Min Gu, Univ. of Shanghai for Science and Technology (China) . . . . . [11284-9]
- Coffee Break. . . . . Mon 3:15 pm to 3:40 pm

#### SESSION 3

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . MON 3:40 PM TO 6:30 PM

#### Integration, Manufacturing and Photonic Circuits

Session Chair: **Bertrand Szlag**, CEA-LETI (France)

- 3:40 pm: **The International Integrated Photonic Systems Roadmap: defining the destination and the path (Keynote Presentation)**, Lionel C. Kimerling, Massachusetts Institute of Technology (USA) . . . . . [11284-10]
- 4:20 pm: **GaAs nano-ridge lasers on silicon (Invited Paper)**, Dries Van Thourhout, imec, Univ. Gent (Belgium); Yuting Shi, Univ. Gent (Belgium); Marina Baryshnikova, imec (Belgium); Yannick De Koninck, imec (Belgium); Marianna Pantouvaki, Joris Van Campenhout, Bernardette Kunert, imec (Belgium) . . . . . [11284-11]
- 4:45 pm: **Multisensor and closed-loop control of component and assembly processes for zero-defect manufacturing of photonics**, Erik Beckert, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Jovana Milenkovic, ATLANTIS Engineering SA (Greece); Andreas Mantelos, SENSAP Swiss AG (Switzerland); Vassilis Tsolekas, ATLANTIS Engineering SA (Greece) . . . . . [11284-12]
- 5:00 pm: **Immersion lithography introduction in Si photonics platform (Invited Paper)**, Cecilia Dupre, CEA-LETI, Univ. Grenoble Alpes (France); Celine Lapeyre, Laetitia Adelmini, Elise Arnoux, Estelle Guyez, Pierre Brianceau, Loic Perraud, Aurelien Fay, Karim Hassan, Quentin Wilmart, Bertrand Szlag, Daivid Fowler, Univ. Grenoble Alpes (France) . . . . . [11284-13]

5:25 pm: **Towards field-programmable photonic gate arrays** (*Invited Paper*), José Capmany Francoy, Daniel Pérez López, Prometheus DasMahapatra, Univ. Politècnica de València (Spain) . . . . . [11284-14]

5:50 pm: **Wavelength-division-multiplexing-based electronic-photonics network for high-speed computing** (*Invited Paper*), Chenghao Feng, Zhufeng Ying, Zheng Zhao, Jiaqi Gu, David Z. Pan, Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [11284-15]

6:15 pm: **A monolithically-integrated 2 ? 25-Gb/s Si photonic WDM receiver with thermally-tunable ring-resonator filters**, Hyun-Kyu Kim, Youngkwan Jo, Minkyu Kim, Yonsei Univ. (Korea, Republic of); Hyun-Yong Jung, Samsung Electronics Co., Ltd. (Korea, Republic of); Christian Mai, Stefan Lischke, Lars Zimmermann, IHP GmbH (Germany); Woo-Young Choi, Yonsei Univ. (Korea, Republic of) . . . . . [11284-16]

**TUESDAY 4 FEBRUARY**

**SESSION 4**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . TUE 8:00 AM TO 10:35 AM**

**Design and Material of Photonic Integrated Devices I**

Session Chair: **Pavel Cheben**, National Research Council Canada (Canada)

8:00 am: **The proliferation of heterogeneous integration approaches in silicon(nitride) integrated photonics** (*Keynote Presentation*), Roel G. Baets, imec, Univ. Gent (Belgium) . . . . . [11284-17]

8:40 am: **Subwavelength grating metamaterial structures for integrated photonics** (*Keynote Presentation*), Iñigo Molina-Fernández, Gonzalo Wangüemert-Perez, Alejandro Ortega-Moñux, Robert Halir, Jose de Oliva Rubio, Alejandro Sánchez Postigo, José Manuel Luque-González, Abdelfettah Hadif-ElHouati, Daniel Pereira-Martín, Univ. de Málaga (Spain); David González-Andrade, Instituto de Óptica “Daza de Valdés”, Consejo Superior de Investigaciones Científicas (Spain); Aitor Villafranca-Velasco, Alaine Herrero-Bermello, Instituto de Óptica “Daza de Valdés” (Spain); Jens H. Schmid, Pavel Cheben, National Research Council Canada (Canada); Jiri Ctyroky, Institute of Photonics and Electronics of the CAS, v.v.i. (Czech Republic) . . . . . [11284-18]

9:20 am: **Silicon chip-integrated fiber couplers with sub-decibel loss** (*Invited Paper*), Daniel Benedikovic, Ctr. de Nanosciences et de Nanotechnologies, CNRS, Univ. Paris-Sud, Univ. Paris-Saclay (France); Carlos A. Alonso-Ramos, Ctr. de Nanosciences et de Nanotechnologies (France); Sylvain Guerber, STMicroelectronics S.A. (France); Xavier Le Roux, Ctr. de Nanosciences et de Nanotechnologies (France); Pavel Cheben, National Research Council Canada (Canada); Bertrand Szelag, Cecilia Dupre, Daivid Fowler, CEA-LETI, Univ. Grenoble Alpes (France); Guillaume Marcaud, Vladyslav Vakarin, Ctr. de Nanosciences et de Nanotechnologies (France); Diego Pérez-Galacho, Instituto de Telecomunicaciones y Aplicaciones Multimedia, Univ. Politècnica de Valencia (Spain); Eric Cassan, Delphine Marris-Morini, Ctr. de Nanosciences et de Nanotechnologies (France); Charles Baudot, Frédéric Boeuf, STMicroelectronics S.A. (France); Laurent Vivien, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11284-19]

9:45 am: **III-V semiconductors: Powerful material platforms for nonlinear photonics** (*Invited Paper*), Ksenia Dolgaleva, Univ. of Ottawa (Canada) . . . . . [11284-20]

10:10 am: **Development of tunable longwave infrared filters based on guided mode resonance** (*Invited Paper*), Neelam Gupta, U.S. Army Combat Capabilities Development Command Research Lab. (USA); Mark S. Mirotznik, Univ. of Delaware (USA); Robert Magnusson, The Univ. of Texas at Arlington (USA) . . . . . [11284-21]

Coffee Break. . . . . Tue 10:35 am to 11:00 am

**SESSION 5**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . TUE 11:00 AM TO 12:35 PM**

**Light Modulation**

Session Chair: **Bertrand Szelag**, CEA-LETI (France)

11:00 am: **High-efficiency membrane InGaAsP Mach-Zehnder modulator on Si platform** (*Invited Paper*), Tatsurou Hiraki, Takuma Aihara, Koji Takeda, Takuro Fujii, Takaaki Kakitsuka, Tai Tsuchizawa, Hiroshi Fukuda, Shinji Matsuo, NTT Device Technology Labs. (Japan) . . . . . [11284-22]

11:25 am: **Barium titanate-on-insulator optoelectronics: a platform superior to lithium niobate**, Yu Cao, Siew Li Tan, Eric J. H. Cheung, National Univ. of Singapore (Singapore); Hassan Ahmad, Univ. Polytechnique Hauts-de-France (France); Yan Liu, National Univ. of Singapore (Singapore); El Hadj Dogheche, Univ. Polytechnique Hauts-de-France (France); Venky Venkatesan, Aaron J. Danner, National Univ. of Singapore (Singapore) . . . . . [11284-23]

11:40 am: **Bit-rate dependent optimization of VCSEL parameters** (*Invited Paper*), Gunter Larisch, Sicong Tian, Chinese Academy of Sciences (China); Dieter Bimberg, Technische Univ. Berlin (Germany) and Chinese Academy of Sciences (China) . . . . . [11284-24]

12:05 pm: **Modulation characteristics of surface-emitting ring DFB quantum cascade lasers**, Borislav Hinkov, Jakob Hayden, Rolf Szedlak, Technische Univ. Wien (Austria); Pedro Martin-Mateos, Borja Jerez, Pablo Acedo, Univ. Carlos III de Madrid (Spain); Bernhard Lendl, Gottfried Strasser, Technische Univ. Wien (Austria) . . . . . [11284-25]

12:20 pm: **Effect of laser chirp on interference-induced distortions in integrated photonic circuits**, Farzad M. Mokhtari-Koushyar, The Univ. of Texas at Austin (USA); McKay Bradford, Monireh Moayedil Pour Fard, Thien-An Nguyen, GenXComm, Inc. (USA); Sriram Vishwanath, The Univ. of Texas at Austin (USA) and GenXComm, Inc. (USA) . . . . . [11284-26]

Lunch/Exhibition Break . . . . . Tue 12:35 pm to 1:40 pm

**SESSION 6**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . TUE 1:40 PM TO 3:45 PM**

**Hyperbolic Metamaterials**

Session Chair: **Augustine M. Urbas**, Air Force Research Lab. (USA)

1:40 pm: **Tunable hyperbolic plasmons of carbon nanotube metamaterials** (*Invited Paper*), Jonathan Fan, John Roberts, Shangjie Yu, Po-Hsun Ho, Stanford Univ. (USA); Stefan Schoeche, J.A. Woollam (USA); Abram Falk, IBM Thomas J. Watson Research Ctr. (USA) . . . . . [11284-27]

2:05 pm: **Tunable graphene-based hyperbolic metamaterials: experimental demonstration and outlook** (*Invited Paper*), Georgia Theano Papadakis, Stanford Univ. (USA); Harry A. Atwater Jr., Caltech (USA) . . . . . [11284-28]

2:30 pm: **Quantum nonlinear light emission in hyperbolic metamaterials** (*Invited Paper*), Artur Davoyan, Univ. of California, Los Angeles (USA); Harry A. Atwater Jr., Caltech (USA) . . . . . [11284-29]

2:55 pm: **Nonlinear optics of photonic hypercrystals: optical limiting and hypercomputing** (*Invited Paper*), Igor I. Smolyaninov, Univ. of Maryland, College Park (USA) . . . . . [11284-30]

3:20 pm: **Shaping bulk second harmonic generation from hyperbolic plasmonic metamaterials** (*Invited Paper*), Giuseppe Marino, Univ. de Paris (France); Anatoly Zayats, King's College London (United Kingdom) . . [11284-31]

Coffee Break. . . . . Tue 3:45 pm to 4:10 pm

**SESSION 7**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . TUE 4:10 PM TO 6:15 PM**

**Plasmonic and Metasurfaces**

Session Chair: **Laurent Vivien**, Ctr. de Nanosciences et de Nanotechnologies (France)

4:10 pm: **Third harmonic generation in magnesium near the metal-to-insulator phase transition** (*Invited Paper*), Harald Giessen, Univ. Stuttgart (Germany) . . . . . [11284-32]

4:35 pm: **Low-loss waveguide-type hyperbolic metamaterials for deep subwavelength cavities** (*Invited Paper*), Jichao Fu, Yi Jin, Julian Evans, Sailing He, Zhejiang Univ. (China) . . . . . [11284-33]

5:00 pm: **Dielectric nanoantennas and metasurfaces: applications in ultrafast nanophotonics, photocatalysis, and beyond** (*Invited Paper*), Stefan A. Maier, Ludwig-Maximilians-Univ. München (Germany) . . . [11284-34]

5:25 pm: **Integrated nonlinear silicon photonics with metallic nanofocusing components on silicon** (*Invited Paper*), Rupert F. Oulton, Nicholas A. Gusken, Imperial College London (United Kingdom); Michael P. Nielsen, Imperial College London (United Kingdom) and The Univ. of New South Wales (Australia); Paul Dichtl, Xingyuan Shi, Imperial College London (United Kingdom); Stefan A. Maier, Imperial College London (United Kingdom) and Ludwig-Maximilians-Univ. München (Germany) . . . . . [11284-35]

5:50 pm: **Tunable THz generation and enhanced nonlinear effects with active and passive graphene hyperbolic metamaterials** (*Invited Paper*), Tianjing Guo, Boyuan Jin, Univ. of Nebraska-Lincoln (USA); Liang Zhu, Pai-Yen Chen, Univ. of Illinois at Chicago (USA); Christos Argyropoulos, Univ. of Nebraska-Lincoln (USA) . . . . . [11284-36]

OPTO

WEDNESDAY 5 FEBRUARY

SESSION 8

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . WED 8:00 AM TO 10:05 AM

Mid-Infrared Optoelectronics I

Session Chair: Rui Q. Yang, The Univ. of Oklahoma (USA)

8:00 am: **Mid-infrared broadband supercontinuum generation from planar waveguide** (*Invited Paper*), Xin Gai, City Univ. of Hong Kong (Hong Kong, China) . . . . . [11284-37]

8:25 am: **Ge platforms for mid-infrared applications** (*Invited Paper*), Jean-Marc Fédéli, Adrien Marchant, CEA-LETI (France); Maryse Fournier, CEA-LETI-DOPT (France); Jean-Michel Hartmann, Redouane Amrar, Badhise Ben Bakir, Jean-Guillaume Coutard, CEA-LETI (France). . . . . [11284-38]

8:50 am: **Mid-infrared interband cascade light-emitting diodes with InAs/GaAsSb superlattices on InAs substrates** (*Invited Paper*), Qi Lu, Lancaster Univ. (United Kingdom); Yi Zhou, Jianxin Chen, Li He, Shanghai Institute of Technical Physics (China); Anthony Krier, Lancaster Univ. (United Kingdom). . . . . [11284-39]

9:15 am: **Interband cascade laser frequency combs** (*Invited Paper*), Benedikt Schwarz, Johannes Hillbrand, Maximilian Beiser, Aaron M. Andrews, Hermann Detz, Technische Univ. Wien (Austria); Robert Weih, nanoplus Nanosystems and Technologies GmbH (Germany); Anne Schade, Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany); Gottfried Strasser, Technische Univ. Wien (Austria) . . . . . [11284-40]

9:40 am: **Submicron resolution infrared spectromicroscopy by mid-infrared photothermal (MIP) imaging for biology and materials** (*Invited Paper*), Delong Zhang, Zhejiang Univ. (China); Ji-Xin Cheng, Boston Univ. (USA) . . . . . [11284-41]

Coffee Break. . . . .Wed 10:05 am to 10:30 am

SESSION 9

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) .WED 10:30 AM TO 12:35 PM

Mid-Infrared Optoelectronics II

Session Chair: Rui Q. Yang, The Univ. of Oklahoma (USA)

10:30 am: **Towards a low-cost on-chip mid-IR gas sensing solution: chemical synthesis of lead-salt photonic materials** (*Invited Paper*), Binbin Weng, The Univ. of Oklahoma (USA) . . . . . [11284-42]

10:55 am: **Mid-infrared semiconductor laser spectroscopy with hollow core fibers** (*Invited Paper*), Wei Ren, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11284-43]

11:20 am: **Nonlinear crystals for imaging and detection of mid-IR radiation** (*Invited Paper*), Christian Pedersen, DTU Fotonik (Denmark). . . . . [11284-44]

11:45 am: **Miniaturized mid-infrared sensors for multicomponent trace-gas detection** (*Invited Paper*), Zhenhui Du, Liming Yuan, Kebin Tong, Tianjin Univ. (China); Lening Wang, Tianjin Univ. (China); Hongfei Guan, Tianjin Univ. (China); Jinyi Li, Tianjin Polytechnic Univ. (China) . . . . . [11284-45]

12:10 pm: **III-V/Si mid-infrared photonic integrated circuits and its applications** (*Invited Paper*), Gunther Roelkens, imec, Univ. Gent (Belgium). . . . . [11284-46]

Lunch/Exhibition Break . . . . .Wed 12:35 pm to 1:40 pm

SESSION 10

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . WED 1:40 PM TO 4:10 PM

Design and Material of Photonic Integrated Devices II

Session Chair: Pavel Cheben, National Research Council Canada (Canada)

1:40 pm: **Augmented low-index waveguides** (*Invited Paper*), J. Stewart Aitchison, Mohammad Mojahedi, Xiao Sun, Univ. of Toronto (Canada) . . . . . [11284-47]

2:05 pm: **Comparison of microresonator devices for WDM-compatible mode-division multiplexing circuits** (*Invited Paper*), Winnie N. Ye, Dusan Gostimirovic, Carleton Univ. (Canada). . . . . [11284-48]

2:30 pm: **Silicon nitride for advanced integrated CMOS photonics** (*Invited Paper*), Frederic Y. Gardes, Thalia Dominguez Bucio, Cosimo Lacava, Greta De Paoli, Stefan Ilie, Ilias Kandalos, Milan Milosevic, Periklis Petropoulos, Univ. of Southampton (United Kingdom); Gonzalo Wangüemert-Perez, Francisco Jurado Romero, Iñigo Molina-Fernández, Univ. de Málaga (Spain); Daniele Melati, Jens H. Schmid, Pavel Cheben, National Research Council Canada (Canada) . . . . . [11284-49]

2:55 pm: **Plasmonics: is it an alternative to photonics?** (*Invited Paper*), Juerg Leuthold, ETH Zurich (Switzerland). . . . . [11284-50]

3:20 pm: **Precision modeling, thermometry and athermal components in silicon photonics** (*Invited Paper*), Dan-Xia Xu, Daniele Melati, Siegfried Janz, Sergey Dedyulin, Andrew Todd, Martin Vachon, John Weber, Shurui Wang, Jean Lapointe, Mohsen Kamandar Dezfouli, Ross Cheriton, Pavel Cheben, Jens H. Schmid, National Research Council Canada (Canada). . . . . [11284-51]

3:45 pm: **High-dimensional d-level cluster states with on-chip quantum frequency combs** (*Invited Paper*), Bennet Fischer, Institut National de la Recherche Scientifique (Canada); Christian Reimer, Hyperlight Corp. (USA) and Institut National de la Recherche Scientifique (Canada); Stefania Sciara, Institut National de la Recherche Scientifique (Canada) and Univ. degli Studi di Palermo (Italy); Piotr Roztocky, Mehedi Islam, Luis Romero Cortés, Yanbing Zhang, Institut National de la Recherche Scientifique (Canada); Sébastien Loranger, Raman Kashyap, Polytechnique Montréal (Canada); Alfonso Cino, Univ. degli Studi di Palermo (Italy); Sai T. Chu, City Univ. of Hong Kong (Hong Kong, China); Brent E. Little, Xi'an Institute of Optics and Precision Mechanics (China); David J. Moss, Swinburne Univ. of Technology (Australia); Lucia Caspani, Univ. of Strathclyde (United Kingdom); William J. Munro, NTT Basic Research Labs. (Japan) and NTT Research Ctr. for Theoretical Quantum Physics, NTT Corp. (Japan); Jose Azana, Institut National de la Recherche Scientifique (Canada); Michael Kues, Hannoversches Zentrum für Optische Technologien, Leibniz Univ. Hannover (Germany); Roberto Morandotti, Institut National de la Recherche Scientifique (Canada) and Institute of Fundamental and Frontier Sciences, Univ. of Electronic Science and Technology of China (China) and ITMO Univ. (Russian Federation) . . . . . [11284-52]

Coffee Break. . . . .Wed 4:10 pm to 4:30 pm

SESSION 11

LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . WED 4:30 PM TO 6:00 PM

Control, Manipulation, and Detection of Photons

Session Chair: Sailing He, KTH Royal Institute of Technology (Sweden), Zhejiang Univ. (China)

4:30 pm: **Noise-enhanced detection and chaos with a driven electromechanical resonator** (*Invited Paper*), Guilhem Madiot, Franck Correia, Avishek Chowdhury, Sylvain Barbay, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Marcel Clerc, Univ. de Chile (Chile); Rémy Braive, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France) . . . . . [11284-53]

4:55 pm: **Ultra-compact polarimeters on a silicon chip** (*Invited Paper*), Zhongjin Lin, Yuxuan Chen, Leslie Rusch, Wei Shi, Univ. Laval (Canada) . . . . . [11284-54]

5:20 pm: **Intermodal four-wave mixing for heralded single-photon sources in the MIR** (*Invited Paper*), Stefano Signorini, Sara Piccione, Matteo Finazzo, Univ. degli Studi di Trento (Italy); Mher Ghulinyan, Martino Bernard, Georg Pucker, Fondazione Bruno Kessler (Italy); Lorenzo Pavesi, Univ. degli Studi di Trento (Italy). . . . . [11284-55]

5:45 pm: **Wideband Si/Sin polarization splitter/rotator simulations for standard datacom integrated photonic circuit**, Thomas Mang, CEA-LETI (France). . . . . [11284-56]

POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**The design of Si-based Fresnel-zone lens for 3D IC optoelectronic interconnect applications**, Ikechi Augustinus Ukaegbu, Nazarbayev Univ. (Kazakhstan); Hyo-Hoon Park, KAIST (Korea, Republic of) . . . . . [11284-72]

**Reconfigurable Bragg gratings design based on novel low-loss phase change material (PCM) GSST2241 on silicon-rich nitride (SRN) platform**, Joaquin Faneca, Liam Trimby, Iago Rodriguez Diez, Univ. of Exeter (United Kingdom); Frederic Y. Gardes, Univ. of Southampton (United Kingdom); Anna Baldycheva, Univ. of Exeter (United Kingdom) . . . . . [11284-73]

**Phase compensation method for optical phased array based on phase-shifting digital holography**, Masato Miura, Yuji Miyamoto, Yoshikuni Hirano, Yasushi Motoyama, Kenji Machida, NHK Japan Broadcasting Corp. (Japan); Rieko Ueda, Chiyumi Yamada, Toshiki Yamada, Akira Otomo, National Institute of Information and Communications Technology (Japan); Hiroshi Kikuchi, NHK Japan Broadcasting Corp. (Japan) . . . . . [11284-75]

**Hybrid vertically integrated thyristor-semiconductor laser assemblies for generating ns laser pulses**, Sergey O. Slipchenko, Aleksandr A. Podoskin, Dmitry Romanovich, Nikita A. Pikhin, Ioffe Institute (Russian Federation); Timur Bagaev, Maxim Ladugin, Aleksandr Marmalyuk, Vladimir Simakov, JSC "Research Institute" POLYUS "them. M.F. Stelmaha" (Russian Federation); Piotr Kop'ev, Ioffe Institute (Russian Federation) . . . . . [11284-76]

**Novel photonic integration platform with dielectrophoretic particle manipulation for chip-based flow cytometry**, Sara-Jayne Gillgrass, Dunia Giliyana, Basmah Almagwashi, Samuel Shutts, Emmanuel Le Boulabr, Peter M. Smowton, Cardiff Univ. (United Kingdom) . . . . . [11284-79]

**Ultra-wideband flat anomalous dispersion in nanostructured silicon membrane waveguides**, Thi-Thuy Duong, Jianhao Zhang, Miguel Montesinos, Xavier Le Roux, Christian Lafforgue, Daniel Benedikovic, Ctr. de Nanosciences et de Nanotechnologies (France); Pavel Cheben, National Research Council Canada (Canada); Eric Cassan, Delphine Marris-Morini, Ctr. de Nanosciences et de Nanotechnologies (France); Grégory Maisons, Mathieu Carras, mirSense (France); Sébastien Crémer, Stéphane Monfray, Charles Baudot, Frédéric Boeuf, STMicroelectronics S.A. (France); Laurent Vivien, Carlos A. Alonso-Ramos, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11284-80]

**THURSDAY 6 FEBRUARY**

**SESSION 12**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . THU 8:10 AM TO 10:15 AM**

**New Light-Induced Properties**

Session Chair: **Zi Jing Wong**, Texas A&M Univ. (USA)

8:10 am: **Topological light sources and sensors** (*Invited Paper*), Boubacar Kante, Univ. of California, Berkeley (USA) . . . . . [11284-57]

8:35 am: **Extreme nonlinear optics of epsilon-near-zero materials** (*Invited Paper*), Yuanmu Yang, Tsinghua Univ. (China) . . . . . [11284-58]

9:00 am: **Ultrafast light-induced magnetism and non-reciprocity in plasmonic Au nanoparticles** (*Invited Paper*), Matthew T. Sheldon, Texas A&M Univ. (USA) . . . . . [11284-59]

9:25 am: **Geometric phase and nonlinear photonic metasurfaces** (*Invited Paper*), Guixin Li, Southern Univ. of Science and Technology of China (China) . . . . . [11284-60]

9:50 am: **Phase transition for hot nanophotonics** (*Invited Paper*), Chloe F. Doiron, Weijian Li, Gururaj V. Naik, Rice Univ. (USA) . . . . . [11284-61]

Coffee Break . . . . . Thu 10:15 am to 10:40 am

**SESSION 13**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . THU 10:40 AM TO 12:20 PM**

**Sensing**

Session Chair: **Ashok Maliakal**, LGS Innovations, LLC (USA)

10:40 am: **Fast and high-sensitivity chemical imaging via compressive Raman microspectroscopy** (*Invited Paper*), Hilton Barbosa de Aguiar, Ecole Normale Supérieure (France) . . . . . [11284-62]

11:05 am: **Recent advancements in surface-enhanced infrared sensing technology: from gold to graphene** (*Invited Paper*), Boris Mizaikoff, Univ. Ulm (Germany) . . . . . [11284-63]

11:30 am: **2D-material-enabled multifunctional mid-IR optoelectronics** (*Invited Paper*), Skylar Deckoff-Jones, Massachusetts Institute of Technology (USA); Yixiu Wang, Purdue Univ. (USA); Hongtao Lin, Zhejiang Univ. (China); Wenzhuo Wu, Purdue Univ. (USA); Juejun Hu, Massachusetts Institute of Technology (USA) . . . . . [11284-64]

11:55 am: **High-sensitivity plasmaphotonic interferometric sensors on a chip** (*Invited Paper*), Evangelia Chatzianagnostou, Athanasios Manolis, George Dabos, Dimitra Ketzaki, Aristotle Univ. of Thessaloniki (Greece) and Ctr. for Interdisciplinary Research and Innovation (Greece); Bartos Chmielak, Anna-Lena Giesecke, Caroline Porschatis, Piotr J. Cegielski, Stephan Suckwo, Advanced Microelectronic Ctr. Aachen, AMO GmbH (Germany); Laurent Markey, Jean-Claude Weeber, Alain Dereux, Lab. Interdisciplinaire Carnot de Bourgogne (France); Stefan Schrittwieser, Rudolf Heer, AIT Austrian Institute of Technology GmbH (Austria); Nikos Pleros, Aristotle Univ. of Thessaloniki (Greece) and Ctr. for Interdisciplinary Research and Innovation, Aristotle Univ. of Thessaloniki (Greece); Dimitris Tsiokos, Aristotle Univ. of Thessaloniki (Greece) and Bialoom Ltd. (Cyprus) . . . . . [11284-65]

Lunch/Exhibition Break . . . . . Thu 12:20 pm to 1:30 pm

**SESSION 14**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . THU 1:30 PM TO 2:35 PM**

**Reconfigurable Systems and Light Switching**

Session Chair: **Laurent Vivien**,

Ctr. de Nanosciences et de Nanotechnologies (France)

1:30 pm: **Smart on-chip Fourier-transform spectrometers harnessing machine learning algorithms** (*Invited Paper*), Alaine Herrero-Bermello, Instituto de Óptica "Daza de Valdés", Consejo Superior de Investigaciones Científicas (Spain); Jiangfeng Li, Mohammad Khazaei, Univ. of Strathclyde (United Kingdom); Yuri Grinberg, National Research Council Canada (Canada); Aitor Villafranca-Velasco, Instituto de Óptica "Daza de Valdés", Consejo Superior de Investigaciones Científicas (Spain); Martin Vachon, Pavel Cheben, National Research Council Canada (Canada); Lina Stankovic, Vladimir Stankovic, Univ. of Strathclyde (United Kingdom); Dan-Xia Xu, Jens H. Schmid, National Research Council Canada (Canada); Carlos A. Alonso-Ramos, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11284-66]

1:55 pm: **Integration of diffractive optical neural networks with electronic neural networks**, Aydogan Ozcan, Deniz Mengu, Yi Luo, Yair Rivenson, Jingxi Li, Univ. of California, Los Angeles (USA) . . . . . [11284-67]

2:10 pm: **Compact and large-port-count silicon photonics switches** (*Invited Paper*), Kazuhiro Ikeda, Keijiro Suzuki, Ryotaro Konoike, Shu Namiki, Hitoshi Kawashima, National Institute of Advanced Industrial Science and Technology (Japan) . . . . . [11284-68]

**SESSION 15**

**LOCATION: ROOM 76 (LOWER MEZZANINE SOUTH) . . . THU 2:35 PM TO 3:30 PM**

**Lidar Approaches**

Session Chair: **Sailing He**, KTH Royal Institute of Technology (Sweden), Zhejiang Univ. (China)

2:35 pm: **Dispersive optical phased array circuit for high-resolution pixelated 2D far-field scanning controlled by a single wavelength variable** (*Invited Paper*), Wim Bogaerts, imec, Univ. Gent (Belgium); Marcus Dahlem, Sarvagya Dwivedi, Roelof Jansen, Xavier Rottenberg, imec (Belgium) . . . . . [11284-69]

3:00 pm: **Swept-source LiDAR based on nonmechanical beam steering and FMCW ranging using a wideband tunable VCSEL**, Masayuki Okano, Changho Chong, Santec Corp. (Japan) and Santec USA Corp. (USA) [11284-70]

3:15 pm: **Compact silicon photonics-based laser modules for FM-CW LiDAR and RFOG**, Simon Ayotte, François Costin, André Babin, Gabriel Paré-Olivier, Émile Girard-Deschênes, Michel Morin, Benoît Filiou, Keven Bédard, Philippe Chréien, Ghislain Bilodeau, Louis-Philippe Perron, Charles-André Davidson, Dominique D'amato, Mathieu Laplante, Alexandre Desbiens, Simon Bastien, Sylvain Boudreau, Guy Rousseau, Jocelyn Blanchet-Létourneau, TeraXion Inc. (Canada) . . . . . [11284-71]

OPTO

# CONFERENCE 11285

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11285

## Silicon Photonics XV

Conference Chairs: **Graham T. Reed**, Optoelectronics Research Ctr. (United Kingdom); **Andrew P. Knights**, McMaster Univ. (Canada)

Program Committee: **Martijn J. R. Heck**, Aarhus Univ. (Denmark); **Siegfried Janz**, National Research Council Canada (Canada); **Delphine Marris-Morini**, Ctr. de Nanosciences et de Nanotechnologies (France); **Goran Z. Mashanovich**, Univ. of Southampton (United Kingdom); **Jurgen Michel**, Massachusetts Institute of Technology (USA); **Liam O'Faolain**, Tyndall National Institute (Ireland); **Jason Ching Eng Png**, A\*STAR Institute of High Performance Computing (Singapore); **Andrew W. Poon**, Hong Kong Univ. of Science and Technology (Hong Kong, China); **Haisheng Rong**, Intel Corp. (USA); **Dries Van Thourhout**, Univ. Gent (Belgium); **Laurent Vivien**, Ctr. de Nanosciences et de Nanotechnologies (France); **Jeremy Witzens**, RWTH Aachen Univ. (Germany); **Winnie N. Ye**, Carleton Univ. (Canada); **Shui-Qing Yu**, Univ. of Arkansas (USA); **Zhiping Zhou**, Peking Univ. (China); **Aaron J. Zilkie**, Rockley Photonics (USA)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) MON 10:30 AM TO 12:30 PM

#### Photonic Integration

Session Chair: **Andrew P. Knights**, McMaster Univ. (Canada)

- 10:30 am: **MORPHIC: Programmable photonic circuits enabled by silicon-photonic MEMS (Invited Paper)**, Wim Bogaerts, Univ. Gent (Belgium); Hamed Sattari, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Pierre Edinger, KTH Royal Institute of Technology (Sweden); Alain Y. Takabayashi, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Iman Zand, Univ. Gent (Belgium); Xiaojing Wang, KTH Royal Institute of Technology (Sweden); Antonio Ribeiro, Univ. Gent (Belgium); Moises A. Jezzini de Anda, Tyndall National Institute (Ireland); Carlos Errando-Herranz, KTH Royal Institute of Technology (Sweden); Giuseppe Talli, Tyndall National Institute (Ireland); Cristina Lerma Arce, Kumar Saurav, CommScope, Inc. (Belgium); Marco A. Garcia Porcel, VLC Photonics S.L. (Spain); Peter Verheyen, imec (Belgium); Banafsheh Abasahl, Univ. Gent (Belgium); Frank Niklaus, KTH Royal Institute of Technology (Sweden); Niels Quack, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Kristinn B. Gylfason, KTH Royal Institute of Technology (Sweden); Peter O'Brien, Tyndall National Institute (Ireland); Muhammad Umar Khan, Univ. Gent (Belgium) . . . . . [11285-1]
- 11:00 am: **Epitaxial integration of high-performance quantum-dot lasers on silicon (Invited Paper)**, Justin Norman, Songtao Liu, Univ. of California, Santa Barbara (USA); Yating Wan, Univ. of California Santa Barbara (USA); Zeyu Zhang, Chen Shang, Mario Dumont, M. J. Kennedy, Univ. of California, Santa Barbara (USA); Daehwan Jung, Korea Institute of Science and Technology (Korea, Republic of); Arthur C. Gossard, John E. Bowers, Univ. of California, Santa Barbara (USA) . . . . . [11285-2]
- 11:30 am: **Toward mid-IR optoelectronic devices on silicon-photonic integrated circuits**, Laura Monge Bartolome, Marta Rio Calvo, Michael Bahriz, Grégoire Narcy, Jean-Baptiste Rodriguez, Laurent Cerutti, Eric Tournié, Univ. de Montpellier (France) . . . . . [11285-3]
- 11:50 am: **Multi-chip heterogeneously integrated array of active three-terminal transistor lasers and passive photonic structures for electronic-photonic integration on silicon**, John A. Carlson, John M. Dallesasse, Univ. of Illinois (USA) . . . . . [11285-4]
- 12:10 pm: **Amorphous silicon waveguide escalator: monolithic integration of active components on 3- $\mu$ m SOI platform**, Arijit Bera, Matteo Cherchi, Kirsi Tappura, Päivi Heimala, Timo Aalto, VTT Technical Research Ctr. of Finland Ltd. (Finland) . . . . . [11285-5]
- Lunch Break . . . . . Mon 12:30 pm to 2:00 pm

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#### SESSION 2

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . MON 2:00 PM TO 3:30 PM

#### Optical Communications I

Session Chair: **Graham T. Reed**, Optoelectronics Research Ctr. (United Kingdom)

- 2:00 pm: **Silicon photonics for high-capacity copackaged optical engines (Invited Paper)**, Dylan F. Logan, RANOVUS, Inc. (Canada); Simon Arega Gebrewold, Kyle Murray, RANOVUS, Inc. (Germany); Edgar Huante-Ceron, Arnab Dewanjee, Dave Kim, Anthony Baker, RANOVUS, Inc. (Canada); Markus Kukiela, Franc Znidarsic, Mike Koehler, James Whiteaway, Georg Roell, RANOVUS, Inc. (Germany) . . . . . [11285-6]
- 2:30 pm: **High-speed PAM-4 and QAM-16 silicon-photonic transmitters using EAMs in unbalanced MZI structures**, Arian Hashemi Talkhoonch, Azita Emami, Caltech (USA) . . . . . [11285-7]
- 2:50 pm: **Fabrication tolerant high-speed SiP ring modulators and optical add-drop multiplexers for WDM applications**, Jovana Nojic, Saeed Sharif Azadeh, Juliana Müller, Florian Merget, Jeremy Witzens, RWTH Aachen Univ. (Germany) . . . . . [11285-8]
- 3:10 pm: **Advanced Si photonics platform for high-speed and energy-efficient optical transceivers for datacom**, Quentin Wilmart, Thomas Mang, Daivid Fowler, Stéphane Brisson, Karen Ribaud, Stéphane Malhouitre, Stéphane Bernabé, Corrado Sciancalepore, Bertrand Szlag, Ségolène Olivier, CEA-LETI (France) . . . . . [11285-9]
- Coffee Break. . . . . Mon 3:30 pm to 4:00 pm

#### SESSION 3

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . MON 4:00 PM TO 6:00 PM

#### Optical Communications II

Session Chair: **Matthew P. Halsall**, The Univ. of Manchester (United Kingdom)

- 4:00 pm: **Power-efficient lumped-element meandered silicon Mach-Zehnder modulators**, Saeed Sharif Azadeh, Jovana Nojic, Alvaro Moscoso-Mártir, Florian Merget, Jeremy Witzens, RWTH Aachen Univ. (Germany) . . . . . [11285-10]
- 4:20 pm: **Strain-induced pockels effect in silicon for electro-optic modulation**, Christian Lafforgue, Ctr. de Nanosciences et de Nanotechnologies (France); Mathias Berciano, imec (Belgium); Lucas Deniel, Guillaume Marcaud, Xavier Le Roux, Carlos A. Alonso-Ramos, Daniel Benedikovic, Vladyslav Vakarin, Alicia Ruiz-Caridad, Paul Crozat, Delphine Marris-Morini, Eric Cassan, Laurent Vivien, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11285-11]
- 4:40 pm: **Ultrafast optical switching of femtosecond 1550 nm pulses in silicon modulators**, Kent A. Hallman, Andrey Baydin, Kevin J. Miller, Sharon M. Weiss, Richard F. Haglund Jr., Vanderbilt Univ. (USA) . . . . . [11285-12]
- 5:00 pm: **16 $\times$ 16 silicon photonic AWGR for dense wavelength division multiplexing (DWDM) O-band interconnects**, Konstantinos Fotiadis, Stelios Pitris, Miltiadis Moralis-Pegios, Charoula Mitsolidou, Aristotle Univ. of Thessaloniki (Greece); Peter De Heyn, Jorris Van Campenhout, imec, Univ. Gent (Belgium); Theonitsa Alexoudi, Nikos Pleros, Aristotle Univ. of Thessaloniki (Greece) . . . . . [11285-13]
- 5:20 pm: **Flat-top interleavers based on single MMIs**, Matteo Cherchi, Fei Sun, Markku Kapulainen, Mikko T. Harjanne, Timo Aalto, VTT Technical Research Ctr. of Finland Ltd. (Finland) . . . . . [11285-14]
- 5:40 pm: **Ultrafast self-induced oscillation in a nonlinear subwavelength grating metamaterial ring resonator**, Xiaochuan Xu, Harbin Institute of Technology Shenzhen Graduate School (China); Yang Wang, Tokyo Institute of Technology (Japan); Zeyu Pan, Chi-Jui Chung, Yue Chen, Yaguo Wang, The Univ. of Texas at Austin (USA); Tsuyoshi Michinobu, Tokyo Institute of Technology (Japan); Ray T. Chen, The Univ. of Texas at Austin (USA) [11285-15]

TUESDAY 4 FEBRUARY

SESSION 4

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . TUE 8:30 AM TO 10:20 AM

Silicon Photonics Enabled LIDAR

Session Chair: **Andrew P. Knights**, McMaster Univ. (Canada)

8:30 am: **Scalable tiled silicon-photonics 2D wavelength-steered optical beam LIDAR apertures** (*Invited Paper*), Milo? A. Popovic, Boston Univ. (USA); Nathan Dostart, Univ. of Colorado Boulder (USA); Bohan Zhang, Anatol N. Khilo, Boston Univ. (USA); Michael Brand, Univ. of Colorado Boulder (USA); Kenaish Al Qubaisi, Deniz Onural, Boston Univ. (USA); Daniel Feldkhun, Kelvin H. Wagner, Univ. of Colorado Boulder (USA) . . . . . [11285-16]

9:00 am: **An overview of silicon photonics for LIDAR** (*Invited Paper*), Jonathan K. Doylend, Intel Corp. (USA) . . . . . [11285-17]

9:30 am: **Integrated optical phased arrays: LiDAR, augmented reality, and beyond** (*Invited Paper*), Jelena Notaros, Milica Notaros, Manan Raval, Christopher V. Poulton, Matthew J. Byrd, Massachusetts Institute of Technology (USA); Nanxi Li, Massachusetts Institute of Technology (USA) and Harvard Univ. (USA); Zhan Su, Emir Salih Magden, Erman Timurdogan, Massachusetts Institute of Technology (USA); Thomas Dyer, Christopher Baiocco, SUNY Polytechnic Institute (USA); Taehwan Kim, Pavan Bhargava, Vladimir M. Stojanovic, Univ. of California, Berkeley (USA); Michael R. Watts, Massachusetts Institute of Technology (USA) . . . . . [11285-18]

10:00 am: **Wide-range longitudinal beam-steering using silicon-based 2?64 tunable optical phased array**, Nam-Hyun Kwon, Seong-Hwan Kim, Hyo-Hoon Park, KAIST (Korea, Republic of) . . . . . [11285-19]

Coffee Break . . . . . Tue 10:20 am to 10:30 am

PHOTONIC INTEGRATION FORUM

LOCATION: INDUSTRY STAGE, HALL DE (EXHIBIT LEVEL) . 10:30 AM TO 12:00 PM

Session Chair: **Martijn J. R. Heck**, Aarhus Univ. (Denmark)

Learn from industry leaders at the forefront of photonic integration as they share expert perspectives on the commercialization of photonic integrated circuits using materials spanning silicon photonics, silicon nitride, polymers, and indium phosphide integration platforms – and their emerging applications.

See event listing at:  
<https://spie.org/PW/special-events/Industry-Event#pf>

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:20 pm

SESSION 5

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . TUE 1:20 PM TO 3:40 PM

Waveguides

Session Chair: **Dan-Xia Xu**, National Research Council Canada (Canada)

1:20 pm: **Subwavelength silicon photonic structures for light coupling, spectral filters, and optical nanoantennas** (*Invited Paper*), Jens H. Schmid, Pavel Cheben, Daniele Melati, Dan-Xia Xu, Siegfried Janz, Jean Lapointe, Mohsen Kamandar Dezfouli, Ross Cheriton, Shurui Wang, Martin Vachon, National Research Council Canada (Canada); Robert Halir, Alejandro Ortega-Moñuz, Gonzalo Wangüemert-Perez, Iñigo Molina-Fernández, Alejandro Sánchez Postigo, Daniel Pereira-Martín, Univ. de Málaga (Spain); Jiri Ctyroky, Institute of Photonics and Electronics of the CAS, v.v.i. (Czech Republic) . . . . . [11285-20]

1:50 pm: **Enhanced second-order nonlinearity in Si<sub>3</sub>N<sub>4</sub> integrated through optical poling** (*Invited Paper*), Camille-Sophie Brès, Edgars Nitiss, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11285-21]

2:20 pm: **High-efficiency silicon and silicon-nitride edge couplers and grating couplers: design, optimization, and experimental realization**, Thomas Y. L. Ang, Flynn Jian Long Loh, Yu Xiang Peh, Jun Rong Ong, Jennifer Tanadi, Yue Chen, Soon Thor Lim, Ching Eng Png, A\*STAR Institute of High Performance Computing (Singapore) . . . . . [11285-22]

2:40 pm: **Suspended subwavelength grating waveguides on SOI for ultra-broadband operation**, Ting Li, Peiji Zhou, Yi Zou, ShanghaiTech Univ. (China) . . . . . [11285-23]

3:00 pm: **Photonic crystal and quasi photonic crystal Ge-on-Si lenses for the combination of QCL array outputs**, Maxime Guais, Grégory Maisons, Johan Abautret, mirSense (France); Delphine Marris-Morini, Ctr. de Nanosciences et de Nanotechnologies (France); Mathieu Carras, mirSense (France) . . . . . [11285-24]

3:20 pm: **Optical reflection from a free-carrier-induced front in a silicon slow-light waveguide**, Mahmoud A. A. Gaafar, Dirk Jalias, Technische Univ. Hamburg-Harburg (Germany); Liam O’Faolain, Univ. of St. Andrews (United Kingdom); Juntao Li, Sun Yat-Sen Univ. (China); Thomas F. Krauss, Univ. of York (United Kingdom); Alexander Petrov, Manfred Eich, Technische Univ. Hamburg-Harburg (Germany) . . . . . [11285-25]

Coffee Break . . . . . Tue 3:40 pm to 4:10 pm

SESSION 6

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . TUE 4:10 PM TO 5:50 PM

Ge/Si Integration

Session Chair: **Dylan F. Logan**, RANOVUS, Inc. (Canada)

4:10 pm: **Lowering GeSn lasing thresholds for future integration on Si**, Anas Elbaz, Univ. Paris-Sud (France); Jeremie Chretien, CEA-INAC (France); Riazul Arefin, Ctr. de Nanosciences et de Nanotechnologies (France) and Univ. Paris-Sud (France); Lara Casiez, CEA-LETI (France); Konstantinos Pantzas, Gilles Patriarche, Isabelle Sagnes, Sebastien Sauvage, Xavier Checoury, Ctr. de Nanosciences et de Nanotechnologies (France) and Univ. Paris-Sud (France); Nicolas Pauc, Vincent Calvo, CEA-INAC (France); Alexei Chelnokov, Vincent Reboud, Jean-Michel Hartmann, CEA-LETI (France); Moustafa El Kurdi, Ctr. de Nanosciences et de Nanotechnologies (France) and Univ. Paris-Sud (France) . . . . . [11285-26]

4:30 pm: **Influence of Si intermixing on optical properties of Ge on Si and monolithic integration of Ge on Si nanocavity**, Chulwon Lee, Hyun Gyu Song, Ki-Young Woo, Daegwang Choi, Yong-Hoon Cho, KAIST (Korea, Republic of) . . . . . [11285-27]

4:50 pm: **Mapping uniaxial and biaxial strain in suspended germanium microstructures via high-resolution Raman scattering**, Laura Martinez Maestro, The Univ. of Manchester (United Kingdom); Dylan Genuth-Okon, Ross Anthony, McMaster Univ. (Canada); Matthew P. Halsall, The Univ. of Manchester (United Kingdom); Andrew P. Knights, McMaster Univ. (Canada); Iain F. Crowe, The Univ. of Manchester (United Kingdom) . . . . . [11285-28]

5:10 pm: **Monolithic integration of up to 40 GHz Ge photodetectors in 3µm SOI**, Tapani Vehmas, Fei Sun, Markku Kapulainen, Feng Gao, Päivi Heimala, Giovanni DelRosso, Timo Aalto, VTT Technical Research Ctr. of Finland Ltd. (Finland) . . . . . [11285-29]

5:30 pm: **Impact of carrier confinement on the emission of mid-infrared GeSn heterojunction LEDs**, Lara Casiez, Mathieu Bertrand, Andréa Quintero, CEA-LETI (France); Quang Minh Thai, CEA-DRF (France); Jérémie Chretien, CEA-LETI (France); Nicolas Pauc, CEA-DRF (France); Yann Mazel, Jerome Richy, Pierre Barritault, Philippe Rodriguez, Jean-Michel Hartmann, Alexei Tchelnokov, CEA-LETI (France); Vincent Calvo, CEA-LETI-DOPT (France); Vincent Reboud, CEA-LETI (France) . . . . . [11285-30]

WEDNESDAY 5 FEBRUARY

SESSION 7

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . WED 8:10 AM TO 10:30 AM

Manufacturing Technology

Session Chair: **Iain F. Crowe**, The Univ. of Manchester (United Kingdom)

8:10 am: **Intelligent exploration of complex design space of nanophotonic components using machine-learning algorithms** (*Invited Paper*), Dan-Xia Xu, Yuri Grinberg, Daniele Melati, Mohsen Kamandar Dezfouli, Pavel Cheben, Siegfried Janz, Jens H. Schmid, National Research Council Canada (Canada) . . . . . [11285-31]

8:40 am: **Hot-wire cvd hydrogenated amorphous silicon for multilayer photonic applications** (*Invited Paper*), Harold M. H. Chong, Univ. of Southampton (United Kingdom) . . . . . [11285-32]

9:10 am: **Identification of a boron-oxygen complex as the origin of a non-radiative recombination process in silicon photodetectors and solar cells**, Matthew P. Halsall, The Univ. of Manchester (United Kingdom); Michelle Vaqueiro Contreras, The Univ. of Manchester (United Kingdom) and The Univ. of New South Wales (Australia); Vladimir P. Markevich, The Univ. of Manchester (United Kingdom); Jose Coutinho, Paulo Santos, Univ. de Aveiro (Portugal); Iain F. Crowe, Ian Hawkins, The Univ. of Manchester (United Kingdom); Stanislaw B. Lastovskii, Leonid I. Murin, National Academy of Sciences of Belarus (Belarus); Anthony R. Peaker, The Univ. of Manchester (United Kingdom) . . . . . [11285-33]

9:30 am: **Experimental phase-error extraction and modelling in silicon photonic arrayed waveguide gratings**, Muhammad Umar Khan, Univ. Gent (Belgium); Martin Fiers, Luceda Photonics (Belgium); Wim Bogaerts, Univ. Gent (Belgium) . . . . . [11285-34]

OPTO

# CONFERENCE 11285

9:50 am: **Supersaturated silicon for near-infrared plasmonics**, Jura Rensberg, Kevin Wolf, Martin Hafermann, Andreas Undisz, Friedrich-Schiller-Univ. Jena (Germany); Jürgen Salfeld, Sebastian Geburt, Innovaent GmbH (Germany); Carsten Ronning, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11285-35]  
10:10 am: **Electrical annealing for Ge ion-implanted optical devices**, Xingshi Yu, Xia Chen, Milan M. Milosevic, Optoelectronics Research Ctr. (United Kingdom); Shinichi Saito, Univ. of Southampton (United Kingdom); Graham T. Reed, Optoelectronics Research Ctr. (United Kingdom) . . [11285-36]  
Coffee Break . . . . . Wed 10:30 am to 11:00 am

## SESSION 8

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . WED 11:00 AM TO 12:30 PM

### Optical Detection and Sensing I

Session Chair: **Jens H. Schmid**,  
National Research Council Canada (Canada)

11:00 am: **Micro PA detector: pushing the limits of mid IR photoacoustic spectroscopy integrated on silicon** (*Invited Paper*), Jean-Guillaume Coutard, Audrey Berthelot, CEA-LETI (France); Alain Glière, CEA-LETI-DOPT (France); Hélène Lhermet, CEA-LETI (France); Benjamin Scherer, E+H Process Solutions (DE) GmbH (Germany); Thomas Strahl, Fraunhofer-Institut für Physikalische Messtechnik IPM (Germany); Alexandre Teulle, CEA-LETI-DOPT (France); Thierry Verdot, CEA-LETI (France) . . . . . [11285-37]  
11:30 am: **Oxide-enhanced IR hot-carrier-based photo detection in metal thin-film Si junctions**, Nicholas Gusken, Alberto Lauri, Imperial College London (United Kingdom); Yi Li, Ludwig-Maximilians-Univ. München (Germany); Takayuki Matsui, Anna Regoutz, Brock G. Doiron, Ryan Bower, Andrei P. Mihai, Rupert F. Oulton, Peter K. Petrov, Lesley F. Cohen, Imperial College London (United Kingdom); Stefan A. Maier, Ludwig-Maximilians-Univ. München (Germany) . . . . . [11285-38]  
11:50 am: **High-speed integrated waveguide lateral Si/Ge/Si photodiodes with optimized transit time**, Hanae Zegmout, Bertrand Szelag, CEA-LETI (France); Stéphane Bernabé, CEA-LETI-DOPT (France); Léopold Virost, Quentin Wilmart, Stéphane Brisson, CEA-LETI (France) . . . . . [11285-39]  
12:10 pm: **Heterodyne detection for the measurement of electro-optical frequency combs generated with a silicon Mach-Zehnder modulator**, Lucas Deniel, Ctr. de Nanosciences et de Nanotechnologies (France); Erwan Weckenmann, Univ. de Rennes 1 (France); Diego Pérez-Galacho, Ctr. de Nanosciences et de Nanotechnologies (Spain); Laurent Bramerie, Univ. de Rennes 1 (France); Charles Baudot, STMicroelectronics S.A. (France); Margaux Barbier, Mathilde Gay, Ecole Nationale Supérieure des Sciences Appliquées et de Technologie (France); Laurent Vivien, Ctr. de Nanosciences et de Nanotechnologies (France); Frédéric Boeuf, STMicroelectronics S.A. (France); Christophe Peucheret, Fonctions Optiques pour les Technologies de l'information (France); Delphine Marris-Morini, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11285-40]  
Lunch/Exhibition Break . . . . . Wed 12:30 pm to 2:00 pm

## SESSION 9

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . WED 2:00 PM TO 3:30 PM

### Emerging Applications I

Session Chair: **Andrew P. Knights**, McMaster Univ. (Canada)

2:00 pm: **Waveguide Bragg gratings for photonic noise suppression in silicon photon-pair sources** (*Invited Paper*), Dorian Oser, Xavier Le Roux, Ctr. de Nanosciences et de Nanotechnologies (France); Florent Mazeas, Institut de Physique de Nice (France); Diego Pérez-Galacho, Univ. Politècnica de València (France); Daniel Benedikovic, Elena Durán-Valdeiglesias, Vladyslav Vakarin, Ctr. de Nanosciences et de Nanotechnologies (France); Olivier Alibart, Univ. Côte d'Azur (France); Pavel Cheben, National Research Council Canada (Canada); Sebastien Tanzilli, Univ. Côte d'Azur (France); Laurent Labonté, Univ. Côte d'Azur (France); Delphine Marris-Morini, Eric Cassan, Laurent Vivien, Carlos A. Alonso-Ramos, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11285-41]

2:30 pm: **Integrated photonic solutions for 3D imaging and sensing using the multi-micron silicon-photonics platform** (*Invited Paper*), Rebecca Schaevitz, Rockley Photonics Ltd. (USA); Roozbeh Parsa, Aaron Birkbeck, Hooman Abediasl, Rockley Photonics (USA); Greg Finn, Rockley Photonics (United Kingdom); Aaron J. Zilkie, Rockley Photonics (USA); Andrew G. Rickman, Rockley Photonics Ltd. (United Kingdom) . . . . . [11285-42]  
3:00 pm: **Accelerating AI computation with integrated photonics** (*Invited Paper*), Huaiyu Meng, Lightelligence, Inc. (USA); Yanfei Bai, Lightelligence, Inc. (USA); Arash Hosseinzadeh, Yelong Xu, Yichen Shen, Lightelligence, Inc. (USA) . . . . . [11285-43]  
Coffee Break . . . . . Wed 3:30 pm to 4:00 pm

## SESSION 10

LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . . WED 4:00 PM TO 5:20 PM

### Emerging Applications II

Session Chair: **Jonathan K. Doylend**, Intel Corp. (USA)

4:00 pm: **Reconfigurable photonic integrated circuits (RPIC) based on functional materials for integrated optical communication applications**, Joaquin Faneca, Univ. of Exeter (United Kingdom); Thalia Dominguez Bucio, Frederic Y. Gardes, Univ. of Southampton (United Kingdom); Anna Baldycheva, Univ. of Exeter (United Kingdom) . . . . . [11285-44]  
4:20 pm: **Photonic-assisted microwave frequency multiplication improved by optical filtering on a silicon-photonics platform**, Daniel N. Nascimento-Duplat, Hanna Becker, Mircea Balauriu, Hakimeh Mohammadhosseini, Martijn J. R. Heck, Aarhus Univ. (Denmark) . . . . . [11285-45]  
4:40 pm: **The effect of two-photon absorption on dynamic range of integrated microwave photonics links**, Jake A. Bass, Huong Tran, Univ. of Arkansas (USA); Brandon Brea, Univ. of Massachusetts Boston (USA); Wei Du, Wilkes Univ. (USA); Richard Soref, Univ. of Massachusetts Boston (USA); Shui-Qing Yu, Univ. of Arkansas (USA) . . . . . [11285-46]  
5:00 pm: **Silicon-photonics-based terahertz-wave signal delivery using wavelength interleavers**, Seungjun Han, Jongwoo Park, KAIST (Korea, Republic of); Joonyoung Kim, Heuk Park, Electronics and Telecommunications Research Institute (Korea, Republic of); Kyoungsik Yu, KAIST (Korea, Republic of) . . . . . [11285-47]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at  
<http://spie.org/PWPosterGuidelines>

**Design of silicon-photonics-based accelerometer for displacement sensing applications**, Alisher Akhmet, Ainur Koshkinbayeva, Ikechi Augustine Ukaegbu, Nazarbayev Univ. (Kazakhstan) . . . . . [11285-54]

**Low-voltage 12-GHz silicon optical electro-absorption modulator (EAM) using a Schottky diode for optical interconnectors in the C-band**, Useok Jeong, Jung Ho Park, Korea Univ. (Korea, Republic of); Kyungwoon Lee, KT Corp. (Korea, Republic of); Jinsik Kim, Dongguk Univ. (Korea, Republic of); Kwangwoong Kim, Nokia Bell Labs. (USA) . . . . . [11285-55]

**Silicon Mach-Zehnder optical modulator with > 50 GHz electro-optic bandwidth**, Jongwoo Park, Seungjun Han, KAIST (Korea, Republic of); Sanghwa Yoo, Electronics and Telecommunications Research Institute (Korea, Republic of); Kyoungsik Yu, KAIST (Korea, Republic of) . . . . . [11285-56]

**Silicon-on-chip compact MMI-based two-mode (de)multiplexer for photonic networks**, Shamsul Hassan, Devendra Chack, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . . . [11285-57]

**Model-based guard ring structure guideline for the enhancement of silicon-based single-photon avalanche diode characteristics**, Dong Seok Shin, Byungchoul Park, Youngcheol Chae, Ilgu Yun, Yonsei Univ. (Korea, Republic of) . . . . . [11285-58]

**A compact structure for realizing electromagnetically induced transparency in a microring resonator**, Fahad Malik, Muhammad Favad Qadir, Aftab Hussain, Muhammad Zakwan, Air Univ. (Pakistan) . . . . . [11285-59]

**Free-carrier absorption induced all-optical data switching in Si-rich SiC waveguide**, Chih-Hsien Cheng, Yen-Wei Hsueh, Bo-Ji Huang, Huai-Yung Wang, Gong-Ru Lin, National Taiwan Univ. (Taiwan) . . . . . [11285-60]

**Twin-fano resonator with widely tunable slope for wavelength monitor**, Xiaoping Guo, Tingge Dai, Bei Chen, Yuehai Wang, Jianyi Yang, Zhejiang Univ. (China) . . . . . [11285-61]

**Dynamic color-tuning of hybrid Si nanowires array in conjugation with plasmonic and photonic-based absorption and scattering**, Soojung Kim, Hyerin Song, Kyujung Kim, Pusan National Univ. (Korea, Republic of) [11285-62]

**Absorptivity enhancement of black silicon using electroless Cu plating**, Ahmed Khaled, Ain Shams Univ. (Egypt); Magdy Hussein Mourad, Cairo Univ. (Egypt) and Ain Shams Univ. (Egypt); Ahmed Amr Elsayed, Ain Shams Univ. (Egypt) and ESIEE Paris (France); Frédéric Marty, Elyes Nefzaoui, Tarik Bourouina, ESIEE Paris (France); Yasser M. Sabry, Daaa A. M. Khalil, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt) . . . . . [11285-63]

**Laterally asymmetrical photonic crystal waveguide as a compact TM-pass polarization filter for C-band operation**, Chandra Prakash, Mrinal Sen, Indian Institute of Technology (Indian School of Mines), Dhanbad (India) . . . . . [11285-64]

**THURSDAY 6 FEBRUARY**

**SESSION 11**

**LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . . THU 9:00 AM TO 10:00 AM**

**Optical Detection and Sensing II**

Session Chair: **Graham T. Reed**,  
Optoelectronics Research Ctr. (United Kingdom)

9:00 am: **Ultra-sensitive and compact on-chip gas sensor on a silicon nitride photonic integrated circuit**, Giuseppe Antonacci, Jeroen Goyvaerts, Haolan Zhao, imec (Belgium); Bettina Baumgartner, Bernhard Lendl, Technische Univ. Wien (Austria); Roel Baets, Univ. Gent (Belgium) . . . [11285-65]

9:20 am: **Compressed sensing Fourier transform spectroscopy based on integrated plasmonic circuitry on VCSEL platform**, Elham Heidari, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Volker J. Sorger, The George Washington Univ. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [11285-48]

9:40 am: **Investigations into group IV photonic waveguides with a wide working optical bandwidth**, Callum J. Stirling, Wei Cao, Optoelectronics Research Ctr. (United Kingdom); Kian Shen Kiang, Univ. of Southampton (United Kingdom); Ali Z. Khokhar, Optoelectronics Research Ctr. (United Kingdom); Benoit Guilhabert, Michael J. Strain, Univ. of Strathclyde (United Kingdom); Milos Nedeljkovic, Goran Z. Mashanovich, Optoelectronics Research Ctr. (United Kingdom) . . . . . [11285-49]

Coffee Break. . . . . Thu 10:00 am to 10:30 am

**SESSION 12**

**LOCATION: ROOM 70 (LOWER MEZZANINE SOUTH) . THU 10:30 AM TO 11:30 AM**

**Optical Communications III**

Session Chair: **Graham T. Reed**,  
Optoelectronics Research Ctr. (United Kingdom)

10:30 am: **Polarization and phase diversity silicon coherent receiver for datacenter applications**, Yujie Xia, Univ. of California, Santa Barbara (USA); Sarvagya Dwivedi, imec (Belgium); Sergio Pinna, Steven Estrella, Hector Andrade, Takako Hirokawa, Aaron Maharry, Junqian Liu, Jonathan Klamkin, Larry A. Coldren, Clint L. Schow, Univ. of California, Santa Barbara (USA) . . . . . [11285-51]

10:50 am: **Dual-mode 3dB splitter based on polarization rotation**, Yingheng Tang, Purdue Univ. (USA); Min Teng, imec USA - Florida (USA); Yunjo Lee, Abdullah Al Noman, Yi Xuan, Ziyun Kong, Minghao Qi, Purdue Univ. (USA) . . . . . [11285-52]

11:10 am: **Fast thermo-optic optimization of high-order SOI microring optical filters by method of gradient descent**, Tyler Zimmerling, Yang Ren, Huynh Ngo, Vien Van, Univ. of Alberta (Canada) . . . . . [11285-53]



**Industry Workshops**

Wednesday • Moscone West Level 2  
30-minute to full-day workshops open to all attendees  
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# CONFERENCE 11286

LOCATION: ROOM 215 (LEVEL 2 SOUTH)

Tuesday–Thursday 4–6 February 2020 • Proceedings of SPIE Vol. 11286

## Optical Interconnects XX

*Conference Chairs:* **Henning Schröder**, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); **Ray T. Chen**, The Univ. of Texas at Austin (USA)

*Program Committee:* **Maggie Yihong Chen**, Texas State Univ. (USA); **Darrell Childers**, US Conec Ltd. (USA); **Hamed Dalir**, Omega Optics, Inc. (USA); **Alan F. Evans**, Corning Incorporated (USA); **Ruth Houbertz**, Multiphoton Optics GmbH (Germany); **Marika P. Immonen**, TTM Technologies, Inc. (Finland); **Takaaki Ishigure**, Keio Univ. (Japan); **Mikko Karppinen**, VTT Technical Research Ctr. of Finland Ltd. (Finland); **Christian Koos**, Karlsruher Institut für Technologie (Germany); **Tobias Lamprecht**, vario-optics ag (Switzerland); **Matthias Lorenz**, AEMtec GmbH (Germany); **Christopher T. Middlebrook**, Michigan Technological Univ. (USA); **Bert-Jan Offrein**, IBM Research – Zürich (Switzerland); **Hyo-Hoon Park**, KAIST (Korea, Republic of); **Ignazio E. M. Piacentini**, ficonTEC Service GmbH (Germany); **Nikos Pleros**, Aristotle Univ. of Thessaloniki (Greece); **Richard C. A. Pitwon**, Univ. of St. Andrews (United Kingdom); **Jie X. Qiao**, Rochester Institute of Technology (USA); **Brandon W. Swatowski**, Dow Corning Corp. (USA); **Dave J. Thomson**, Optoelectronics Research Ctr. (United Kingdom); **Huiping Tian**, Beijing Univ. of Posts and Telecommunications (China); **Alan X. Wang**, Oregon State Univ. (USA); **Ian H. White**, Univ. of Cambridge (United Kingdom); **Chris Q. Wu**, Corning Incorporated (USA)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... TUE 8:30 AM TO 11:00 AM

#### Optical Interconnect Systems

Session Chair: **Henning Schröder**, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany)

8:30 am: **Optical interconnects in enterprise and hyperscale datacenters** (*Invited Paper*), David Pehler, Dell EMC (USA) ..... [11286-1]

9:00 am: **Advances in optical interconnect technology and market trends** (*Invited Paper*), Bernard Lee, SENKO Advanced Components Ltd. (Hong Kong, China) ..... [11286-2]

9:30 am: **Optical interconnect space market and technical challenges** (*Invited Paper*), Guillaume Blanchette, Reflex Photonics, Inc. (Canada) [11286-3]

10:00 am: **Nanoseconds photonic integrated switches for optical data center interconnect systems** (*Invited Paper*), Nicola Calabretta, Kristif Prifti, Xuwei Xue, Fulong Yan, Bitao Pan, Xiaotao Guo, Technische Univ. Eindhoven (Netherlands) ..... [11286-4]

10:30 am: **Board- and rack-scale optical interconnection architectures for disaggregated data centers** (*Invited Paper*), Nikos Terzenidis, Miltiadis Moralis-Pegios, Stelios Pitris, George Mourgas-Alexandris, Charoula Mitsolidou, Konstantinos Fotiadis, Konstantinos Vyrsokinos, Theoni Alexoudi, Nikos Pleros, Aristotle Univ. of Thessaloniki (Greece) ..... [11286-47]

Coffee Break. .... Tue 11:00 am to 11:30 am

#### SESSION 2

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... TUE 11:30 AM TO 12:30 PM

#### Hybrid Device Integration Approaches for PIC I

Session Chair: **Ray T. Chen**, The Univ. of Texas at Austin (USA)

11:30 am: **Photonic plug for scalable silicon photonics packaging** (*Invited Paper*), Hesham Taha, Abraham Israel, Leonid Pascar, Teramount Ltd. (Israel) ..... [11286-5]

12:00 pm: **Hybrid InP on SOI nanophotonic devices** (*Invited Paper*), Fabrice Raineri, CNRS (France) ..... [11286-6]

Lunch/Exhibition Break ..... Tue 12:30 pm to 2:00 pm

#### SESSION 3

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... TUE 2:00 PM TO 3:10 PM

#### Hybrid Device Integration Approaches for PIC II

Session Chair: **Ray T. Chen**, The Univ. of Texas at Austin (USA)

2:00 pm: **Photodiodes for Si photonics** (*Invited Paper*), Joe C. Campbell, Andreas Beling, Univ. of Virginia (USA) ..... [11286-7]

2:30 pm: **Detachable 1x8 single-mode optical interface for DWDM microring silicon photonic transceivers**, Sagi Mathai, Paul Rosenberg, Hewlett Packard Enterprise (USA); George Panotopoulos, oeWORKS LLC (USA); Dan Kurtz, Darrell Childers, US Conec Ltd. (USA); Thomas Van Vaerenbergh, Peng Sun, Jared Hulme, Ashkan Seyedi, Hewlett Packard Enterprise (USA); Michael Tan, Hewlett Packard Enterprise Development LP (USA); Marco Fiorentino, Hewlett Packard Enterprise (USA) ..... [11286-8]

2:50 pm: **High-speed silicon photonic optical interconnects for cryogenic readout**, Steven B. Estrella, Freedom Photonics, LLC (USA) and Univ. of California, Santa Barbara (USA); Takako Hirokawa, Aaron Maharry, Univ. of California, Santa Barbara (USA); Daniel S. Renner, Freedom Photonics, LLC (USA); Clint L. Schow, Univ. of California, Santa Barbara (USA) ..... [11286-9]

Coffee Break. .... Tue 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... TUE 3:40 PM TO 5:50 PM

#### Fiber Optics and Micro-Optic Assembly

Session Chair: **Alethea Vanessa Zamora Gomez**, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany)

3:40 pm: **Low cutoff G.657-compatible fibers for data center interconnects operating in the 1064- and 1310-nm windows** (*Invited Paper*), Scott R. Bickham, Corning Optical Communications LLC (USA); Ewa Simpanen, Tamás Langyel, Johan S. Gustavsson, Anders Larsson, Chalmers Univ. of Technology (Sweden) ..... [11286-10]

4:10 pm: **MT-ferrule compatible passive optical coupling for single-mode polymer waveguide in co-packaged optics** (*Invited Paper*), Akihiro Noriki, Takeru Amano, National Institute of Advanced Industrial Science and Technology (Japan) and Photonics Electronics Technology Research Association (Japan) ..... [11286-11]

4:40 pm: **Fiber-optic interconnect technologies** (*Invited Paper*), Ryo Nagase, Chiba Institute of Technology (Japan) ..... [11286-12]

5:10 pm: **Automated PM-fiber array assembly with high-precision four DOF alignment**, Marvin Berger, Fraunhofer-Institut für Produktionstechnologie IPT (Germany); Andrea Alippi, PHIX Photonics Assembly (Netherlands); Sebastian Haag, AIXEMTEC GmbH (Germany); Maximilian Hoeren, Tobias Mueller, Christian Brecher, Fraunhofer-Institut für Produktionstechnologie IPT (Germany) ..... [11286-13]

5:30 pm: **Modular lensed-ferrule solution for single-mode fiber connectors**, Andrea Tonini, Victor Coggi, Diamond SA (Switzerland); Thieu Do, Diamond USA (USA) ..... [11286-14]

WEDNESDAY 5 FEBRUARY

SESSION 5

LOCATION: ROOM 215 (LEVEL 2 SOUTH) .....WED 8:20 AM TO 10:10 AM

Novel Optical Waveguide and Integrated Interconnect Technologies

Session Chair: Ruth Houbertz, Multiphoton Optics GmbH (Germany)

8:20 am: Bridging the gap: Manufacturing optical transceivers in the multibillion-dollar silicon electronics supply chain (Invited Paper), Theodore Schmidt, Juniper Networks, Inc. (USA)..... [11286-15]

8:50 am: Polymer interposer for efficient light coupling into 3 μm silicon-on-insulator waveguides, Marianne Hiltunen, Mikko T. Harjanne, Fei Sun, Tapani Vehmas, Noora Heinilehto, Ben Wälchi, Päivi Heimala, Timo Aalto, VTT Technical Research Ctr. of Finland Ltd. (Finland) ..... [11286-16]

9:10 am: High-density optical module for on-board optical interconnects utilizing graded-index core polymer waveguide, Naohiro Kohmu, Hitachi, Ltd. (Japan) and Keio Univ. (Japan); Maho Ishii, Takaaki Ishigure, Keio Univ. (Japan)..... [11286-17]

9:30 am: Bending loss improvement and twisting loss study of flexible multimode polymer waveguides, Fengyuan Shi, Nikos Bamiedakis, Richard Penty, Ian White, Daping Chu, Univ. of Cambridge (United Kingdom)..... [11286-18]

9:50 am: Novel technology for dispensing liquid polymers of a wide viscosity range on a picoliter scale for photonic applications, Philipp Wachholz, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Johannes Wolf, micro resist technology GmbH (Germany); Sebastian Marx, Daniel Weber, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Jan Klein, micro resist technology GmbH (Germany); Henning Schröder, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany) ..... [11286-49]

Coffee Break..... Wed 10:10 am to 10:40 am

SESSION 6

LOCATION: ROOM 215 (LEVEL 2 SOUTH) .....WED 10:40 AM TO 12:10 PM

PICs for Optical Interconnects

Session Chair: Maggie Yihong Chen, Texas State Univ. (USA)

10:40 am: Integrated silicon photonics for high-volume data center applications (Invited Paper), Robert Blum, Intel Corp. (USA)..... [11286-19]

11:10 am: Integrated photonic chip to chip interconnection utilizing grating coupler technology, Tatiana Pashkova, Peter O'Brien, Tyndall National Institute (Ireland)..... [11286-20]

11:30 am: High-speed and power-efficient beam-steering using 1x16 silicon optical phased array with electro-optic phase shifters, Geumbong Kang, Dae-Seong Lee, Hyeonho Yoon, Hyo-Hoon Park, KAIST (Korea, Republic of) ..... [11286-21]

11:50 am: Building blocks of a scalable and radiation-hardened integrated transmitter unit based on 250-nm SOI, Yunlong Zhang, Marc Schneider, Djorn Karnick, Lars Eisenbätter, Thomas Kühner, Marc Weber, Karlsruhe Institut für Technologie (Germany)..... [11286-22]

Lunch/Exhibition Break .....Wed 12:10 pm to 1:30 pm

SESSION 7

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... WED 1:30 PM TO 3:10 PM

Hybrid Integrated Optical Link Modules I

Session Chair: Jie X. Qiao, Rochester Institute of Technology (USA)

1:30 pm: Design modifications to an existing high-density mid-board optical engine to survive harsh environments (Invited Paper), Kevin Burt, Samtec, Inc. (USA); Raymond Lee, Louis LaCroix, Samtec Inc. (USA) [11286-23]

2:00 pm: Short-reach low-cost silicon photonic microtransceivers for embedded and copackaged system integration (Invited Paper), Kazuhiko Kurata, AIO Core Co., Ltd. (Japan); Richard C. A. Pitwon, Resolute Photonics Ltd. (United Kingdom)..... [11286-24]

2:30 pm: Integrated receiver module with demultiplexer for chip-to-chip optical interconnects, Nga T. H. Nguyen, LS Mtron (Korea, Republic of); Ikechi Augustine Ukaegbu, Nazarbayev Univ. (Kazakhstan); Jamshid Sangirov, Quantum5x Systems Inc. (Canada); Hyo-Hoon Park, KAIST (Korea, Republic of)..... [11286-25]

2:50 pm: Injection molded low-thermal-expansion multi-fiber ferrule, Ulrich Neukirch, Woraphat Dockchooring, Stephen Q. Smith, Robert A. Bellman, Corning Incorporated (USA); Darrell Childers, DJ Hastings, Inc. Conec Ltd. (USA); Esteban B. Marin, Corning Incorporated (USA) ..... [11286-26]

Coffee Break.....Wed 3:10 pm to 3:40 pm

SESSION 8

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... WED 3:40 PM TO 6:00 PM

Optical Interconnect Devices I

Session Chair: Ignazio E. M. Piacentini, ficonTEC Service GmbH (Germany)

3:40 pm: Low-voltage modulators using thin-film lithium niobate (Invited Paper), Abu Naim R. Ahmed, Shouyuan Shi, Sean Nelan, Univ. of Delaware (USA); Andrew J. Mercante, Peng Yao, Phase Sensitive Innovations, Inc. (USA); Dennis W. Prather, Univ. of Delaware (USA) ..... [11286-27]

4:10 pm: Non-Hermitian engineered single-mode transverse coupled cavity VCSEL, Elham Heidari, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Mohammad H. Teimourpour, Volker J. Sorger, The George Washington Univ. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA)..... [11286-28]

4:30 pm: Comparison of three monolithically integrated TIA topologies for 50 Gb/s OOK, Hector Andrade, Aaron Maharry, Takako Hirokawa, Luis Valenzuela, Univ. of California, Santa Barbara (USA); Stefan Simon, IHP Microelectronics (Germany); Clint Schow, James Buckwalter, Univ. of California, Santa Barbara (USA) ..... [11286-29]

4:50 pm: Strain-engineered group IV light sources for photonic-integrated circuits (Invited Paper), Donguk Nam, Nanyang Technological Univ. (Singapore)..... [11286-30]

5:20 pm: A High-performance Echelle Grating De-multiplexer Based on Two Stigmatic Points and Its Flat-top Solution, Yunlong Zhang, Marc Schneider, Djorn Karnick, Lars Eisenbätter, Thomas Kühner, Marc Weber, Karlsruhe Institut für Technologie (Germany) ..... [11286-31]

5:40 pm: Mach-Zehnder interferometer-based tunable mode converters, Peiji Zhou, Yi Zou, ShanghaiTech Univ. (China) ..... [11286-32]

POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

Design of a high-speed CSI-2 image processing system, Zhanchao Wang, Huang Min, Lulu Qian, Academy of Opto-Electronics, Chinese Academy of Sciences (China)..... [11286-51]

Robust optical properties of PLC-based compact RGB coupler resistant to fabrication error using bent-mode coupling, Tomohiro Inaba, NTT Basic Research Labs. (Japan); Junji Sakamoto, NTT Advanced Technology Corp. (Japan); Toshikazu Hashimoto, NTT Device Technology Labs. (Japan)[11286-52]

OPTO

## THURSDAY 6 FEBRUARY

### SESSION 9

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... THU 8:30 AM TO 10:30 AM

#### Hybrid Integrated Optical Link Modules II

Session Chair: **Richard C. A. Pitwon**,  
Univ. of St. Andrews (United Kingdom)

8:30 am: **Packaging challenges for next-generation high bandwidth opto-electrical switch modules** (*Invited Paper*), Alexander Janta-Polczynski, Nicolas Boyer, Elaine Cyr, Richard Langlois, Patrick Jacques, Paul Fortier, IBM Canada Ltd. (Canada)..... [11286-33]

9:00 am: **Photonics packaging: from pluggable transceivers to co-packaged optics** (*Invited Paper*), Kobi Hasharoni, Dust Photonics (Israel) ..... [11286-34]

9:30 am: **Ring-assisted Mach-Zehnder interferometer switch with multiple rings per switch element**, Takako Hirokawa, Mitra Saeidi, Luke Theogarajan, Adel A. M. Saleh, Clint L. Schow, Univ. of California, Santa Barbara (USA) ..... [11286-35]

9:50 am: **Highest accuracy passive alignment: a reliable and cost-effective approach for silicon photonic systems**, Dan Negrea, Robert Gierz, AEMtec GmbH (Germany) ..... [11286-37]

10:10 am: **Chip level fiber coupling**, Christian Möller, Hans-Georg Ortlepp, Indra Käßlinger, Kristin Neckermann, Thomas Ortlepp, CiS Forschungsinstitut für Mikrosensorik GmbH (Germany) ..... [11286-38]

Coffee Break ..... Thu 10:30 am to 11:00 am

### SESSION 10

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... THU 11:00 AM TO 12:20 PM

#### Optical Interconnect Devices II

Session Chair: **Hamed Dalir**, Omega Optics, Inc. (USA)

11:00 am: **Fundamental limitations for phase-locking of integrated laser arrays** (*Invited Paper*), Mohammad-Ali Miri, Queens College (USA) .. [11286-39]

11:30 am: **Oxide-free lithographically defined vertical-cavity light sources for low bit energy optical interconnects for room temperature and cryogenic operation** (*Invited Paper*), Dennis G. Deppe, sdPhotonics, LLC (USA) ..... [11286-40]

12:00 pm: **Optical interconnects for datacenter links: design and modeling challenges** (*Invited Paper*), André Richter, Stefanos Dris, Igor Koltchanov, Saleem Alreesh, VPIphotonics GmbH (Germany); Dmitry Yevseyenko, Sergei Mingaleev, VPI Development Ctr. (Belarus); Eugene Sokolov, Jim Farina, VPIphotonics (USA) ..... [11286-41]

Lunch/Exhibition Break ..... Thu 12:20 pm to 1:50 pm

### SESSION 11

LOCATION: ROOM 215 (LEVEL 2 SOUTH) ..... THU 1:50 PM TO 3:50 PM

#### Nanophotonic Technology for Optical Interconnects

Session Chair: **Darrell Childers**, US Conec Ltd. (USA)

1:50 pm: **Transfer printing automation for heterogeneous 3D photonic integration** (*Invited Paper*), Weidong Zhou, The Univ. of Texas at Arlington (USA) ..... [11286-42]

2:20 pm: **3D additive microfabrication for relaxed optical packaging** (*Invited Paper*), Matthias Blaicher, Tobias Hoose, Nicole Lindenmann, Michael Thiel, Nanoscribe GmbH (Germany); Stefan Hengesbach, Michael Förtsch, Q.ant GmbH (Germany) ..... [11286-43]

2:50 pm: **High-speed data transmission with beam-steering using silicon-based optical phased array**, Hyun-Woo Rhee, Min Chul Kim, Joonsup Shim, Kyeongjin Han, Hyo-Hoon Park, KAIST (Korea, Republic of) ..... [11286-44]

3:10 pm: **High-speed low-loss graphene optical modulator based on adiabatic coupled waveguides**, Elham Heidari, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Volker J. Sorger, The George Washington Univ. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA) ..... [11286-45]

3:30 pm: **Metallic optical benches with stamped micro-mirrors for photonic assemblies and optical interconnects** (*Invited Paper*), Yang Chen, King-Fu Hii, R. Ryan Vallance, nanoPrecision Products Inc. (USA) ... [11286-46]

### Startup Challenge

Wednesday • Moscone West Level 2

Hear pitches for the “best of the best” new photonics businesses; open to all attendees

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# CONFERENCE 11287

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH)

Tuesday–Thursday 4–6 February 2020 • Proceedings of SPIE Vol. 11287

## Photonic Instrumentation Engineering VII

Conference Chair: **Yakov Soskind**, Apple Inc. (USA)

Conference Co-Chair: **Lynda E. Busse**, U.S. Naval Research Lab. (USA)

Program Committee: **Ishwar D. Aggarwal**, The Univ. of North Carolina at Charlotte (USA); **James B. Breckinridge**, Caltech (USA); **James T. A. Carriere**, Coherent, Inc. (USA); **Catalin Florea**, Honeywell International Inc. (USA); **Sanjay Gangadhara**, Zemax, LLC (USA); **G. Groot Gregory**, Synopsys, Inc. (USA); **Daniel C. Herrmann**, Synopsys Inc. (USA); **Gary B. Hughes**, California Polytechnic State Univ., San Luis Obispo (USA); **Jacob B. Khurgin**, Johns Hopkins Univ. (USA); **Patrick C. Mock**, RAM Photonics, LLC (USA); **Kristen Norton**, Synrad, a Novanta Co. (USA); **Nada A. O'Brien**, Facebook Technologies, LLC (USA); **S. Craig Olson**, L-3 Sonoma EO (USA); **Lucas Redlarski**, Mitutoyo Research Ctr. Europe B.V. (Netherlands); **Mariano Troccoli**, Evolution Photonics (USA)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . TUE 1:30 PM TO 3:10 PM

#### Metamaterials, Plasmonic, and Nanostructures in Photonic Instruments

Session Chair: **Yakov Soskind**, Apple Inc. (USA)

- 1:30 pm: **Thermally tuned resonances in chalcogenide glass dielectric metasurfaces** (*Invited Paper*), Jesse A. Frantz, Jason D. Myers, U.S. Naval Research Lab. (USA); Anthony R. Clabeau, Robel Y. Bekele, Univ. Research Foundation (USA); Vinh Q. Nguyen, U.S. Naval Research Lab. (USA); Natalia M. Litchinitser, Duke Univ. (USA); Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA) . . . . . [11287-1]
- 2:00 pm: **Compact full-Stokes polarization imaging with metasurfaces**, Noah A. Rubin, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); Gabriele D'Aversa, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Paul Chevalier, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); Zhujun Shi, Harvard Univ. (USA); Wei Ting Chen, Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences (USA) . . . . . [11287-2]
- 2:20 pm: **Bio-inspired metalens depth sensor**, Zhujun Shi, Qi Guo, Yao-Wei Huang, Harvard Univ. (USA); Emma Alexander, Univ. of California, Berkeley (USA); Cheng-Wei Qiu, National Univ. of Singapore (Singapore); Todd Zickler, Federico Capasso, Harvard Univ. (USA) . . . . . [11287-3]
- 2:40 pm: **In optical sensing the interaction time is what matters most** (*Invited Paper*), Jacob B. Khurgin, Johns Hopkins Univ. (USA) . . . . . [11287-4]
- Coffee Break. . . . . Tue 3:10 pm to 3:40 pm

#### SESSION 2

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . TUE 3:40 PM TO 5:00 PM

#### Light Sources in Photonic Instrumentation

Session Chair: **James T. A. Carriere**, Coherent, Inc. (USA)

- 3:40 pm: **Ultra-broadband (>700 cm<sup>-1</sup>) QCL-based spectrometer with millisecond acquisition-time**, Yuri V. Flores, Marko Härtelt, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany); David J. M. Stothard, Fraunhofer Ctr. for Applied Photonics (United Kingdom); Stefan Hugger, Christian Schilling, Peter Holl, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany); Adam T. Polak, Matthew Warden, Fraunhofer Ctr. for Applied Photonics (United Kingdom); Andreas Merten, Markus Schwarzenberg, André Dreyhaupt, Jan Grahmann, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany); Marcel Rattunde, Ralf Ostendorf, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany) . . . [11287-5]
- 4:00 pm: **Stabilized OEM diode-laser system for metrology applications**, Christian Nölleke, Niklas Kolodzie, Lisa Winkler, TOPTICA Photonics AG (Germany); Hendrick Thiem, Matthias Reggentin, eagleyard Photonics GmbH (Germany); Patrick Leisching, TOPTICA Photonics AG (Germany) . . . . [11287-6]
- 4:20 pm: **Fourier pulse shaper for high-power fiber-coupled lasers and supercontinuum sources**, Vishal Choudhury, Arun Surendran, V. R. Supradeepa, Ctr. for Nano Science and Engineering (CeNSE) (India) . . . . . [11287-7]
- 4:40 pm: **Amplitude-modulated continuous-wave laser scanner employing adaptive gain control for avoidance of receiver saturation**, Chao Zhang, Sifan Liu, Zheyuan Zhang, Fulin Xiang, The Univ. of Tokyo (Japan); Neisei Hayashi, Tokyo Institute of Technology (Japan); Lei Jin, Sze Yun Set, Shinji Yamashita, The Univ. of Tokyo (Japan) . . . . . [11287-8]

### WEDNESDAY 5 FEBRUARY

#### SESSION 3

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . WED 8:30 AM TO 10:10 AM

#### Design, Development, and Fabrication of Photonic Instruments

Session Chair: **Sanjay Gangadhara**, Zemax, LLC (USA)

- 8:30 am: **Next-generation optical design methodology**, Alessandra Croce, Zemax Europe Ltd. (United Kingdom) . . . . . [11287-9]
- 8:50 am: **Freeform optics design for Raman spectroscopy**, Tobias Grabe, Yang Li, Alexander G. Wolf, Henrik Krauss, Leibniz Univ. Hannover (Germany); Junjun Wu, Chenyu Yao, Qiang Wang, The Chinese Univ. of Hong Kong (Hong Kong, China); Roland Lachmayer, Leibniz Univ. Hannover (Germany); Wei Ren, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11287-10]
- 9:10 am: **Integrated discrete beam combiner with a pupil remapper for stellar interferometry**, Simone Piacentini, Politecnico di Milano (Italy) and CNR-Istituto di Fotonica e Nanotecnologie (Italy); Giacomo Corrielli, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Abani Shankar Nayak, Leibniz-Institut für Astrophysik Potsdam (Germany); Tarun Kumar Sharma, Univ. zu Köln (Germany); Kalaga V. Madhav, Leibniz-Institut für Astrophysik Potsdam (Germany); Ettore Pedretti, STFC Rutherford Appleton Lab. (United Kingdom); Stefano Minardi, Leibniz-Institut für Astrophysik Potsdam (Germany); Lucas Labadie, Univ. zu Köln (Germany); Roberto Osellame, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . . . [11287-11]
- 9:30 am: **Machine-learning-assisted design of depth-graded multilayer x-ray structure**, Thae M. Dieb, Masashi Ishii, National Institute for Materials Science (Japan) . . . . . [11287-12]
- 9:50 am: **Self-consistent analysis of the structural, thermal, and optical performance of a steering prism pair**, Vladimir A. Smagley, Erin M. Elliott, Uday Mathur, Sanjay Gangadhara, Michael Humphreys, Zemax, LLC (USA) . . . . . [11287-13]
- Coffee Break. . . . . Wed 10:10 am to 10:40 am

#### SESSION 4

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) .WED 10:40 AM TO 12:00 PM

#### Applications of Photonic Instruments

Session Chair: **G. Groot Gregory**, Synopsys, Inc. (USA)

- 10:40 am: **Enhanced dynamic range of the grating array based zonal wavefront sensor using a zone-wise scanning method**, Nagendra Kumar, Alika Khare, Bosanta R. Boruah, Indian Institute of Technology Guwahati (India) . . . . . [11287-14]
- 11:00 am: **Enhanced optical absorption in droplet-based microfluidics for on-chip polymerase chain reactions**, Isaac Spotts, Camille A. Leclerc, Christopher M. Collier, Univ. of Guelph (Canada) . . . . . [11287-15]
- 11:20 am: **Laser-based soldering of a high-resolution optical filter instrument for space applications**, Marcel Hornaff, Erik Beckert, Mariia Kepper, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Eddie Prevost, Francis Descours, Isabelle Toubhans, SODERN (France); Ramona Eberhardt, Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) . . . . . [11287-16]
- 11:40 am: **A new simple and cost-effective tunable filter for illumination and imaging**, Jun Hee Kang, Spectrolight Inc. (USA) . . . . . [11287-17]
- Lunch/Exhibition Break . . . . . Wed 12:00 pm to 1:30 pm

OPTO

# CONFERENCE 11287

## SESSION 5

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . WED 1:30 PM TO 3:20 PM

### Photonic Instrumentation for Astronomy and Imaging

Session Chair: **James B. Breckinridge**, Caltech (USA)

1:30 pm: **Space-flight LiDARs, navigation, and science instrument implementations: lasers, optoelectronics, integrated photonics, fiber-optic subsystems, and components** (*Invited Paper*), Melanie N. Ott, Cameron H. Parvini, Hali L. Flores, W. Joe Thomes, Eleanya E. Onuma, NASA Goddard Space Flight Ctr. (USA) . . . . . [11287-18]

2:00 pm: **Picosecond pulsewidth direct detection lidar for imaging applications**, Narasimha S. Prasad, NASA Langley Research Ctr. (USA) . . . . . [11287-19]

2:20 pm: **Status and future developments of integrated photonic spectrographs for astronomy**, Nemanja Jovanovic, Caltech (USA); Nick Cvetojevic, Observatoire de la Côte d'Azur (France); Gautam Vasisht, Jet Propulsion Lab. (USA); Miguel Daal, Benjamin A. Mazin, Univ. of California, Santa Barbara (USA); Dimitri P. Mawet, Charles A. Beichman, Caltech (USA); Stephanie Leifer, Jet Propulsion Lab. (USA); Richard G. Dekany, Michael Porter, Caltech (USA) . . . . . [11287-20]

2:40 pm: **A new compact and rugged hyperspectral camera based on a birefringent ultrastable common-path interferometer with broad spectral coverage and resolution**, Antonio Perri, Politecnico di Milano (Italy); Bárbara E. Nogueira de Faria, Danielle C. Teles Ferreira, Univ. Federal de Minas Gerais (Brazil); Dario Polli, Daniela Comelli, Gianluca Valentini, Giulio N. Cerullo, Politecnico di Milano (Italy); Cristian Manzoni, CNR-Istituto di Fotonica e Nanotecnologie (Italy) . . . . . [11287-21]

3:00 pm: **Compressive sensing hyperspectral imaging with optimized diffractive optical elements**, Matthias Hübner, Leonhard Lenk, Eric Markweg, Stefan Sinzinger, Technische Univ. Ilmenau (Germany) . . . . . [11287-22]

Coffee Break . . . . . Wed 3:20 pm to 3:50 pm

## SESSION 6

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . WED 3:50 PM TO 5:30 PM

### Sensors and Ruggedized Systems I

Session Chair: **Patrick C. Mock**, RAM Photonics, LLC (USA)

3:50 pm: **Hybrid distributed acoustic-temperature sensing using a few-mode fiber**, Islam Ashry, Yuan Mao, Tien Khee Ng, King Abdullah Univ. of Science and Technology (Saudi Arabia); Frode Hveding, Muhammad Arsalan, Saudi Aramco (Saudi Arabia); Boon S. Ooi, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11287-23]

4:10 pm: **Millimeter-sized particle sensor using a wide FoV monolithic lens assembly for light scattering analysis in Fourier domain**, Gabriel Jobert, Maryse Fournier, Salim Boutami, CEA-LETI (France); Andrea Lovera, Daniele Braga, FEMTOprint SA (Switzerland); Cécile Jamois, Christian Seassal, Institut des Nanotechnologies de Lyon (France) . . . . . [11287-24]

4:30 pm: **Resonant optomechanical transduction for photoacoustic detection**, Thomas Lauwers, CEA-LETI, Univ. Grenoble Alpes (France); Alain Glière, CEA-LETI, Univ. Grenoble Alpes (France); Skandar Basrour, Ctr. National de la Recherche Scientifique, Univ. Grenoble Alpes (France) and TIMA, Grenoble INP (France) . . . . . [11287-25]

4:50 pm: **Cavity-enhanced spectroscopy using multilongitudinal-mode laser RF beating**, Mahmoud A. Selim, Ain Shams Univ. (Egypt); Radwa Ahmed Abas, The German Univ. in Cairo (Egypt); Yasser M Sabry, Diaa A. M. Khalil, Ain Shams Univ. (Egypt) . . . . . [11287-26]

5:10 pm: **Phase-optical time domain reflectometry (OTDR) with enhanced performance**, Nageswara R. Lalam, Ping Lu, Paul R. Ohodnicki, Michael P. Buric, National Energy Technology Lab. (USA) . . . . . [11287-27]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**An ex-situ surface profile measurement scheme using a zonal wavefront sensor with simultaneous presence of reference and test wavefronts**, Nagendra Kumar, Alika Khare, Bosanta R. Boruah, Indian Institute of Technology Guwahati (India) . . . . . [11287-45]

**A new type of refractive index of sea water sensor based on Mach Zender interference**, Guoqiang Li, Qingquan Sun, Juan Su, Chi Wu, Shandong Univ. (China) . . . . . [11287-46]

**An innovative approach based on hyperspectral imaging (HSI) combined with chemometrics for soil phytoremediation monitoring**, Giuseppe Bonifazi, Giuseppe Capobianco, Silvia Serranti, Maria Luisa Antenzio, Sapienza Univ. di Roma (Italy); Patrizia Brunetti, Maura Cardarelli, Istituto di Biologia e Patologia Molecolari, Consiglio Nazionale delle Ricerche (Italy) . . . . . [11287-48]

**Luminescent method for control of sewage contamination by light fractions of petroleum products**, Irina Smirnova, Victor Prokopenko, Nikolay Belov, Alexey Shamolin, ITMO Univ. (Russian Federation) . . . [11287-49]

**Precision interferometric thickness measurement of optical flat using wavelength tuning Fizeau interferometer**, Yangjin Kim, Jiwon Seo, Sungtae Kim, Wonjun Bae, Pusan National Univ. (Korea, Republic of); Mamoru Mitsuishi, The Univ. of Tokyo (Japan) . . . . . [11287-50]

**An electric measuring equipment integrated with an automatic optical registration and a chamber-based gas supply system for wafer-based gas sensors**, Ming-Fu Chen, Yi-Hao Lin, Chih W. Chen, Po-Jui Chen, Yu-Hsin Lin, Wen-Hao Cho, Jian-Lin Chen, Taiwan Instrument Research Institute (Taiwan) . . . . . [11287-51]

**Modeling the influence function on a fused silica surface for CNC bonnet polishing process**, Hao Lun Chang, Wei-Jen Huang, Yi-Chun Lin, Hong-Tsu Young, National Taiwan Univ. (Taiwan); Ching-Hsiang Kuo, Zong-Ru Yu, Cheng-Fang Ho, Taiwan Instrument Research Institute (Taiwan) . . . . . [11287-52]

**Fiber-based mode scrambler prototype**, Jędrzej Mijas, Univ. of Warsaw (Poland), Institute of High Pressure Physics, Polish Academy of Sciences (Poland); Yuri Ivonyak, Witold A. Trzeciakowski, Institute of High Pressure Physics, Polish Academy of Sciences (Poland) . . . . . [11287-53]

**Interferometric optical fiber sensor implemented to rotational seismology research**, Anna Kurzych, Leszek R. Jaroszewicz, Zbigniew Krajewski, Wojskowa Akademia Techniczna im. Jarosława Dąbrowskiego (Poland); Jerzy K. Kowalski, Elproma Elektronika Sp. z o.o. (Poland) . . . . . [11287-54]

**Design of a phase-shifting algorithm for interferometric measurement of optical thickness variation**, Wonjun Bae, Pusan National Univ. (Korea, Republic of); Yangjin Kim, Pusan National Univ. (Korea, Republic of) . [11287-55]

**CMOS active pixel sensor with adjustable sensitivity using MOSFET-type photodetector with a built-in transfer gate**, Jewon Lee, Junwoo Lee, Hyeunwoo Kwen, Sang-Hwan Kim, Jimin Lee, Jang-Kyoo Shin, Kyungpook National Univ. (Korea, Republic of) . . . . . [11287-56]

**A novel measurement system to aid polished optical surface manufacturing when working with coated surfaces**, Joe Armstrong, Lisa Kadner, Polytec GmbH (Germany) . . . . . [11287-57]

**Impact of vibrations and reflector movements on the measurement uncertainty of Fourier-based frequency sweeping interferometry**, Mateusz Sosin, Helene Mainaud-Durand, Jaroslaw Rutkowski, Vivien Rude, CERN (Switzerland) . . . . . [11287-59]

THURSDAY 6 FEBRUARY

SESSION 7

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . THU 8:40 AM TO 10:20 AM

**Metrological Instrumentation I**

Session Chair: **Lucas Redlarski**,  
Mitutoyo Research Ctr. Europe B.V. (Netherlands)

8:40 am: **Novel piezo-motor for a high-precision motion axis**, Roman Yasinov, Gal Peled, Nanomotion Ltd. (Israel); Alan Feinstein, Nanomotion Inc. (USA); Nir Karasikov, Nanomotion Ltd. (Israel) . . . . . [11287-28]

9:00 am: **Long travel tip, tilt, z-stage**, Leonid Skigin, Roman Yasinov, Gal Peled, Nanomotion Ltd. (Israel); Alan Feinstein, Nanomotion Inc. (USA); Nir Karasikov, Nanomotion Ltd. (Israel) . . . . . [11287-29]

9:20 am: **Optical-frequency-comb microscopy with laser-scanning configuration for simultaneous and spectroscopic amplitude, quantitative phase, and polarization imaging**, Takeo Minamikawa, Shota Nakano, Eiji Hase, Tokushima Univ. (Japan); Akifumi Asahara, The Univ. of Electro-Communications (Japan); Hidenori Koresawa, Takahiko Mizuno, Tokushima Univ. (Japan); Hirotsugu Yamamoto, Utsunomiya Univ. (Japan); Kaoru Minoshima, The Univ. of Electro-Communications (Japan); Takeshi Yasui, Tokushima Univ. (Japan) . . . . . [11287-30]

9:40 am: **Fast measurement of optical components using a PSD for experimental ray tracing**, Tobias Binkele, David Hilbig, Mahmoud Essameldin, Thomas Henning, Friedrich Fleischmann, Hochschule Bremen Univ. of Applied Sciences (Germany) . . . . . [11287-31]

10:00 am: **Wavefront phase imaging of wafer geometry using high pass filtering to reveal nanotopography**, Juan Manuel Trujillo-Sevilla, José Manuel Rodríguez-Ramos, Wooptix, S.L. (Spain); Jan O. Gaudestad, Wooptix, S.L. (USA) . . . . . [11287-32]

Coffee Break . . . . . Thu 10:20 am to 10:50 am

SESSION 8

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . THU 10:50 AM TO 12:10 PM

**Metrological Instrumentation II**

Session Chair: **Lynda E. Busse**, U.S. Naval Research Lab. (USA)

10:50 am: **Frequency-modulated comb LIDAR**, Naoya Kuse, IMRA America, Inc. (USA) and Tokushima Univ. (Japan); Martin E. Fermann, IMRA America, Inc. (USA) . . . . . [11287-33]

11:10 am: **A real-time and portable digital lock-in amplifier for quartz-enhanced photo-acoustic spectroscopy (QEPAS)**, Hervé Tatenguem Fankem, Amrita Devi Josnan, Philipp Butt, Morten Hoppe, Tobias Milde, Joachim Sacher, Sacher Lasertechnik GmbH (Germany) . . . . . [11287-34]

11:30 am: **Holographic point replication as a sensor-enhancing technique for adaptive building control**, Flavio S. Guerra, Institut für Technische Optik, Univ. Stuttgart (Germany); Alexander Warsewa, Univ. Stuttgart (Germany); Simon Hartlieb, Tobias Haist, Institut für Technische Optik, Univ. Stuttgart (Germany); Wolfgang Osten, Univ Stuttgart (Germany); Oliver Sawodny, Univ. Stuttgart (Germany) . . . . . [11287-35]

11:50 am: **Lock-in optical instrumentation for snapshot hyperspectral imaging**, C. Harrison Brodie, Jasen Devasagayam, Christopher M. Collier, Univ. of Guelph (Canada) . . . . . [11287-36]

Lunch/Exhibition Break . . . . . Thu 12:10 pm to 1:40 pm

SESSION 9

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . THU 1:40 PM TO 3:00 PM

**Sensors and Ruggedized Systems II**

Session Chair: **Catalin Florea**, Honeywell International Inc. (USA)

1:40 pm: **In-water fiber-optic evanescent wave sensing in the mid-infrared**, Paul Chevalier, Marco Piccardo, Federico Capasso, Harvard Univ. (USA) . . . . . [11287-37]

2:00 pm: **Spectral background removal of MEMS FTIR spectrometer-based gas analyzer**, Mariam Amr, Ain Shams Univ. (Egypt); Yasser M. Sabry, Daa A. M. Khalil, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt) . . . . . [11287-38]

2:20 pm: **Advanced silicon avalanche photodiodes on NASA's Global Ecosystem Dynamics Investigation (GEDI) mission**, Xiaoli Sun, James B. Blair, NASA Goddard Space Flight Ctr. (USA); Jack L. Bufton, Global Science & Technology, Inc. (USA); Marcela Faina, Sigrid Dahl, Philippe Bérard, Richard J. Seymour, Excelitas Technologies Corp. (Canada) . . . . . [11287-39]

2:40 pm: **Solid-state flash LiDAR solution for autonomous robot applications**, James R. Steele, Benchmark Electronics, Inc. (USA) . . [11287-40]

Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

SESSION 10

LOCATION: ROOM 54 (LOWER MEZZANINE SOUTH) . . . THU 3:30 PM TO 5:00 PM

**Photonic Instrumentation for Consumer Applications**

Session Chair: **Nada A. O'Brien**, Facebook Technologies, LLC (USA)

3:30 pm: **Hyperspectral imaging using a linear variable filter (LVF) based ultra-compact camera**, Thomas D. Rahmlow Jr., William Cote, Robert L. Johnson Jr., Omega Optical, Inc. (USA) . . . . . [11287-41]

3:50 pm: **A fast simple-to-use and inexpensive multispectral camera to detect skin conditions**, Andrea L. Dunbar, Sébastien Blanc, Pedram Pad, Pierre-Alain Beuchat, CSEM SA (Switzerland); Athanasios Papathanasiou, Antonios Nikitakis, Konstantinos Makantasis, Althexis Solutions (Cyprus) . . . . . [11287-42]

4:10 pm: **A miniaturized optical sensor for particulate matter detection**, Maryse Fournier, Pierre Barritault, Gabriel Jobert, Salim Boutami, CEA-LETI (France); Julien Michelot, Pierre Lienhard, Pyxalis (France); Sergio Nicoletti, Laurent Duraffourg, CEA-LETI (France) . . . . . [11287-43]

4:30 pm: **Structured light concepts for ultrafast production of micro-optical components (Invited Paper)**, Daniel Flamm, Daniel G. Grossmann, Malte Kumkar, TRUMPF Laser- und Systemtechnik GmbH (Germany) . . . . . [11287-44]

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# CONFERENCE 11288

LOCATION: ROOM 302 (LEVEL 3 SOUTH)

Sunday–Thursday 2–6 February 2020 • Proceedings of SPIE Vol. 11288

# Quantum Sensing and Nano Electronics and Photonics XVII

Conference Chair: **Manijeh Razeghi**, Northwestern Univ. (USA)

Conference Co-Chairs: **Jay S. Lewis**, Defense Advanced Research Projects Agency (USA); **Giti A. Khodaparast**, Virginia Polytechnic Institute and State Univ. (USA); **Pedram Khalili**, Northwestern Univ. (USA)

Program Committee: **Amir H. Atabaki**, Massachusetts Institute of Technology (USA); **Jason M. Auxier**, U.S. Naval Research Lab. (USA); **Henri-Jean Drouhin**, Ecole Polytechnique (France); **Jérôme Faist**, ETH Zürich (Switzerland); **Riad Haïdar**, ONERA (France); **Amr S. Helmy**, Univ. of Toronto (Canada); **Sven Höfling**, Julius-Maximilians-Univ. Würzburg (Germany); **John E. Hubbs**, Ball Aerospace (USA); **Jean-Pierre Huignard**, Jphopto (France); **M. Saif Islam**, Univ. of California, Davis (USA); **Woo-Gwang Jung**, Kookmin Univ. (Korea, Republic of); **Tsukuru Katsuyama**, Sumitomo Electric Industries, Ltd. (Japan); **Kwok Keung Law**, Naval Air Warfare Ctr. Weapons Div. (USA); **Giuseppe Leo**, Lab. Matériaux et Phénomènes Quantiques (France); **Amy W. K. Liu**, IQE Inc. (USA); **Ryan McClintock**, Northwestern Univ. (USA); **Jerry R. Meyer**, U.S. Naval Research Lab. (USA); **Maya P. Mikhaliyova**, Ioffe Institute (Russian Federation); **Minh Nguyen**, HRL Labs., LLC (USA); **Jill A. Nolde**, U.S. Naval Research Lab. (USA); **Shanee Paclay**, Air Force Research Lab. (USA); **Jean-Luc Pelouard**, Ctr. de Nanosciences et de Nanotechnologies (France); **Edik U. Rafailov**, Aston Univ. (United Kingdom); **Fengbo Ren**, Arizona State Univ. (USA); **Isabelle Ribet-Mohamed**, ONERA (France); **James P. Shaffer**, The Univ. of Oklahoma (USA), Quantum Valley Ideas Labs. (Canada); **Meimei Z. Tidrow**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Joseph G. Tischler**, U.S. Naval Research Lab. (USA); **Cunzhu Tong**, Changchun Institute of Optics, Fine Mechanics and Physics (China); **Eric Tournié**, Univ. de Montpellier (France); **Miriam S. Vitiello**, CNR-NANO (Italy)

## SUNDAY 2 FEBRUARY

### WELCOME AND OPENING REMARKS

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... 9:00 AM TO 9:30 AM

Manijeh Razeghi, Northwestern Univ. (USA);

Jay S. Lewis, Defense Advanced Research Projects Agency (USA)

### SESSION 1

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SUN 9:30 AM TO 10:30 AM

#### Quantum Engineered Devices for Detectors

Session Chair: **Manijeh Razeghi**, Northwestern Univ. (USA)

9:30 am: **QWIPs, SLS, Landsat and the International Space Station** (*Keynote Presentation*), Murzy D. Jhabvala, NASA Goddard Space Flight Ctr. (USA); Kwong-kit Choi, Space Systems and Applications (USA); Sarath Gunapala, Jet Propulsion Lab (USA); Manijeh Razeghi, Northwestern Univ. (USA); mani Sundaram, QmagiQ, LLC (USA) ..... [11288-1]

10:05 am: **III-nitride-based solar-blind avalanche photodetectors** (*Invited Paper*), Ryan McClintock, Samy Annabi, Alexandre G. Jaud, Manijeh Razeghi, Northwestern Univ. (USA) ..... [11288-2]

Coffee Break ..... Sun 10:30 am to 11:00 am

### SESSION 2

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SUN 11:00 AM TO 11:55 AM

#### Detectors and Sensors

Session Chairs: **John E. Hubbs**, Ball Aerospace (USA); **Riad Haïdar**, ONERA (France)

11:00 am: **Advanced SWIR photon-sensing integrated circuit heterojunction phototransistor-based focal plane array for space applications** (*Invited Paper*), Narasimha S. Prasad, NASA Langley Research Ctr. (USA) ..... [11288-3]

11:25 am: **64x48 pixel backside illuminated SPAD detector array for LiDAR applications**, Jennifer Ruskowski, Charles Thattil, Jan Drewes, Werner Brockherde, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme IMS (Germany) ..... [11288-5]

11:40 am: **Room-temperature heterodyne detection up to 70GHz with patch-antenna QWIP detectors at 10.3µm**, Michael Haki, Quyang Lin, Institut d'Electronique de Microélectronique et de Nanotechnologie, CNRS (France); Stefano Pirota, Raffaele Colombelli, Ctr. de Nanosciences et de Nanotechnologies (France) and CNRS (France); Wenjian Wan, Hua Li, Jun-Cheng Cao, Shanghai Institute of Microsystem and Information Technology (China); Jean-François Lampin, Emilien Peytavit, Stefano Barbieri, Institut d'Electronique de Microélectronique et de Nanotechnologie (France) and CNRS (France) ..... [11288-6]

Lunch Break ..... Sun 11:55 am to 1:30 pm

### SESSION 3

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SUN 1:30 PM TO 3:05 PM

#### Quantum Cascade Lasers I

Session Chairs: **Tsukuru Katsuyama**, Sumitomo Electric Industries, Ltd. (Japan); **Frédéric Grillot**, Télécom ParisTech (France)

1:30 pm: **Enabling low-cost QCL by large scale fabrication on CMOS pilot line** (*Invited Paper*), Jean-Guillaume Coutard, CEA-LETI (France) and Univ. Grenoble Alpes (France); Mickaël Brun, mirSense (France); Maryse Fournier, Olivier Lartigue, Florian Fedeli, CEA-LETI (France) and Univ. Grenoble Alpes (France); Grégory Maisons, mirSense (France); Jean-Marc Fédéli, Sergio Nicoletti, CEA-LETI (France) and Univ. Grenoble Alpes (France); Mathieu Carras, mirSense (France); Laurent Duraffourg, CEA-LETI (France) and Univ. Grenoble Alpes (France) ..... [11288-7]

1:55 pm: **Thermal modeling of quantum cascade lasers with 3D anisotropic heat transfer analysis**, Farhat Abbas, The Univ. of Texas at Dallas (USA); Binay Jung Pandey, Kevin Clark, Max-IR Labs., LLC (USA); Kevin Lascola, Yamac Dikmelik, Thorlabs Quantum Electronics (USA); Dennis Robbins, David Hinojos, Kimari L. Hodges, Max-IR Labs., LLC (USA); Katy Roodenko, Max-IR Labs., LLC (USA) and The Univ. of Texas at Dallas (USA); Qing Gu, The Univ. of Texas at Dallas (USA) ..... [11288-8]

2:10 pm: **Measurement concept to reduce environmental impact in direct time-of-flight LiDAR sensors**, Jan F. Haase, Andre Buchner, Sara Grollius, Jennifer Ruskowski, Holger Vogt, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme IMS (Germany) ..... [11288-9]

2:25 pm: **Peculiarities and predictions of rogue waves in mid-infrared quantum cascade lasers under conventional optical feedback**, Olivier Spitz, Télécom ParisTech (France) and mirSense (France); Andreas Herdt, Technische Univ. Darmstadt (Germany); Jiagui Wu, Univ. of California, Los Angeles (USA) and Southwest Univ. (China); Grégory Maisons, Mathieu Carras, mirSense (France); Chee-Wei Wong, Univ. of California, Los Angeles (USA); Wolfgang E. Elsässer, Technische Univ. Darmstadt (Germany); Frédéric Grillot, Télécom ParisTech (France) and The Univ. of New Mexico (USA) . . . . [11288-10]

2:40 pm: **Title to be determined** (*Invited Paper*), Miriam S. Vitiello, Istituto Nanoscienze (Italy) ..... [11288-11]

Coffee Break ..... Sun 3:05 pm to 3:35 pm

**SESSION 4**

**LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... SUN 3:35 PM TO 5:15 PM**

**Quantum Sensors and Photonic Systems I**

Session Chairs: **Edik U. Rafailov**, Aston Univ. (United Kingdom);  
**Isabelle Ribet-Mohamed**, ONERA (France)

3:35 pm: **Quantum devices: QWIPs/QDIPs, QCLs/ ICLs, and topological excitations** (*Keynote Presentation*), Jason M. Auxier, U.S. Naval Research Lab. (USA) ..... [11288-12]

4:10 pm: **Efficient light emission from inelastic tunneling junctions** (*Invited Paper*), Zhaowei Liu, Univ. of California, San Diego (USA) ... [11288-13]

4:35 pm: **Investigation of individual subwavelength-sized thermal emitters with infrared spatial modulation spectroscopy** (*Invited Paper*), Yannick De Wilde, Institut Langevin Ondes et Images (France); Claire Li, Institut Langevin Ondes et Images (France) and ONERA (France); Valentina Krachmalnicoff, Rémi Carminati, Institut Langevin Ondes et Images (France); Riad Haïdar, Patrick Bouchon, ONERA (France); Joris Doumouro, Institut Langevin Ondes et Images (France); Houssein Kallel, Karl Joulain, Institut Pprime (France); Nathalie Bardou, Ctr. de Nanosciences et de Nanotechnologies (France) ..... [11288-14]

5:00 pm: **Contrasting quantum sensing light sources generating different photo-current-pulse statistics**, ChandraSekhar Roychoudhuri, Gayanath Fernando, Univ. of Connecticut (USA); Negussie Tirfessa, Manchester Community College (USA); Narasimha S. Prasad, NASA Langley Research Ctr. (USA) ..... [11288-15]

**MONDAY 3 FEBRUARY**

**OPTO PLENARY SESSION**

**LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) .... MON 8:00 AM TO 10:05 AM**

8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)

8:05 am: **The future of optical components and materials in the fibre** (*Plenary*)  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)

8:45 am: **Efficient light emission from hexagonal SiGe** (*Plenary*)  
Erik P. A. M. Bakkers, Eindhoven Univ. of Technology (Netherlands)

9:25 am: **Product design for the next wave of computing** (*Plenary*)  
**Trond Wuellner**, Google (USA)

Coffee Break ..... Mon 10:05 am to 10:30 am

**SESSION 5**

**LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... MON 10:30 AM TO 12:00 PM**

**Quantum Sensing I**

Session Chairs: **Jason M. Auxier**, U.S. Naval Research Lab. (USA);  
**Shanee Pacley**, Air Force Research Lab. - Wright Patterson AFB (USA)

10:30 am: **Next-generation imaging sensors** (*Keynote Presentation*), Whitney Mason, Defense Advanced Research Projects Agency (USA) ..... [11288-16]

11:05 am: **Performance and limitations of NIR and extended wavelength eSWIR InP/InGaAs image sensors** (*Invited Paper*), Roger E. DeWames, MTEQ, Inc. (USA); Jonathan Schuster, U.S. Army Research Lab. (USA) ..... [11288-17]

11:30 am: **Cooling-free infrared sensors with high-performance thermoelectric materials**, Kotaro Hirose, Masahiro Adachi, Sumitomo Electric Industries, Ltd. (Japan); Makoto Murata, Sumitomo Electric Industries (Japan); Yoshiyuki Yamamoto, Sumitomo Electric Industries, Ltd. (Japan); Tsunehiro Takeuchi, Toyota Technological Institute (Japan) ..... [11288-19]

11:45 am: **Cerium dioxide (CeO<sub>2</sub>) quantum dots as hole blocking layer for avalanche amorphous selenium photodetector**, HariPriya Kannan, NYU Tandon School of Engineering (USA); Jann Stavro, Atreyo Mukherjee, Stony Brook Univ. (USA); Sébastien Léveillé, Analogic Canada Corp. (Canada); Lizhu Guan, New York Univ. (USA) and Harbin Univ. of Science and Technology (China); Wei Zhao, Stony Brook Medicine (USA); Ayaskanta Sahu, New York Univ. (USA); Amir H. Goldan, Stony Brook Univ. School of Medicine (USA) ..... [11288-20]

Lunch Break ..... Mon 12:00 pm to 1:30 pm

**SESSION 6**

**LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... MON 1:30 PM TO 2:50 PM**

**Quantum Sensing II**

Session Chairs: **Joan Manel Ramirez**, III-V Lab. (France);  
**M. Saif Islam**, Univ. of California, Davis (USA)

1:30 pm: **Antimonides T2SL mid-wave and long-wave infrared focal plane arrays for Earth remote sensing applications** (*Invited Paper*), Sarath D. Gunapala, David Z. Ting, Sir B. Rafol, Alexander Soibel, Arezou Khoshakhlagh, Sam A. Keo, Brian J. Pepper, Anita M. Fisher, Cory J. Hill, Thomas Pagano, Jet Propulsion Lab. (USA); Paul Lucey, Robert Wright, Miguel Nunes, Luke Flynn, Univ. of Hawai'i at Manoa (USA); Sachidananda Babu, Parminder Ghuman, NASA Earth Science Technology Office (USA) ..... [11288-21]

1:55 pm: **Broad-spectral-bandwidth high-resolution dual-comb spectroscopy with single photons** (*Invited Paper*), Zaijun Chen, Theodor W. Hänsch, Nathalie Picqué, Max-Planck-Institut für Quantenoptik (Germany) ..... [11288-22]

2:20 pm: **High-performance integrated circuits for fast and picosecond-precision measurements with single-photon avalanche diodes**, Giulia Acconcia, Angelo Gulinatti, Massimo Ghioni, Ivan Rech, Politecnico di Milano (Italy) ..... [11288-23]

2:35 pm: **Research on the high-resolution infrared quantum spectral detection imaging technology**, Siwen Bi, Institute of Remote Sensing and Digital Earth (China) ..... [11288-25]

Coffee Break ..... Mon 2:50 pm to 3:20 pm

**SESSION 7**

**LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... MON 3:20 PM TO 5:25 PM**

**Spin-Based Devices**

Session Chairs: **Henri Jaffrès**, Unité Mixte de Physique CNRS/Thales (France); **Giovanni Finocchio**, Univ. degli Studi di Messina (Italy)

3:20 pm: **Putting spin into photonics** (*Invited Paper*), Igor Zutic, Gaofeng Xu, Univ. at Buffalo (USA); Markus Lindemann, Ruhr-Univ. Bochum (Germany); Paulo E. Faria Junior, Univ. Regensburg (Germany); Martin R. Hofmann, Nils C. Gerhardt, Ruhr-Univ. Bochum (Germany) ..... [11288-26]

3:45 pm: **Voltage-controlled MRAM for unconventional computing: recent progress and perspectives** (*Invited Paper*), Pedram Khalili, Northwestern Univ. (USA) ..... [11288-27]

4:10 pm: **Low-threshold pure circular-polarization-electroluminescence from spin-light-emitting diodes consisting of oxidized Al/AIAs tunneling barriers** (*Invited Paper*), Hiro Munekata, Tokyo Institute of Technology (Japan) ..... [11288-28]

4:35 pm: **Ultrafast polarization modulation in birefringent spin-VCSELS** (*Invited Paper*), Markus Lindemann, Natalie Jung, Ruhr-Univ. Bochum (Germany); Tobias Pusch, Univ. Ulm (Germany); Gaofeng Xu, Igor Zutic, Univ. at Buffalo (USA); Rainer Michalzik, Univ. Ulm (Germany); Martin R. Hofmann, Nils C. Gerhardt, Ruhr-Univ. Bochum (Germany) ..... [11288-29]

5:00 pm: **Theory of excitonic states in lead salt quantum dots** (*Invited Paper*), Mikhail Nestoklon, Ivan D. Avdeev, Ioffe Institute (Russian Federation); Serguei V. Goupalov, Ioffe Institute (Russian Federation) and Jackson State Univ. (USA) ..... [11288-30]

OPTO

# CONFERENCE 11288

## TUESDAY 4 FEBRUARY

### SESSION 8

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... TUE 8:30 AM TO 9:55 AM

#### Quantum Sensors and Photonic Systems II

Session Chair: **Giuseppe Leo**,  
Lab. Matériaux et Phénomènes Quantiques (France)

8:30 am: **Maximum integration of quantum sensors with photonics** (*Keynote Presentation*), John H. Burke, Defense Advanced Research Projects Agency (USA) ..... [11288-31]

9:05 am: **Electrical scanning probe microscopy approaches to investigate solar cell junctions and devices** (*Invited Paper*), José Alvarez, CentraleSupélec (France) and Institut Photovoltaïque d'Ile-de-France (France); Clément Marchat, Institut Photovoltaïque d'Ile-de-France (France) and Lab. Génie électrique et électronique de Paris (France); Audrey Morisset, CEA-LITEN (France) and Institut Photovoltaïque d'Ile-de-France (France) and Lab. Génie électrique et électronique de Paris (France); Letian Dai, Lab. Génie électrique et électronique de Paris (France) and Lab. de Physique des Interfaces et des Couches Minces (France) and Lab. de Physique de la Matière Condensée (France); Raphael Cabal, CEA-LITEN (France); Pere Roca i Cabarrocas, Lab. de Physique des Interfaces et des Couches Minces (France); Jean-Paul Kleider, Lab. Génie électrique et électronique de Paris (France) and Institut Photovoltaïque d'Ile-de-France (France) ..... [11288-32]

9:30 am: **Mid-IR devices exploiting the strong light-matter coupling regime: detectors, emitters, and ultrafast modulators** (*Invited Paper*), Raffaele Colombelli, Ctr. de Nanosciences et de Nanotechnologies (France) ..... [11288-33]

Coffee Break. .... Tue 9:55 am to 10:20 am

### SESSION 9

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... TUE 10:20 AM TO 12:00 PM

#### Spin-Orbitronic Devices

Session Chairs: **Igor Zutic**, Univ. at Buffalo (USA);  
**Hiro Munekata**, Tokyo Institute of Technology (Japan)

10:20 am: **spin-orbit torques and room-temperature skyrmions in magnetic hybrid structures** (*Invited Paper*), Guoqiang Yu, Institute of Physics (China) ..... [11288-34]

10:45 am: **New directions for microwave and THz detectors based on spintronic diodes** (*Invited Paper*), Giovanni Finocchio, Univ. degli Studi di Messina (Italy) ..... [11288-35]

11:10 am: **Spin-orbit torque magnetometry in transition-metal based devices using advanced AMR-based wheatstone bridges and THz-TDS methods** (*Invited Paper*), Henri Jaffrès, Unité Mixte de Physique CNRS/Thales (France); Augustin Jouy, Sysnav (France); Jacques Hawecker, Lab. Pierre Aigrain (France); Malik Mansour, Lab. de Physique des Plasmas (France); Thi-Huong Dang, Sophie Collin, Jean-Marie George, Unité Mixte de Physique CNRS/Thales (France); David Vissière, Sysnav (France); Sukhdeep Dhillon, Lab. de Physique Statistique de l'ENS (France); James Boust, Unité Mixte de Physique CNRS/Thales (France); Luca Perfetti, Lab. des Solides Irradiés (France) ..... [11288-36]

11:10 am: **Current-controlled spin-orbit torque switching in antiferromagnetic PtMn devices** (*Invited Paper*), Victor Lopez Dominguez, Jiacheng Shi, Northwestern Univ. (USA); Francesca Garesci, Univ. degli Studi di Messina (Italy); Chulin Wang, Hamid Almasi, Matthew Grayson, Northwestern Univ. (USA); Giovanni Finocchio, Univ. degli Studi di Messina (Italy); Pedram Khalili, Northwestern Univ. (USA) ..... [11288-37]

Lunch/Exhibition Break ..... Tue 12:00 pm to 1:30 pm

### SESSION 10

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... TUE 1:30 PM TO 2:55 PM

#### Infrared Devices and Phononics

Session Chairs: **Nils C. Gerhardt**, Ruhr-Univ. Bochum (Germany);  
**Joseph G. Tischler**, U.S. Naval Research Lab. (USA)

1:30 pm: **Understanding phonon polaritons for infrared devices** (*Keynote Presentation*), Joseph G. Tischler, U.S. Naval Research Lab. (USA) ..... [11288-38]

2:05 pm: **Phononic properties of hetero-epitaxial BaTiO<sub>3</sub>-BiFeO<sub>3</sub> films and nanorods** (*Invited Paper*), Giti A. Khodaparast, Virginia Polytechnic Institute and State Univ. (USA) ..... [11288-39]

2:30 pm: **Actively modulating surface phonon polariton resonances within the long-wave and far-infrared** (*Invited Paper*), Chase T. Ellis, Adam D. Dunkelberger, Virginia D. Wheeler, Daniel C. Ratchford, U.S. Naval Research Lab. (USA); Dmitry N. Chigrin, RWTH Aachen Univ. (Germany); Marc Currie, Mijin Kim, Chul Soo Kim, Alexander J. Giles, Bryan T. Spann, Igor Vurgaftman, Jeffrey C. Owrutsky, U.S. Naval Research Lab. (USA); Joshua D. Caldwell, Vanderbilt Univ. (USA); Joseph G. Tischler, U.S. Naval Research Lab. (USA) ..... [11288-40]

Coffee Break. .... Tue 2:55 pm to 3:30 pm

### SESSION 11

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... TUE 3:30 PM TO 4:30 PM

#### Student Presentations

Session Chairs: **Whitney Mason**,  
Defense Advanced Research Projects Agency (USA);  
**John H. Burke**, Defense Advanced Research Projects Agency (USA)

3:30 pm: **High speed short wavelength infrared heterojunction phototransistors based on type II superlattices**, Jiakai Li, Arash Dehzangi, Donghai Wu, Manijeh Razeghi, Northwestern Univ. (USA) ..... [11288-41]

3:45 pm: **High-speed free-space optical communications based on quantum cascade lasers and type-II superlattice detectors**, Stephen Johnson, Emily Dial, Manijeh Razeghi, Northwestern Univ. (USA) ..... [11288-42]

4:00 pm: **Gas sensing spectroscopy system utilizing a sample grating distributed feedback quantum cascade laser array and type II superlattice detector**, Nate Coirier, Andrea Gomez-Patron, Manijeh Razeghi, Northwestern Univ. (USA) ..... [11288-43]

4:15 pm: **Surface-enhanced near-infrared absorption (SENIRA) of C-H and N-H groups with gold nanoarray**, Daler R. Dadadzhyanov, ITMO Univ. (Russian Federation) and Ben-Gurion Univ. of the Negev (Israel); Tigran A. Vartanyan, ITMO Univ. (Russian Federation); Alina Karabchevsky, Ben-Gurion Univ. of the Negev (Israel) ..... [11288-44]

### Innovation Awards

LOCATION: INTERCONTINENTAL HOTEL, INTERCONTINENTAL A (5TH FLOOR)  
7:30 PM TO 9:00 PM

#### Quantum Sensing, Nano Electronics, and Photonics

Session Chair: **Manijeh Razeghi**, Northwestern Univ. (USA)

SPIE announces the Innovation Award in Quantum Sensing, Nano Electronics, and Photonics, initiated by Prof. Manijeh Razeghi, at SPIE Photonics West OPTO 2020. These awards will recognize the outstanding scientific contribution of investigators who present the most notable recent discoveries with broad impact in the areas of quantum sensing, nano electronics, and photonics. These discoveries should be innovative in that they represent a new paradigm or way of thinking which will have a broad impact in their respective field. Participants will be required to give a 15-minute presentation. The winners will be announced at the end of the event.

WEDNESDAY 5 FEBRUARY

SESSION 12

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... WED 8:30 AM TO 10:10 AM

Advanced Photonic Materials and Devices I

Session Chairs: **Mikhail Nestoklon**, Institute of Physics and Technology of the RAS (Russian Federation); **Yannick De Wilde**, Institut Langevin Ondes et Images (France)

8:30 am: **Novel polymorphic superlattices and unique properties** (*Keynote Presentation*), Robert P. H. Chang, Northwestern Univ. (USA) ..... [11288-45]

9:05 am: **Ultrafast and ultrabroadband photocurrent microscopy resolves dynamics driving 2D-material photosensors and amorphous oxide thin-film transistors** (*Invited Paper*), Kyle T. Vogt, George Mattson, Matt W. Graham, Oregon State Univ. (USA) ..... [11288-46]

9:30 am: **Novel materials and concepts for active metaphotonic devices** (*Invited Paper*), Luca Dal Negro, Boston Univ. (USA) ..... [11288-4]

9:55 am: **Crystalline InGaZnO quaternary nanowires with superlattice structure for high-performance thin-film transistors and UV photodetectors**, Johnny Ho, City Univ. of Hong Kong (Hong Kong, China) ..... [11288-47]

Coffee Break ..... Wed 10:10 am to 10:30 am

SESSION 13

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... WED 10:30 AM TO 12:10 PM

Non-Linear Spectroscopy

Session Chairs: **Jean-Luc Pelouard**, Ctr. de Nanosciences et de Nanotechnologies (France); **Giti A. Khodaparast**, Virginia Polytechnic Institute and State Univ. (USA)

10:30 am: **Half-harmonic generation: enabling photonic solutions for molecular sensing and non-classical computing** (*Invited Paper*), Alireza Marandi, Caltech (USA) ..... [11288-48]

10:55 am: **Optical harmonic generation from semiconductor metasurfaces** (*Invited Paper*), Carlo Gigli, Giuseppe Marino, Univ. Paris Diderot (France); Davide Rocco, Costantino De Angelis, Univ. degli Studi di Brescia (Italy) and Istituto Nazionale di Ottica (Italy); Grégoire Beaudoin, Ctr. de Nanosciences et de Nanotechnologies (France) and Univ. Paris-Saclay (France) and CNRS (France); Konstantinos Pantzas, Gilles Patriarche, Isabelle Sagnes, Aristide Lemaître, Ctr. de Nanosciences et de Nanotechnologies (France); Giuseppe Leo, Univ. Paris Diderot (France) ..... [11288-49]

11:20 am: **Squeezed light generated by CPT-enabled phase sensitive amplification** (*Invited Paper*), Fabien Brettenaker, Lab. Aimé Cotton (France) and Raman Research Institute (India); Pascal Neveu, Joseph Delpy, Chitram Banerjee, Lab. Aimé Cotton (France); Jasleen Lugani, Friedrich-Schiller-Univ. Jena (Germany); Etienne Brion, Fabienne Goldfarb, Lab. Aimé Cotton (France) ..... [11288-50]

11:45 am: **Near-zero-index photonics: an overview** (*Invited Paper*), Nader Engheta, Univ. of Pennsylvania (USA) ..... [11288-51]

Lunch/Exhibition Break ..... Wed 12:10 pm to 1:40 pm

SESSION 14

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... WED 1:40 PM TO 3:30 PM

Advanced Photonic Materials and Devices II

Session Chairs: **Miriam S. Vitiello**, Istituto Nanoscienze (Italy); **Chase T. Ellis**, U.S. Naval Research Lab. (USA)

1:40 pm: **Semiconductor nanowires for optoelectronics applications** (*Keynote Presentation*), Chennupati Jagadish, The Australian National Univ. (Australia) ..... [11288-52]

2:15 pm: **The hybrid III-V on Si photonic platform revisited: achievements and challenges** (*Invited Paper*), Joan Manel Ramirez, Hajar Elfaiki, Théo Vérolet, Claire Besançon, Delphine Néel, III-V Lab. (France); Karim Hassan, Christophe Jany, Stéphane Malhouitre, CEA-LETI (France); Alexandre Shen, Christophe Caillaud, Dalila Make, Harry Garriah, Jean Decobert, Mohand Achouche, III-V Lab. (France) ..... [11288-53]

2:40 pm: **Monitoring hot-electron injection from single gold nanoparticles into graphene** (*Invited Paper*), Marcel Weinhold, Sangam Chatterjee, Peter J. Klar, Justus-Liebig-Univ. Giessen (Germany) ..... [11288-54]

3:05 pm: **Nanowire-based materials technologies for realization of photonic structures and devices** (*Invited Paper*), Lars Samuelson, Lund Univ. (Sweden) and Glo AB (Sweden) ..... [11288-95]

Coffee Break ..... Wed 3:30 pm to 4:00 pm

SESSION 15

LOCATION: ROOM 302 (LEVEL 3 SOUTH) ..... WED 4:00 PM TO 5:10 PM

Advanced Photonic Materials and Devices III

Session Chairs: **Sangam Chatterjee**, Justus-Liebig-Univ. Giessen (Germany); **Matt W. Graham**, Oregon State Univ. (USA)

4:00 pm: **Bandgap modeling of alloy and associated superlattice materials and photonic processes in a barrier infrared detector device** (*Invited Paper*), Yajun Wei, L3Harris Technologies, Inc. (USA) ..... [11288-57]

4:25 pm: **3D inkjet printing of ferrite nanomaterial thin films for magneto-optical devices**, Maggie Y. Chen, Texas State Univ. (USA) ..... [11288-58]

4:40 pm: **High-performance THz QCL frequency combs**, Andres Forrer, Lorenzo Bosco, Mattias Beck, Jérôme Faist, Giacomo Scalari, ETH Zurich (Switzerland) ..... [11288-59]

4:55 pm: **High-power cavity-based terahertz photoconductive sources for real-time terahertz imaging**, Jacques Hawecker, Valentino Pistore, Lab. de Physique de l'ens de Lyon (France); Amalya Minasyan, i2S SA (France); Kenneth Maussang, José Palomo, Lab. de Physique de l'ens de Lyon (France); Isabelle Sagnes, Raffaele Colombelli, Ctr. de Nanosciences et de Nanotechnologies (France); Jerome Tignon, Lab. de Physique Statistique de l'ENS (France); Juliette Mangeney, Lab. de Physique de l'ens de Lyon (France); Sukhdeep Dhillon, Lab. de Physique Statistique de l'ENS (France) ..... [11288-60]

POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Reproducible array image translation and recreation in nanophotolithography**, Rachit Sood, Chaoran Tu, Univ. of Maryland, Baltimore County (USA); Douglas Bamford, Joel M. Hensley, David Woolf, Physical Sciences Inc. (USA); Curtis R. Menyuk, Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA) ..... [11288-18]

**Characterizing nanoscale defects and wrinkles in MoS<sub>2</sub> by tip-enhanced Raman spectroscopy**, Ryo Kato, Takayuki Umakoshi, Rhea Thankam Sam, Prabhat Verma, Osaka Univ. (Japan) ..... [11288-79]

**Characterization of a megapixel quanta image sensor for scientific applications**, Yu-Wing Chung, Dakota A. Starkey, Jiaju Ma, Gigajot Technology Inc. (USA) ..... [11288-81]

**Adaptive time-gating and target tracking for noise reduction in a SPAD TCSPC imager**, Konstantinos Bantounos, Francescopaolo Mattioli Della Rocca, Istvan Gyongy, Hanning Mai, Robert K. Henderson, Ian Underwood, Scottish Microelectronics Ctr. (United Kingdom) ..... [11288-82]

OPTO

**Mid-IR Ag<sub>2</sub>Se-based colloidal quantum-dot photodetectors**, Michael Scimeca, NYU Tandon School of Engineering (USA) . . . . . [11288-83]

**Hyper-Raman optical activity of biologically relevant chiral molecules**, Christopher B. Marble, Xingqi Xu, Georgi I. Petrov, Texas A&M Univ. (USA); Dawei Wang, Zhejiang Univ. (China); Vladislav V. Yakovlev, Texas A&M Univ. (USA) . . . . . [11288-84]

**Hybrid silver nanowire networks for highly transparent electrodes of optoelectronic devices**, Sungjin Jo, Junyeong Lee, Kyungpook National Univ. (Korea, Republic of) . . . . . [11288-85]

**Partial least squares regression as novel tool for gas mixtures analysis in quartz-enhanced photoacoustic spectroscopy**, Andrea Zifarelli, Univ. degli Studi di Bari Aldo Moro (Italy); Pietro Patimisco, Angelo Sampaolo, Marilena Giglio, Giansergio Menduni, Politecnico di Bari (Italy); Arianna Elefante, Univ. degli Studi di Bari Aldo Moro (Italy); Vittorio M. N. Passaro, Politecnico di Bari (Italy); Frank K. Tittel, Rice Univ. (USA); Vincenzo Spagnolo, Politecnico di Bari (Italy) . . . . . [11288-86]

**Measurement of non-radiative gas molecules relaxation rates by using quartz-enhanced photoacoustic spectroscopy**, Stefano dello Russo, Univ. degli Studi di Bari Aldo Moro (Italy); Pietro Patimisco, Angelo Sampaolo, Marilena Giglio, Giansergio Menduni, Politecnico di Bari (Italy); Arianna Elefante, Univ. degli Studi di Bari Aldo Moro (Italy); Vittorio M. N. Passaro, Politecnico di Bari (Italy); Frank K. Tittel, Rice Univ. (USA); Vincenzo Spagnolo, Politecnico di Bari (Italy) . . . . . [11288-87]

**Fiber-coupled quartz-enhanced photoacoustic sensor for methane and ethane trace detection**, Fabrizio Sgobba, Univ. degli Studi di Bari Aldo Moro (Italy); Giansergio Menduni, Angelo Sampaolo, Pietro Patimisco, Marilena Giglio, Politecnico di Bari (Italy); Arianna Elefante, Univ. degli Studi di Bari Aldo Moro (Italy); Vittorio M. N. Passaro, Politecnico di Bari (Italy); Frank K. Tittel, Rice Univ. (USA); Vincenzo Spagnolo, Politecnico di Bari (Italy) . . . . . [11288-88]

**A compact cantilever-based photoacoustic sensor for trace-gas detection**, Mario Siciliani de Cumis, Agenzia Spaziale Italiana (Italy); Inaki Lopez Garcia, Istituto Nazionale di Ottica (Italy); Marica Canino, Istituto per la Microelettronica e Microsistemi (Italy); Pablo Cancio Pastor, Istituto Nazionale di Ottica (Italy); Filippo Bonafè, Alberto Roncaglia, Istituto per la Microelettronica e Microsistemi (Italy); Simone Borri, Paolo De Natale, Istituto Nazionale di Ottica (Italy) . . . . . [11288-89]

**Monolithic integration of quantum cascade laser, quantum cascade detector, and passive components for absorption sensing at  $\lambda = 4.6 \mu\text{m}$** , Jason Midkiff, Ali Rostamian, Kyoung Min Yoo, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [11288-90]

**Parts-per-million level detection of carbon monoxide using grating array waveguides in InP/InGaAs at  $\lambda = 4.6 \mu\text{m}$** , Ali Rostamian, Jason Midkiff, Kyoung Min Yoo, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [11288-91]

**Ultra-sensitive SWIR FPA with enhanced quantum efficiency based on electron multi-injector**, Simone Bianconi, Hooman Mohseni, Northwestern Univ. (USA) . . . . . [11288-92]

**Fiber pigtailed on-chip mid-infrared difference frequency generation on silicon platform**, Yue Cheng, The Univ. of Texas at Austin (USA); Hamed Dalir, Omega Optics, Inc. (USA); Jason Midkiff, Ali Rostamian, Kyoung Min Yoo, Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [11288-93]

**Laser event distribution and timing circuit design constraints in direct TOF LiDAR applications**, Andre Buchner, Jan F. Haase, Jennifer Ruskowski, Werner Brockherde, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme IMS (Germany) . . . . . [11288-94]

## THURSDAY 6 FEBRUARY

### SESSION 16

LOCATION: ROOM 302 (LEVEL 3 SOUTH) . . . . . THU 8:30 AM TO 10:10 AM

#### Quantum Cascades Lasers II

Session Chair: **Chennupati Jagadish**, The Australian National Univ. (Australia)

8:30 am: **Effects of ion bombardment on interband cascade laser structures (Keynote Presentation)**, Jerry R. Meyer, Charles D. Merritt, William W. Bewley, U.S. Naval Research Lab. (USA); Mijin Kim, KeyW Corp. (USA); Chul Soo Kim, Chadwick L. Canedy, Stephanie Tomasulo, Igor Vurgaftman, U.S. Naval Research Lab. (USA) . . . . . [11288-61]

9:05 am: **Picosecond pulses from an actively mode-locked quantum cascade laser (Invited Paper)**, Benedikt Schwarz, Johannes Hillbrand, Technische Univ. Wien (Austria); Marco Piccardo, Harvard Univ. (USA); Aaron Maxwell Andrews, Hermann Detz, Technische Univ. Wien (Austria); Harald Schneider, Helmholtz-Zentrum Dresden-Rossendorf e. V. (Germany); Gottfried Strasser, Technische Univ. Wien (Austria); Federico Capasso, Harvard Univ. (USA) . . . . . [11288-62]

9:30 am: **Towards private communications with mid-infrared chaotic light (Invited Paper)**, Frédéric Grillot, Olivier Spitz, Télécom ParisTech (France); Andreas Herdt, Technische Univ. Darmstadt (Germany); Grégory Maisons, mirSense (France); Wolfgang E. Elsässer, Technische Univ. Darmstadt (Germany); Mathieu Carras, mirSense (France) . . . . . [11288-63]

9:55 am: **IR-SNOM on a Fork: Infrared scanning near-field optical microscopy for thermal profiling of quantum cascade lasers**, Binay Jung Pandey, Kevin Clark, Farhat Abbas, Max-IR Labs., LLC (USA); E. Fuchs, Zyvex Labs, LLC (USA); K. Lascola, Thorlabs Quantum Electronics (USA); David Hinojos, Max-IR Labs., LLC (USA); Kimari Hodges, The Univ. of Texas at Dallas (USA); Dennis Robbins, Max-IR Labs., LLC (USA); M. Platkov, Tel-Aviv Univ. (Israel) and Nuclear Research Ctr. Negev-Soreq (Israel); A. Katzir, Tel Aviv Univ. (Israel); Ahmed Suliman, G. Spingarn, Hamamatsu Corp. (USA); A. Niguès, Lab. de Physique de l'Ecole Normale Supérieure (France) and Sorbonne Univ. (France) and CNRS (France); J.-F. Veyan, Qing Gu, The Univ. of Texas at Dallas (USA); Katy Roodenko, Max-IR Labs., LLC (USA) and The Univ. of Texas at Dallas (USA) . . . . . [11288-64]

Coffee Break. . . . . Thu 10:10 am to 10:40 am

### SESSION 17

LOCATION: ROOM 302 (LEVEL 3 SOUTH) . . . . . THU 10:40 AM TO 12:30 PM

#### Non-Linear Spectroscopy and THz Devices

Session Chairs: **Sven Höfling**, Julius-Maximilians-Univ. Würzburg (Germany); **Fabien Bretenaker**, Lab. Aimé Cotton (France)

10:40 am: **Electrically driven MIM nanogap antennas (Invited Paper)**, Jean-Luc Pelouard, Ctr. de Nanosciences et de Nanotechnologies (France) . . . . . [11288-65]

11:05 am: **Nanostructured photodiodes for room-temperature infrared detection through two-photon absorption (Invited Paper)**, Maxence Dauphin, Baptiste Fix, Julien Jaeck, ONERA (France); Grégoire Beaudoin, Isabelle Sagnes, Ctr. de Nanosciences et de Nanotechnologies (France); Riad Haidar, ONERA (France) . . . . . [11288-66]

11:30 am: **Recent progress in GaAs THz-QCLs and towards realizing GaN based QCLs**, Ke Wang, Nanjing Univ. (China); Tsung-Tse Lin, Li Wang, Hideki Hirayama, RIKEN (Japan) . . . . . [11288-67]

11:45 am: **Ultrafast response of active and self-starting harmonic mode-locked THz laser**, Valentino Pistore, Feihu Wang, Lab. de Physique de l'ens de Lyon (France); Michael Riesch, Technische Univ. München (Germany); Hanond Nong, Lab. de Physique de l'ens de Lyon (France); Pierre-Baptiste Vigneron, Raffaele Colombelli, Ctr. de Nanosciences et de Nanotechnologies (France); Olivier Parillaud, III-V Lab. (France); Juliette Mangeney, Jerome Tignon, Lab. de Physique Statistique de l'ENS (France); Christian Jirauschek, Technische Univ. München (Germany); Sukhdeep Dhillon, Lab. de Physique Statistique de l'ENS (France) . . . . . [11288-68]

12:00 pm: **Advances in GaN laser diodes for quantum sensors and optical atomic clocks**, Stephen P. Najda, Piotr Perlin, Mike Leszczynski, Szymon Stanczyk, TopGaN Ltd. (Poland); C. C. Clark, Helia Photonics Ltd. (United Kingdom); Thomas J. Slight, Compound Semiconductor Technologies Global Ltd. (United Kingdom); John Macarthur, Ludwig Prade, Loyd J. McKnight, Fraunhofer Ctr. for Applied Photonics (United Kingdom) . . . . . [11288-69]

12:15 pm: **N<sub>2</sub>-cooled THz quartz-enhanced photoacoustic sensor operating in pulsed mode for hydrogen sulfide detection in the part-per-billion concentration range**, Andrea Zifarelli, Università degli Studi di Bari (Italy); Angelo Sampaolo, Pietro Patimisco, Marilena Giglio, Politecnico di Bari (Italy); Chenren Yu, Huan Zhu, Haiqing Zhu, Gaolei Chang, Fangfang Wang, Jianxin Chen, Shanghai Institute of Technical Physics (China); Lianhe H. Li, Giles A. Davies, Edmund H. Linfield, Univ. of Leeds (United Kingdom); Li He, Shanghai Institute of Technical Physics (China); Tingting Wei, Hongpeng Wu, Lei Dong, Shanxi Univ. (China); Gangyi Xu, Shanghai Institute of Technical Physics (China); Vincenzo Spagnolo, Politecnico di Bari (Italy) . . . . . [11288-70]

Lunch/Exhibition Break . . . . . Thu 12:30 pm to 1:30 pm

**SESSION 18**

**LOCATION: ROOM 302 (LEVEL 3 SOUTH) . . . . . THU 1:30 PM TO 3:45 PM**

**Thermoelectrics and Gas Sensing**

Session Chair: **James P. Shaffer**, The Univ. of Oklahoma (Canada)

1:30 pm: **Nanostructured oxides for next-generation thermoelectrics** (*Invited Paper*), Luna Lu, Yining Feng, Purdue Univ. (USA); Ian T. Ferguson, Missouri Univ. of Science and Technology (USA) . . . . . [11288-71]

1:55 pm: **Accelerator-driven compact neutron sources, RANS, and their applications** (*Invited Paper*), Yoshie Otake, RIKEN Ctr. for Advanced Photonics (Japan) . . . . . [11288-72]

2:20 pm: **Hollow fiber mid-IR spectrometer with UV laser ablation sampling for fine spatial resolution of isotope ratios in solids**, Jason M. Kriesel, Camille N. Makarem, Opto-Knowledge Systems, Inc. (USA); James J. Moran, Timothy Linley, Pacific Northwest National Lab. (USA); Andrew Fahrland, Opto-Knowledge Systems (USA); James F. Kelly, Opto-Knowledge Systems, Inc. (USA) . . . . . [11288-73]

2:35 pm: **Helmholtz-like resonators for optical sensing of nitrosaromatics molecules** (*Invited Paper*), Alice Fabas, ONERA (France); Jean-Paul Hugonin, Institut d'Optique Graduate School (France); Hasnaa El Ouazzani, Riad Haïdar, ONERA (France); Jean-Jacques Greffet, Institut d'Optique Graduate School (France); Patrick Bouchon, ONERA (France) . . . . . [11288-75]

3:00 pm: **Intracavity quartz-enhanced photoacoustic spectroscopy for CO/N<sub>2</sub>O detection in the part-per-trillion concentration range**, Jakob Hayden, Technische Univ. Wien (Austria); Marilena Giglio, Angelo Sampaolo, Pietro Patimisco, Vincenzo Spagnolo, Politecnico di Bari (Italy); Bernhard Lendl, Technische Univ. Wien (Austria) . . . . . [11288-76]

3:15 pm: **Pressure-dependent sensitivity of battery based methane detection system using tunable diode laser at 3270 nm**, Seyed Ghasem Razavipour, James A. Gupta, Graeme Sabiston, Nicolaus Sabourin, Andrew Bezinger, Jean Lapointe, Daniel Poitras, National Research Council Canada (Canada) . . . . . [11288-77]

3:30 pm: **PAS-WRAP: a new approach to optical fiber photoacoustic sensing**, Davide Iannuzzi, Sheng Zhou, Vrije Univ. Amsterdam (Netherlands); Grzegorz Gruca, Optics11 (Netherlands) . . . . . [11288-78]



**BIOS Expo Industry Stage**

Saturday – Sunday • Hall DE  
 Keynotes and panels on the latest developments, open to all attendees.  
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# CONFERENCE 11289

LOCATION: ROOM 303 (LEVEL 3 SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11289

# Photonic and Phononic Properties of Engineered Nanostructures X

*Conference Chairs:* **Ali Adibi**, Georgia Institute of Technology (USA); **Shawn-Yu Lin**, Rensselaer Polytechnic Institute (USA); **Axel Scherer**, Caltech (USA)

*Program Committee:* **Andrea Alù**, The City Univ. of New York Advanced Science Research Ctr. (USA); **Amir Arbabi**, Univ. of Massachusetts Amherst (USA); **Ali A. Eftekhar**, Georgia Institute of Technology (USA); **Mercedeh Khajavikhan**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Reginald K. Lee**, Caltech (USA); **Marko Loncar**, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); **Arka Majumdar**, Univ. of Washington (USA); **Susumu Noda**, Kyoto Univ. Graduate School of Engineering (Japan); **Masaya Notomi**, NTT Basic Research Labs. (Japan); **Ekmel Özbay**, Bilkent Univ. (Turkey); **Yong Xu**, Virginia Polytechnic Institute and State Univ. (USA); **Eli Yablonovitch**, Univ. of California, Berkeley (USA); **Rashid Zia**, Brown Univ. (USA)

## MONDAY 3 FEBRUARY

### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break . . . . . Mon 10:05 am to 10:30 am

### SESSION 1

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . MON 10:30 AM TO 11:30 AM

#### Recent Advances in Engineered Nanostructures

Session Chair: **Ali Adibi**, Georgia Institute of Technology (USA)

10:30 am: **Recent advances in metasurface flat optics (Invited Paper)**, **Federico Capasso**, Harvard John A. Paulson School of Engineering and Applied Sciences (USA) . . . . . [11289-1]

11:00 am: **Integrated nanophotonics technology and applications (Invited Paper)**, **Yeshiahu Fainman**, Univ. of California, San Diego (USA) . . . . . [11289-2]

Lunch Break . . . . . Mon 11:30 am to 1:30 pm

### SESSION 2

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . MON 1:30 PM TO 3:10 PM

#### Photonic Metamaterials

Session Chair: **Shawn-Yu Lin**, Rensselaer Polytechnic Institute (USA)

1:30 pm: **Symphotonic metamaterials: Volumetric metamaterials for multiplexing and information processing (Invited Paper)**, **David R. Smith**, Duke Univ. (USA) . . . . . [11289-3]

2:00 pm: **Strong light-matter interaction in lithography-free metamaterial perfect absorbers: energy conversion, color filtering, and sensing applications (Invited Paper)**, **Ekmel Özbay**, **Amir Ghobadi**, **Hodjat Hajian**, **Bayram Butun**, Bilkent Univ. (Turkey) . . . . . [11289-4]

2:30 pm: **Strong self-induced nonreciprocal transmission by using nonlinear PT-symmetric epsilon-near-zero metamaterials**, **Boyuan Jin**, **Christos Argyropoulos**, Univ. of Nebraska-Lincoln (USA) . . . . . [11289-5]

2:50 pm: **Light confinement in low-index particles with all-dielectric anisotropic metamaterial shell**, **Saman Jahani**, **Joong Hwan Bahng**, Caltech (USA); **Douglas Montjoy**, Univ. of Michigan (USA); **Timothy A. Yao**, Caltech (USA); **Nicholas A. Kotov**, Univ. of Michigan (USA); **Alireza Marandi**, Caltech (USA) . . . . . [11289-6]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

### SESSION 3

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . MON 3:30 PM TO 5:40 PM

#### Photonic Crystals

Session Chair: **Yeshiahu Fainman**, Univ. of California, San Diego (USA)

3:30 pm: **Super Planckian thermal radiation emitted from a nano-filament of photonic crystal: a direct imaging study (Invited Paper)**, **Shawn-Yu Lin**, Rensselaer Polytechnic Institute (USA); **Sajeev John**, Univ. of Toronto (Canada); **Mei-Li Hsieh**, Rensselaer Polytechnic Institute (USA) . . . . . [11289-7]

4:00 pm: **Collective mechanisms for the self-organization of dynamic photonic crystals out of thermodynamic equilibrium**, **Nicolas Bachelard**, **Chad Ropp**, **Xiang Zhang**, Univ. of California, Berkeley (USA) . . . . . [11289-8]

4:20 pm: **Higher-order photonic topological insulator in all-dielectric photonic crystal slab**, **Dia'aaldin J. Bisharat**, **Dan Sievenpiper**, Univ. of California, San Diego (USA) . . . . . [11289-9]

4:40 pm: **Directed assembly of 3D nanophotonic systems from building blocks**, **Euan McLeod**, **Jeffrey Melzer**, **Weilin Liu**, **James C. Wyant** College of Optical Sciences (USA) . . . . . [11289-10]

5:00 pm: **Quantifying the saturation of structural colour from thin-film photonic crystals**, **Giselle R. Morris**, **John J. Tomes**, Aberystwyth Univ. (United Kingdom); **Mike Butters**, **Varichem Co., Ltd.** (United Kingdom); **Matt Gunn**, **Chris E. Finlayson**, Aberystwyth Univ. (United Kingdom) . . . . . [11289-11]

5:20 pm: **Dual-mode UV photodetector using 1D organometal micro crystal**, **Seokho Kim**, **Jinho Choi**, **Seong Jae Oh**, **Inha Univ.** (Korea, Republic of); **Young Ki Hong**, **Gyeongsang National Univ.** (Korea, Republic of); **Dong Hyuk Park**, **Inha Univ.** (Korea, Republic of) . . . . . [11289-12]

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . TUE 8:00 AM TO 10:10 AM

#### Photonic Metasurfaces I

Session Chair: **Ekmel Özbay**, Bilkent Univ. (Turkey)

8:00 am: **System-level models for metasurfaces (Invited Paper)**, **Mahsa Torfeh**, **Andrew C. McClung**, **Amir Arbabi**, Univ. of Massachusetts Amherst (USA) . . . . . [11289-13]

8:30 am: **Bilayered plasmonic metasurface for non-reciprocal holographic image encryption**, **Daniel Frese**, Univ. Paderborn (Germany); **Qunshuo Wei**, **Yongtian Wang**, **Lingling Huang**, Beijing Institute of Technology (China); **Thomas Zentgraf**, Univ. Paderborn (Germany) . . . . . [11289-14]

8:50 am: **Deep-learning-based design of Fano resonant HfO<sub>2</sub> metasurfaces for full color generation**, **Omid Hemmatyar**, **Sajjad Abdollahramezani**, **Yashar Kiarashinejad**, **Mohammadreza Zandehshahvar**, **Ali Adibi**, Georgia Institute of Technology (USA) . . . . . [11289-15]

9:10 am: **Nanocasting of dielectric metasurfaces with sub-100-nm Resolution**, **Kwan Kim**, Korea Univ. (Korea, Republic of); **Gwanho Yoon**, Pohang Univ. of Science and Technology (Korea, Republic of); **Junho Jun**, **Sucheol Ju**, **Daihong Huh**, **Heon Lee**, Korea Univ. (Korea, Republic of) [11289-16]

9:30 am: **Ultra-high-Q plasmonic metasurface at 1550-nm telecommunication wavelength**, **Md Saad-Bin-Alam**, **Orad Reshef**, Univ. of

Ottawa (Canada); Mikko J. Huttunen, Tampere Univ. (Finland); Yaryna Mamchur, National Technical Univ. of Ukraine (Ukraine) and Univ. of Ottawa (Canada); Graham Carlow, Brian Sullivan, Iridian Spectral Technologies Ltd. (Canada); Jean-Michel Ménard, Univ. of Ottawa (Canada); Robert W. Boyd, Univ. of Ottawa (Canada) and Univ. of Rochester (USA); Ksenia Dolgaleva, Univ. of Ottawa (Canada) . . . . . [11289-17]

9:50 am: **Scalable fabrication of nano-architected materials using 3D interference lithography with metasurfaces at visible wavelengths**, Philippe Pearson, Seyedeh Mahsa Kamali, Farzaneh Afshinmanesh, Luizetta Navrazhnykh, Ryan Ng, Andrei Faraon, Julia R. Greer, Caltech (USA) . . . . . [11289-18]

Coffee Break . . . . . Tue 10:10 am to 10:30 am

**SESSION 5**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . TUE 10:30 AM TO 12:00 PM**

**Photonic Metasurfaces II**

Session Chair: **Ali Adibi**, Georgia Institute of Technology (USA)

10:30 am: **High-quality factor phase gradient metasurfaces** (*Invited Paper*), Jennifer A. Dionne, Stanford Univ. (USA) . . . . . [11289-19]

11:00 am: **Programmable hybrid metasurfaces: using artificial intelligence to reveal fundamental physics of light-matter interactions**, Sajjad Abdollahramezani, Yashar Kiarashinejad, Omid Hemmatyar, Mohammadreza Zandehshahvar, Hossein Taghinejad, Tianren Fan, Ali A. Eftekhar, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11289-20]

11:20 am: **Free-space-coupled microdisk resonators**, Babak Mirzapourbeinekalaye, Sarath Samudrala, Mahdad Mansouree, Amir Arbabi, Univ. of Massachusetts Amherst (USA) . . . . . [11289-21]

11:40 am: **Multifocal metalens based on multilayer Pancharatnam-Berry phase elements architecture**, Ronghui Lin, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11289-22]

Lunch/Exhibition Break . . . . . Tue 12:00 pm to 1:30 pm

**SESSION 6**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . TUE 1:30 PM TO 3:00 PM**

**Novel Design Techniques for Photonic Nanostructures**

Session Chair: **Jennifer A. Dionne**, Stanford Univ. (USA)

1:30 pm: **Exploring the degrees of freedom in photonic crystal unit cell design and their impact** (*Invited Paper*), Sharon M. Weiss, Vanderbilt Univ. (USA) . . . . . [11289-23]

2:00 pm: **Sample-efficient machine-learning method for designing photonic nanostructures**, Mohammadreza Zandehshahvar, Yashar Kiarashinejad, Sajjad Abdollahramezani, Omid Hemmatyar, Hossein Maleki, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11289-24]

2:20 pm: **Discovery of feasible optical responses in photonic nanostructures using geometric deep learning**, Yashar Kiarashinejad, Mohammadreza Zandehshahvar, Sajjad Abdollahramezani, Omid Hemmatyar, Hossein Maleki, Georgia Institute of Technology (USA); Reza Pourabolghasem, Independent Researcher (USA); Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11289-25]

2:40 pm: **Inverse design of absorptive chiral metasurfaces**, Alexander Y. Zhu, Zhujun Shi, Wei Ting Chen, Yao-Wei Huang, Harvard Univ. (USA); Cheng-Wei Qiu, National Univ. of Singapore (Singapore); Federico Capasso, Harvard Univ. (USA) . . . . . [11289-26]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

**SESSION 7**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . TUE 3:30 PM TO 5:40 PM**

**Plasmonic Nanostructures**

Session Chair: **Amir Arbabi**, Univ. of Massachusetts Amherst (USA)

3:30 pm: **Topological lasing spaser** (*Invited Paper*), Mark I. Stockman, Georgia State Univ. (USA) . . . . . [11289-27]

4:00 pm: **Kramers hopping of nanoparticle in plasmonic double-well potential**, Seung Ju Yoon, Hwi-Min Kim, KAIST (Korea, Republic of); Chang-Kyu Kim, Korea Polytechnic Univ. (Korea, Republic of); Yong-Hee Lee, KAIST (Korea, Republic of) . . . . . [11289-28]

4:20 pm: **Active chiral metamaterials for tunable modulation of chiroptical coupling and light-valley interactions**, Zilong Wu, Yuebing Zheng, The Univ. of Texas at Austin (USA) . . . . . [11289-29]

4:40 pm: **Hybrid plasmonic-dielectric resonant waveguide grating for wavelength-selective diffraction**, Giorgio Quaranta, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland); Olivier Martin, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Benjamin Gallinet, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) . . . . . [11289-30]

5:00 pm: **Polarization conversion of surface plasmons through multi-vector superimposed gratings**, Eoin Dawson, Ribal Georges Sabat, Royal Military College of Canada (Canada) . . . . . [11289-31]

5:20 pm: **Strengthened absorption of ultra-thin-film bismuth vanadate through a motheye-structured triple-deck photoanode: Au/SnO<sub>2</sub>/BiVO<sub>4</sub>/AuNP nanocomposites**, Junho Jun, Korea Univ. (Korea, Republic of) . . . . . [11289-32]

**WEDNESDAY 5 FEBRUARY**

**SESSION 8**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . WED 8:00 AM TO 10:00 AM**

**Resonance-Based Photonic Devices and Applications**

Session Chair: **Amir Safavi-Naeini**, Stanford Univ. (USA)

8:00 am: **Soliton microcombs: physics and applications** (*Invited Paper*), Kerry J. Vahala, Caltech (USA) . . . . . [11289-33]

8:30 am: **Dispersion-engineered nanophotonic resonators for visible-telecom nonlinear optics** (*Invited Paper*), Kartik Srinivasan, National Institute of Standards and Technology (USA) . . . . . [11289-34]

9:00 am: **Non-reciprocal devices based on optical pumping**, Andrea Alù, The City Univ. of New York Advanced Science Research Ctr. (USA); Robert Duggan, The Univ. of Texas at Austin (USA) . . . . . [11289-35]

9:20 am: **Purcell enhancement of Er ions based on very small metallic cavity**, Jungmin Lee, Hwi-Min Kim, Seung Ju Yoon, KAIST (Korea, Republic of); Chang-Kyu Kim, Korea Polytechnic Univ. (Korea, Republic of); Yong-Hee Lee, KAIST (Korea, Republic of) . . . . . [11289-36]

9:40 am: **Cylindrical hyperbolic metamaterials exhibiting superscattering with whispering gallery-like resonance**, Rahul Kumar, Kotaro Kajikawa, Tokyo Institute of Technology (Japan) . . . . . [11289-37]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

**SESSION 9**

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . WED 10:30 AM TO 12:10 PM**

**Quantum Nanostructures**

Session Chair: **Kartik Srinivasan**, National Institute of Standards and Technology (USA)

10:30 am: **The power of materials innovation: breaking spectral and performance barriers for quantum devices** (*Invited Paper*), Manijeh Razeghi, Northwestern Univ. (USA) . . . . . [11289-38]

11:00 am: **Piezo-optomechanical modulation and quantum transduction** (*Invited Paper*), Amir Safavi-Naeini, Stanford Univ. (USA) . . . . . [11289-39]

11:30 am: **Wavelength-resolved Purcell enhancement of PbS/CdS**



# CONFERENCE 11289

**quantum dots measured on a chip-based platform**, Lukas Elsinger, Univ. Gent (Belgium) and imec (Belgium); Ronan Gourgues, Single Quantum B.V. (Netherlands); Iman E. Zadeh, Technische Univ. Delft (Netherlands); Jorick Maes, Univ. Gent (Belgium); Antonio Guardiani, Single Quantum B.V. (Netherlands); Silvania F. Pereira, Technische Univ. Delft (Netherlands); Gabriele Bulgarini, Sander N. Dorenbos, Single Quantum B.V. (Netherlands); Val Zwiller, KTH Royal Institute of Technology (Sweden); Zeger Hens, Univ. Gent (Belgium); Dries Van Thourhout, Univ. Gent (Belgium) and imec (Belgium) . . . . . [11289-40]

11:50 am: **Multimode quantum-dot optomechanics in suspended nanophonic strings**, Anja Vogeles, Maximilian M. Sonner, Benjamin Mayer, Univ. Augsburg (Germany); Xueyong Yuan, Johannes Kepler Univ. Linz (Austria); Matthias Weiß, Emeline D. S. Nysten, Univ. Augsburg (Germany); Saimon F. C. da Silva, Armando Rastelli, Johannes Kepler Univ. Linz (Austria); Hubert J. Krenner, Univ. Augsburg (Germany) . . . . . [11289-41]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:30 pm

## SESSION 10

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . WED 1:30 PM TO 3:00 PM**

### Phononic Crystals and Optomechanical Structures

Session Chair: **Harish Bhaskaran**, Univ. of Oxford (United Kingdom)

1:30 pm: **Experimental demonstration of pseudospin behavior and classical entanglement in a phononic structure** (*Invited Paper*), Pierre A. Deymier, Lazaro Calderin, Arif Hasan, Trevor Lata, Pierre Lucas, Keith Runge, The Univ. of Arizona (USA) . . . . . [11289-42]

2:00 pm: **Inertial sensing and phase noise of phonon-engineered optomechanical crystal oscillators near the thermodynamic limits** (*Invited Paper*), Jaime G. Flor Flores, Talha Yerebakan, Yongjun Huang, Jia-Gui Wu, James F. McMillan, Wenting Wang, Chee-Wei Wong, Univ. of California, Los Angeles (USA) . . . . . [11289-43]

2:30 pm: **Acoustical activity by chiral phonons in 3D metamaterials** (*Invited Paper*), Martin Wegener, Institut für Angewandte Physik, Karlsruher Institut für Technologie (Germany) . . . . . [11289-44]

Coffee Break . . . . . Wed 3:00 pm to 3:30 pm

## SESSION 11

**LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . WED 3:30 PM TO 5:40 PM**

### Phase-Change Materials for Optoelectronics

Session Chair: **Martin Wegener**,  
Karlsruher Institut für Technologie (Germany)

3:30 pm: **Silicon-integrated phase-change photonic computing** (*Invited Paper*), Harish Bhaskaran, Univ. of Oxford (United Kingdom) . . . . . [11289-45]

4:00 pm: **Reconfigurable Si/SiN-based integrated photonic devices enabled by integration with phase change materials**, Sajjad Abdollahramezani, Hossein Taghinejad, Tianren Fan, Ali A. Eftekhari, Omid Hemmatyar, Amir H. Hosseinnia, Ali Eshaghian Dorche, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11289-46]

4:20 pm: **Broadband mid-infrared reflective-type optical limiters enabled by phase-transition materials**, Chenghao Wan, Univ. of Wisconsin-Madison (USA); Zhen Zhang, Purdue Univ. (USA); Jad Salman, Yuzhe Xiao, Zhaoning Yu, Univ. of Wisconsin-Madison (USA); Shiram Ramanathan, Purdue Univ. (USA); Mikhail Kats, Univ. of Wisconsin-Madison (USA) . . . . . [11289-47]

4:40 pm: **Phase-change material-based active optical metasurfaces enabled by ion irradiation techniques**, Martin Hafermann, Philipp Schöppe, Jura Rensberg, Carsten Ronning, Friedrich-Schiller-Univ. Jena (Germany) . . . . . [11289-48]

5:00 pm: **Achieving far-field thermal rectification using gold-vanadium dioxide micro-gratings**, Romil Audhkhasi, Michelle Povinelli, The Univ. of Southern California (USA) . . . . . [11289-49]

5:20 pm: **Sub-wavelength plasmonic-enhanced phase-change memory**, Emanuele Gemo, Santiago Garcia-Cuevas Carrillo, Joaquin Faneca, Carlota Ruiz de Galarreta, Anna Baldycheva, Univ. of Exeter (United Kingdom); Hasan Hayat, Univ. of Exeter (United Kingdom) and Swansea Univ. (United Kingdom); Nathan Youngblood, Harish Bhaskaran, Univ. of Oxford (United Kingdom); Wolfram H. P. Pernice, Westfälische Wilhelms-Univ. Münster (Germany); C. David Wright, Univ. of Exeter (United Kingdom) . . . . . [11289-50]

## POSTERS-WEDNESDAY

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Wednesday 10:00 AM – 5:00 PM**

View poster presentation guidelines and set-up instructions at  
<http://spie.org/PWPosterGuidelines>

**Conversion of frequency of light via down-shifting 2D metamaterials fabricated by nanoimprint soft lithography**, Won Bae Sohn, Woong Kim, Gang Yeol Yoo, Chi Ho Lee, Sung Nam Park, Korea Univ. (Korea, Republic of) . . . . . [11289-70]

**Tailoring response of a cluster of nanoparticles on a substrate and its application for design of geometrical phase elements**, Sergej Orlov, Klemensas Laurinavičius, Justas Berškys, Ctr. for Physical Sciences and Technology . . . . . [11289-71]

**Far-field wavefront optimization of the optical near-field in nanoscale disordered plasmonic 2D material**, Gauthier Roubaud, Sébastien Bidault, Institut Langevin Ondes et Images (France); Sylvain Gigan, Lab. Kastler Brossel (France); Samuel Gresillon, Institut Langevin Ondes et Images (France) . . . . . [11289-72]

**Analyzing the light transmittance through a virtual chicken cornea tissue model via simulation**, Tzu-Hao Kuo, Snow H. Tseng, National Taiwan Univ. (Taiwan) . . . . . [11289-73]

**A plasmonic ruler to measure angle using two metal blocks**, Young Jin Lee, Youngsoo Kim, Eunso Shin, Soon-Hong Kwon, Chung-Ang Univ. (Korea, Republic of) . . . . . [11289-75]

**Ultra-coherent supercontinuum generation in isopropanol-silica-based photonic crystal fiber at 1300nm and 1600nm wavelengths**, Pooja Chauhan, Ajeet Kumar, Yogita Kalra, Delhi Technological Univ. (India) . . . . . [11289-76]

**Sensitivity comparison of EOT signal according to incident light shape**, Junha Choi, Taeyeon Kim, Seunghun Lee, Kyujung Kim, Heesang Ahn, Pusan National Univ. (Korea, Republic of) . . . . . [11289-77]

**Temperature Sensors with far-field patterns generated by a nanometer-sized bimetallic multi-slit array**, Eunso Shin, Young Jin Lee, Yongsoo Kim, Soon-Hong Kwon, Chung-Ang Univ. (Korea, Republic of) . . . . . [11289-78]

**Broadband plasmonic effect for high solar-thermal conversion efficiency**, Jonghyeok Im, Monu Nath Baitha, Kyoungsik Kim, Yonsei Univ. (Korea, Republic of) . . . . . [11289-79]

**handedness-dependent electromagnetic-induced transparency in dielectric polymer-based 3D structures**, Chieh-Ii Liu, Po-Lin Lai, Yu-Chueh Hung, National Tsing Hua Univ. (Taiwan) . . . . . [11289-80]

**Label-free graphene-based biosensor**, Diana Aznakayeva, National Aviation Univ. (Ukraine); Emir Aznakayev, National Aviation Univ. (Ukraine) and National Technical Univ. of Ukraine (Ukraine) . . . . . [11289-81]

**Biaxial hyperbolic metamaterials**, Changkee Hong, Azad Siahmakoun, Hossein Alisafoee, Rose-Hulman Institute of Technology (USA) . . . . . [11289-82]

**Lasing at hierarchical topological photonic states in two-dimensional photonic crystals**, Chang hyun Han, Minsu Kang, Heonsu Jeon, Seoul National Univ. (Korea, Republic of) . . . . . [11289-83]

**Optical waveguiding characteristics according direction of  $\pi$ -electron in 1D rubrene crystal**, Jinho Choi, Seongjae Oh, Seokho Kim, Inha Univ. (Korea, Republic of); Young Ki Hong, Gyeongsang National Univ. (Korea, Republic of); Dong Hyuk Park, Inha Univ. (Korea, Republic of) . . . . . [11289-84]

**Reconfigurable electro-optic metasurface employing phase-change material GST**, Omid Hemmatyar, Sajjad Abdollahramezani, Yashar Kiarashinejad, Mohammadreza Zandehshahvar, Hossein Taghinejad, Ali Asghar Eftekhari, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11289-86]

**Leveraging latent learning to design nanophotonic structures**, Mohammadreza Zandehshahvar, Omid Hemmatyar, Yashar Kiarashinejad, Sajjad Abdollahramezani, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11289-87]

**Tunable mixed electro-optic metasurface with a hybrid plasmonic phase-change material architecture**, Sajjad Abdollahramezani, Omid Hemmatyar, Yashar Kiarashinejad, Mohammadreza Zandehshahvar, Hossein Taghinejad, Ali A. Eftekhari, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11289-88]

**Dynamically tunable reflecting NIR band-pass filter based on hybrid graphene-nanometallic structure**, Seyededris Mirniaharikandi, Brian A. Lail, Florida Institute of Technology (USA) . . . . . [11289-85]

THURSDAY 6 FEBRUARY

SESSION 12

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . THU 8:00 AM TO 10:10 AM

Photonic Nanostructures for Sensing and Imaging

Session Chair: **Juejun Hu**,  
Massachusetts Institute of Technology (USA)

8:00 am: **Structured photonic surfaces for imaging and spectroscopy** (*Invited Paper*), Luca Dal Negro, Boston Univ. (USA) . . . . . [11289-51]

8:30 am: **Towards ultra-thin monolithic imaging systems: introduction of an optic that mimics space**, Orad Reshef, Michael DelMastro, Katherine Bearne, Ali Alhulaymi, Univ. of Ottawa (Canada); Lambert Giner, Univ. of Ottawa (Canada) and National Research Council Canada (Canada); Robert W. Boyd, Univ. of Ottawa (Canada) and Univ. of Rochester (USA); Jeff S. Lundeen, Univ. of Ottawa (Canada) . . . . . [11289-52]

8:50 am: **Enhancing light-matter interaction with dielectric nanoantennas for sensing, spectroscopy, and light guiding**, Angela I. Barreda, Francisco González, Fernando Moreno, Pablo Albella, Univ. de Cantabria (Spain) . . . . . [11289-53]

9:10 am: **Self-referenced integrated plasmonic device based on engineered periodic nanostructures for sensing applications**, Pankaj Arora, Sambhavi Shukla, Birla Institute of Technology and Science, Pilani (India) . . . . . [11289-54]

9:30 am: **Vibrant reflective structural colors with lossy metals using grating supermode resonances**, Youngji Kim, Jerome K. Hyun, Kyungmin Jung, Ewha Womans Univ. (Korea, Republic of) . . . . . [11289-55]

9:50 am: **Analysis of biological creature color appearance via FDTD simulation**, Liang-Yu Huang, Snow H. Tseng, National Taiwan Univ. (Taiwan) . . . . . [11289-56]

Coffee Break. . . . . Thu 10:10 am to 10:30 am

SESSION 13

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . THU 10:30 AM TO 12:00 PM

Novel Materials and Phenomena in Engineered Nanostructures I

Session Chair: **Luca Dal Negro**, Boston Univ. (USA)

10:30 am: **Filling in the missing link: monolithic optical isolators on silicon with high performance, broadband operation, and polarization diversity** (*Invited Paper*), Juejun Hu, Massachusetts Institute of Technology (USA); Yan Zhang, Univ. of Electronic Science and Technology of China (China); Qingyang Du, Massachusetts Institute of Technology (USA); Chuangtang Wang, Univ. of Electronic Science and Technology of China (China); Takian Fukhrul, Yifei Zhang, Massachusetts Institute of Technology (USA); Shuyuan Liu, Longjiang Deng, Univ. of Electronic Science and Technology of China (China); Claudia Goncalves, Cesar Blanco, Kathleen Richardson, The College of Optics and Photonics, Univ. of Central Florida (USA); Duanni Huang, Paolo Pintus, John Bowers, Univ. of California, Santa Barbara (USA); Caroline A. Ross, Massachusetts Institute of Technology (USA); Lei Bi, Univ. of Electronic Science and Technology of China (China) . . . . . [11289-57]

11:00 am: **Characterization of the Yb-doped glass Anderson localizing optical fiber**, Cody Bassett, Mostafa Peysokhan, Esmaeil Mobini, The Univ. of New Mexico (USA); Matthew Tuggle, John Ballato, Clemson Univ. (USA); Arash Mafi, The Univ. of New Mexico (USA) . . . . . [11289-58]

11:20 am: **Active hyperbolic metamaterials**, Zhitong Li, Ross Haroldson, Dayang Lin, Roberta Hawkins, Abouzar Gharajeh, Jiyoung Moon, Walter Hu, Anvar Zakhidov, Qing Gu, The Univ. of Texas at Dallas (USA) . . . . . [11289-59]

11:40 am: **High-performance infrared thermoelectric bolometers based on nanomembranes**, Aapo Varpula, Kirsi Tappura, Jonna Tiira, Kestutis Grigoras, Kai Viherkanto, Jouni Ahopelto, Mika Prunnila, VTT Technical Research Ctr. of Finland Ltd. (Finland) . . . . . [11289-60]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:30 pm

SESSION 14

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . THU 1:30 PM TO 3:00 PM

Novel Materials and Phenomena in Engineered Nanostructures II

Session Chair: **Yi Yang**, Massachusetts Institute of Technology (USA)

1:30 pm: **Metaphotonics: from backward phase-matching to augmented reality** (*Invited Paper*), Shoufeng Lan, Texas A&M Univ. (USA) . . . . . [11289-61]

2:00 pm: **Optical scattering measurements of random anti-reflective nanostructured surfaces in the mid- and long-wave IR**, David A. Gonzalez, The Univ. of North Carolina at Charlotte (USA); Jesus Meza-Galvan, David Sharp, Karun Vijayraghavan, Nanohmics, Inc. (USA); Menelaos K. Poutous, The Univ. of North Carolina at Charlotte (USA) [11289-62]

2:20 pm: **Subwavelength nanoantennas with lattice and Zenneck modes**, Viktoriia E. Babicheva, The Univ. of New Mexico (USA); Jerome Moloney, James C. Wyant College of Optical Sciences (USA) . . . . . [11289-63]

2:40 pm: **Non-hermitian control of topological charge in random media**, Nicolas Bachelard, Univ. of California, Berkeley (USA) and Technische Univ. Wien (Austria); Stefan Rotter, Technische Univ. Wien (Austria) . . . . . [11289-64]

Coffee Break. . . . . Thu 3:00 pm to 3:30 pm

SESSION 15

LOCATION: ROOM 303 (LEVEL 3 SOUTH) . . . . . THU 3:30 PM TO 5:20 PM

Modeling and Simulation of Nanophotonic Structures

Session Chair: **Shoufeng Lan**, Georgia Institute of Technology (USA)

3:30 pm: **A few novel phenomena in electromagnetic scattering** (*Invited Paper*), Yi Yang, Marin Soljacic, Massachusetts Institute of Technology (USA) . . . . . [11289-65]

4:00 pm: **Programmable quasi-random nanostructured coating with omnidirectional broadband improvement for photon management**, Yihong Zhao, Ming Zhu, Shengjie Zhai, Hui Zhao, Univ. of Nevada, Las Vegas (USA) . . . . . [11289-66]

4:20 pm: **Selection rule and line shape of Dirac-cone modes in SOI photonic crystals**, Yuanzhao Yao, Takashi Kuroda, Naoki Ikeda, Yoshimasa Sugimoto, Takaaki Mano, Hiromi Koyama, Kazuaki Sakoda, National Institute for Materials Science (Japan) . . . . . [11289-67]

4:40 pm: **Analytical and numerical treatment of nonlocal nanoplasmonic resonant effects**, Milan Burda, Pavel Kwiecien, Ivan Richter, Czech Technical Univ. in Prague (Czech Republic) . . . . . [11289-68]

5:00 pm: **Numerical modeling of optoelectric characterization of GaAs/In<sub>0.2</sub>Ga<sub>0.8</sub>As nanowire solar cells**, Latef Bilbas, Erbil Polytechnic Univ. (Iraq) . . . . . [11289-69]

OPTO

# CONFERENCE 11290

LOCATION: ROOM 301 (LEVEL 3 SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11290

## High Contrast Metastructures IX

Conference Chairs: **Connie J. Chang-Hasnain**, Univ. of California, Berkeley (USA); **Andrei Faraon**, Caltech (USA); **Weimin Zhou**, U.S. Army Combat Capabilities Development Command (USA)

Program Committee: **Andrea Alù**, The City Univ. of New York Advanced Science Research Ctr. (USA); **Markus-Christian Amann**, Walter Schottky Institut (Germany); **Il-Sug Chung**, Ulsan National Institute of Science and Technology (Korea, Republic of); **Mikhail A. Kats**, Univ. of Wisconsin-Madison (USA); **Fumio Koyama**, Tokyo Institute of Technology (Japan); **Arseniy I. Kuznetsov**, Institute of Materials Research and Engineering (Singapore); **Philippe Lalanne**, Lab. Photonique, Numérique et Nanosciences (France); **John R. Lawall**, National Institute of Standards and Technology (USA); **Tien-Chang Lu**, National Chiao Tung Univ. (Taiwan); **Rainer F. Mahr**, IBM Research – Zürich (Switzerland); **Arka Majumdar**, Univ. of Washington (USA); **Bala Pesala**, CSIR-Central Electronics Engineering Research Institute (India); **Jon A. Schuller**, Univ. of California, Santa Barbara (USA); **Pierre Viktorovitch**, Ecole Centrale de Lyon (France); **Alan E. Willner**, The Univ. of Southern California (USA); **Ming C. Wu**, Univ. of California, Berkeley (USA)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 301 (LEVEL 3 SOUTH) . . . . . MON 1:30 PM TO 3:00 PM

#### Harnessing Light I

Session Chair: **Weimin Zhou**,  
U.S. Army Combat Capabilities Development Command (USA)

1:30 pm: **High-contrast grating and its application in VCSEL array (Keynote Presentation)**, **Connie J. Chang-Hasnain**, Univ. of California, Berkeley (USA) . . . . . [11290-1]

2:00 pm: **Trajectory-selective dispersion engineering using cascaded metasurfaces**, **Andrew McClung**, **Mahdad Mansouree**, **Amir Arbabi**, Univ. of Massachusetts Amherst (USA) . . . . . [11290-2]

2:20 pm: **Supersymmetry in optics for corrugated waveguides and leaky wave antenna design**, **Nitish Chandra**, **Wiktor Walasik**, **Natalia M. Litchinitser**, Duke Univ. (USA) . . . . . [11290-3]

2:40 pm: **Multifunctional all-silicon metastructures**, **Conner Ballew**, **Philip Camayd-Muñoz**, **Gregory Roberts**, **Andrei Faraon**, Caltech (USA) . . . . [11290-4]

Coffee Break. . . . . Mon 3:00 pm to 3:30 pm

#### SESSION 2

LOCATION: ROOM 301 (LEVEL 3 SOUTH) . . . . . MON 3:30 PM TO 5:30 PM

#### Harnessing Light II

Session Chair: **Connie J. Chang-Hasnain**,  
Univ. of California, Berkeley (USA)

3:30 pm: **Properties of resonant photonic lattices: Bloch mode dynamics, band flips, and applications (Invited Paper)**, **Robert Magnusson**, The Univ. of Texas at Arlington (USA) . . . . . [11290-5]

4:00 pm: **High-volume manufacturing of near-infrared metasurface optical devices**, **Sage Doshay**, **Rutger M. T. Hijssen**, **Naamah Argaman**, **Ludovic Godet**, **Jinrui Guo**, **Edison Chen**, Applied Materials, Inc. (USA) . . . . . [11290-6]

4:20 pm: **Mixed order nonlinear frequency mixing from metasurfaces of multi-resonant gold antennas**, **Rupert F. Oulton**, Imperial College London (United Kingdom); **Sylvain D. Gennaro**, Imperial College London (United Kingdom) and Sandia National Labs. (USA); **Paul Dichtl**, Imperial College London (United Kingdom); **Stefan A. Maier**, Imperial College London (United Kingdom) and Ludwig-Maximilians-Univ. München (Germany) . . . . . [11290-7]

4:40 pm: **Spatiotemporal manipulation of optical fields enabled by metasurfaces (Invited Paper)**, **Amit K. Agrawal**, National Institute of Standards and Technology (USA) . . . . . [11290-8]

5:10 pm: **Flat optics for optical image processing**, **You Zhou**, **Hanyu Zheng**, Vanderbilt Univ. (USA); **Ivan I. Kravchenko**, Oak Ridge National Lab. (USA); **Jason G. Valentine**, Vanderbilt Univ. (USA) . . . . . [11290-63]

### TUESDAY 4 FEBRUARY

#### SESSION 3

LOCATION: ROOM 301 (LEVEL 3 SOUTH) . . . . . TUE 8:40 AM TO 10:20 AM

#### Nonlinear Metasurfaces

Session Chair: **Howard Lee**, Baylor Univ. (USA)

8:40 am: **Nonlinear dielectric metasurfaces: frequency mixing and infrared image upconversion (Invited Paper)**, **Dragomir N. Neshev**, The Australian National Univ. (Australia) . . . . . [11290-9]

9:10 am: **Observation of highly efficient second-harmonic generation at the nanoscale driven by bound states in the continuum**, **Kirill L. Koshelev**, The Australian National Univ. (Australia) and ITMO Univ. (Russian Federation); **Sergey Kruk**, The Australian National Univ. (Australia); **Elizaveta Melik-Gaykazyan**, The Australian National Univ. (Australia) and M.V. Lomonosov Moscow State Univ. (Russian Federation); **Jae-Hyuck Choi**, Korea Univ. (Korea, Republic of); **Andrey Bogdanov**, ITMO Univ. (Russian Federation); **Hong-Gyu Park**, Korea Univ. (Korea, Republic of); **Yuri Kivshar**, The Australian National Univ. (Australia) and ITMO Univ. (Russian Federation) . . . . . [11290-10]

9:30 am: **Frequency doubling in cavity-resonant integrated grating filters**, **Francois Renaud**, Aix Marseille Univ. (France); **Olivier Gauthier-Lafaye**, Antoine Monmayrant, Lab. d'Analyse et d'Architecture des Systèmes du CNRS (France); **Evgeni Popov**, Anne-Laure Fehrembach, Aix Marseille Univ. (France); **Stéphane Calvez**, Lab. d'Analyse et d'Architecture des Systèmes du CNRS (France) . . . . . [11290-11]

9:50 am: **Infrared limiters, diodes, and tunable filters (Invited Paper)**, **Mikhail A. Kats**, Univ. of Wisconsin-Madison (USA) . . . . . [11290-12]

Coffee Break. . . . . Tue 10:20 am to 10:50 am

WEDNESDAY 5 FEBRUARY

SESSION 4

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... TUE 10:50 AM TO 12:00 PM

ENZ and Anisotropic Metasurfaces

Session Chair: **Mikhail A. Kats**, Univ. of Wisconsin-Madison (USA)

10:50 am: **Nano-engineering of epsilon-near-zero optical nonlinearity on AZO meta-film** (*Invited Paper*), Howard Lee, Baylor Univ. (USA) ..... [11290-13]

11:20 am: **Metasurfaces for chiral surface wave propagation**, Sara Kandil, Dia'aaldin J. Bisharat, Dan Sievenpiper, Univ. of California, San Diego (USA) ..... [11290-14]

11:40 am: **Manipulating color-centers in atomically thin crystals with phase gradient metasurfaces**, Pankaj K. Jha, Ghazaleh K. Shirmanesh, Hamidreza Akbari, Meir Grajower, Benjamin Vest, Harry A. Atwater, Caltech (USA) ..... [11290-15]

Lunch/Exhibition Break ..... Tue 12:00 pm to 1:30 pm

SESSION 5

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... TUE 1:30 PM TO 3:10 PM

Integrated Photonic Metastructure Devices

Session Chair: **Giuseppe Leo**,

Lab. Matériaux et Phénomènes Quantiques (France)

1:30 pm: **On-chip wavefront shaping with dielectric metasurface** (*Invited Paper*), Tingyi Gu, Univ. of Delaware (USA) ..... [11290-16]

2:00 pm: **Integrated RF-photonic beamforming circuit using high-contrast grating delay-line waveguides**, Stephen Anderson, U.S. Army Combat Capabilities Development Command (USA) and Rensselaer Polytechnic Institute (USA); Amir Begović, Zhaoran R. Huang, Alexander Chen, Rensselaer Polytechnic Institute (USA); Weimin Zhou, U.S. Army Combat Capabilities Development Command (USA); Lingjun Jiang, MACOM (USA) ..... [11290-17]

2:20 pm: **Mid-wave infrared filtering in silicon subwavelength zero-contrast gratings**, Michael Barrow, Jamie Phillips, Univ. of Michigan (USA) ..... [11290-18]

2:40 pm: **Parametric down-conversion in semiconductor metasurfaces** (*Invited Paper*), Giuseppe Marino, Adrien Borne, Carlo Gigli, Univ. de Paris (France); Aristide Lemaître, Ctr. de Nanosciences et de Nanotechnologies (France) and CNRS (France) and Univ. Paris-Saclay (France); Alberto Artioli, Univ. Grenoble Alpes (France) and CEA-Grenoble (France); Jean-Michel Gérard, Univ. Grenoble Alpes (France); Giuseppe Leo, Univ. de Paris (France) ..... [11290-19]

Coffee Break ..... Tue 3:10 pm to 3:40 pm

SESSION 6

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... TUE 3:40 PM TO 5:40 PM

Metasurface/Metastructure: Design and Topological Concept

Session Chair: **Jonathan A. Fan**, Stanford Univ. (USA)

3:40 pm: **Global topology optimization neural networks for metasurface design** (*Invited Paper*), Jonathan A. Fan, Stanford Univ. (USA) ..... [11290-20]

4:10 pm: **Topological local-valley interface in ordinary photonic crystal waveguide**, Dia'aaldin J. Bisharat, Dan Sievenpiper, Univ. of California, San Diego (USA) ..... [11290-21]

4:30 pm: **Interface modes based on Zak phase for finite dielectric slabs**, Shreya Singh, Dia'aaldin J. Bisharat, Dan Sievenpiper, Univ. of California, San Diego (USA) ..... [11290-22]

4:50 pm: **Modeling of high-contrast metasurfaces and their performance in general optical system using fast physical optics**, Site Zhang, LightTrans International UG (Germany); Christian Hellmann, Wyrowski Photonics GmbH (Germany); Frank Wyrowski, Friedrich-Schiller-Univ. Jena (Germany) [11290-23]

5:10 pm: **Efficient pixel-by-pixel optimization of silicon photonic devices** (*Invited Paper*), Salim Boutami, CEA-LETI (France); Shanhui Fan, Stanford Univ. (USA) ..... [11290-24]

SESSION 7

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... WED 8:30 AM TO 10:10 AM

Metasurface Optics and Imaging I

Session Chair: **Andrei Faraon**, Caltech (USA)

8:30 am: **Matrix Fourier optics and full-Stokes polarization imaging with metasurfaces** (*Invited Paper*), Noah A. Rubin, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); Gabriele D'Aversa, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Paul Chevalier, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); Zhujun Shi, Harvard Univ. (USA); Wei Ting Chen, Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences (USA). [11290-25]

9:00 am: **Quantitative phase gradient microscope based on multifunctional metasurfaces**, Hyoungchan Kwon, Ehsan Arbabi, Mohammad Sadegh Faraji-Dana, Seyedeh Mahsa Kamali, Andrei Faraon, Caltech (USA) ..... [11290-26]

9:20 am: **Compact single-shot metalens depth sensors inspired by eyes of jumping spiders**, Zhujun Shi, Qi Guo, Yao-Wei Huang, Harvard Univ. (USA); Emma Alexander, Univ. of California, Berkeley (USA); Cheng-Wei Qiu, National Univ. of Singapore (Singapore); Federico Capasso, Todd Zickler, Harvard Univ. (USA) ..... [11290-27]

9:40 am: **Metalenses: field-of-view and aberration** (*Invited Paper*), Philippe Lalanne, Lab. Photonique, Numérique et Nanosciences (France) ..... [11290-28]

Coffee Break ..... Wed 10:10 am to 10:40 am

SESSION 8

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... WED 10:40 AM TO 12:10 PM

Metasurface Optics and Imaging II

Session Chair: **Philippe Lalanne**,

Lab. Photonique, Numérique et Nanosciences (France)

10:40 am: **Cascaded metasurface optics** (*Invited Paper*), Andrew McClung, Mahsa Torfeh, Babak Mirzapourbeinekalaye, Mahdad Mansouree, Sarath Samudrala, Amir Arbabi, Univ. of Massachusetts Amherst (USA) ..... [11290-29]

11:10 am: **Compact metasurface hyperspectral imaging system**, Andrew McClung, Sarath Samudrala, Amir Arbabi, Univ. of Massachusetts Amherst (USA) ..... [11290-30]

11:30 am: **Highly chromatic phase mask using reflective nanoresonators**, Mieke Boher, Julien Jaeck, Patrick Bouchon, Jérôme Primot, Riad Haidar, ONERA (France) ..... [11290-31]

11:50 am: **Ultrabroadband, high efficiency, and linear polarization achromatic meta-lens**, Abdoulaye Ndao, LiYi Hsu, Univ. of California, San Diego (USA); Boubacar Kante, Univ. of California, Berkeley (USA) ... [11290-32]

Lunch/Exhibition Break ..... Wed 12:10 pm to 1:40 pm

SESSION 9

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... WED 1:40 PM TO 3:20 PM

Metastructure Optics

Session Chair: **Amir Arbabi**, Univ. of Massachusetts Amherst (USA)

1:40 pm: **Metastructures consisting of cascaded high-contrast subwavelength gratings** (*Invited Paper*), Anthony Grbic, Luke Szymanski, Steve Young, Univ. of Michigan (USA) ..... [11290-33]

2:10 pm: **Enhancing near-ultraviolet circular dichroism and chirality-sorting optical forces using dielectric metasurfaces**, Kan Yao, Yuebing Zheng, The Univ. of Texas at Austin (USA) ..... [11290-34]

2:30 pm: **Spin-switched dielectric meta-hologram: information encoding and three-dimensional full-color scene reconstruction**, Hang Feng, Peking Univ. (China); Qitong Li, Stanford Univ. (USA); Fengliang Dong, Lihua Xu, National Ctr. for Nanoscience and Technology (China); Weiping Wan, Peking Univ. (China); Weiguo Chu, National Ctr. for Nanoscience and Technology (China); Mark L. Brongersma, Stanford Univ. (USA); Yan Li, Peking Univ. (China) ..... [11290-35]

2:50 pm: **Achromatic metasurface optics operating in the visible spectrum** (*Invited Paper*), Victor M. Acosta, The Univ. of New Mexico (USA) ... [11290-36]

Coffee Break ..... Wed 3:20 pm to 3:50 pm

OPTO

# CONFERENCE 11290

## SESSION 10

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... WED 3:50 PM TO 5:40 PM

### Metastructure Lasers, Modulators, and Detectors

Session Chair: **Victor M. Acosta**, The Univ. of New Mexico (USA)

3:50 pm: **Ultrafast photodetection with plasmonic metasurfaces** (*Invited Paper*), Maiken H. Mikkelsen, Duke Univ. (USA) ..... [11290-37]

4:20 pm: **Monolithic high-contrast gratings as planar focusing reflectors for VCSELs**, Paulina Komar, Lodz Univ. of Technology (Poland); Marcin Gębski, Lodz Univ. of Technology (Poland), Technische Univ. Berlin (Germany); Maciej Dems, Tomasz G. Czyszczanowski, Michał Wasiak, Lodz Univ. of Technology (Poland) ..... [11290-38]

4:40 pm: **Room-temperature fast amplitude modulator of mid-IR free-space laser beams**, Stefano Pirotta, Ngoc-Linh Tran, Ctr. de Nanosciences et de Nanotechnologies (France) and Univ. Paris Sud (France) and CNRS (France); Giorgio Biasiol, Istituto Officina dei Materiali, Consiglio Nazionale delle Ricerche (Italy); Paul Crozat, Jean-Michel Manceau, Adel Bousseksou, Raffaele Colombelli, Ctr. de Nanosciences et de Nanotechnologies (France) and Univ. Paris Sud (France) and CNRS (France) ..... [11290-39]

5:00 pm: **Optimization of monolithic high-contrast gratings**, Magdalena Marciniak, Lodz Univ. of Technology (Poland), Technische Univ. Berlin (Germany); Artur Broda, Institute of Electron Technology (Poland); Marcin Gębski, Lodz Univ. of Technology (Poland), Technische Univ. Berlin (Germany); Jan Muszalski, Łukasiewicz Research Network-Institute of Electron Technology (Poland); Michał Wasiak, Maciej Dems, Lodz Univ. of Technology (Poland); James A. Lott, Technische Univ. Berlin (Germany); Tomasz G. Czyszczanowski, Lodz Univ. of Technology (Poland) ..... [11290-40]

5:20 pm: **Monolithic deep-subwavelength grating integrated with metal as transparent electrode**, Tomasz G. Czyszczanowski, Adam K. Sokół, Maciej Dems, Michał Wasiak, Lodz Univ. of Technology (Poland) . . . . [11290-41]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Genetic optimization of highly polarization-selective broadband absorber of plasmonic metamaterial**, Shun Jiang, Fei Yi, Huazhong Univ. of Science and Technology (China) ..... [11290-59]

**Scalable approach to fiber-tip metastructures**, Anne Sauermann, Kaylee D. Hakkel, Luca Picelli, Francesco Pagliano, Technische Univ. Eindhoven (Netherlands); Nicolò Fiaschi, Technische Univ. Eindhoven (Netherlands) and Univ. degli Studi di Firenze (Italy); Gustav G. Lindgren, Ivana Sersic-Vollenbroek, Petrus J. van Veldhoven, Rob W. van der Heijden, Andrea Fiore, Technische Univ. Eindhoven (Netherlands) ..... [11290-60]

**Control of emission angle on 940-nm photonic crystal surface-emitting lasers with integrated metal gratings**, Lih-Ren Chen, National Chiao Tung Univ. (Taiwan) ..... [11290-61]

**Tailoring the enhanced transmission and absorption in 1D subwavelength semiconductor-based metamaterial high-contrast gratings**, Andrzej Gawlik, imec (Belgium) and KU Leuven (Belgium) and Wroclaw Univ. of Science and Technology (Poland); Janusz Bogdanowicz, imec (Belgium); Andreas Schulze, Applied Materials, Inc. (USA); Jan Misiewicz, Wroclaw Univ. of Science and Technology (Poland); Wilfried Vandervorst, imec (Belgium) ..... [11290-62]

## THURSDAY 6 FEBRUARY

## SESSION 11

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... THU 8:30 AM TO 10:00 AM

### Tunable Metasurfaces I

Session Chair: **Andrea Alù**,

The City Univ. of New York Advanced Science Research Ctr. (USA)

8:30 am: **Active and tunable dielectric nanoantennas and metasurfaces** (*Invited Paper*), Arseniy I. Kuznetsov, A\*STAR - Institute of Materials Research and Engineering (Singapore) ..... [11290-42]

9:00 am: **Electrically tunable filter based on plasmonic phase retarder and liquid crystals**, Luc Driencourt, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland); François Federspiel, Rolic Technologies Ltd. (Switzerland); Dimitrios Kazazis, Li-Ting Tseng, Yasin Ekinci, Paul Scherrer Institut (Switzerland); Richard Frantz, Rolic Technologies Ltd. (Switzerland); Rolando Ferrini, Benjamin Gallinet, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) ..... [11290-43]

9:20 am: **Tunable and reconfigurable high-index semiconductor meta-optics**, Tomer Lewi, Bar-Ilan Univ. (Israel) ..... [11290-44]

9:40 am: **Dynamic control of visible light with dielectric nanoantennas: towards next-gen spatial light modulators**, Shi-Qiang Li, Xuewu Xu, Rasna Maruthiyodan Veetil, Parikshit Moitra, Xinan Liang, Vytautas Valuckas, Ramón Paniagua-Dominguez, Arseniy I. Kuznetsov, Institute of Materials Research and Engineering (Singapore) ..... [11290-45]

Coffee Break ..... Thu 10:00 am to 10:30 am

## SESSION 12

LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... THU 10:30 AM TO 12:10 PM

### Tunable Metasurfaces II

Session Chair: **Arseniy I. Kuznetsov**, A\*STAR - Data Storage Institute (Singapore)

10:30 am: **TMD-based metasurfaces** (*Invited Paper*), Andrea Alù, Ahmed Mekkawy, The City Univ. of New York Advanced Science Research Ctr. (USA) ..... [11290-46]

11:00 am: **Holographic metasurfaces multiplexed by surrounding media**, Haogang Cai, James Dolan, David Czuplewski, Alex Martinson, Daniel López, Argonne National Lab. (USA) ..... [11290-53]

11:20 am: **Fano-resonance based tunable all-dielectric metasurfaces**, Keshav Samrat Modi, Academy of Scientific & Innovative Research (India) and CSIR - Central Scientific Instruments Organisation (India); Jasleen Kaur, Satya Pratap Singh, Umesh Tiwari, Ravindra Kumar Sinha, CSIR - Central Scientific Instruments Organisation (India) ..... [11290-48]

11:40 am: **Nonlinear metasurfaces for generation and manipulation of THz waves** (*Invited Paper*), Tal Ellenbogen, Tel Aviv Univ. (Israel) ..... [11290-49]

Lunch/Exhibition Break ..... Thu 12:10 pm to 1:40 pm

**SESSION 13**

**LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... THU 1:40 PM TO 3:00 PM**

**Metastructure Waveguides**

Session Chair: **Aurelien Romain Dantan**, Aarhus Univ. (Denmark)

1:40 pm: **Enhancing transverse spin through structural asymmetry in ordinary dielectric waveguides**, Shreya Singh, Dia'aaldin J. Bisharat, Dan Sievenpiper, Univ. of California, San Diego (USA) ..... [11290-50]

2:00 pm: **High-resolution single-shot refractive index variation measurement using quadriwave lateral shearing interferometry**, Antoine Federici, Sherazade Aknoun, William Boucher, Benoit Wattellier, PHASICS S.A. (France) ..... [11290-51]

2:20 pm: **Silicon-based high-contrast waveguides for visible light**, Darius Urbonas, Rainer F. Marth, Thilo Stöferle, IBM Research - Zürich (Switzerland) ..... [11290-52]

2:40 pm: **Silicon subwavelength waveguiding devices**, Iñigo Molina-Fernández, Juan G. Wangüemert-Perez, Alejandro Ortega-Moñuz, Robert Halir, Jose de Oliva Rubio, Alejandro Sánchez-Postigo, José M. Luque-González, Daniel Pereira-Martín, Univ. de Málaga (Spain); David Gonzalez-Andrade, Instituto de Óptica “Daza de Valdés”, Consejo Superior de Investigaciones Científicas (Spain); Aitor V. Velasco, Instituto de Óptica “Daza de Valdés” (Spain); Alaine Herrero-Bermello, Instituto de Óptica “Daza de Valdés”, Consejo Superior de Investigaciones Científicas (Spain); Jens H. Schmid, Pavel Cheben, National Research Council Canada (Canada); Jiry Čtyroký, Institute of Photonics and Electronics of the CAS, v.v.i. (Czech Republic) ..... [11290-54]

Coffee Break. .... Thu 3:00 pm to 3:30 pm

**SESSION 14**

**LOCATION: ROOM 301 (LEVEL 3 SOUTH) ..... THU 3:30 PM TO 5:00 PM**

**Emerging Applications**

Session Chair: **Tal Ellenbogen**, Tel Aviv Univ. (Israel)

3:30 pm: **Nanostructured trampoline microcavities for sensing and optomechanics** (*Invited Paper*), Aurelien Dantan, Aarhus Univ. (Denmark) ..... [11290-55]

4:00 pm: **Transdimensional photonic lattices and van der Waals metasurfaces with hyperbolic-medium antennas**, Viktoriia E. Babicheva, The Univ. of New Mexico (USA) ..... [11290-56]

4:20 pm: **Achieving high numerical aperture near-infrared imaging based on an ultrathin cylinder dielectric metalens**, Kuo-Feng Lin, VisEra Technologies, Inc. (Taiwan) ..... [11290-57]

4:40 pm: **High-contrast grating based broadband thermal filters for thermophotovoltaic applications**, Surendra V. N. Gupta, Academy of Scientific & Innovative Research (India); Bala Pesala, Council of Scientific & Industrial Research (India); Anand Veeraragavan, The Univ. of Queensland (Australia); Ameen E., Academy of Scientific & Innovative Research (India) ..... [11290-58]

**OPTO**

**Photonics West Industry Stage**

Tuesday - Thursday • Hall DE  
Keynotes and panels open to all attendees  
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# CONFERENCE 11291

LOCATION: ROOM 304 (LEVEL 3 SOUTH)

Wednesday 5 February 2020 • Proceedings of SPIE Vol. 11291

# Quantum Dots, Nanostructures, and Quantum Materials: Growth, Characterization, and Modeling XVII

Conference Chairs: **Diana L. Huffaker**, Cardiff Univ. (United Kingdom); **Holger Eisele**, Technische Univ. Berlin (Germany)

Program Committee: **Mark Fox**, The Univ. of Sheffield (United Kingdom); **Bruno Grandier**, Institut Supérieur d'Electronique du Nord (France), Institut d'Electronique de Microélectronique et de Nanotechnologie, CNRS (France); **Hyunseok Kim**, Massachusetts Institute of Technology (USA); **Gunter Larisch**, Chinese Academy of Sciences (China), Changchun Institute of Optics (China); **Andrea Lenz**, Technische Univ. Berlin (Germany); **Baolai L. Liang**, California NanoSystems Institute (USA); **Huiyun Liu**, Univ. College London (United Kingdom); **Qihua Xiong**, Nanyang Technological Univ. (Singapore)

## WEDNESDAY 5 FEBRUARY

### SESSION 1

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... WED 8:00 AM TO 10:10 AM

#### Quantum Dots

Session Chair: **Diana L. Huffaker**, Cardiff Univ. (United Kingdom)

8:00 am: **Quantum-dot light sources for silicon photonics** (*Invited Paper*), Yasuhiko Arakawa, Jinkwan Kwoen, Yasutomo Ota, Ryota Katsumi, Satoshi Iwamoto, The Univ. of Tokyo (Japan) ..... [11291-1]

8:30 am: **Efficient single-photon sources at telecom wavelength with fiber-optic interface**, Chang-Min Lee, Mustafa Atabay Buyukkaya, Shahriar Aghaeimeibodi, Univ. of Maryland, College Park (USA); Christopher J. K. Richardson, Lab. for Physical Sciences (USA); Edo Waks, Univ. of Maryland, College Park (USA) ..... [11291-2]

8:50 am: **Investigations on heterogeneously coupled submonolayer (SML) on Stranski-Krastanov (SK) quantum-dot heterostructures with higher (0.1ML/sec) and lower (0.05ML/sec) growth rates**, Samesta Samesta, Jhuma Saha, Debabrata Das, Debi Prasad Panda, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) ..... [11291-3]

9:10 am: **Impact of growth rate variabilities of quantum dots and capping layer on photoluminescence of epitaxially grown near-surface InAs quantum dots**, Manas R. Mantri, Debi Prasad Panda, Sanowar Alam Gazi, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) ..... [11291-4]

9:30 am: **Evaluation of internal quantum efficiency of InAs quantum dots using power-dependent photoluminescence measurements**, Chibuzo Onwukaeme, Guen-Hwan Ryu, Inha Univ. (Korea, Republic of); Jin-Dong Song, Won-Jun Choi, Korea Institute of Science and Technology (Korea, Republic of); Han-Youl Ryu, Inha Univ. (Korea, Republic of) ... [11291-5]

9:50 am: **Directed self-assembly of InAs quantum dots using in-situ interference lithography**, Mark Hopkinson, Yunran Wang, Im Sik Han, Saraswati Behera, Chaoyuan Jin, The Univ. of Sheffield (United Kingdom) ..... [11291-6]

Coffee Break ..... Wed 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... WED 10:40 AM TO 12:40 PM

#### Devices

Session Chair: **David J. Mowbray**, The Univ. of Sheffield (United Kingdom)

10:40 am: **Ultrafast photodetectors based on high-mobility indium gallium antimonide nanowires** (*Invited Paper*), Johnny Ho, City Univ. of Hong Kong (Hong Kong, China) ..... [11291-7]

11:10 am: **Metal-oxide control of exciton-plasmon coupling**, Seyed M. Sadeghi, Waylin Wing, The Univ. of Alabama in Huntsville (USA) ..... [11291-8]

11:30 am: **Long-wave infrared InAs/InAsSb superlattices**, Arezou Khoshakhlagh, Linda Høglund, David Ting, Sarath Gunapala, Jet Propulsion Lab. (USA) ..... [11291-9]

11:50 am: **On-chip generation of near-unity indistinguishability single photons from in-plane integrated quantum-dot waveguide devices**, Lukasz Dusanowski, Dominik Köck, Julius-Maximilians-Univ. Würzburg (Germany); Soon-Hong Kwon, Chung-Ang Univ. (Korea, Republic of); Christian Schneider, Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany) ..... [11291-10]

12:10 pm: **SWIR and MIR emission and detection using an all-group IV platform** (*Invited Paper*), Simone Assali, Anis Attiaoui, Salim Abdi, Mahmood Atalla, Étienne Bouthillier, Lu Luo, Léonor Groell, Jérôme Nicolas, Ecole Polytechnique de Montréal (Canada); Samik Mukherjee, Sebastian Koelling, Oussama Moutanabbir, Polytechnique Montréal (Canada) ..... [11291-40]

Lunch/Exhibition Break ..... Wed 12:40 pm to 1:40 pm

### SESSION 3

LOCATION: ROOM 304 (LEVEL 3 SOUTH) ..... WED 1:40 PM TO 4:00 PM

#### Optical Properties and Novel Materials

Session Chair: **Johnny Ho**, City Univ. of Hong Kong (Hong Kong, China)

1:40 pm: **Novel van der Waals heterostructures based on alloys of transitional metal dichalcogenides and machine vision methods for large scale optical analysis of mono- and bi-layers** (*Invited Paper*), Armando Genco, Alessandro Catanzaro, The Univ. of Sheffield (United Kingdom); Aleksey Kozikov, The Univ. of Manchester (United Kingdom); Luca Sortino, Charalambos Louca, Daniel Gillard, Evgeny Alexeev, Toby Severs Millard, Sam Randerson, The Univ. of Sheffield (United Kingdom); Riccardo Pisoni, ETH Zurich (Switzerland); Lee Hague, The Univ. of Manchester (United Kingdom); Klaus Einsslin, ETH Zurich (Switzerland); A-rang Jang, Seongjoon Ahn, Hyeon Suk Shin, Ulsan National Institute of Science and Technology (Korea, Republic of); Alexander I. Tartakovskii, The Univ. of Sheffield (United Kingdom) [11291-41]

2:10 pm: **Efficient boundary conditions for quantum finite-difference time-domain method in nanoscale systems** (*Invited Paper*), Haotian Xue, Ankhitha Manjunatha, Ronak J. Singh, Nelson Tansu, Lehigh Univ. (USA) ..... [11291-11]

2:40 pm: **Characterization of antiphase boundaries in GaP layers grown on Si(001)**, Andrea Lenz, Pascal Farin, Mario Dähne, Holger Eisele, Technische Univ. Berlin (Germany) ..... [11291-36]

3:00 pm: **Single-crystal metal thin films for photonics applications**, Su Jae Kim, Pusan National Univ. (Korea, Republic of); Yong In Kim, Sungkyunkwan Univ. (Korea, Republic of); Miyeon Cheon, Pusan National Univ. (Korea, Republic of); Young Hee Lee, Sungkyunkwan Univ. (Korea, Republic of); Seong-Gon Kim, Mississippi State Univ. (USA); Young-Min Kim, Sungkyunkwan Univ. (Korea, Republic of); Se-Young Jeong, Pusan National Univ. (Korea, Republic of) ..... [11291-13]

3:20 pm: **Resonant energy transfer properties of perovskite nanocrystals**, Peter J. Shaw, Thomas M. Mercier, Christopher Bailey, Giacomo Piana, Antonios G. Kanaras, Pavlos G Lagoudakis, Martin D. B. Charlton, Univ. of Southampton (United Kingdom) ..... [11291-14]

3:40 pm: **Transition metal-alloyed halide perovskite nanocrystals for solid-state lighting**, Peifen Zhu, Saroj Thapa, Gopi Adhikari, Hongyang Zhu, The Univ. of Tulsa (USA) ..... [11291-15]

Coffee Break ..... Wed 4:00 pm to 4:20 pm

**SESSION 4**

**LOCATION: ROOM 304 (LEVEL 3 SOUTH) . . . . . WED 4:20 PM TO 6:20 PM**

**Novel Nano Structures**

Session Chair: **Mark Hopkinson**,  
The Univ. of Sheffield (United Kingdom)

4:20 pm: **GaAsP nanowires containing intentional and self-forming quantum** (*Invited Paper*), David J. Mowbray, Anton V. Velychko, George D. Davis, The Univ. of Sheffield (United Kingdom); Yunyan Zhang, Huiyun Liu, Univ. College London (United Kingdom); Aruni Fonseka, James A. Gott, Ana M. Sanchez, Richard Beanland, The Univ. of Warwick (United Kingdom) . . . . . [11291-16]

4:50 pm: **A needle in a needlestack: exploiting functional inhomogeneity for optimized nano-optoelectronics** (*Invited Paper*), Patrick Parkinson, Juan A. Alanis, Stefan Skalsky, The Univ. of Manchester (United Kingdom); Yunyan Zhang, Huiyun Liu, Univ. College London (United Kingdom); Mykhaylo Lysevych, Hark H. Tan, Chennupati Jagadish, The Australian National Univ. (Australia) . . . . . [11291-37]

5:20 pm: **Optical reflectance-based software for automated characterization of 2D materials**, Vu Nguyen, Hayden Taylor, Univ. of California, Berkeley (USA) . . . . . [11291-17]

5:40 pm: **Raman spectroscopy of two-dimensional van der Waals heterostructures**, Ping-Heng Tan, Institute of Semiconductors (China) . . . . . [11291-18]

6:00 pm: **Novel synthesis of graphene quantum dots using L-Aspartic acid**, Suparnaaya Prasad, Massachusetts Institute of Technology (USA) . . . . . [11291-19]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Enhanced optical performance through growth strategy in coupled InAs P-i-P QDIPs**, Suryansh Dongre, Debi Prasad Panda, Sanowar Alam Gazi, Debabrata Das, Ravinder Kumar, Nivedita Pandey, Abhishek Kumar, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11291-20]

**Optimization of strain-coupled InAs QD layers in P-i-P infrared photodetector heterostructures**, Suryansh Dongre, Debi Prasad Panda, Sanowar Alam Gazi, Debabrata Das, Ravinder Kumar, Abhishek Kumar, Nivedita Pandey, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11291-21]

**Submonolayer quantum dots in P-I-P configuration: study on effects of monolayer coverage and stacking variations**, Suryansh Dongre, Debi Prasad Panda, Sanowar Alam Gazi, Debabrata Das, Ravinder Kumar, Nivedita Pandey, Abhishek Kumar, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11291-22]

**Selective hydrothermal growth of MnO<sub>2</sub> nanostructures using laser under ambient conditions**, Suwon Hwang, Heejung Kong, Tae Seung Hwang, Junyeob Yeo, Kyungpook National Univ. (Korea, Republic of) . . . . . [11291-23]

**Optoelectronic properties of arginine-doped tungsten disulfide quantum dots synthesized via microwave heating**, Svetta Reina Merden S. Santiago, Chih-Ying Weng, Tzu-Neng Lin, Ji-Lin Shen, Chung Yuan Christian Univ. (Taiwan) . . . . . [11291-24]

**Synthesis and optical properties of cadmium-based perovskite nanocrystals**, Peter J. Shaw, Pavlos G. Lagoudakis, Antonios G. Kanaras, Martin D. B. Charlton, Univ. of Southampton (United Kingdom) . . . . . [11291-25]

**Determination of the first-order hyperpolarizability anisotropy of spherical and cubic magnetic nanoparticles**, Eduardo S. Gonçalves, Instituto de Física, Univ. de São Paulo (Brazil); Leandro Cocca, Instituto de Física de São Carlos (Brazil); Wagner Wlysses, Instituto de Física, Univ. de São Paulo (Brazil); Kinnari Parekh, Charotar Univ. of Science and Technology (CHARUSAT) (India); Cristiano Oliveira, Antônio M. Figueiredo Neto, Instituto de Física, Univ. de São Paulo (Brazil); Leonardo De Boni, Instituto de Física de São Carlos (Brazil) . . . . . [11291-26]

**Snap-shooting the phase transition: thermoelectric studies of long-lived mixed states in 1T-TaS<sub>2</sub>**, Katarzyna Ludwiczak, Ewa Laciniska, Johannes Binder, Univ. of Warsaw (Poland); Iaroslav Lutsyk, Maciej Rogala, Pawel Dabrowski, Zbigniew Klusek, Univ. of Lodz (Poland); Roman Stepniowski, Andrzej Wyszomolek, Univ. of Warsaw (Poland) . . . . . [11291-27]

**Controlling migration kinetics of Ga atoms for formation of GaN nanowires with various shapes**, Siyun Noh, Ilgyu Choi, Sangmoon Han, Hohyun Yang, Chonbuk National Univ. (Korea, Republic of); Mee-Yi Ryu, Kangwon National Univ. (Korea, Republic of); Jin Soo Kim, Chonbuk National Univ. (Korea, Republic of) . . . . . [11291-28]

**Two-photon absorption by spherical and cubic magnetic nanoparticles: external magnetic field effects on ultrafast and magnitude measurements**, Eduardo S. Gonçalves, Wagner Wlysses, Instituto de Física, Univ. de São Paulo (Brazil); Kinnari Parekh, Charotar Univ. of Science and Technology (CHARUSAT) (India); Jonathas Siqueira, Cleber Mendonça, Instituto de Física de São Carlos (Brazil); Antônio M. Figueiredo Neto, Univ. de São Paulo (Brazil); Leonardo De Boni, Instituto de Física de São Carlos (Brazil) . . . . . [11291-29]

**A comparative analysis between heterogeneously coupled Stranski-Krastanov (SK) on submonolayer (SML) and submonolayer (SML) on Stranski-Krastanov (SK) quantum-dot heterostructures**, Samesta Samesta, Jhuma Saha, Binita Tongbram, Debi Prasad Panda, Debabrata Das, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11291-30]

**Optical and structural behaviour of InAs quantum dots grown on the Si substrate without Si buffer layer and migration-enhanced epitaxy layer**, Ravinder Kumar, Debi Prasad Panda, Sanowar Alam Gazi, Suryansh Dongre, Jhuma Saha, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11291-31]

**Chaotic approach to disorder in photonic bandgap structures**, Changkee Hong, Xinhang Zhang, Hossein Alisafaei, Azad Siahmakoun, Rose-Hulman Institute of Technology (USA) . . . . . [11291-33]

**Optical metrology for nanowires grown with molecular beam epitaxy**, Jonas Madsen, DFM A/S (Denmark) . . . . . [11291-34]

**Effects of external factors on optical properties of two different quantum dots with excitonic system**, Suman Dahiya, Delhi Technological Univ. (India) . . . . . [11291-35]

**Optical properties of hybrid films of inhomogeneous ensemble of gold nanoparticles coated by cyanine J-aggregates**, Rezida Nabiullina, Anton A. Starovoytov, Igor A. Gladskikh, ITMO Univ. (Russian Federation) . . . . . [11291-38]

**Studying the effect of the substrate in metal-enhanced chemiluminescence**, Daler R. Dadadzhyanov, ITMO Univ. (Russian Federation) and Ben-Gurion University of the Negev (Israel); Tigran A. Vartanyan, ITMO Univ. (Russian Federation); Alina Karabchevsky, Ben-Gurion Univ. of the Negev (Israel) . . . . . [11291-39]

**OPTO**

# CONFERENCE 11292

LOCATION: ROOM 213 (LEVEL 2 SOUTH)

Sunday–Wednesday 2–5 February 2020 • Proceedings of SPIE Vol. 11292

## Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIII

*Conference Chairs:* **Georg von Freymann**, Technische Univ. Kaiserslautern (Germany); **Eva Blasco**, Karlsruher Institut für Technologie (Germany); **Debashis Chanda**, Univ. of Central Florida (USA)

*Program Committee:* **Cornelia Denz**, Münster Univ. (Germany); **Ruth Houbertz**, Multiphoton Optics GmbH (Germany); **Saulius Juodkazis**, Swinburne Univ. of Technology (Australia); **Stephen M. Kuebler**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Mangirdas Malinauskas**, Vilnius Univ. (Lithuania); **Robert R. McLeod**, Univ. of Colorado at Boulder (USA); **Hernán R. Míguez**, Institute of Materials Science of Seville (Spain); **Aaron J. Pung**, Clemson Univ. (USA); **John A. Rogers**, Univ. of Illinois at Urbana-Champaign (USA); **Raymond C. Rumpf**, The Univ. of Texas at El Paso (USA); **Winston V. Schoenfeld**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Thomas J. Suleski**, The Univ. of North Carolina at Charlotte (USA); **Michael Thiel**, Nanoscribe GmbH (Germany); **Sandra Wolff**, Technische Univ. Kaiserslautern (Germany)

*Conference Co-Sponsor:*



### SESSION 1

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SUN 8:10 AM TO 10:00 AM

#### Microoptics: Sensors and Concentrators

Session Chair: **Debashis Chanda**, Univ. of Central Florida (USA)

8:10 am: **Harnessing femtosecond laser filaments for nano-structuring of “Lab-in-Fibre” sensors and “Spectrometer-in-Fibre” microsystems** (*Invited Paper*), Peter R. Herman, Ehsan Alimonhammadian, Keivan M. Aghdami, Erden Ertorer, Young Hwan Kim, Jianzhao Li, Abdullah Rahnama, Univ. of Toronto (Canada) ..... [11292-1]

8:40 am: **A liquid- infiltrated-based temperature sensor with large lateral offset**, Yundong Zhang, Ying Guo, Fuxing Zhu, Kaiyue Qi, Harbin Institute of Technology (China) ..... [11292-2]

9:00 am: **Fabrication and replication of high efficiency blazed gratings with grayscale electron beam lithography and UV nanoimprint lithography**, Marie-Aline Mattelin, Ana Radosavljevic, Jeroen Missinne, Dieter Cuypers, Ctr. for Microsystems Technology (Belgium); Sander Kommeren, Morphotonics B.V. (Netherlands); Jos Vandael, Zweko Optics BVBA (Belgium); Jan Matthijs ter Meulen, Morphotonics B.V. (Netherlands); Luc Verduyck, Zweko Optics BVBA (Belgium); Geert Van Steenberge, Ctr. for Microsystems Technology (Belgium) ..... [11292-3]

9:20 am: **Femtosecond laser inscribed advanced calibration phantom for optical coherence tomography (OCT)**, Yang Lu, Neil Gordon, Aston Univ. (United Kingdom); Benjamin Coldrick, Optimec Ltd. (United Kingdom); Izzati Ibrahim, Aston Univ. (United Kingdom) and Optimec Ltd. (United Kingdom); Vladimir Mezentsev, Aston Univ. (United Kingdom); David Robinson, Arden Photonics Ltd. (United Kingdom); Kate Sugden, Aston Univ. (United Kingdom) ..... [11292-4]

9:40 am: **Direct laser writing of optical field concentrators based on chirped three-dimensional photonic crystals**, Vygantas Mizeikis, Shizuoka Univ. (Japan); Zeki Hayran, Hamza Kurt, TOBB ETÜ (Turkey); Mirbek Turduev, TED Univ. (Turkey); Darius Gailevicius, Mangirdas Malinauskas, Vilnius Univ. (Lithuania); Saulius Juodkazis, Swinburne Univ. of Technology (Australia); Kestutis Staliunas, Institució Catalana de Recerca i Estudis Avançats (Spain) ..... [11292-5]

Coffee Break ..... Sun 10:00 am to 10:30 am

### SESSION 2

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SUN 10:30 AM TO 12:10 PM

#### Plasmonics

Session Chair: **Wolfram H.P. Pernice**, Westfälische Wilhelms-Univ. Münster (Germany)

10:30 am: **Fabrication of plasmonic slot waveguides in single-crystalline gold films and freestanding photonic metasurfaces by focused ion beam milling** (*Invited Paper*), Stefan Linden, Rheinische Friedrich-Wilhelms-Univ. Bonn (Germany) ..... [11292-6]

11:00 am: **Novel features of plasmon-assisted solid-state lasers at the nanoscale** (*Invited Paper*), Luisa Bausa, Univ. Autónoma de Madrid (Spain) ..... [11292-7]

11:30 am: **Optical tweezers for micro- and nano-assembly**, Jeffrey E. Melzer, Euan McLeod, Wyant College of Optical Sciences (USA) ..... [11292-8]

11:50 am: **Strongly-coupled, high-quality plasmonic nanoantennas fabricated using a sketch and peel fabrication technique**, Martin Silies, Moritz Gittinger, Carl von Ossietzky Univ. Oldenburg (Germany); Katja Höflich, Helmholtz-Zentrum Berlin für Materialien und Energie (Germany); Vladimir Smirnov, Heiko Kollmann, Christoph Lienau, Carl von Ossietzky Univ. Oldenburg (Germany) ..... [11292-9]

Lunch/BiOS Expo Break ..... Sun 12:10 pm to 1:40 pm

### SESSION 3

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SUN 1:40 PM TO 3:10 PM

#### Metasurfaces

Session Chair: **Stefan Linden**, Rheinische Friedrich-Wilhelms-Univ. Bonn (Germany)

1:40 pm: **High NA silicon metalenses for wide-field imaging** (*Invited Paper*), Thomas F. Krauss, Univ. of York (United Kingdom) ..... [11292-10]

2:10 pm: **3D-printed miniature spectrometer**, Andrea Toulouse, Simon Thiele, Johannes Drozella, Institut für Technische Optik (Germany); Harald Giessen, Univ. Stuttgart (Germany); Alois Herkommer, Institut für Technische Optik (Germany) ..... [11292-56]

2:30 pm: **Self-assembled glass-based Fano resonant metasurfaces**, Louis Martin-Monier, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11292-12]

2:50 pm: **New methods for fabrication, trapping and printing of resonant spherical silicon nanoparticles in monodisperse solutions**, Vytautas Valuckas, Ramón Paniagua-Domínguez, Institute of Materials Research and Engineering (Singapore); Aili Maimaiti, Partha Pratim Patra, Chalmers Univ. of Technology (Sweden); Seng Kai Wong, Institute of Materials Research and Engineering (Singapore); Ruggero Verre, Mikael Käll, Chalmers Univ. of Technology (Sweden); Arseniy I. Kuznetsov, Institute of Materials Research and Engineering (Singapore) ..... [11292-13]

Coffee Break ..... Sun 3:10 pm to 3:40 pm

**SESSION 4**

**LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... SUN 3:40 PM TO 5:50 PM**

**Novel Materials**

Session Chair: **Christophe Moser**, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

3:40 pm: **Spatially-targeted laser fabrication of multimaterial microstructures in hydrogel** (*Invited Paper*), Mitsuhiro Terakawa, Manan Machida, Kosuke Mizuguchi, Ryo Sano, Hiroaki Onoe, Keio Univ. (Japan); Takuro Niidome, Kumamoto Univ. (Japan); Alexander Heisterkamp, Leibniz Univ. Hannover (Germany). ..... [11292-14]

4:10 pm: **Light as a tool for 3D additive and subtractive manufacturing on the microscale, with a single photoresist**, Tobias Messer, Rhiannon Batchelor, Marc Hippler, Karlsruher Institut für Technologie (Germany); Christopher Barner-Kowollik, Queensland Univ. of Technology (Australia); Martin Wegener, Eva Blasco, Karlsruher Institut für Technologie (Germany) ..... [11292-15]

4:30 pm: **Multiphoton 3D laser printing of nanoporous architectures**, Frederik Mayer, Karlsruher Institut für Technologie (Germany); Daniel Ryklin, Ruprecht-Karls-Univ. Heidelberg (Germany); Martin Calkovsky, Zheqin Dong, Karlsruher Institut für Technologie (Germany); Irene Wacker, UniversitätsKlinikum Heidelberg (Germany); Pavel Levkin, Dagmar Gerthsen, Karlsruher Institut für Technologie (Germany); Rasmus R. Schröder, Ruprecht-Karls-Univ. Heidelberg (Germany); Martin Wegener, Karlsruher Institut für Technologie (Germany). ..... [11292-16]

4:50 pm: **UV-curing materials for wafer level optics**, Patrick Heissler, Markus Brehm, Isabel Pilottek, DELO Industrie Klebstoffe GmbH & Co. KGaA (Germany) ..... [11292-17]

5:10 pm: **Biologically inspired methods for volumetric deposition of colloidal materials for 3D nano-fabrication of optics and photonics.**, Daniel Oran, Gaojie Yang, Rachel Weisman, Massachusetts Institute of Technology (USA); Edward Boyden, MIT Media Lab. (USA). ..... [11292-19]

5:30 pm: **Realization of high-quality polymeric photonic structures by two-photon polymerization**, Lei Zheng, Bernhard Roth, Leibniz Univ. Hannover (Germany) ..... [11292-55]

**MONDAY 3 FEBRUARY**

**OPTO PLENARY SESSION**

**LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) .... MON 8:00 AM TO 10:05 AM**

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre** (*Plenary*)  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe** (*Plenary*)  
Erik P. A. M. Bakkers, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing** (*Plenary*)  
**Trond Wuellner**, Google (USA)

Coffee Break. .... Mon 10:05 am to 10:30 am

**SESSION 5**

**LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... MON 10:30 AM TO 12:10 PM**

**3D Circuits and Emitters**

Session Chair: **Georg von Freymann**, Technische Univ. Kaiserslautern (Germany)

10:30 am: **Realization of functional nanophotonic circuits by hybrid 2D-3D integration** (*Invited Paper*), Wolfram H. P. Pernice, Westfälische Wilhelms-Univ. Münster (Germany). ..... [11292-20]

11:00 am: **Photonic materials tailor the emission of rare-earth nanophosphors** (*Invited Paper*), Gabriel Sebastián Lozano Barbero, Instituto de Ciencia de Materiales de Sevilla (Spain) ..... [11292-21]

11:30 am: **Three-dimensional fused silica templates to fabricate integrated photonic platforms**, Abhishek Kottaram Amrithanath, Sridhar Krishnaswamy, Northwestern Univ. (USA) ..... [11292-22]

11:50 am: **Trapping single photon emitters onto ion-exchanged waveguide by two-photo polymerization**, Xiaolun Xu, Lab. de Nanotechnologie et Instrumentation Optique, CNRS, Univ. de Technologie Troyes (France); Tiziana Ritacco, Istituto di Nanotecnologia, Consiglio Nazionale delle Ricerche (Italy) and Univ. della Calabria (Italy); Aurélie Broussier, Lab. de Nanotechnologie et Instrumentation Optique, CNRS, Univ. de Technologie Troyes (France); Fabien Geoffroy, Grégoire Souhaité, Teem Photonics (France); Ali Issa, Safi Jradi, Renaud Bachelot, Christophe Couteau, Sylvain Blaize, Lab. de Nanotechnologie et Instrumentation Optique, CNRS, Univ. de Technologie Troyes (France) ..... [11292-23]

Lunch Break ..... Mon 12:10 pm to 1:40 pm

**SESSION 6**

**LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... MON 1:40 PM TO 3:30 PM**

**Large Area Optics**

Session Chair: **Lauren D. Zarzar**, The Pennsylvania State Univ. (USA)

1:40 pm: **Adhesion properties of polymeric microstructures fabricated by two-photon polymerization** (*Invited Paper*), Tommaso Baldacchini, Chapman Univ. (USA); Yunfei Zhang, Cameron Crook, Lorenzo Valdevit, Univ. of California, Irvine (USA) ..... [11292-24]

2:10 pm: **Microscope projection photolithography of functional polymeric optical micro- and nanocomponents**, Lei Zheng, Leibniz Univ. Hannover (Germany); Carsten Reinhardt, Hochschule Bremen Univ. of Applied Sciences (Germany); Bernhard Roth, Leibniz Univ. Hannover (Germany) ..... [11292-25]

2:30 pm: **Freeform microlens arrays: Current and future challenges**, Oscar Fernández, Tamara Aderneuer, Rolando Ferrini, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) ..... [11292-26]

2:50 pm: **Direct nanoimprinted inorganic nano-photonics by Substrate Conformal Imprint Lithography**, Marc A. Verschuuren, Rob Voorkamp, Philips SCIL Nanoimprint Solutions (Netherlands) ..... [11292-27]

3:10 pm: **172 nm patterning of optical components on polymers**, Andrey E. Mironov, Dane J. Sievers, Univ. of Illinois (USA) and Cygnus Photonics (USA); Austin W. Steinforth, Jinhong Kim, Univ. of Illinois (USA); Sung-Jin Park, J. Gary Eden, Univ. of Illinois (USA) and Cygnus Photonics (USA) ..... [11292-28]

Coffee Break. .... Mon 3:30 pm to 4:00 pm

**SESSION 7**

**LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... MON 4:00 PM TO 5:20 PM**

**DLW: Sensing and Waveguides**

Session Chair: **Tommaso Baldacchini**, Newport Corp., a division of MKS Instruments (USA)

4:00 pm: **Reversible deformations in laser-written polymeric microstructures: New platform for sensing and micro-actuation applications** (*Invited Paper*), Domas Paipulas, Sima Reksštytė, Titas Tičkunas, Mangirdas Malinauskas, Vilnius Univ. (Lithuania); Vyngantas Mizeikis, Shizuoka Univ. (Japan) ..... [11292-29]

4:30 pm: **Two-photon polymerisation with anisotropic materials** (*Invited Paper*), Patrick S. Salter, Univ. of Oxford (United Kingdom) .. [11292-30]

5:00 pm: **Direct laser writing of waveguides using the exposure dependent polymerization of IP-Dip**, Christina Jörg, Julian Schulz, Technische Univ. Kaiserslautern (Germany); Georg von Freymann, Technische Univ. Kaiserslautern (Germany) and Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ..... [11292-31]

**SESSION 8**

**LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... MON 5:20 PM TO 6:10 PM**

**DLW: Structural Colors**

Session Chair: **Tommaso Baldacchini**, Univ. of California, Irvine (USA)

5:20 pm: **Structural coloration by cascading total internal reflection and interference at microscale concave interfaces** (*Invited Paper*), Amy Goodling, The Pennsylvania State Univ. (USA); Sara Nagelberg, Massachusetts Institute of Technology (USA); Bryan J. Kaehr, Sandia National Labs. (USA); Caleb Meredith, Seong Ik Cheon, Ashley Saunders, The Pennsylvania State Univ. (USA); Mathias Kolle, Massachusetts Institute of Technology (USA); Lauren Zarzar, The Pennsylvania State Univ. (USA) ..... [11292-32]

5:50 pm: **Design and fabrication of bio-inspired nanostructures exhibiting structural coloration**, Bianca C. Datta, MIT Media Lab. (USA); Christine Ortiz, Massachusetts Institute of Technology (USA) ..... [11292-33]



# CONFERENCE 11292

## SESSION 9

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... TUE 8:20 AM TO 10:10 AM

### DLW: Microoptics and Metals

Joint Session with Conferences 11271 and 11292

Session Chair: **Georg von Freymann**,  
Technische Univ. Kaiserslautern (Germany)

8:20 am: **3D printed micro-optics: Millimeter size, multiple materials, and combining refractive and diffractive imaging leads to novel functionalities** (*Invited Paper*), Harald Giessen, Univ. Stuttgart (Germany) ..... [11292-34]

8:50 am: **3D printing of transparent glass**, Frederik Kotz, Bastian E. Rapp, Dorothea Helmer, Univ. of Freiburg (Germany) ..... [11271-1]

9:10 am: **Fabrication and characterization of 3D silver micro-structures**, Erik Hagen Waller, Technische Univ. Kaiserslautern (Germany); Georg von Freymann, Technische Univ. Kaiserslautern (Germany) and Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ..... [11292-35]

9:30 am: **High-throughput fabrication of right-angle prism mirrors with selective metalization by two-step 3D printing and computer vision alignment**, Andrea Bertocini, King Abdullah Univ. of Science and Technology (Saudi Arabia); Gheorghe Cojoc, TU Dresden (Germany); Jochen Guck, Max-Planck-Institut für Lichtwissenschaft (Germany) and TU Dresden (Germany); Carlo Liberale, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11292-36]

9:50 am: **Space-variant quarter- and half-wave plates fabricated by combining 3D laser direct writing and electroplating**, Stefan Belle, Hochschule Aschaffenburg (Germany); Stefan F. Helfert, FernUniv. in Hagen (Germany); Ralf Hellmann, Hochschule Aschaffenburg (Germany); Jürgen Jahns, FernUniv. in Hagen (Germany) ..... [11292-37]

Coffee Break. .... Tue 10:10 am to 10:40 am

## SESSION 10

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... TUE 10:40 AM TO 12:30 PM

### DLW: High Speed Printing

Joint Session with Conferences 11271 and 11292

Session Chair: **Harald Giessen**, Univ. Stuttgart (Germany)

10:40 am: **Rapid multi-focus multi-photon three-dimensional laser micro-printing** (*Invited Paper*), Vincent Hahn, Jingyuan Qu, Tobias Frenzel, Pascal M. Kiefer, Patrick Ziemke, Karlsruher Institut für Technologie (Germany); Peter Gumbsch, Karlsruher Institute für Technologie (Germany) and Fraunhofer-Institut für Werkstoffmechanik IWM (Germany); Eva Blasco, Karlsruher Institut für Technologie (Germany); Christopher Barner-Kowollik, Queensland Univ. of Technology (Australia) and Karlsruher Institut für Technologie (Germany); Martin Wegener, Karlsruher Institut für Technologie (Germany) ..... [11271-2]

11:10 am: **Two-photon grayscale lithography**, Michael Thiel, Yann Tanguy, Nicole Lindenmann, Alok Tungal, Roman Reiner, Matthias Blaicher, Jörg Hoffmann, Thomas Sauter, Fabian Niesler, Timo Gissibl, André Radke, Nanoscribe GmbH (Germany) ..... [11292-38]

11:30 am: **Dynamic holographic two-photon polymerization method for processing microtube array and its application**, Shengyun Ji, Yanlei Hu, Jiawen Li, Dong Wu, Univ. of Science and Technology of China (China) [11271-3]

11:50 am: **Impact of massive parallelization on two-photon absorption micro- and nanofabrication**, Fabian Hilbert, Jonas Wiedenmann, Benedikt Stender, Multiphoton Optics GmbH (Germany); Quentin Carlier, Luis A. Perez Covarrubias, Kevin Heggarty, IMT Atlantique Bretagne-Pays de la Loire (France); Caroline Arnoux, Cyrille Monnereau, Patrice Baldeck, Ecole Normale Supérieure de Lyon (France); Ruth Houbertz, Multiphoton Optics GmbH (Germany) ..... [11271-4]

12:10 pm: **High-speed single-photon 3D nanolithography by controlling polymerization inhibition**, Shih-Hsin Hsu, Teng Chi, Paul Somers, Bryan W. Boudouris, Xianfan Xu, Liang Pan, Purdue Univ. (USA) ..... [11271-5]

Lunch/Exhibition Break ..... Tue 12:30 pm to 2:00 pm

## SESSION 11

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... TUE 2:00 PM TO 3:10 PM

### Advanced Manufacturing using a DMD or other SLM

Joint Session with 11292 and 11294

Session Chair: **Roland Höfling**, ViALUX GmbH (Germany)

2:00 pm: **Rapid prototyping MEMS using Laminated Resin Printing** (*Invited Paper*), Harrison Jones, Callaghan Innovation (New Zealand); Ciaran P. Moore, Univ. of Canterbury (New Zealand); Andrea Bubendorfer, Andrew Best, Neil Glasson, Callaghan Innovation (New Zealand) ..... [11294-6]

2:30 pm: **Curing subpixel structures for high-resolution printing of translucent materials using standard DLP-projectors**, Yannick Bauckhage, Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany) ..... [11294-7]

2:50 pm: **Effects of post curing on 3D printed DOEs**, Manuel Rank, Hochschule Aalen - Technik und Wirtschaft (Germany) and Univ. Augsburg (Germany); Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany) ..... [11294-8]

Coffee Break. .... Tue 3:10 pm to 3:40 pm

## SESSION 12

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... TUE 3:40 PM TO 6:00 PM

### 3D Lithography with DMD and SLM Devices

Joint Session with 11292 and 11294

Session Chairs: **Georg von Freymann**, Technische Univ. Kaiserslautern (Germany); **Ganapathy Sivakumar**, Texas Instruments Inc. (USA)

3:40 pm: **High resolution volumetric additive manufacturing** (*Invited Paper*), Christophe Moser, Paul Delrot, Damien Loterie, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11292-39]

4:10 pm: **Direct laser writing below the diffraction limit using spatially and temporally tuned ultrashort pulses** (*Invited Paper*), Xiaoming Yu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) ..... [11292-40]

4:40 pm: **Ultrafast multi-focus 3D printing based on a digital micro-mirror device**, Wenqi Ouyang, Dihan Chen, Qiang Geng, Songyung Gu, Ximeng Zheng, Shih-Chi Chen, The Chinese Univ. of Hong Kong (Hong Kong, China) ..... [11292-41]

5:00 pm: **Two-Photon laser lithography for metrology and vice versa**, Julian Hering, Matthias Eifler, Technische Univ. Kaiserslautern (Germany) and Opti-Cal GmbH (Germany); Xiukun Hu, Gaoliang Dai, Physikalisch-Technische Bundesanstalt (Germany); Jörg Seewig, Technische Univ. Kaiserslautern (Germany) and Opti-Cal GmbH (Germany); Georg von Freymann, Technische Univ. Kaiserslautern (Germany) and Opti-Cal GmbH (Germany) and Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ... [11292-42]

5:20 pm: **Micro-continuous liquid interface production 3D printing of customized optical components in minutes**, Rihan Hai, Guangbin Shao, Cheng Sun, Northwestern Univ. (USA) ..... [11292-43]

5:40 pm: **Fabricating large aperture and durable meta-optics for powerful lasers**, Eyal Feigenbaum, Jae Hyuck Yoo, Nathan Ray, Hoang Nguyen, Michael Johnson, Salmaan Baxamusa, Selim Elhadj, Manyalibo Matthews, Lawrence Livermore National Lab. (USA) ..... [11292-11]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Photo-polymerization-based endoscopic multi-layers printing system,** Marcel Nassif, Erwan Dupont, Frederic Lamarque, Hani Al-Hajjar, Univ. de Technologie Compiègne (France) . . . . . [11292-44]

**Simultaneous improvement of absorption and separation efficiencies of nanopatterned SnO<sub>2</sub>/Au/Mo:BiVO<sub>4</sub> photoanodes via nanoimprint,** Sucheol Ju, Korea Univ. (Korea, Republic of) . . . . . [11292-45]

**Thin micro lens array realizing wide and uniform illumination,** Takeshi Matsuo, Nalux Co., Ltd. (Japan). . . . . [11292-46]

**Laser assist patterning of graphene/graphene oxide patterns and its applications in biology,** Min Hyung Lee, Kyung Hee Univ. (Korea, Republic of); Junghyo Nah, Chungnam National Univ. (Korea, Republic of). . . . . [11292-47]

**Low-loss optical sensing devices utilizing a single-crystalline silver and gold films,** Kenzo Yamaguchi, Tokushima Univ. (Japan); Tomohiro Mori, Industrial Technology Ctr. of Wakayama Prefecture (Japan) . . . . . [11292-48]

**Design and fabrication of nano structures for Mid-IR antireflection surface texturing applications,** Rachit Sood, Fatima Nafisa, Univ. of Maryland, Baltimore County (USA); Douglas Bamford, David Woolf, Joel Hensley, Physical Sciences Inc. (USA); Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA) . . . . . [11292-49]

**High-resolution and wide gamut nanoprinting of structural colors on cm-large areas,** Ning Li, Andrea Fratolocchi, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11292-50]

**Femtosecond optical curing of SU-8 photoresist,** Christopher B. Marble, Kassie S. Marble, Vladislav V. Yakovlev, Texas A&M Univ. (USA) . . . . [11292-51]

**An efficient nanofabrication process of the plasmonic nano pixels on quartz substrate by chemical nanoimprinting with peeling processes,** Potejanasak Potejana, Univ. of Phayao (Thailand) . . . . . [11292-52]

**Hybrid micro-optical elements in lithium niobate with complex non-parabolic surface profiles,** Sergey Gorelick, Alex de Marco, Monash Univ. (Australia). . . . . [11292-53]

**A continuum model for direct laser writing of microscale metallic structures,** Thomas Palmer, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); Erik Hagen Waller, Technische Univ. Kaiserslautern (Germany); Heiko André, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany); Georg von Freymann, Technische Univ. Kaiserslautern (Germany) and Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) . . . . . [11292-54]

**OPTO**

**Photonics West Industry Stage**

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# CONFERENCE 11293

LOCATION: ROOM 204 (LEVEL 2 SOUTH);

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH)

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## MOEMS and Miniaturized Systems XIX

*Conference Chairs:* **Wibool Piyawattanametha**, King Mongkut's Institute of Technology Ladkrabang (Thailand), Michigan State Univ. (USA); **Yong-Hwa Park**, KAIST (Korea, Republic of); **Hans Zappe**, Univ. of Freiburg (Germany)

*Program Committee:* **Çağlar Ataman**, Univ. of Freiburg (Germany); **Robert Brunner**, Ernst-Abbe-Hochschule Jena (Germany); **Pei-Yu Eric Chiou**, Univ. of California, Los Angeles (USA); **David L. Dickensheets**, Montana State Univ. (USA); **Jan Grahmann**, Fraunhofer-Institut für Photonische Mikrosysteme (Germany); **Ulrich Hofmann**, OQmented GmbH (Germany); **Ki-Hun Jeong**, KAIST (Korea, Republic of); **Diaa Abdel Maguid Khalil**, Si-Ware Systems (Egypt); **David G. Lishan**, Plasma-Therm LLC (USA); **Veljko Milanović**, Mirrorcle Technologies, Inc. (USA); **Yves-Alain Peter**, Ecole Polytechnique de Montréal (Canada); **Zhen Qiu**, Michigan State Univ. (USA); **Niels Quack**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Anna Rissanen**, Outisight Oy (Finland); **Stefan Richter**, Carl Zeiss AG (Germany); **Hamdi Torun**, Northumbria Univ. (United Kingdom); **Frédéric Zamkotsian**, Lab. d'Astrophysique de Marseille (France); **Guangya Zhou**, National Univ. of Singapore (Singapore)

*Conference Co-Sponsor:*



### SATURDAY 1 FEBRUARY

#### SESSION 1

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... SAT 8:10 AM TO 10:00 AM

#### Micro-mirrors

Session Chair: **Çağlar Ataman**, Univ. of Freiburg (Germany)

8:10 am: **Novel CMOS-integrated 512x320 tip-tilt micro mirror array and related technology platform** (*Invited Paper*), Andreas Gehner, Peter Dürr, Detlef Kunze, Dirk Rudloff, Andreas Elgner, Sara Francés González, Jörg Heber, Hannes Torlee, Mark Eckert, Martin Friedrichs, Jan-Uwe Schmidt, Wolfram Pufe, Sebastian Döring, Christoph Hohle, Matthias Schulze, Michael Wagner, Leander Hänzel, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany) ..... [11293-1]

8:40 am: **A multi-ring concentric micromirror array for high-speed random-access axial focusing**, Nathan Tessema Ersumo, Cem Yalcin, Univ. of California, Berkeley (USA); Nicolas Pegard, The Univ. of North Carolina at Chapel Hill (USA); Laura Waller, Univ. of California, Berkeley (USA); Daniel López, Argonne National Lab. (USA); Rikky Muller, Univ. of California, Berkeley (USA) ..... [11293-2]

9:00 am: **A triple-wafer-bonded AlScN driven quasi-static MEMS mirror with high linearity and large tilt angles**, Shanshan Gu-Stoppel, Thomas Lisec, Maria Claus, Nico Funck, Saskia Schröder, Simon Fichtner, Bernhard Wagner, Fabian Lofink, Fraunhofer-Institut für Siliziumtechnologie ISIT (Germany) ..... [11293-3]

9:20 am: **A bi-axial vacuum-packaged piezoelectric MEMS mirror for smart headlights**, Gundula Piechotta, Fraunhofer-Institut für Siliziumtechnologie ISIT (Germany); Ulrich Hofmann, OQmented GmbH (Germany); Frank Senger, Jörg Albers, Fraunhofer-Institut für Siliziumtechnologie ISIT (Germany); Thomas von Wantoch, OQmented GmbH (Germany); Shanshan Gu-Stoppel, Fraunhofer-Institut für Siliziumtechnologie ISIT (Germany) ..... [11293-4]

9:40 am: **A two-axis water-immersible micro scanning mirror using hybrid polymer hinges**, Xiaoyu Duan, Anthony Medellin, Chao Ma, Jun Zou, Texas A&M Univ. (USA) ..... [11293-5]

Coffee Break ..... Sat 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... SAT 10:30 AM TO 12:30 PM

#### LIDAR

Session Chair: **Veljko Milanović**, Mirrorcle Technologies, Inc. (USA)

10:30 am: **MOEMS enabled agile LiDAR** (*Invited Paper*), James Jung, AEye, Inc. (USA) ..... [11293-6]

11:00 am: **Vibration analysis of micro mirrors for LIDAR, using on-chip piezoresistive sensors** (*Invited Paper*), Jan Grahmann, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany); Richard Schroedter, Technische Univ. Wien (Austria); Oliver Kiethe, Ulrich Todt, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany); Klaus Janschek, TU Dresden (Germany) ..... [11293-7]

11:30 am: **Resonant 1D MEMS mirror with a total optical scan angle of 180° for automotive LiDAR**, Fabian Schwarz, OQmented GmbH (Germany); Frank Senger, Jörg Albers, Pauline Malaurie, Fraunhofer-Institut für Siliziumtechnologie ISIT (Germany); Christian Janicke, Leon Pohl, OQmented GmbH (Germany); Felix Heinrich, Dirk Kaden, Hans-Joachim Quenzer, Fabian Lofink, Fraunhofer-Institut für Siliziumtechnologie ISIT (Germany); Thomas von Wantoch, Ulrich Hofmann, OQmented GmbH (Germany) ..... [11293-8]

11:50 am: **A laser scanning based 3D object sensing method using multiple frequencies modulation**, InGyu Jang, Yong-Hwa Park, KAIST (Korea, Republic of) ..... [11293-9]

12:10 pm: **Comparison of MEMS mirror LiDAR architectures**, Abhishhek Kasturi, Mirrorcle Technologies Inc (USA); Veljko Milanovic, Daniel B Lovell, Frank Hu, Derek Ho, Yu Su, Lj. Ristic, Mirrorcle Technologies, Inc. (USA) ..... [11293-31]

Lunch/BiOS Expo Break ..... Sat 12:30 pm to 2:00 pm

#### SESSION 3

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... SAT 2:00 PM TO 3:30 PM

#### Novel Optical Devices I

Session Chair: **David G. Lishan**, Plasma-Therm LLC (USA)

2:00 pm: **Wide and fast mode-hop free MEMS tunable ECDL concept and realization in the NIR and MIR spectral regime** (*Invited Paper*), Morten Hoppe, Hanna Rohling, Sacher Lasertechnik GmbH (Germany); Sebastian Schmidtmann, Martin Honsberg, Sensor Photonics GmbH (Germany); Hervé Tatenguem Fankem, Tobias Milde, Sacher Lasertechnik GmbH (Germany); Jan Grahmann, Fraunhofer Institute for Photonic Microsystems IPMS (Germany); Thomas Schanze, Technische Hochschule Mittelhessen (THM) - University of Applied Sciences (Germany); Joachim R. Sacher, Sacher Lasertechnik GmbH (Germany) and Sensor Photonics GmbH (Germany) ..... [11293-10]

2:30 pm: **Minimization of nonlinearities in nano electrostatic drive actuators using validated coupled-field simulation**, Anton Melnikov, Hermann Schenk, Barbara Spitz, Franziska Wall, Lutz Ehrig, Sergiu Langa, Michael Stolz, Bert Kaiser, Holger Conrad, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany); Harald Schenk, Fraunhofer-Institut für Photonische Mikrosysteme IPMS (Germany) and Brandenburg Univ. of Technology Cottbus-Senftenberg (Germany) ..... [11293-11]

2:50 pm: **Engineering the glass waveguide surface for uniform light refraction inside an optofluidic photoreactor**, Xiangkun Cao, Tao Hong, Tingwei Liu, David Erickson, Cornell Univ. (USA) ..... [11293-12]

3:10 pm: **Dynamic pattern generation by singlemode fibers for endoscopic 3D measurement systems**, Silvio Pulwer, Technische Hochschule Wildau (Germany); Daniel Jahns, Technische Hochschule Wildau (Germany) and INDI-Jahns (Germany); Claus Villringer, Sigurd Schrader, Technische Hochschule Wildau (Germany) ..... [11293-13]

Coffee Break ..... Sat 3:30 pm to 4:00 pm

**SESSION 4**

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... SAT 4:00 PM TO 5:40 PM

**Novel Optical Devices II**

Session Chair: **Hans Zappe**, Univ. of Freiburg (Germany)

- 4:00 pm: **Foveated display by laser scanning**, Ran Gabai, Gady Yearim, Gil Cahana, Meni Yehiel, Adi Baram, Matan Naftali, Maradin Ltd. (Israel) ..... [11293-14]
- 4:20 pm: **MEMS-integrated metasurface lens with tunable focus**, Zheyi Han, Shane Colburn, Arka Majumdar, Karl F. Böhringer, Univ. of Washington (USA) ..... [11293-15]
- 4:40 pm: **Large-dynamic-range displacement sensing using a nanomechanical photonic integrated circuit**, Tianran Liu, Technische Univ. Eindhoven (Netherlands); Francesco M. Pagliano, Technische Univ. Eindhoven (Netherlands) and nanoPHAB (Netherlands); René van Veldhoven, Vadim Pogoretskiy, Yuqing Jiao, Andrea Fiore, Technische Univ. Eindhoven (Netherlands) ..... [11293-16]
- 5:00 pm: **Miniaturization of the Hanbury Brown-Twiss configuration**, Martin Jahn, Dominik Karolewski, Julia Baldauf, Geert Brokmann, Thomas Ortlepp, CiS Forschungsinstitut für Mikrosensorik GmbH (Germany) ..... [11293-18]
- 5:20 pm: **Combined MEMS spectrometer based on Michelson interferometer and tunable filter for wideband selective operation**, Amir Shaheen, Yasser M. Sabry, Diaa A. M. Khalil, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt) ..... [11293-19]

**SUNDAY 2 FEBRUARY**

**SESSION 5**

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... SUN 8:00 AM TO 10:20 AM

**Imaging**

Session Chair: **Zhen Qiu**, Michigan State Univ. (USA)

- 8:00 am: **Portable spectroscopy and hyperspectral imaging in 2020** (*Invited Paper*), Richard A. Crocombe, Crocombe Spectroscopic Consulting (USA) ..... [11293-20]
- 8:30 am: **Light-sheet microscopy using MEMS and active optics for 3D image acquisition control** (*Invited Paper*), Spyridon Bakas, Deepak Uttamchandani, Ralf Bauer, Univ. of Strathclyde (United Kingdom) .. [11293-21]
- 9:00 am: **Bioinspired ultrathin arrayed camera for multi-view plane imaging**, Kisoo Kim, Kyung-Won Jang, Sang-In Bae, Ki-Hun Jeong, KAIST (Korea, Republic of) ..... [11293-22]
- 9:20 am: **Single-pixel hyperspectral imaging using Hadamard transformation**, Yi Qi, Guangya Zhou, Zi Heng Lim, Liang Li, Guangan Zhou, Fook Siong Chau, National Univ. of Singapore (Singapore) ..... [11293-23]
- 9:40 am: **Highly enhanced signal-to-noise ratio and spectral resolution in micro-spectrometer using spreading coded light excitation**, Park JungWoo, Ki-Beom Kim, Won-Kyung Lee, Ki-Hun Jeong, KAIST (Korea, Republic of) ..... [11293-24]
- 10:00 am: **Near range imaging using fully integrated bioinspired ultrathin camera**, Kyung-Won Jang, Kisoo Kim, Ki-Hun Jeong, KAIST (Korea, Republic of) ..... [11293-25]

**BEST PAPER AWARDS CEREMONY**

LOCATION: ROOM 204 (LEVEL 2 SOUTH) ..... 10:20 AM TO 10:30 AM

**MOEMS and Miniaturized Systems Best Paper Awards Ceremony**

Session Chair: **Yong-Hwa Park**, KAIST (Korea, Republic of)

AWARDS SPONSOR:



**SESSION 6**

LOCATION: ROOM 50 (LOWER MEZZANINE SOUTH) ... SUN 3:30 PM TO 4:50 PM

**NOTE ROOM CHANGE**

**Endoscopic Microscopy**

Joint Session with 11214 and 11293

Session Chair: **Wibool Piyawattanametha**, King Mongkut's Institute of Technology Ladkrabang (Thailand), Michigan State Univ. (USA)

- 3:30 pm: **Low-voltage magnetic actuated fiber scanning endoscope for 3D optical coherence tomography**, Hinnerk Schulz-Hildebrandt, Univ. zu Lübeck (Germany); Tim Eixmann, Malte vom Endt, Medizinisches Laserzentrum Lübeck GmbH (Germany); Gereon M. Hüttmann, Univ. zu Lübeck (Germany). [11214-31]
- 3:50 pm: **Dual modality multiphoton-OCT flexible endomicroscope with an integrated electromagnetic z-actuator for optical field-of-view switching and a piezo-fiber-scanner for image acquisition**, Bernhard Messerschmidt, Gregor Matz, Sven Flämig, Karl Reichwald, Ekaterina Pshenay-Severin, Grintech GmbH (Germany); Andreas Kamm, Claudia Reinlein, Beatrice Korn, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Karsten Kühnert, David Vasquez, Marianne Heilmann, piezosystem jena GmbH (Germany); Thomas Frank, Thomas Sattel, Tom Ströhla, Technische Univ. Ilmenau (Germany); Xiang Lu, Herbert Gross, Friedrich-Schiller-Univ. Jena (Germany) ..... [11214-32]
- 4:10 pm: **Multimodal two-photon and three-photon endomicroscopy for 3D tissue imaging**, Qihao Liu, Mukhlisar Rahman Tanvir, Lin Huang, Shuo Tang, The Univ. of British Columbia (Canada) ..... [11214-33]
- 4:30 pm: **A 3D actuator for laser scanning endoscopy**, Oguz Gurcuoglu, Irem D. Derman, Istanbul Technical Univ. (Turkey); Melisa Altinsoy, Politecnico di Milano (Italy); Ramin Khayatzaeh, Ahmet C. Erten, Istanbul Technical Univ. (Turkey); Fehmi Civitci, Oregon Health and Science Univ. (USA); Onur Ferhanoglu, Istanbul Technical Univ. (Turkey) ..... [11293-26]

**MONDAY 3 FEBRUARY**

**OPTO PLENARY SESSION**

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) ... MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre** (*Plenary*)  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe** (*Plenary*)  
Erik P. A. M. Bakkers, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing** (*Plenary*)  
**Trond Wuellner**, Google (USA)

Coffee Break ..... Mon 10:05 am to 10:30 am

OPTO

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# CONFERENCE 11293

## POSTERS-MON

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . MON 5:30 PM TO 7:00 PM

*Conference attendees are invited to attend the poster session on Monday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Monday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Effects of optically absorbent coatings on parallel optical control of levitating milli-robots**, Jared Young, Srija Makkapati, Steven Yee, Hatem ElBidweihy, Charles Nelson, U.S. Naval Academy (USA) . . . . . [11293-17]

**Compressive sensing MEMS FTIR spectrometer**, Karim S. Hedayet, Yasser M. Sabry, Diaa A. M. Khalil, Si-Ware Systems (Egypt) . . . . . [11293-27]

**Multi-walled carbon nanotubes based near-infrared radiation source**, Ahmed Saeed, Electronics Research Institute (Egypt); Ahmed A. Elsayed, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt); Frédéric Marty, ESIEE Paris (France); Elyes Nefzaoui, Tarik Bourouina, ESIEE Paris (France); H. A. Shawkey, Electronics Research Institute (Egypt); Yasser M. Sabry, Diaa A. M. Khalil, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt) . . . . . [11293-28]

**Modeling and characterization of the reflectance of vertical metal-coated micromirrors in deeply-etched optical benches**, Moez El-Massry, Yasser M. Sabry, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt); Ahmed Shebl, Si-Ware Systems (Egypt); Sébastien Nazeer, Si-Ware Systems (France); Diaa A. M. Khalil, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt) . . . . . [11293-29]

**Attenuated total reflection (ATR) MEMS FTIR spectrometer**, Amr O. Ghoname, Ain Shams Univ. (Egypt); Yasser M. Sabry, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt); Momen Anwar, Si-Ware Systems (Egypt); Diaa A. M. Khalil, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt) . . . . . [11293-30]

**Coupled MOEMS membranes for enhanced sensing purposes**, Andreas Naesby Rasmussen, DFM A/S (Denmark) and Aarhus Univ. (Denmark); Sepideh Naserbakht, Aurelien Dantan, Aarhus Univ. (Denmark) . . . . . [11293-32]

**Molybdenum silicide in infrared emitting devices**, Julia Baldauf, CiS Forschungsinstitut für Mikrosensorik GmbH (Germany); Rüdiger Schmidt-Grund, Technische Univ. Ilmenau (Germany); Manfred Reiche, Thomas Ortlepp, CiS Forschungsinstitut für Mikrosensorik GmbH (Germany) . . . . . [11293-33]

# CONFERENCE 11294

LOCATION: TUESDAY AM: ROOM 159 (UPPER MEZZANINE SOUTH);  
LOCATION: TUESDAY PM - WEDNESDAY: ROOM 213 (LEVEL 2 SOUTH)

Tuesday-Wednesday 4-5 February 2020 • Proceedings of SPIE Vol. 11294

## Emerging Digital Micromirror Device Based Systems and Applications XII

Conference Chairs: **John Ehmke**, Texas Instruments Inc. (USA); **Benjamin L. Lee**, Texas Instruments Inc. (USA)

Program Committee: **Michael R. Douglass**, Texas Instruments Inc. (USA); **Jeremy Gribben**, Ajile Light Industries Inc. (Canada); **Roland Höfling**, VIALUX GmbH (Germany); **Alfred Jacobsen**, Visitech Engineering GmbH (Germany); **Yuval Kapellner Rabinovitz**, EKB Technologies Ltd. (Israel); **Badia Koudsi**, Optecks, LLC (USA); **Daniel L. Lau**, Univ. of Kentucky (USA); **Beiwen Li**, Iowa State Univ. of Science and Technology (USA); **Jinyang Liang**, Institut National de la Recherche Scientifique (Canada); **Alex Lyubarsky**, Texas Instruments Inc. (USA); **Jorge Moguel**, Digital Light Innovations (USA); **Ganapathy Sivakumar**, Texas Instruments Inc. (USA); **Brandon A. Sosa**, Greenlight Optics, LLC (USA); **Hakki H. Refai**, Optecks, LLC (USA); **Bin Yang**, Duquesne Univ. (USA); **Song Zhang**, Purdue Univ. (USA); **Renjie Zhou**, The Chinese Univ. of Hong Kong (Hong Kong, China); **Karel J. Zuzak**, Univ. of Texas Southwestern Medical Ctr. (USA), The Lab. of Biomedical Imaging and Engineering, LBI-51, LLC (USA)

Conference Co-Sponsor:



### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . . TUE 8:45 AM TO 10:25 AM

#### Biomedical Imaging Using a DMD or Other MEMS Array

Joint Session with 11243 and 11294

Session Chairs: **Karel J. Zuzak**, Univ. of Texas Southwestern Medical Ctr. (USA), The Lab. of Biomedical Imaging and Engineering, LBI-51, LLC (USA); **Bin Yang**, Duquesne Univ. (USA)

8:45 am: **Digital micromirror device-based angle-multiplexed optical diffraction tomography for high throughput 3D imaging of cells**, Yanping He, Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11294-1]

9:05 am: **Spectral illumination system utilizing spherical reflection optics**, Samantha Gunn Mayes, Samuel A. Mayes, Craig M. Browning, Marina Parker, Thomas C. Rich, Silas J. Leavesley, Univ. of South Alabama (USA) . . [11243-22]

9:25 am: **A high throughput synthetic aperture phase microscope**, Shiyuan Wei, Yi Xiao, Renjie Zhou, The Chinese Univ. of Hong Kong (Hong Kong, China) . . . . . [11294-2]

9:45 am: **Imaging layered mucosa with visible modulated light**, Min Xu, The City Univ. of New York (USA); Yang Zheng, Da Pan, Xiafei Qian, Weihao Lin, Bixin Zeng, Wenzhou Medical Univ. (China) . . . . . [11243-23]

10:05 am: **DMD-based scattering assisted imaging with unknown speckle patterns**, Marco Leonetti, Alfonso Grimaldi, Silvia Ghirga, Giancarlo Ruocco, Giuseppe Antonacci, Istituto Italiano di Tecnologia (Italy) . . . . . [11294-3]

Coffee Break . . . . . Tue 10:25 am to 10:55 am

#### SESSION 2

LOCATION: ROOM 159 (UPPER MEZZANINE SOUTH) . TUE 10:55 AM TO 12:20 PM

#### Biomedical Fabrication Using a DMD or Other MEMS Array

Joint Session with 11243 and 11294

Session Chairs: **Jorge Moguel**, Digital Light Innovations (USA); **Attila Tárnok**, Univ. Leipzig (Germany)

10:55 am: **DMD-based rapid 3D bioprinting for precision tissue engineering and regenerative medicine (Keynote Presentation)**, Shaochen Chen, Univ. of California, San Diego (USA) . . . . . [11294-4]

11:40 am: **High-resolution biopatterning with beam pen lithography**, Andrey Ivankin, Jared Magoline, Shaowei Ding, William Hutson, TERA-print, LLC (USA) . . . . . [11294-5]

12:00 pm: **Time-resolved multi-dimensional fluorescence imaging using a Digital-Micromirror-Device and a SPAD-array detector**, Andrea Farina, CNR-Istituto di Fotonica e Nanotecnologie (Italy); Laura Di Sieno, Giulia Acconcia, Angelo Gulinatti, Politecnico di Milano (Italy); Gianluca Valentini, Politecnico di Milano (Italy) and Istituto di Fotonica e Nanotecnologie (Italy); Ivan Rech, Politecnico di Milano (Italy); Cosimo D'Andrea, Politecnico di Milano (Italy) and Istituto Italiano di Tecnologia (Italy) . . . . . [11243-24]

Lunch/Exhibition Break . . . . . Tue 12:20 pm to 2:00 pm

#### SESSION 3

LOCATION: ROOM 213 (LEVEL 2 SOUTH) . . . . . TUE 2:00 PM TO 3:10 PM

#### NOTE ROOM CHANGE

#### Advanced Manufacturing Using a DMD or Other SLM

Joint Session with 11292 and 11294

Session Chair: **Roland Höfling**, VIALUX GmbH (Germany)

2:00 pm: **Rapid prototyping MEMS using Laminated Resin Printing (Invited Paper)**, Harrison Jones, Callaghan Innovation (New Zealand); Ciaran P. Moore, Univ. of Canterbury (New Zealand); Andrea Bubendorfer, Andrew Best, Neil Glasson, Callaghan Innovation (New Zealand) . . . . . [11294-6]

2:30 pm: **Curing subpixel structures for high-resolution printing of translucent materials using standard DLP-projectors**, Yannick Bauchhage, Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany) . . . . . [11294-7]

2:50 pm: **Effects of post curing on 3D printed DOEs**, Manuel Rank, Hochschule Aalen - Technik und Wirtschaft (Germany) and Univ. Augsburg (Germany); Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany) . . . . . [11294-8]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

OPTO

# CONFERENCE 11294

## SESSION 4

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... TUE 3:40 PM TO 6:00 PM

### 3D Lithography with DMD and SLM Devices

Joint Session with 11292 and 11294

Session Chairs: **Georg von Freymann**, Technische Univ. Kaiserslautern (Germany); **Ganapathy Sivakumar**, Texas Instruments Inc. (USA)

3:40 pm: **High resolution volumetric additive manufacturing** (*Invited Paper*), Christophe Moser, Paul Delrot, Damien Loterie, Ecole Polytechnique Fédérale de Lausanne (Switzerland) ..... [11292-39]

4:10 pm: **Direct laser writing below the diffraction limit using spatially and temporally tuned ultrashort pulses** (*Invited Paper*), Xiaoming Yu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) ..... [11292-40]

4:40 pm: **Ultrafast multi-focus 3D printing based on a digital micro-mirror device**, Wengqi Ouyang, Dihan Chen, Qiang Geng, Songyung Gu, Ximeng Zheng, Shih-Chi Chen, The Chinese Univ. of Hong Kong (Hong Kong, China) ..... [11292-41]

5:00 pm: **Two-Photon laser lithography for metrology and vice versa**, Julian Hering, Matthias Eifler, Technische Univ. Kaiserslautern (Germany) and Opti-Cal GmbH (Germany); Xiukun Hu, Gaoliang Dai, Physikalisch-Technische Bundesanstalt (Germany); Jörg Seewig, Technische Univ. Kaiserslautern (Germany) and Opti-Cal GmbH (Germany); Georg von Freymann, Technische Univ. Kaiserslautern (Germany) and Opti-Cal GmbH (Germany) and Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM (Germany) ... [11292-42]

5:20 pm: **Micro-continuous liquid interface production 3D printing of customized optical components in minutes**, Rihan Hai, Guangbin Shao, Cheng Sun, Northwestern Univ. (USA) ..... [11292-43]

5:40 pm: **Fabricating large aperture and durable meta-optics for powerful lasers**, Eyal Feigenbaum, Jae Hyuck Yoo, Nathan Ray, Hoang Nguyen, Michael Johnson, Salmaan Baxamusa, Selim Elhadj, Manyalibo Matthews, Lawrence Livermore National Lab. (USA) ..... [11292-11]

## WEDNESDAY 5 FEBRUARY

## SESSION 5

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... WED 8:15 AM TO 10:15 AM

### Beam Shaping

Session Chair: **Michael R. Douglass**, Texas Instruments Inc. (USA)

8:15 am: **Digital micromirror device-enabled OAM beam transmission in scattering environment**, Lei Gong, Univ. of Science and Technology of China (China) ..... [11294-9]

8:35 am: **Complex wavefront manipulation and correction system using feedback between digital micromirror device and off-axis digital holography systems**, Alexandra O. Georgieva, Andrei V. Belashov, Nikolay V. Petrov, ITMO Univ. (Russian Federation) ..... [11294-10]

8:55 am: **Angular and spatial light modulation by single digital micromirror device for beam and pattern steering**, Brandon Hellman, Joshua Rodriguez, Heejoo Choi, Chuan Luo, Yuzuru Takashima, Wyant College of Optical Sciences (USA) ..... [11294-11]

9:15 am: **New Fourier CGH coding using DMD generated masks**, Frédéric Zamkotsian, Lab. d'Astrophysique de Marseille (France); Giorgio Pariani, Istituto Nazionale di Astrofisica (Italy); Patrick Lanzoni, Lab. d'Astrophysique de Marseille (France); Luca Oggioni, Istituto Nazionale di Astrofisica (Italy); Chiara Bertarelli, Politecnico di Milano (Italy); Andrea Bianco, Istituto Nazionale di Astrofisica (Italy) ..... [11294-12]

9:35 am: **Complex holograms in PTR glass recorded by using digital micromirror device**, Oussama Mhibik, Zachary J. Labossiere, Ivan B. Divliansky, Leonid B. Glebov, Univ. of Central Florida (USA) . . [11294-13]

9:55 am: **Extended depth-of-field microscopy by using a synthetic Bessel light needle**, Jiamiao Yang, Caltech (USA) ..... [11294-14]

Coffee Break. .... Wed 10:15 am to 10:45 am

## SESSION 6

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... WED 10:45 AM TO 12:05 PM

### Novel and Advanced Applications

Session Chair: **Benjamin L. Lee**, Texas Instruments Inc. (USA)

10:45 am: **Innovations with a massively paralleled, microelectromechanical systems (MEMS) toward piston-mode-based phase light modulator (PLM)**, Patrick I. Oden, Terry A. Bartlett, William C. McDonald, James N. Hall, Texas Instruments Inc. (USA) . . [11294-15]

11:05 am: **Single DMD intelligent headlight with LiDAR**, Kenneth K. Li, Optronomous Technologies Inc. (USA); Yung Peng Chang, Taiwan Color Optics, Inc. (Taiwan) ..... [11294-16]

11:25 am: **Further investigation of the effects of total ionizing dose on digital micromirror devices**, Kathleen Oram, Zoran Ninkov, Rochester Institute of Technology (USA); Dmitry Vorobiev, Lab. for Atmospheric and Space Physics, Univ. of Colorado Boulder (USA); Alexis Irwin, Rochester Institute of Technology (USA); Martin Carls, NASA Goddard Space Flight Ctr. (USA) ..... [11294-17]

11:45 am: **Refocused image acquisition from high angular resolution parallax images in integral photography applying single-pixel imaging**, Ren Usami, The Univ. of Electro-Communications (Japan); Teruyoshi Nobukawa, Masato Miura, Norihiko Ishii, NHK Japan Broadcasting Corp. (Japan); Eriko Watanabe, The Univ. of Electro-Communications (Japan); Tetsuhiko Muroi, NHK Japan Broadcasting Corp. (Japan) . . . . . [11294-18]

Lunch/Exhibition Break ..... Wed 12:05 pm to 1:35 pm

## SESSION 7

LOCATION: ROOM 213 (LEVEL 2 SOUTH) ..... WED 1:35 PM TO 3:25 PM

### AR/VR Displays Using DMDs or Other SLM Devices

Joint Session with 11294 and 11304

Session Chairs: **Alex Lyubarsky**, Texas Instruments Inc. (USA); **Hong Hua**, Wyant College of Optical Sciences (USA)

1:35 pm: **Quality evaluation of hologram based on digital and analog types of spatial light modulators** (*Invited Paper*), Hoang Yan Lin, Chih-Hao Chuang, National Taiwan Univ. (Taiwan); Chien-Yu Chen, National Taiwan Univ. of Science and Technology (Taiwan) ..... [11304-10]

2:05 pm: **Projector-based augmented reality with simultaneous 3D inspection using a single DMD**, Marc-Antoine Drouin, Jonathan Boisvert, Michel Picard, Guy Godin, Louis-Guy Dicaire, National Research Council Canada (Canada) ..... [11294-19]

2:25 pm: **Augmented reality, 3D measurement, and thermal imagery for computer-assisted manufacturing**, Marc-Antoine Drouin, Jonathan Boisvert, Guy Godin, Michel Picard, Louis-Guy Dicaire, National Research Council Canada (Canada) ..... [11294-20]

2:45 pm: **Optical calibration and distortion correction for a volumetric augmented reality display**, Kishore Rathinavel, Hanpeng Wang, Henry Fuchs, The Univ. of North Carolina at Chapel Hill (USA) ..... [11294-21]

3:05 pm: **Spatial light modulators with large phase-modulation: application to encode lenses with very short focal lengths**, Ignacio Moreno, Univ. Miguel Hernández (Spain); Jeffrey A. Davis, Benjamin K. Gutierrez, Don M. Cottrell, San Diego State Univ. (USA) . . . . . [11304-11]

Coffee Break. .... Wed 3:25 pm to 3:55 pm

**SESSION 8**

**LOCATION: ROOM 213 (LEVEL 2 SOUTH) . . . . . WED 3:55 PM TO 5:35 PM**

**3D Metrology**

Session Chair: **Roland Höfling**, ViALUX GmbH (Germany)

3:55 pm: **Impact of the shape of digital micro-mirrors on super high-resolution 3D shape measurement**, Jae-Sang Hyun, Song Zhang, Purdue Univ. (USA) . . . . . [11294-22]

4:15 pm: **Structured-light systems using programmable quasi-analogue projection subsystem**, Marc-Antoine Drouin, Guy Godin, Michel Picard, Louis-Guy Dicaire, Jonathan Boisvert, National Research Council Canada (Canada) . . . . . [11294-23]

4:35 pm: **Digital image correlation for highly reflective objects using digital micro-mirror device**, Vignesh Suresh, Beiwen Li, Iowa State Univ. of Science and Technology (USA) . . . . . [11294-24]

4:55 pm: **An introduction to high-speed structured light 3D imaging using a digital micromirror device**, Thomas Tong, Polyga (Canada) . . . . . [11294-25]

5:15 pm: **One shot high resolution refractive index profile measurement for 3D printed optics**, Manuel Rank, Hochschule Aalen - Technik und Wirtschaft (Germany) and Univ. Augsburg (Germany); Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany) . . . . . [11294-26]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Tailoring the spatially variant polarization states of light through scattering media**, Panpan Yu, Univ. of Science and Technology of China (China) . . . . . [11294-27]



# CONFERENCE 11295

LOCATION: ROOM 211 (LEVEL 2 SOUTH)

Tuesday–Wednesday 4–5 February 2020 • Proceedings of SPIE Vol. 11295

# Advanced Optical Techniques for Quantum Information, Sensing, and Metrology

Conference Chairs: **Philip R. Hemmer**, Texas A&M Univ. (USA); **Alan L. Migdall**, National Institute of Standards and Technology (USA); **Zameer Ul Hasan**, Temple Univ. (USA)

Program Committee: **Michael Brodsky**, U.S. Army Research Lab. (USA); **Paulina S. Kuo**, National Institute of Standards and Technology (USA); **Marko Loncar**, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); **Olivier Pfister**, Univ. of Virginia (USA); **Geoff J. Pryde**, Griffith Univ. (Australia); **Matthew J. Sellars**, The Australian National Univ. (Australia); **Selim M. Shahriar**, Northwestern Univ. (USA); **Devin H. Smith**, Univ. of Southampton (United Kingdom); **Alan E. Willner**, The Univ. of Southern California (USA); **Jörg Wrachtrup**, Univ. Stuttgart (Germany)

## TUESDAY 4 FEBRUARY

### SESSION 1

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... TUE 8:00 AM TO 10:10 AM

### Photonic Quantum Computing

Session Chair: **Marcos Curty**, Univ. de Vigo (Spain)

8:00 am: **Photonic quantum computing** (*Invited Paper*), Mark Thompson, PsiQuantum Corp. (USA) ..... [11295-1]

8:30 am: **Photonic quantum walks as quantum simulators**, Farshad Nejadshattari, Univ. of Ottawa (Canada); Yingwen Zhang, Univ. of Ottawa (Canada) and National Research Council Canada (Canada); Frédéric Bouchard, Univ. of Ottawa (Canada); Hugo Larocque, Univ. of Ottawa (Canada) and Massachusetts Institute of Technology (USA); Alicia Sit, Univ. of Ottawa (Canada); Eliahu Cohen, Bar-Ilan Univ. (Israel); Robert Fickler, Univ. of Ottawa (Canada) and Tampere Univ. (Finland); Ebrahim Karimi, Univ. of Ottawa (Canada) ..... [11295-2]

8:50 am: **Filtering biphoton quantum states to recover quantum information**, Daniel E. Jones, Brian T. Kirby, U.S. Army Combat Capabilities Development Command (USA); Gabriele Riccardi, Cristian Antonelli, Antonio Mecozzi, Univ. degli Studi dell'Aquila (Italy); Michael Brodsky, U.S. Army Combat Capabilities Development Command (USA) ..... [11295-3]

9:10 am: **Continuous variable quantum photonics** (*Invited Paper*), Zachary Vernon, Christian Weedbrook, Xanadu Quantum Technologies Inc. (Canada) ..... [11295-4]

9:40 am: **From two-atom interference to BEC: Scaling atom arrays in optical tweezers** (*Invited Paper*), Tobias T. Thiele, JILA, Univ. of Colorado Boulder (USA); Cindy A. Regal, JILA (USA) ..... [11295-5]

Coffee Break ..... Tue 10:10 am to 10:40 am

### SESSION 2

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... TUE 10:40 AM TO 12:20 PM

### Quantum Communication and Entanglement I

Session Chair: **Tobias T. Thiele**, Univ. of Colorado Boulder (USA)

10:40 am: **Quantum key distribution beyond the repeaterless rate-loss limit** (*Invited Paper*), Marco Lucamarini, Mirko Pittaluga, Mariella Minder, George L. Roberts, James F. Dynes, Zhiliang L. Yuan, Andrew J. Shields, Toshiba Research Europe Ltd. (United Kingdom) ..... [11295-6]

11:10 am: **Silicon photonics-based experimental daylight free-space quantum key distribution at telecom wavelength**, Marco Avesani, Luca Calderaro, Matteo Schiavon, Andrea Stanco, Costantino Agnesi, Alberto Santamato, Mujtaba Zahidy, Alessia Scriminich, Giulio Fioletto, Univ. degli Studi di Padova (Italy); Marco Chiesa, Sant'Anna Scuola Univ. Superiore Pisa (Italy); Massimo Artiglia, CNIT - Photonic Networks & Technologies National Lab. (Italy); Alberto Montanaro, CNIT - Photonic Networks & Technologies National Lab. (Italy); Marco Romagnoli, Vito Soriano, CNIT - Photonic Networks & Technologies National Lab. (Italy); Francesco Vedovato, Giuseppe Vallone, Paolo Villorosi, Univ. degli Studi di Padova (Italy) ..... [11295-7]

11:30 am: **Experimental demonstration of a scalable M-ary quantum receiver**, M. V. Jabir, Ivan A. Burenkov, Abdella Battou, Sergey V. Polyakov, National Institute of Standards and Technology (USA) ..... [11295-8]

11:50 am: **Non-classical photons for long-distance quantum applications: from quantum frequency conversion to quantum dots emitting at 1550 nm** (*Invited Paper*), Peter Michler, Univ. Stuttgart (Germany) ..... [11295-9]

Lunch/Exhibition Break ..... Tue 12:20 pm to 1:50 pm

### SESSION 3

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... TUE 1:50 PM TO 3:30 PM

### Quantum Communication and Entanglement II

Session Chair: **Peter Michler**, Institut für Halbleitertechnik und Funktionelle Grenzflächen (Germany)

1:50 pm: **Quantum-repeater-enabled networks**, William J. Munro, NTT Basic Research Labs. (Japan); Kae Nemoto, National Institute of Informatics (Japan) ..... [11295-10]

2:20 pm: **Evaluation of volume Bragg gratings as a wavelength division multiplexer in entanglement-based free-space quantum key distribution**, Riza Fazili, Fabian O. Steinlechner, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11295-11]

2:40 pm: **Towards high-performance quantum key distribution with implementation security** (*Invited Paper*), Marcos Curty, Univ. de Vigo (Spain) ..... [11295-12]

3:10 pm: **Frequency bin entanglement using cross-polarized twin-photon frequency comb source**, Kirthanana Indumathi, Thomas L. Daugey, Amélie Piveteau, Luca Furfaro, Institut Franche-Comte Electronique Mecanique Thermique et Optique (France); Johann Cussey, AUREA Technology (France); Yanne K. Chemo, Univ. of Maryland, College Park (USA); Jean-Marc Merolla, Institut Franche-Comte Electronique Mecanique Thermique et Optique (France) ..... [11295-13]

Coffee Break ..... Tue 3:30 pm to 4:00 pm

**SESSION 4**

**LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... TUE 4:00 PM TO 6:00 PM**

**Quantum Memory**

Session Chair: **William J. Munro**, NTT Basic Research Labs. (Japan)

4:00 pm: **High-retrieval efficiency quantum memory for the quantum internet**, Laszlo Gyongyosi, Univ. of Southampton (United Kingdom) and Budapest Univ. of Technology and Economics (Hungary) and Hungarian Academy of Sciences (Hungary); Sandor Imre, Budapest Univ. of Technology and Economics (Hungary) ..... [11295-14]

4:20 pm: **Quantum-memory-based spin-wave processor for light**, Michał P. Parniak, Univ. of Warsaw (Poland), Niels Bohr Institute, Univ. of Copenhagen (Denmark); Mateusz Mazelanik, Adam Leszczynski, Michał Lipka, Michał Dabrowski, Wojciech Wasilewski, Univ. of Warsaw (Poland) . . . [11295-15]

4:40 pm: **Quantum devices for memory reduction (Invited Paper)**, Nora Tischler, Farzad Ghafari, Alex Pepper, Griffith Univ. (Australia); Carlo Di Franco, Nanyang Technological Univ. (Singapore); Jayne Thompson, National Univ. of Singapore (Singapore); Mile Gu, Nanyang Technological Univ. (Singapore); Howard M. Wiseman, Geoff J. Pryde, Griffith Univ. (Australia) ..... [11295-16]

5:10 pm: **40-GHz RF spectral analyzer based on spectral hole-burning in Tm:YAG crystal**, Perrine Berger, Loic Morvan, Muriel Schwarz, Cyril Vanep, Thales Research & Technology (France); Anne Louchet-Chauvet, Lab. Aimé Cotton, Ctr. National de la Recherche Scientifique (France) and Univ. Paris-Sud (France); Pascale Nouchi, Daniel Dolfi, Thales Research & Technology (France) ..... [11295-17]

5:30 pm: **Diamond optomechanics for coherent manipulation of light (Invited Paper)**, Paul E. Barclay, Univ. of Calgary (Canada) ..... [11295-18]

**WEDNESDAY 5 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... WED 8:00 AM TO 10:10 AM**

**Quantum Sources**

Session Chair: **Nora Tischler**, Griffith Univ. (Australia)

8:00 am: **Quantum-enhanced photonic sensors with applications to RF photonics, gyroscopes and precision pointing (Invited Paper)**, Saikat Guha, Wyant College of Optical Sciences (USA) ..... [11295-31]

8:30 am: **Optimised tapered amplifier systems for quantum technologies**, Ludwig Prade, Christopher H. Carson, Loyd J. McKnight, Brynmor E. Jones, Adam Selyem, Fraunhofer Ctr. for Applied Photonics (United Kingdom); Richard Walker, Ryan E. Warburton, Photon Force Ltd. (United Kingdom); William Dorward, Douglas Bremner, Stephen T. Lee, Optocap Ltd. (United Kingdom) ..... [11295-19]

8:50 am: **Generation of time-energy entangled photon pairs by a self-pumped silicon microring resonator**, Francesco Garrisi, Savda Sam, Federicoandrea Sabatelli, Andrea Barone, Univ. degli Studi di Pavia (Italy); Micol Previde Massara, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Federico Pirzio, Marco Liscidini, Matteo Galli, Daniele Bajoni, Univ. degli Studi di Pavia (Italy) ..... [11295-20]

9:10 am: **Machine learning-assisted classification of quantum emitters**, Zhaxylyk A. Kudyshev, Simeon Bogdanov, Theodor Isacsson, Alexander V. Kildishev, Alexandra Boltasseva, Vladimir M. Shalaev, Purdue Univ. (USA) ..... [11295-21]

9:30 am: **Photon phase shift at the few-photon level and optical switching in a quantum dot-micropillar system**, Louise Wells, Univ. of Cambridge (United Kingdom) and Toshiba Research Europe Ltd. (United Kingdom); Sokratis Kalliakos, Toshiba Research Europe Ltd. (United Kingdom); Bruno Villa, Toshiba Research Europe Ltd. (United Kingdom) and Univ. of Cambridge (United Kingdom); David J. P. Ellis, Richard M. Stevenson, Anthony J. Bennett, Toshiba Research Europe Ltd. (United Kingdom); Ian Farrer, David A. Ritchie, Univ. of Cambridge (United Kingdom); Andrew J. Shields, Toshiba Research Europe Ltd. (United Kingdom) ..... [11295-22]

9:50 am: **Laser-written coherent nitrogen-vacancy centers as building block for efficient quantum photonic devices**, Viktoria Yurgens, Josh A. Zuber, Sigurd Flagan, Marta De Luca, Brendan Shields, Tomasz Jakubczyk, Ilaria Zardo, Patrick Maletinsky, Richard J. Warburton, Univ. Basel (Switzerland) ..... [11295-32]

Coffee Break ..... Wed 10:10 am to 10:40 am

**SESSION 6**

**LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... WED 10:40 AM TO 12:20 PM**

**Quantum Metrology**

Session Chair: **Marco Lucamarini**,

Toshiba Research Europe Ltd. (United Kingdom)

10:40 am: **A comprehensive experimental system for measuring molecular two-photon absorption using ultrafast entangled photon excitation**, Alexander Mikhaylov, JILA, Univ. of Colorado Boulder (USA); Kristen M. Parzuchowski, Univ. of Colorado Boulder (USA); Michael D. Mazurek, Martin J. Stevens, Thomas Gerrits, National Institute of Standards and Technology (USA); Ralph Jimenez, JILA, Univ. of Colorado Boulder (USA) ..... [11295-23]

11:00 am: **Near infrared single-photon imaging based on compressive sensing with a sinusoidally gated InGaAs/InP single-photon avalanche diode**, Hiroki Hagihara, Kazuhiro Yokota, Naoto Namekata, Shuichiro Inoue, Nihon Univ. (Japan) ..... [11295-24]

11:20 am: **Versatile super-sensitive metrology using induced coherence**, William N. Plick, Univ. of Dayton (USA); Nathaniel R. Miller, Louisiana State Univ. (USA); Sven Ramelow, Humboldt-Univ. zu Berlin (Germany) . . . [11295-25]

11:40 am: **An information theory perspective of nonlocal PMD compensation**, Gabriele Riccardi, Univ. degli Studi dell'Aquila (Italy); Brian T. Kirby, Michael Brodsky, U.S. Army Research Lab. (USA); Cristian Antonelli, Univ. degli Studi dell'Aquila (Italy) ..... [11295-26]

12:00 pm: **Direct temporal mode determination for the characterization of temporally multiplexed high-dimensional entanglement**, Xiaoying Li, Ang Sun, Nan Huo, Yuhong Liu, Jiamin Li, Tianjin Univ. (China); Xin Chen, Z.Y. Jeff Ou, Indiana Univ.-Purdue Univ. Indianapolis (USA) ..... [11295-30]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Wednesday 10:00 AM – 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Miniaturized and ultra-bright entangled photon-pair source**, Emma Celina Brambila Tamayo, Fabian O. Steinlechner, Erik Beckert, Markus Gräfe, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) ..... [11295-27]

**Measuring of the petroleum product leaks by distributed systems**, Jakub Jaros, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . [11295-28]

**OPTO**

# CONFERENCE 11296

## CONCURRENT SESSIONS: NOTE ROOM LOCATIONS

LOCATION: ROOM 209 (LEVEL 2 SOUTH) AND

LOCATION: ROOM 211 (LEVEL 2 SOUTH)

Saturday–Thursday 1–6 February 2020 • Proceedings of SPIE Vol. 11296

# Optical, Opto-Atomic, and Entanglement-Enhanced Precision Metrology II

Conference Chairs: **Selim M. Shahriar**, Northwestern Univ. (USA); **Jacob Scheuer**, Tel Aviv Univ. (Israel)

Program Committee: **Nancy Aggarwal**, Northwestern Univ. (USA); **Angelo Bassi**, Univ. degli Studi di Trieste (Italy); **Robert W. Boyd**, Univ. of Ottawa (Canada), Univ. of Rochester (USA); **Danielle A. Braje**, MIT Lincoln Lab. (USA); **John H. Burke**, Defense Advanced Research Projects Agency (USA); **Eliahu Cohen**, Bar-Ilan Univ. (Israel); **Brian D’Urso**, Montana State Univ. (USA); **Andrew Geraci**, Northwestern Univ. (USA); **John C. Howell**, The Hebrew Univ. of Jerusalem (Israel); **Jacob B. Khurgin**, Johns Hopkins Univ. (USA); **Jaewan Kim**, Korea Institute for Advanced Study (Korea, Republic of); **John E. Kitching**, National Institute of Standards and Technology (USA); **Timothy Kovachy**, Northwestern Univ. (USA); **Uriel Levy**, The Hebrew Univ. of Jerusalem (Israel); **Frank A. Narducci**, Naval Postgraduate School (USA); **Irina Novikova**, William & Mary (USA); **Gour S. Pati**, Delaware State Univ. (USA); **Stefania Residori**, Institut de Physique de Nice (France); **Monika H. Schleier-Smith**, Stanford Univ. (USA); **David D. Smith**, NASA Marshall Space Flight Ctr. (USA); **Misha Sumetsky**, Aston Univ. (United Kingdom); **Renu Tripathi**, Delaware State Univ. (USA); **Sharon M. Weiss**, Vanderbilt Univ. (USA); **Yanhong Xiao**, Fudan Univ. (China); **Avinoo Zadok**, Bar-Ilan Univ. (Israel)

## SATURDAY 1 FEBRUARY

Sessions 1-4 run concurrently with sessions 5-8

### SESSION 1

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SAT 8:30 AM TO 10:10 AM

#### Quantum Sensing, Spin Squeezing, and Related Technologies I

Session Chair: **William J. Munro**, NTT Basic Research Labs. (Japan)

8:30 am: **Unscrambling entanglement through a complex medium** (*Invited Paper*), Mehul Malik, Heriot-Watt Univ. (United Kingdom). . . . [11296-1]

8:55 am: **Sensing protocols for the NV-NMR spectrometer** (*Invited Paper*), Alex Retzker, Racah Institute of Physics (Israel). . . . [11296-2]

9:20 am: **Attosecond-resolution optical path evaluation and sensing using quantum optical interferometry with dispersion cancellation** (*Invited Paper*), Alexander V. Sergienko, Boston Univ. (USA). . . . [11296-3]

9:45 am: **Spectroscopic sensing enhanced by quantum molecular coherence and by plasmonic nanoantennas** (*Invited Paper*), Alexei Sokolov, Texas A&M Univ. (USA) . . . . [11296-4]

Coffee Break. . . . . Sat 10:10 am to 10:30 am

### SESSION 5

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SAT 8:00 AM TO 10:20 AM

#### Atomic Clocks, Atomic Interferometers, and Enabling Technologies I

Session Chair: **Gour S. Pati**, Delaware State Univ. (USA)

8:00 am: **A moving waveguide Sagnac atom interferometer** (*Invited Paper*), Malcolm Boshier, Los Alamos National Lab. (USA) . . . . [11296-19]

8:25 am: **Decoherence and dynamics in continuous 3D-cooled atom interferometry** (*Invited Paper*), Adam T. Black, Jonathan Kwolek, U.S. Naval Research Lab. (USA); Charles Fancher, The MITRE Corporation (USA); Mark Bashkansky, U.S. Naval Research Lab. (USA) . . . . [11296-20]

8:50 am: **Measurements of the dipole moments of cesium Rydberg-ground molecules** (*Invited Paper*), Jianming Zhao, Shanxi Univ. (China) . . . [11296-21]

9:15 am: **A compact microwave clock based on atoms cooled with a diffractive optic** (*Invited Paper*), Erling Riis, Univ. of Strathclyde (United Kingdom). . . . [11296-22]

9:40 am: **Noise control in dual-frequency VECSELS for Cs CPT Clocks** (*Invited Paper*), Fabien Bretenaker, Lab. Aimé Cotton (France) and Raman Research Institute (India); Gregory Gredat, Hui Liu, Fabienne Goldfarb, Lab. Aimé Cotton (France); Ghaya Baili, François Gully, Thales Research & Technology (France); Isabelle Sagnes, Ctr. de Nanosciences et de Nanotechnologies (France); Jeremy Cotxet, François Tricot, Thales Research & Technology (France). . . . [11296-23]

10:05 am: **A T<sup>3</sup> interferometer with magnetically sensitive transitions**, Jeffrey Lee, Naval Postgraduate School (USA). . . . [11296-24]

Coffee Break. . . . . Sat 10:20 am to 10:50 am

Sessions 1-4 run concurrently with sessions 5-8

SESSION 2

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SAT 10:30 AM TO 12:10 PM

Quantum Sensing, Spin Squeezing, and Related Technologies II

Session Chair: **Mehul Malik**, Heriot-Watt Univ. (United Kingdom)

10:30 am: **Simultaneous quantum sensing of multiple parameters** (*Invited Paper*), Animesh Datta, The Univ. of Warwick (United Kingdom) ..... [11296-5]

10:55 am: **Robust quantum sensing with strongly interacting probe systems** (*Invited Paper*), William J. Munro, National Institute of Informatics (Japan) ..... [11296-6]

11:20 am: **Near-unitary spin squeezing with ytterbium** (*Invited Paper*), Boris Braverman, Univ. of Ottawa (Canada); Akio Kawasaki, Stanford Univ. (USA); Edwin Pedrozo-Peñafiel, Simone Colombo, Massachusetts Institute of Technology (USA); Chi Shu, Harvard Univ. (USA); Zeyang Li, Enrique Mendez, Megan Yamoah, Massachusetts Institute of Technology (USA); Leonardo Salvi, Univ. degli Studi di Firenze (Italy); Daisuke Akamatsu, National Metrology Institute of Japan (Japan); Yanhong Xiao, Fudan Univ. (China); Vladan Vuletic, Massachusetts Institute of Technology (USA) ..... [11296-7]

11:45 am: **Measuring the time tunneling particles spend in the barrier** (*Invited Paper*), David Spierings, Univ. of Toronto (Canada) ..... [11296-8]

Lunch Break ..... Sat 12:10 pm to 1:40 pm

SESSION 3

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SAT 1:40 PM TO 2:55 PM

Quantum Sensing, Spin Squeezing, and Related Technologies III

Session Chair: **Robert Fickler**, Tampere Univ. (Finland)

1:40 pm: **Realizing quantum image scanning microscopy with novel detectors** (*Invited Paper*), Gur Lubin, Weizmann Institute of Science (Israel) ..... [11296-10]

2:05 pm: **Polarization-based truncated SU(1,1) interferometer based on four-wave mixing in Rb vapor** (*Invited Paper*), Irina Novikova, William & Mary (USA) ..... [11296-11]

2:30 pm: **Two-photon sensing and microscopy with quantum light** (*Invited Paper*), Girish S. Agarwal, Texas A&M Univ. (USA) ..... [11296-12]

Coffee Break ..... Sat 2:55 pm to 3:30 pm

SESSION 4

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SAT 3:30 PM TO 5:35 PM

Quantum Sensing, Spin Squeezing, and Related Technologies IV

Session Chair: **Irina Novikova**, William & Mary (USA)

3:30 pm: **Quantum superhet based on dressed Rydberg atoms** (*Invited Paper*), Linjie Zhang, Shanxi Univ. (China) ..... [11296-14]

3:55 pm: **Magnetization and entanglement entropy of spin-squeezed condensates: recent developments** (*Invited Paper*), Michael S. Chapman, Georgia Institute of Technology (USA) ..... [11296-15]

4:20 pm: **Polarization dichroic mirrors for quantum optics with atomic ensembles** (*Invited Paper*), Michal Bajcsy, Stanford Univ. (Canada) . [11296-16]

4:45 pm: **Temporal tomography of quantum signals** (*Invited Paper*), Moti Fridman, Elisha Cohen, Bar-Ilan Univ. (Israel) ..... [11296-17]

5:10 pm: **High-dimensional entanglement distribution: How I stopped worrying and learned to love the noise** (*Invited Paper*), Robert Fickler, Institut für Quantenoptik und Quanteninformation ÖAW (Austria) ..... [11296-18]

SESSION 6

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SAT 10:50 AM TO 12:30 PM

Atomic Clocks, Atomic Interferometers, and Enabling Technologies II

Session Chair: **Jianming Zhao**, Shanxi Univ. (China)

10:50 am: **Exploring magnetic resonances with modulated beam coherent population trapping** (*Invited Paper*), Gour S. Pati, Delaware State Univ. (USA) ..... [11296-25]

11:15 am: **Molecular lattice clock with long vibrational coherence** (*Invited Paper*), Hendrick Bekker, Columbia Univ. (USA) ..... [11296-26]

11:40 am: **Atom-based electromagnetic field sensing** (*Invited Paper*), James P. Shaffer, The Univ. of Oklahoma (Canada) ..... [11296-27]

12:05 pm: **A compact two-photon rubidium atomic clock with long-term stability in the low 10<sup>-15</sup>s** (*Invited Paper*), John Elgin, Air Force Research Lab. (USA) ..... [11296-28]

Lunch Break ..... Sat 12:30 pm to 2:00 pm

SESSION 7

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SAT 2:00 PM TO 3:45 PM

Atomic Clocks, Atomic Interferometers, and Enabling Technologies III

Session Chair: **May Eun Yeon Kim**, National Institute of Standards and Technology (USA)

2:00 pm: **Large momentum transfer point source atom interferometry**, Jinyang Li, Northwestern Univ. (USA) ..... [11296-29]

2:15 pm: **Portable atomic clocks** (*Invited Paper*), Joseph Kinast, Draper Lab. (USA) ..... [11296-30]

2:40 pm: **modified Ramsey spectroscopy methods for light shift mitigation in CPT clocks** (*Invited Paper*), Juniper W. Pollock, Moshe Shuker, Rodolphe Boudot, National Institute of Standards and Technology (USA); Valera Yudin, Alexey Taichenachev, Novosibirsk State Univ. (Russian Federation); John E. Kitching, Elizabeth A. Donley, National Institute of Standards and Technology (USA) ..... [11296-31]

3:05 pm: **Atom interferometry with squeezed atomic states** (*Invited Paper*), Mark A. Kasevich, Stanford Univ. (USA) ..... [11296-32]

3:30 pm: **A compact and reliable 780nm laser for atom cooling on-board a CubeSat**, Thomas H. Legg, Gooch & Housego (United Kingdom); Mark C. Farries, Gooch & Housego (Torquay) Ltd. (United Kingdom); Matthew Welch, Gooch & Housego (United Kingdom); Stephen Maddox, Diviya Devani, Teledyne e2v UK Ltd. (United Kingdom) ..... [11296-33]

Coffee Break ..... Sat 3:45 pm to 4:15 pm

SESSION 8

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SAT 4:15 PM TO 5:55 PM

Atomic Clocks, Atomic Interferometers, and Enabling Technologies IV

Session Chair: **Malcolm Boshier**, Los Alamos National Lab. (USA)

4:15 pm: **Optical atomic clock comparisons using correlation spectroscopy** (*Invited Paper*), May Eun Yeon Kim, National Institute of Standards and Technology (USA) ..... [11296-34]

4:40 pm: **One-axis twisting in a Rydberg-dressed atomic clock** (*Invited Paper*), Victoria Borish, Monika H. Schleier-Smith, Ognjen Markovic, Jacob Hines, Shankari Rajagopal, Stanford Univ. (USA) ..... [11296-35]

5:05 pm: **Atom interferometry with entangled spins** (*Invited Paper*), Peter F. Barker, Univ. College London (United Kingdom) ..... [11296-36]

5:30 pm: **Towards a strontium optical clock enabled by integrated photonics** (*Invited Paper*), Scott B. Papp, National Institute of Standards and Technology (USA) ..... [11296-37]

OPTO

SUNDAY 2 FEBRUARY

Sessions 9-12 run concurrently with sessions 13-16

SESSION 9

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SUN 8:00 AM TO 10:05 AM

Quantum Sensing, Spin Squeezing, and Related Technologies V

Session Chair: **Avi Pe'er**, Bar-Ilan Univ. (Israel)

- 8:00 am: **Quantum-enhanced velocimetry with Doppler-broadened atomic vapour** (*Invited Paper*), Shau-Yu Lan, Nanyang Technological Univ. (Singapore) ..... [11296-38]
- 8:25 am: **Applications in optical quantum metrology** (*Invited Paper*), Thomas Gerrits, National Institute of Standards and Technology (USA) ..... [11296-39]
- 8:50 am: **Measurements with prediction and retrodiction on the collective spin in a hot atom vapor beat the standard quantum limit** (*Invited Paper*), Yanhong Xiao, Fudan Univ. (China) ..... [11296-40]
- 9:15 am: **Recent progress towards the development of a spin-squeezed atomic interferometer** (*Invited Paper*), Onur Hosten, Institute of Science and Technology Austria (Austria) ..... [11296-41]
- 9:40 am: **Quantum sensing with neutral atoms** (*Invited Paper*), Robert Compton, Honeywell (Canada) ..... [11296-42]
- Coffee Break ..... Sun 10:05 am to 10:30 am

SESSION 10

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SUN 10:30 AM TO 12:25 PM

Quantum Sensing, Spin Squeezing, and Related Technologies VI

Session Chair: **Robert Compton**, Honeywell (Canada)

- 10:30 am: **Frequency multiplexed QKD with broadband-squeezed vacuum** (*Invited Paper*), Avi Pe'er, Bar-Ilan Univ. (Israel) ..... [11296-151]
- 10:55 am: **Engineering diamond color centers for quantum sensing and metrology** (*Invited Paper*), Philip R. Hemmer, Texas A&M Univ. (USA) ..... [11296-44]
- 11:20 am: **Advanced Hamiltonian engineering in spin ensembles for enhanced sensing and control** (*Invited Paper*), Nir Bar-Gill, The Hebrew Univ. of Jerusalem (Israel) ..... [11296-45]
- 11:45 am: **Heisenberg limited atomic sensing using Schrödinger cat states with extreme insensitivity to excess noise** (*Invited Paper*), Selim M. Shahriar, Northwestern Univ. (USA) ..... [11296-46]
- 12:10 pm: **Quantum sensing of rapidly varying magnetic fields**, Chris Perrella, Andre N. Luiten, The Univ. of Adelaide (Australia) ..... [11296-13]
- Lunch Break ..... Sun 12:25 pm to 1:50 pm

SESSION 11

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SUN 1:50 PM TO 3:20 PM

New Laser Technologies for Precision Metrology and Sensing

Session Chair: **Nancy Aggarwal**, Northwestern Univ. (USA)

- 1:50 pm: **Photonic integrated atom cooling and ultra-low linewidth stable Brillouin laser oscillators** (*Invited Paper*), Daniel J. Blumenthal, Univ. of California, Santa Barbara (USA) ..... [11296-47]
- 2:15 pm: **Semiconductor diode laser from UV to THz for the information era** (*Invited Paper*), Manijeh Razeghi, Northwestern Univ. (USA) ..... [11296-48]
- 2:40 pm: **Wide bandwidth laser noise suppression using dynamic spectral hole filters** (*Invited Paper*), Charles W. Thiel, Montana State Univ. (USA) ..... [11296-49]
- 3:05 pm: **Narrowing the linewidth of a distributed Bragg reflector laser with an intracavity electro-optic modulator**, Boris Braverman, Univ. of Ottawa (Canada) ..... [11296-50]
- Coffee Break ..... Sun 3:20 pm to 3:50 pm

SESSION 13

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SUN 8:00 AM TO 10:05 AM

Atomic Clocks, Atomic Interferometers, and Enabling Technologies V

Session Chair: **Shimon Kolkowitz**, Univ. of Wisconsin-Madison (USA)

- 8:00 am: **Recent advances in precision atomic clock measurements at NIST** (*Invited Paper*), Tara M. Fortier, National Institute of Standards and Technology (USA) ..... [11296-56]
- 8:25 am: **Laser wavefront perturbations in extreme momentum transfer atom interferometers: effects and mitigation strategies** (*Invited Paper*), Tim Kovachy, Northwestern Univ. (USA) ..... [11296-57]
- 8:50 am: **Advances in Sr optical lattice clocks at NIM** (*Invited Paper*), Yige Lin, National Institute of Metrology (China) ..... [11296-58]
- 9:15 am: **Quantum-enabled sensors for aerospace** (*Invited Paper*), Chad Fertig, Honeywell Aerospace (USA) ..... [11296-59]
- 9:40 am: **Towards the photonic integration of optical atomic clocks** (*Invited Paper*), Zach L. Newman, National Institute of Standards and Technology (USA) ..... [11296-60]
- Coffee Break ..... Sun 10:05 am to 10:35 am

SESSION 14

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SUN 10:35 AM TO 12:15 PM

Atomic Clocks, Atomic Interferometers, and Enabling Technologies VI

Session Chair: **Tim Kovachy**, Northwestern Univ. (USA)

- 10:35 am: **Large-scale atom interferometers: towards tests of general relativity** (*Invited Paper*), Philippe Bouyer, Lab. Photonique, Numérique et Nanosciences (France) ..... [11296-61]
- 11:00 am: **Searching for new physics with differential optical lattice clock comparisons** (*Invited Paper*), Shimon Kolkowitz, Univ. of Wisconsin-Madison (USA) ..... [11296-62]
- 11:25 am: **Atomic clocks for Space: basic physics research at The Aerospace Corporation** (*Invited Paper*), Zachary Warren, The Aerospace Corp. (USA) ..... [11296-63]
- 11:50 am: **Vector curvature sensor based on a single fiber Bragg grating** (*Invited Paper*), Yundong Zhang, Fuxing Zhu, Yanchen Qu, Ying Guo, Huaiyin Su, Kaiyue Qi, Weiguo Jiang, Harbin Institute of Technology (China) ..... [11296-64]
- Lunch Break ..... Sun 12:15 pm to 1:30 pm

SESSION 15

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SUN 1:30 PM TO 3:35 PM

Atomic Metrology: New Directions

Session Chair: **Hui Cao**, Yale Univ. (USA)

- 1:30 pm: **Microfabricated atomic devices: developments in atomic flux circuits** (*Invited Paper*), Douglas G. Bopp, National Institute of Standards and Technology (USA) ..... [11296-65]
- 1:55 pm: **Precision measurements with Rydberg atoms** (*Invited Paper*), Georg A. Raithel, Univ. of Michigan (USA) ..... [11296-66]
- 2:20 pm: **Recent developments in measuring inertial forces with ultracold neutral atoms** (*Invited Paper*), Grant Biedermann, Sandia National Labs. (USA) ..... [11296-67]
- 2:45 pm: **Sensing gravity by holding atoms for 20 seconds** (*Invited Paper*), Victoria Xu, Holger Muller, Univ. of California, Berkeley (USA) ..... [11296-68]
- 3:10 pm: **Internal-state interferometry with trapped Rydberg atoms** (*Invited Paper*), Alex M. Kuzmich, Univ. of Michigan (USA) ..... [11296-69]
- Coffee Break ..... Sun 3:35 pm to 4:05 pm

Sessions 9-12 run concurrently with sessions 13-16

**SESSION 12**

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... SUN 3:50 PM TO 5:30 PM

**Optomechanics and Force Detection I**

Session Chair: **Daniel J. Blumenthal**,  
Univ. of California, Santa Barbara (USA)

- 3:50 pm: **Active-cavity optomechanics** (*Invited Paper*), John R. Lawall, National Institute of Standards and Technology (USA) ..... [11296-52]
- 4:15 pm: **Room-temperature optomechanical squeezing** (*Invited Paper*), Nancy Aggarwal, Northwestern Univ. (USA) ..... [11296-53]
- 4:40 pm: **Sensing weak force using a diamagnetic levitated micromechanical oscillator** (*Invited Paper*), Pu Huang, Nanjing Univ. (China) ..... [11296-54]
- 5:05 pm: **Search for non-Newtonian gravity with optically-levitated microspheres** (*Invited Paper*), Akio Kawasaki, Stanford Univ. (USA) ..... [11296-55]

**SESSION 16**

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... SUN 4:05 PM TO 5:40 PM

**Fiber Optics Sensing, Metrology, and Related Technologies**

Session Chair: **Alex M. Kuzmich**, Univ. of Michigan (USA)

- 4:05 pm: **A 1800-km optical fiber link for metrology, geodesy, and clock comparison**, Mario Siciliani de Cumis, Agenzia Spaziale Italiana (Italy); Cecilia Clivati, Istituto Nazionale di Ricerca Metrologica (Italy); Luigi Santamaria Amato, Agenzia Spaziale Italiana (Italy); Valentina Di Sarno, Istituto Nazionale di Ottica (Italy); Anna Tampellini, Alberto Mura, Istituto Nazionale di Ricerca Metrologica (Italy); Roberto Ricci, Federico Perini, Istituto Nazionale di Astrofisica (Italy); Pasquale Maddaloni, Istituto Nazionale di Ottica (Italy); Mauro Nanni, Roberto Ambrosini, Istituto Nazionale di Astrofisica (Italy); Roberto Aiello, Istituto Nazionale di Ottica (Italy); Claudio Bortolotti, Mauro Roma, Giuseppe Maccaferri, Matteo Stagni, Istituto Nazionale di Astrofisica (Italy); Filippo Levi, Istituto Nazionale di Ricerca Metrologica (Italy); Monia Negusini, Istituto Nazionale di Astrofisica (Italy); Paolo De Natale, Istituto Nazionale di Ottica (Italy); Giuseppe Bianco, Agenzia Spaziale Italiana (Italy); Davide Calonico, Istituto Nazionale di Ricerca Metrologica (Italy) ..... [11296-70]
- 4:20 pm: **High-resolution optical phase demodulation and all-fiber resonance cavities with dynamic population Bragg gratings recorded in Ytterbium-doped fibers at 1064 nm**, Serguei I. Stepanov, Emilio Aguilar, Eliseo Hernández, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) ..... [11296-71]
- 4:35 pm: **Quantum metrology with fiber cavities** (*Invited Paper*), Jakob Reichel, Lab. Kastler Brossel (France) ..... [11296-72]
- 5:00 pm: **Nonlinear optical effects in the acetylene filled microstructured fibers with Maxwell distribution of relaxation rates**, Serguei I. Stepanov, Nayeli Casillas, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico); Manuel Ocegueda, Univ. Autónoma de Baja California (Mexico); Eliseo Hernández, Ctr. de Investigación Científica y de Educación Superior de Ensenada B.C. (Mexico) ..... [11296-73]
- 5:15 pm: **Nonlinear pulse measurement with a multimode fiber** (*Invited Paper*), Hui Cao, Yale Univ. (USA) ..... [11296-74]

OPTO

**Industry Workshops**

Wednesday • Moscone West Level 2  
30-minute to full-day workshops open to all attendees  
Pages 64-67

MONDAY 3 FEBRUARY

OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
Sailing He, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); Yasuhiro Koike, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre** (*Plenary*)  
David N. Payne, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe** (*Plenary*)  
Erik P. A. M. Bakkers, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing** (*Plenary*)  
Trond Wuellner, Google (USA)

Coffee Break . . . . . Mon 10:05 am to 10:30 am

Sessions 17-19 run concurrently with sessions 20-22

SESSION 17

LOCATION: ROOM 211 (LEVEL 2 SOUTH) . . . . . MON 10:30 AM TO 12:10 PM

**Optomechanics and Force Detection II**

Session Chair: **Jean-Pierre Zengri**, Istituto Nazionale di Fisica Nucleare (Italy)

- 10:30 am: **Gravimetry through nonlinear optomechanics** (*Invited Paper*), Sougato Bose, Univ. College London (United Kingdom) . . . . . [11296-75]
- 10:55 am: **Precision measurements on mechanical systems at ultra-low temperatures** (*Invited Paper*), Tjerk Oosterkamp, Leiden Univ. (Netherlands) . . . . . [11296-76]
- 11:20 am: **New optomechanical probing methods for high-precision sensing** (*Invited Paper*), Thomas Purdy, Univ. of Pittsburgh (USA) . . . [11296-77]
- 11:45 am: **Laser-driven GHz rotation and ultrasensitive torque detection** (*Invited Paper*), Tongcang Li, Purdue Univ. (USA) . . . . . [11296-78]
- Lunch Break . . . . . Mon 12:10 pm to 1:40 pm

SESSION 18

LOCATION: ROOM 211 (LEVEL 2 SOUTH) . . . . . MON 1:40 PM TO 3:45 PM

**Frequency Combs**

Session Chair: **Nan Yu**, Jet Propulsion Lab. (USA)

- 1:40 pm: **Using Kerr frequency combs for optical signal processing functions** (*Invited Paper*), Alan E. Willner, The Univ. of Southern California (USA) . . . . . [11296-79]
- 2:05 pm: **Ultra-high-resolution comb spectroscopy** (*Invited Paper*), Andre N. Luiten, The Univ. of Adelaide (Australia) . . . . . [11296-80]
- 2:30 pm: **Ultrasensitive sensing with combs: when squeezing is not only for hugs** (*Invited Paper*), Jean-Claude M. Diels, The Univ. of New Mexico (USA) . . . . . [11296-81]
- 2:55 pm: **Development of microresonator-based frequency combs and spectral translation devices for optical atomic clocks** (*Invited Paper*), Kartik Srinivasan, National Institute of Standards and Technology (USA) . . . . . [11296-82]
- 3:20 pm: **High-resolution direct optical frequency comb Raman spectroscopy of single ions: from atomic fine structures to rotational spectra of molecular ions** (*Invited Paper*), Michael Drewsen, Aarhus Univ. (Denmark) . . . . . [11296-83]
- Coffee Break . . . . . Mon 3:45 pm to 4:15 pm

SESSION 20

LOCATION: ROOM 209 (LEVEL 2 SOUTH) . . . . . MON 10:30 AM TO 12:00 PM

**Tests of Fundamental Physics I**

Session Chair: **Gadi Afek**, Yale Univ. (USA)

- 10:30 am: **Recent results on gravitational decoherence and collapse** (*Invited Paper*), Angelo Bassi, Univ. degli Studi di Trieste (Italy) . . . . [11296-89]
- 10:55 am: **Tabletop tests of the standard model: a tale of two electron dipole moments** (*Invited Paper*), Gerald Gabrielse, Northwestern Univ. (USA) . . . . . [11296-90]
- 11:20 am: **New measurement of the permanent electric dipole moment of <sup>129</sup>Xe** (*Invited Paper*), Natasha Sachdev, Univ. of Michigan (USA). [11296-91]
- 11:45 am: **Testing collapse models for macroscopic quantum superpositions using an atomic interferometer without entanglement**, Jinyang Li, Northwestern Univ. (USA) . . . . . [11296-92]
- Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

SESSION 21

LOCATION: ROOM 209 (LEVEL 2 SOUTH) . . . . . MON 1:30 PM TO 2:45 PM

**Tests of Fundamental Physics II**

Session Chair: **Natasha Sachdev**, Univ. of Michigan (USA)

- 1:30 pm: **A quantum-enhanced search for ultra-light axion-like dark matter** (*Invited Paper*), Alexander O. Sushkov, Boston Univ. (USA) . . [11296-93]
- 1:55 pm: **Precision tests of charge quantization and searches for millicharged particles using levitated optomechanics** (*Invited Paper*), Gadi Afek, Yale Univ. (USA) . . . . . [11296-94]
- 2:20 pm: **Direct semiconductor diode laser system for an optical lattice clock based on neutral strontium for future tests of fundamental physics in space** (*Invited Paper*), Vladimir Schkolnik, Jason R. Williams, Nan Yu, Jet Propulsion Lab. (USA) . . . . . [11296-95]
- Coffee Break . . . . . Mon 2:45 pm to 3:15 pm

Sessions 17-19 run concurrently with sessions 20-22

SESSION 19

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... MON 4:15 PM TO 6:20 PM

Gravitational Wave Detection and Related Technologies

Session Chair: **Sougato Bose**, Univ. College London (United Kingdom)

4:15 pm: **Quantum noise reduction methods in the Virgo interferometric gravitational wave detector** (*Invited Paper*), Jean-Pierre Zendri, Istituto Nazionale di Fisica Nucleare (Italy) ..... [11296-84]

4:40 pm: **Advanced mode-mismatch sensing: innovative approaches for precise beam-cavity coupling in gravitational wave interferometers** (*Invited Paper*), Marco Bazzan, Univ. degli Studi di Padova (Italy) . . . [11296-85]

5:05 pm: **Advanced quantum-enhanced metrology for gravitational-wave detection** (*Invited Paper*), Stefan L. Danilishin, M.V. Lomonosov Moscow State Univ. (Russian Federation) . . . [11296-86]

5:30 pm: **High-frequency gravitational wave detection with optically-levitated particles** (*Invited Paper*), George Winstone, Northwestern Univ. (USA) . . . [11296-87]

5:55 pm: **Application of optical frequency comb in LISA space laser interferometry** (*Invited Paper*), Nan Yu, Jet Propulsion Lab. (USA) . . [11296-88]

SESSION 22

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... MON 3:15 PM TO 5:35 PM

Quantum Information Processing and Related Technologies I

Session Chair: **Alexander O. Sushkov**, Boston Univ. (USA)

3:15 pm: **Multimode squeezed light and coupled three-mode squeezed vacuum** (*Invited Paper*), Ryan T. Glasser, Wenlei Zhang, Erin M Knutson, Sara K Wyllie, Jonathan S Cross, Tulane Univ. (USA) . . . [11296-96]

3:40 pm: **Quantum state discrimination for optimal classical communications**, Ivan A. Burenkov, M. V. Jabir, Abdella Battou, Sergey V. Polyakov, National Institute of Standards and Technology (USA) . . . [11296-97]

3:55 pm: **Spatial correlation functions for arbitrary pump profiles in bright squeezed vacuum** (*Invited Paper*), Samuel Lemieux, Univ. of Ottawa (Canada) . . . [11296-98]

4:20 pm: **Controlling atomic wave packets at the quantum speed limit** (*Invited Paper*), Andrea Alberti, Rheinische Friedrich-Wilhelms-Univ. Bonn (Germany) . . . [11296-99]

4:45 pm: **Recent developments in cybersecurity using quantum entanglement** (*Invited Paper*), Michael Brodsky, U.S. Army Combat Capabilities Development Command (USA) . . . [11296-100]

5:10 pm: **Quantum tennis-racket effect** (*Invited Paper*), Myungshik Kim, Imperial College London (United Kingdom) . . . [11296-150]

TUESDAY 4 FEBRUARY

SESSION 23

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... TUE 8:00 AM TO 10:20 AM

Slow and Fast Light in Cavities, Resonators, and Waveguides

Session Chair: **Kerry J. Vahala**, Caltech (USA)

8:00 am: **Brillouin scattering in micropillars** (*Invited Paper*), Daniel Lanzillotti-Kimura, Ctr. de Nanosciences et de Nanotechnologies (France) . . . [11296-101]

8:25 am: **Front induced transitions in slow light and dispersive waveguides**, Mahmoud A. A. Gaafar, Technische Univ. Hamburg-Harburg (Germany); Toshihiko Baba, Yokohama National Univ. (Japan); Manfred Eich, Alexander Petrov, Technische Univ. Hamburg-Harburg (Germany) . . [11296-102]

8:40 am: **20-fm resonances in an amplified slow-light FBG for high-precision metrology** (*Invited Paper*), Michel J. F. Digonnet, Stanford Univ. (USA) . . . [11296-103]

9:05 am: **Slow light in SNAP structures: new classical and quantum applications** (*Invited Paper*), Misha Sumetsky, Aston Univ. (United Kingdom) . . . [11296-104]

9:30 am: **Large nonlinear amplification in gases using stimulated Brillouin scattering** (*Invited Paper*), Luc Thévenaz, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . [11296-105]

9:55 am: **Dispersion engineering in distributed Brillouin dynamic sensing with spectrum engineering** (*Invited Paper*), Thomas Schneider, Technische Univ. Braunschweig (Germany); Cheng Feng, Technische Universität Braunschweig, THz-Photonics Group (Germany) . . . [11296-106]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

SESSION 24

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... TUE 10:50 AM TO 12:25 PM

Gyroscopes and Precision Rotation Sensing I

Session Chair: **Misha Sumetsky**, Aston Univ. (United Kingdom)

10:50 am: **Tutorial: Many things are white light cavities**, Jacob Scheuer, Tel Aviv Univ. (Israel) . . . [11296-107]

11:35 am: **Non-Hermitian ring laser gyroscope with an enhanced Sagnac sensitivity** (*Invited Paper*), Mohammad Parvinnezhad Hokmabadi, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Alex Schumer, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and Technische Univ. Wien (Austria); Demetrios Christodoulides, Mercedesh Khajavikhan, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . [11296-108]

12:00 pm: **Hafele and Keating on a chip: Sagnac interferometry with a single clock** (*Invited Paper*), Thomas Fernholz, The Univ. of Nottingham (United Kingdom) . . . [11296-109]

Lunch/Exhibition Break . . . . . Tue 12:25 pm to 1:45 pm

SESSION 25

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... TUE 1:25 PM TO 3:30 PM

Gyroscopes and Precision Rotation Sensing II

Session Chair: **Michel J. F. Digonnet**, Stanford Univ. (USA)

1:25 pm: **Rotational sensing with nitrogen-vacancy centers in diamond** (*Invited Paper*), Andrey Jarmola, Univ. of California, Berkeley (USA) . [11296-110]

1:50 pm: **Rotation measurements and evidence of fast-light in an all-fiber ring laser gyro** (*Invited Paper*), Caleb A. Christensen, MagiQ Technologies, Inc. (USA) . . . [11296-111]

2:15 pm: **PT-symmetry-breaking gyroscopes** (*Invited Paper*), David D. Smith, NASA Marshall Space Flight Ctr. (USA) . . . [11296-159]

2:40 pm: **A dual cold atom beam accelerometer/gyroscope** (*Invited Paper*), Frank A. Narducci, Naval Postgraduate School (USA) . . . [11296-112]

3:05 pm: **Detection of the Earth's rotation using a chip-based laser gyroscope** (*Invited Paper*), Kerry J. Vahala, Caltech (USA) . . . [11296-113]

Coffee Break . . . . . Tue 3:30 pm to 3:50 pm

OPTO

# CONFERENCE 11296

## SESSION 26

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... TUE 3:50 PM TO 5:05 PM

### Gyroscopes and Precision Rotation Sensing III

Session Chair: **Frank A. Narducci**, Naval Postgraduate School (USA)

3:50 pm: **Towards a compact atomic inertial sensor for satellite application** (*Invited Paper*), He Wang, The Aerospace Corp. (USA) . [11296-114]

4:15 pm: **Quantum-limited rotation measurements** (*Invited Paper*), Luis Lorenzo Sánchez-Soto, Univ. Complutense de Madrid (Spain) . . . . . [11296-115]

4:40 pm: **An atom-chip TOP trap for gyroscopic sensing** (*Invited Paper*), Cass A. Sackett, Univ. of Virginia (USA) . . . . . [11296-116]

## SESSION 27

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... TUE 5:05 PM TO 6:20 PM

### Precision Magnetometry and Enabling Technologies

Session Chair: **He Wang**, The Aerospace Corp. (USA)

5:05 pm: **Atomic magnetometry for dark matter search** (*Invited Paper*), Ibrahim Sulai, Bucknell Univ. (USA) . . . . . [11296-117]

5:30 pm: **Magneto-optical fluorescence resonance studies from sodium D2 manifold for remote magnetometry application** (*Invited Paper*), Renu Tripathi, Gour S. Pati, Delaware State Univ. (USA) . . . . . [11296-118]

5:55 pm: **Microfabricated magnetometers for imaging and communication** (*Invited Paper*), Vladislav P. Gerginov, Univ. of Colorado Boulder (USA) . . . . . [11296-119]

## WEDNESDAY 5 FEBRUARY

## SESSION 28

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... WED 8:00 AM TO 10:20 AM

### Integrated/Chip Scale Sensing and Related Technologies I

Session Chair: **John E. Kitching**, National Institute of Standards and Technology (USA)

8:00 am: **Enhanced dissipative sensing in a microresonator with multimode input (theory)** (*Invited Paper*), Albert T. Rosenberger, Sreekul R Rajagopal, Oklahoma State Univ. (USA) . . . . . [11296-120]

8:25 am: **A wavelength reference at 1560 nm using a photonic rubidium spectrometer and aluminum nitride microresonator frequency doubler**, Casey McKenna, Douglas G. Bopp, Zach L. Newman, National Institute of Standards and Technology (USA); Joshua B. Surya, Yale Univ. (USA); Alexander Yulaev, Daron Westly, Kartik Srinivasan, Vladimir Aksyuk, National Institute of Standards and Technology (USA); Hong X. Tang, Yale Univ. (USA); John E. Kitching, Matthew T. Hummon, National Institute of Standards and Technology (USA) . . . . . [11296-121]

8:40 am: **Dynamic suppression of Rayleigh backscattering and recovery of ultra-high-Q resonances** (*Invited Paper*), Gaurav Bahl, Univ. of Illinois (USA) . . . . . [11296-122]

9:05 am: **MEMS-integrated PDMS metasurface designed for autonomous vehicles sensing: a new approach for LiDAR application** (*Invited Paper*), Bar Zirinski, Tel Aviv Univ. (Israel) . . . . . [11296-123]

9:30 am: **Surface acoustic wave-photonic devices in standard silicon-on-insulator** (*Invited Paper*), Avinoam Zadok, Bar-Ilan Univ. (Israel) . . . [11296-124]

9:55 am: **Integrated nanophotonic structures for enhanced light-matter interaction** (*Invited Paper*), Sajjad Abdollahramezani, Hossein Taghinejad, Tianren Fan, Amir H. Hosseinnia, Ali A. Eftekhar, Ali Adibi, Georgia Institute of Technology (USA) . . . . . [11296-125]

Coffee Break . . . . . Wed 10:20 am to 10:50 am

## SESSION 29

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... WED 10:50 AM TO 12:05 PM

### Integrated/Chip Scale Sensing and Related Technologies II

Session Chair: **Albert T. Rosenberger**, Oklahoma State Univ. (USA)

10:50 am: **Integrating atomic ensembles with photonics: new devices and instruments** (*Invited Paper*), John E. Kitching, National Institute of Standards and Technology (USA) . . . . . [11296-126]

11:15 am: **Photon-number-resolved experiments: From the photon statistics of nanophotonic devices to quantum-optical studies of a single quantum dot** (*Invited Paper*), Martin von Helversen, Technische Univ. Berlin (Germany) . . . . . [11296-127]

11:40 am: **Microwave photonic processing with spatial-spectral holographic materials** (*Invited Paper*), Wm. Randall Babbitt, Montana State Univ. (USA) . . . . . [11296-128]

Lunch/Exhibition Break . . . . . Wed 12:05 pm to 1:30 pm

## SESSION 30

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... WED 1:30 PM TO 3:25 PM

### Integrated/Chip Scale Sensing and Related Technologies III

Session Chair: **Jacob B. Khurgin**, Johns Hopkins Univ. (USA)

1:30 pm: **Protecting an inhomogeneously broadened atomic ensemble from decoherence by strong coupling to an optical cavity** (*Invited Paper*), Sylvain Schwartz, Lab. Kastler Brossel (France) . . . . . [11296-129]

1:55 pm: **Precision laser-frequency stabilization with photonic resonators** (*Invited Paper*), Scott B. Papp, National Institute of Standards and Technology (USA) . . . . . [11296-130]

2:20 pm: **Chip-scale precision metrology using atoms and molecules in the near- and the mid-IR** (*Invited Paper*), Uriel Levy, The Hebrew Univ. of Jerusalem (Israel) . . . . . [11296-131]

2:45 pm: **Research progress of trace uranyl ions detection by surface-enhanced Raman scattering (SERS)** (*Invited Paper*), Xuan He, China Academy of Engineering Physics (China) . . . . . [11296-132]

3:10 pm: **Enhanced dissipative sensing in a microresonator with multimode input (experiment)**, Sreekul R. Rajagopal, Albert T. Rosenberger, Oklahoma State Univ. (USA) . . . . . [11296-158]

Coffee Break . . . . . Wed 3:25 pm to 3:45 pm

## SESSION 31

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... WED 3:45 PM TO 6:10 PM

### Optical Metrology: New Developments I

Session Chair: **Uriel Levy**, The Hebrew Univ. of Jerusalem (Israel)

3:45 pm: **Tutorial: Epsilon near-zero materials for nonlinear optics and adiabatic frequency conversion**, Jacob B. Khurgin, Johns Hopkins Univ. (USA) . . . . . [11296-133]

4:30 pm: **Control of spatial quantum correlations in bright twin beams** (*Invited Paper*), Alberto M. Marino, The Univ. of Oklahoma (USA) . . . [11296-134]

4:55 pm: **Wavelength-scale errors in optical localization due to spin-orbit coupling of light** (*Invited Paper*), Arno Rauschenbeutel, Technische Univ. Wien (Austria) . . . . . [11296-135]

5:20 pm: **Self-homodyne detection of a narrow EIT signal using the superflash effect** (*Invited Paper*), Chetan Sriram, Nanyang Technological Univ. (Singapore) . . . . . [11296-136]

5:45 pm: **Rapidly reversible alkali sources for cold-atom precision metrology** (*Invited Paper*), Christopher Roper, HRL Labs., LLC (USA) . . . . . [11296-137]

THURSDAY 6 FEBRUARY

SESSION 32

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... THU 8:00 AM TO 9:55 AM

Optical Metrology: New Developments II

Session Chair: **Stefania Residori**, Institut de Physique de Nice (France)

8:00 am: **Nonlocal light-mediated interactions for fast scrambling** (*Invited Paper*), Gregory Bentsen, Stanford Univ. (USA) ..... [11296-138]

8:25 am: **Prospects for precision sensing and metrology utilizing levitated optomechanics** (*Invited Paper*), Hendrik Ulbricht, Univ. of Southampton (United Kingdom) ..... [11296-139]

8:50 am: **Laser spectroscopy of Palladium for nuclear structure studies**, Ibrahim Sulai, Univ. of Wisconsin-Madison (USA) ..... [11296-140]

9:05 am: **A modern description of Rayleigh's criterion** (*Invited Paper*), Liang Jiang, Pritzker School of Molecular Engineering, The Univ. of Chicago (USA) ..... [11296-141]

9:30 am: **Distance estimation at and beyond the shot noise limit using spectral or spatial optical mode demultiplexing** (*Invited Paper*), Nicolas Treps, Lab. Kastler Brossel (France) ..... [11296-142]

Coffee Break. .... Thu 9:55 am to 10:20 am

SESSION 33

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... THU 10:20 AM TO 12:15 PM

Optical Metrology: New Developments III

Session Chair: **Liang Jiang**, The Univ. of Chicago (USA)

10:20 am: **Unitary transformations of full-field transverse spatial modes**, Robert Fickler, Institut für Quantenoptik und Quanteninformation ÖAW (Austria); Markus Hiekkamäki, Tampere Univ. (Finland) ..... [11296-143]

10:35 am: **Photon-efficient direct tomography of structured light** (*Invited Paper*), Zhimin Shi, Univ. of South Florida (USA) ..... [11296-144]

11:00 am: **Applications for interferometry and beam clean-up with liquid crystal light valves** (*Invited Paper*), Stefania Residori, Institut de Physique de Nice (France) ..... [11296-145]

11:25 pm: **Fundamentals of the quantum covariance matrix and its implications for entanglement detection and sensing** (*Invited Paper*), Eliahu Cohen, Bar-Ilan Univ. (Israel) ..... [11296-154]

11:50 am: **Optical phase estimation with entangled states approaching the exact Heisenberg limit** (*Invited Paper*), Sergei Slussarenko, Griffith Univ. (Australia) ..... [11296-147]

Lunch/Exhibition Break. .... Thu 12:15 pm to 1:30 pm

SESSION 34

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... THU 1:30 PM TO 3:10 PM

Quantum Information Processing and Related Technologies II

Session Chair: **Eliahu Cohen**, Bar-Ilan Univ. (Israel)

1:30 pm: **Variable strength measurements of non-local observables** (*Invited Paper*), Aharon Brodutch, Univ. of Toronto (Canada) ..... [11296-148]

1:55 pm: **Space quantum communications exploiting temporal modes** (*Invited Paper*), Paolo Villorosi, Univ. degli Studi di Padova (Italy) ... [11296-149]

2:20 pm: **Quantum-enhanced x-ray detection** (*Invited Paper*), Sharon Shwartz, Bar-Ilan Univ. (Israel) ..... [11296-43]

2:45 pm: **Entanglement of spatially separated Bose-Einstein condensates** (*Invited Paper*), Carsten Klempt, Leibniz Univ. Hannover (Germany) . [11296-152]

Coffee Break. .... Thu 3:10 pm to 3:40 pm

SESSION 35

LOCATION: ROOM 209 (LEVEL 2 SOUTH) ..... THU 3:40 PM TO 5:20 PM

Quantum Information Processing and Related Technologies III

Session Chair: **Sharon Shwartz**, Bar-Ilan Univ. (Israel)

3:40 pm: **Quantum repeaters for quantum astrometry** (*Invited Paper*), Eden V. Figueroa, Stony Brook Univ. (USA) ..... [11296-153]

4:05 pm: **Experimental realization of robust weak measurements** (*Invited Paper*), Marco Genovese, Enrico Rebufello, Fabrizio Piacentini, Alessio Avella, Muriel Aparecida De Souza, Marco Gramagna, Istituto Nazionale di Ricerca Metrologica (Italy); Rudi Lussana, Federica Villa, Alberto Tosi, Politecnico di Milano (Italy); Jan Dziewior, Max-Planck-Institut für Quantenoptik (Germany); Eliahu Cohen, Bar-Ilan Univ. (Israel); Lev Vaidman, Tel Aviv Univ. (Israel); Ivo Pietro Degiovanni, Fabio Saccomandi, Istituto Nazionale di Ricerca Metrologica (Italy) ..... [11296-157]

4:30 pm: **Loss estimation with continuous and discrete variable quantum light** (*Invited Paper*), George Atkinson, Univ. of Bristol (United Kingdom) ..... [11296-155]

4:55 pm: **Implementation of a canonical phase measurement with quantum feedback** (*Invited Paper*), Leigh Martin, Univ. of California, Berkeley (USA) ..... [11296-156]

OPTO

# CONFERENCE 11297

LOCATION: ROOM 216 (LEVEL 2 SOUTH)

Tuesday–Wednesday 4–5 February 2020 • Proceedings of SPIE Vol. 11297

## Complex Light and Optical Forces XIV

Conference Chairs: **David L. Andrews**, Univ. of East Anglia (United Kingdom); **Enrique J. Galvez**, Colgate Univ. (USA); **Halina Rubinsztein-Dunlop**, The Univ. of Queensland (Australia)

Program Committee: **Cornelia Denz**, Westfälische Wilhelms-Universität Münster (Germany); **Kishan Dholakia**, Univ. of St. Andrews (United Kingdom); **Wolfgang A. Ertmer**, Leibniz Universität Hannover (Germany); **Andrew Forbes**, Univ. of the Witwatersrand, Johannesburg (South Africa); **Jesper Glückstad**, OptoRobotix ApS (Denmark); **Jörg B. Götte**, Nanjing Univ. (China); **Rüdiger Grunwald**, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); **Simon Hanna**, Univ. of Bristol (United Kingdom); **Jandir M. Hickmann**, Univ. Federal do Rio Grande do Sul (Brazil); **Martin P. J. Lavery**, Univ. of Glasgow (United Kingdom); **Ting-Hua Lu**, National Taiwan Normal Univ. (Taiwan); **Lorenzo Marrucci**, Univ. degli Studi di Napoli Federico II (Italy); **Giovanni Milione**, NEC Labs. America, Inc. (USA); **Miles J. Padgett**, Univ. of Glasgow (United Kingdom); **Daryl Preece**, Beckman Laser Institute and Medical Clinic (USA); **Monika Ritsch-Marte**, Medizinische Univ. Innsbruck (Austria); **Nirmal K. Viswanathan**, Univ. of Hyderabad (India)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 216 (LEVEL 2 SOUTH) ..... TUE 8:10 AM TO 10:00 AM

#### Fundamentals of Complex Light

Session Chair: **Enrique J. Galvez**, Colgate Univ. (USA)

- 8:10 am: **Conceptualization of the photon for quanta of structured light** (*Invited Paper*), David L. Andrews, Univ. of East Anglia (United Kingdom) ..... [11297-1]
- 8:40 am: **Anomalous refraction of spatio-temporally structured wavepackets**, Murat Yessenov, Basanta Bhaduri, Ayman F. Abouraddy, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . [11297-40]
- 9:00 am: **Quantum signatures in the classical limit of electromagnetic waves**, Jukka Tulkki, Mikko Partanen, Aalto Univ. (Finland) ..... [11297-3]
- 9:20 am: **Closed-form analytical Mie theory of vector complex source vortices**, Sergejus Orlovskas, Justas Beržys, Klemensas Laurinavicius, Ctr. for Physical Sciences and Technology (Lithuania) ..... [11297-4]
- 9:40 am: **Calculation of spot diagrams of different vector beams using geometrical ray tracing**, Karuna Sindhu Malik, Bosanta Ranjan Boruah, Indian Institute of Technology Guwahati (India) ..... [11297-5]
- Coffee Break ..... Tue 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 216 (LEVEL 2 SOUTH) ..... TUE 10:30 AM TO 12:00 PM

#### Novel Interactions for Complex Light Generation

Session Chair: **Kayn A. Forbes**, Univ. of East Anglia (United Kingdom)

- 10:30 am: **Structured light manipulation in strongly anisotropic metamaterials** (*Invited Paper*), Natalia M. Litchinitser, Jingbo Sun, Duke Univ. (USA) ..... [11297-6]
- 11:00 am: **Size-selective optical printing of silicon nanoparticles through their dipolar magnetic resonance**, María Cecilia Zaza, Ctr. de Investigaciones en Bionanociencias (Argentina) and Univ. de Buenos Aires (Argentina); Ianina Lucinla Violi, Ctr. de Investigaciones en Bionanociencias (Argentina); Julian Gargiulo, Imperial College London (United Kingdom); Germán Chiarelli, Ctr. de Investigaciones en Bionanociencias (Argentina) and Univ. de Buenos Aires (Argentina); Ludmilla Schumacher, Ctr. for Nanointegration Duisburg-Essen, Univ. Duisburg-Essen (Germany); Jurij Jakobi, Univ. Duisburg-Essen (Germany); Jorge Olmos-Trigo, Donostia International Physics Ctr. (Spain); Emiliano Cortés, Imperial College London (United Kingdom); Matthias König, Univ. Duisburg-Essen (Germany); Stephan Barcikowski, Ctr. for Nanointegration Duisburg-Essen, Univ. Duisburg-Essen (Germany); Sebastian Schlücker, Univ. Duisburg-Essen (Germany); Juan José Sáenz, Donostia International Physics Ctr. (Spain); Stefan Maier, Imperial College London (United Kingdom); Fernando D. Stefani, Ctr. de Investigaciones en Bionanociencias (Argentina) and Consejo Nacional de Investigaciones Científicas y Técnicas (Argentina); Guillermo Acuna, Univ. de Fribourg (Switzerland) ..... [11297-7]
- 11:20 am: **Convection- and bubble-assisted nanoaperture-based plasmonic tweezers**, Abhay Kotnala, The Univ. of Texas at Austin (USA) ..... [11297-8]
- 11:40 am: **Orientation of swimming cells with annular beam optical tweezers**, Declan Armstrong, Isaac C. Lenton, Halina Rubinsztein-Dunlop, Timo A. Nieminen, Alexander B. Stilgoe, Anatoli V. Kashchuk, The Univ. of Queensland (Australia) ..... [11297-39]
- Lunch/Exhibition Break ..... Tue 12:00 pm to 1:30 pm

#### SESSION 3

LOCATION: ROOM 216 (LEVEL 2 SOUTH) ..... TUE 1:30 PM TO 2:50 PM

#### Manipulation and Interactions with Light

Session Chair: **Eileen Otte**, Westfälische Wilhelms-Universität Münster (Germany)

- 1:30 pm: **Patterning ultrafine metal nanoparticles using optoelectronic tweezers (OET)**, Finlay Walton, Steven L. Neale, Song Tang, Univ. of Glasgow (United Kingdom) ..... [11297-11]
- 1:50 pm: **Rayleigh and Raman optical activity with Laguerre-Gaussian twisted light**, Kayn A. Forbes, Univ. of East Anglia (United Kingdom) [11297-12]
- 2:10 pm: **Optimal micro-manipulation in disordered media**, Michael Horodyski, Matthias Kühmayer, Andre Brandstötter, Kevin Pichler, Technische Univ. Wien (Austria); Yan V. Fyodorov, King's College London (United Kingdom); Ulrich Kuhl, Univ. Cote d'Azur (France); Stefan Rotter, Technische Univ. Wien (Austria) ..... [11297-41]
- 2:30 pm: **Magneto tropism of Mycobacterium Smegatis in an optical tweezer**, Ashok S. Vudayagiri, Univ. of Hyderabad (India) ..... [11297-13]
- Coffee Break ..... Tue 2:50 pm to 3:20 pm

#### SESSION 4

LOCATION: ROOM 216 (LEVEL 2 SOUTH) ..... TUE 3:20 PM TO 5:30 PM

#### Optical Fields and Forces

Session Chair: **Martin P. J. Lavery**, Univ. of Glasgow (United Kingdom)

- 3:20 pm: **Non-conservative instabilities in optical vacuum traps** (*Invited Paper*), Stephen H. Simpson, Czech Academy of Sciences (Czech Republic) ..... [11297-14]
- 3:50 pm: **Sculpting 3D light fields by counter-propagating light**, Eileen Otte, Ramon Runde, Eric Asché, Cornelia Denz, Westfälische Wilhelms-Universität Münster (Germany) ..... [11297-15]
- 4:10 pm: **Single low-NA objective counterpropagating optical traps enabled by 3D-printed mirrors**, Andrea Bertoncini, King Abdullah Univ. of Science and Technology (Saudi Arabia); Gheorghe Cojoc, Biotechnologische Zentrum (BIOTEC), TU Dresden (Germany); Jochen Guck, Max-Planck-Institut für die Physik des Lichts (Germany) and Biotechnologische Zentrum (BIOTEC), TU Dresden (Germany); Carlo Liberale, King Abdullah Univ. of Science and Technology (Saudi Arabia) ..... [11297-16]
- 4:30 pm: **Vacuum optomechanics of optically levitated objects**, Martin Šiler, Jana Damková, Vojtěch Svak, Petr Ják, Stephen H. Simpson, Oto Brzobohatý, Pavel Zemánek, Institute of Scientific Instruments of the CAS, v.v.i. (Czech Republic) ..... [11297-17]
- 4:50 pm: **Continuous symmetries and conservation laws in chiral media**, Frances Crimin, Neel Mackinnon, Univ. of Glasgow (United Kingdom); Jörg Götte, Univ. of Glasgow (United Kingdom) and Nanjing Univ. (China); Stephen Barnett, Univ. of Glasgow (United Kingdom) ..... [11297-18]
- 5:10 pm: **Understanding particle trajectories by mapping optical force vortices**, Isaac C. Lenton, Alexander B. Stilgoe, Timo A. Nieminen, Halina Rubinsztein-Dunlop, The Univ. of Queensland (Australia) ..... [11297-19]

WEDNESDAY 5 FEBRUARY

SESSION 5

LOCATION: ROOM 216 (LEVEL 2 SOUTH) ..... WED 8:20 AM TO 10:00 AM

Generation and Communication

Session Chair: **Andrew Forbes**,  
Univ. of the Witwatersrand, Johannesburg (South Africa)

8:20 am: **New protocols in high-dimensional quantum-key distribution with twisted photons** (*Invited Paper*), Frédéric Bouchard, Univ. of Ottawa (Canada) ..... [11297-20]

8:50 am: **Turbulence-resilient high-capacity free-space optical communication** (*Invited Paper*), Ziyi Zhu, Darrick Hay, Univ. of South Florida (USA); Yiyu Zhou, Univ. of Rochester (USA); Gerd Leuchs, Max-Planck-Institut für die Physik des Lichts (Germany); Robert W. Boyd, Univ. of Rochester (USA) and Univ. of Ottawa (Canada); Zhimin Shi, Univ. of South Florida (USA) ..... [11297-21]

9:20 am: **Perfect vortex beams and their applications in classical and quantum information processing**, Jonathan Pinnell, Valeria Rodriguez-Fajardo, Najmeh Tabebordbar, Andrew Forbes, Univ. of the Witwatersrand, Johannesburg (South Africa) ..... [11297-23]

9:40 am: **GRIN lens: a new element for complex vectorial beam modulation**, Chao He, Univ. of Oxford (United Kingdom); Jianyu Lin, The Hamlyn Ctr., Institute of Global Health Innovation, Imperial College London (United Kingdom); Ben Dai, City Univ. of Hong Kong (China); Peng Xi, Peking Univ. (China); Martin Booth, Univ. of Oxford (United Kingdom) ..... [11297-24]

Coffee Break. ....Wed 10:00 am to 10:30 am

SESSION 6

LOCATION: ROOM 216 (LEVEL 2 SOUTH) ..... WED 10:30 AM TO 12:10 PM

Structured Light

Session Chair: **Enrique J. Galvez**, Colgate Univ. (USA)

10:30 am: **Tailoring light at the source: structured light from lasers** (*Keynote Presentation*), Andrew Forbes, Univ. of the Witwatersrand, Johannesburg (South Africa) ..... [11297-25]

11:10 am: **Machine-learning orbital angular momentum spectra**, Pavleen Kaur, Giovanni Milione, Eric Cosatto, Philip Ji, NEC Labs. America, Inc. (USA) ..... [11297-26]

11:30 am: **Polarization control for single-mode optical nanofibers: fundamentals and applications**, Georgiy Tkachenko, Fuchuan Lei, Jonathan M. Ward, Sile Nic Chormaic, Okinawa Institute of Science and Technology Graduate Univ. (Japan) ..... [11297-27]

11:50 am: **Limits of weak light phase measurements for inter-spacecraft laser interferometry and coherent optical communications**, Daniel A. Shaddock, The Australian National Univ. (Australia) ..... [11297-28]

Lunch/Exhibition Break .....Wed 12:10 pm to 1:40 pm

WORKSHOP

LOCATION: ROOM 211 (LEVEL 2 SOUTH) ..... 1:40 PM TO 3:10 PM

Experimental Methods of Complex Light

Session Chairs: **Alasdair W. Clark**, Univ. of Glasgow (United Kingdom); **Andrew Forbes**, Univ. of the Witwatersrand, Johannesburg (South Africa); **Martin P. J. Lavery**, Univ. of Glasgow (United Kingdom); **Daryl Preece**, Beckman Laser Institute and Medical Clinic (USA)

In this special session we will cover the experimental techniques of controlling optical light fields that are central to a wide variety of novel scientific advances. In small workgroups attendees will get hands on training in four fundamental procedures and introductions to equipment that could be integrated into their future research. The session will be designed to accommodate both students and experienced researchers with a passion to learn new skills.

The four topics that will be focused on will be:

- wavefront control using digital holography
- 3D printing and its application to experimental optics
- optical manipulation of matter
- sensing of phase and intensity of optical fields.

Attendees will gain from the session new skills, complete a critical evaluation of used technologies, such as spatial light modulators, example control code, or design files to support future research activities.

Coffee Break. ....Wed 3:10 pm to 3:40 pm

SESSION 7

LOCATION: ROOM 216 (LEVEL 2 SOUTH) ..... WED 3:40 PM TO 5:50 PM

Propagation

Session Chair: **Halina Rubinsztein-Dunlop**,  
The Univ. of Queensland (Australia)

3:40 pm: **Higher-order Bessel beams integrated with time (HOBBIT) for dynamic structured light control** (*Invited Paper*), Eric G. Johnson, Clemson Univ. (USA) ..... [11297-29]

4:10 pm: **Propagation dynamics of ballistic light carrying orbital angular momentum**, Shaun Viola, Univ. of Glasgow (United Kingdom); Alison Yao, David McKee, Univ. of Strathclyde (United Kingdom); Martin P. J. Lavery, Univ. of Glasgow (United Kingdom) ..... [11297-30]

4:30 pm: **Wavepacket pendulum beams**, Enrique J. Galvez, Fabio J. Auccapuella, Yingsi Qin, Kristina L. Wittler, Colgate Univ. (USA) .... [11297-31]

4:50 pm: **Controlling the spectral rotation of ultrashort vortex pulses**, Max Liebmann, Alexander Treffer, Martin Bock, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany); Ulrike Wallrabe, Institut für Mikrosystemtechnik-IMTEK, Univ. of Freiburg (Germany); Rüdiger Grunwald, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) ..... [11297-32]

5:10 pm: **Anatomy of a spiral beam**, Daryl Preece, Univ. of California, Irvine (USA); Zhiwei Shi, Guangdong Univ. of Technology (China); Zhigang Chen, San Francisco State Univ. (USA) ..... [11297-33]

5:30 pm: **Holographic endoscopy and the transport properties of high NA multimode optical fibres**, Stephen H. Simpson, Czech Academy of Sciences (Czech Republic) ..... [11297-34]

POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

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Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Experimental investigation on the maximum translation speed of a trapped particle in a holographic optical trap**, Karuna Sindhu Malik, Bosanta Ranjan Boruah, Indian Institute of Technology Guwahati (India) ..... [11297-35]

**Mode-conversion in nanophotonic waveguides via symmetry-breaking optomechanical near-field interactions**, Dmitry A. Kozak, Marcel W. Pruessner, Todd H. Stievater, William S. Rabinovich, U.S. Naval Research Lab. (USA) ..... [11297-36]

**Predicting self-healing ability through modal content**, Jonathan Pinnell, Valeria Rodriguez-Fajardo, Univ. of the Witwatersrand, Johannesburg (South Africa); Saoussene Chabou, Karima Mihoubi, Abdelhalim Bencheikh, Univ. Ferhat Abbas de Sétif (Algeria); Andrew Forbes, Univ. of the Witwatersrand, Johannesburg (South Africa) ..... [11297-37]

**Room temperature test of wave-function collapse using a levitated micro-oscillator**, Di Zheng, Yingchun Leng, Xi Kong, Nanjing Univ. (China); Rui Li, Univ. of Science and Technology of China (China); Zizhe Wang, Xiaohui Luo, Nanjing Univ. (China); Jie Zhao, Changkui Duan, Univ. of Science and Technology of China (China); Pu Huang, Nanjing Univ. (China); Jiangfeng Du, Univ. of Science and Technology of China (China) . . . . [11297-38]

OPTO

# CONFERENCE 11298

LOCATION: ROOM 210 (LEVEL 2 SOUTH)

Wednesday–Thursday 5–6 February 2020 • Proceedings of SPIE Vol. 11298

# Photonic Heat Engines: Science and Applications II

**Conference Chairs:** Denis V. Seletskiy, Ecole Polytechnique de Montréal (Canada); Richard I. Epstein, ThermoDynamic Films LLC (USA); Mansoor Sheik-Bahae, The Univ. of New Mexico (USA)

**Program Committee:** Michel J. F. Digonnet, Stanford Univ. (USA); James G. Eden, Univ. of Illinois (USA); Raman Kashyap, Ecole Polytechnique de Montréal (Canada); Masaru K. Kuno, Univ. of Notre Dame (USA); Peter J. Pauzauskie, Univ. of Washington (USA); Ali Sayir, Air Force Office of Scientific Research (USA); Mauro Tonelli, Univ. di Pisa (Italy); Eli Yablonovitch, Univ. of California, Berkeley (USA)

## WEDNESDAY 5 FEBRUARY

### SESSION 1

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... WED 8:00 AM TO 10:30 AM

#### Novel Methods for Thermometry

Session Chair: Denis V. Seletskiy, Polytechnique Montréal (Canada)

- 8:00 am: **Luminescence-quenched ytterbium-doped optical fiber microheater and its applications** (*Invited Paper*), Nanjie Yu, Univ. of Illinois (USA); Matthew Tuggle, Clemson Univ. (USA); Andrew E. Mironov, Sehyun Park, Univ. of Illinois (USA); Jane Gragg, Courtney Kucera, Thomas Hawkins, Clemson Univ. (USA); J. Gary Eden, Univ. of Illinois (USA); John Ballato, Clemson Univ. (USA); Peter Dragic, Univ. of Illinois (USA) ..... [11298-1]
- 8:30 am: **Up-conversion emission thermometry for semiconductor laser cooling** (*Invited Paper*), Shubin Zhang, Zhuoming Zhang, Masaru K. Kuno, Univ. of Notre Dame (USA) ..... [11298-2]
- 9:00 am: **Fluorescence up-conversion for differential luminescence thermometry in Ho-doped crystals**, Saeid Rostami, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) ..... [11298-3]
- 9:20 am: **Fast monitoring of the fiber core temperature changes based on birefringence in polarization maintaining fibers**, Hanieh Afkhamiardakani, Jean-Claude Diels, The Univ. of New Mexico (USA) ..... [11298-4]
- 9:40 am: **Thermally enhanced photoluminescence and fundamental upper limit of luminescence: theoretical study**, Matej Kurtulic, Assaf Manor, Rafi Weill, Carmel Rotschild, Technion-Israel Institute of Technology (Israel) ..... [11298-5]
- 10:00 am: **All-optical temperature sensing of radiation balanced laser materials using NV-centers in nanodiamonds** (*Invited Paper*), Anupum Pant, Xiaojing Xia, Robert G. Felsted, Alexander B. Bard, Peter J. Pauzauskie, Univ. of Washington (USA) ..... [11298-6]
- Coffee Break ..... Wed 10:30 am to 11:00 am

### SESSION 2

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... WED 11:00 AM TO 12:20 PM

#### Optical Cryocoolers: Optimization and Spaceborne Applications

Session Chair: Raman Kashyap, Polytechnique Montréal (Canada)

11:00 am: **Laser cooling for low-earth observation missions: size, weight, and power consequences at the satellite level and practical optical implementation** (*Keynote Presentation*), Gilles Nagues, Institut NÉEL (France) and Univ. Grenoble Alpes (France) and CNRS (France); Rémi Vicente, Institut NÉEL (France) and Air Liquide Advanced Technologies (France) and CNRS (France); Jean-Michel Niot, Thierry Wiertz, Pierre Contini, Arnaud Gardelein, Air Liquide Advanced Technologies (France); Giovanni Cittadino, Univ. di Pisa (Italy); Alberto Di Lieto, Mauro Tonelli, Univ. di Pisa (Italy) and Istituto Nanoscienze, Consiglio Nazionale delle Ricerche (Italy) ..... [11298-7]

11:40 am: **Advances in optical cryo-cooler device development**, Jackson Kock, Junwei Meng, Azzurra Volpi, Alexander R. Albrecht, The Univ. of New Mexico (USA); Richard I. Epstein, ThermoDynamic Films LLC (USA); Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) ..... [11298-8]

12:00 pm: **The role of absorption saturation in optical refrigeration**, Azzurra Volpi, Jackson Kock, Alexander R. Albrecht, The Univ. of New Mexico (USA); Markus P. Hehlen, Los Alamos National Lab. (USA); Richard I. Epstein, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) ..... [11298-9]

Lunch/Exhibition Break ..... Wed 12:20 pm to 1:50 pm

### SESSION 3

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... WED 1:50 PM TO 3:50 PM

#### Laser Cooling of Rare-Earths: Bulk Systems

Session Chair: Peter D. Dragic, Univ. of Illinois (USA)

- 1:50 pm: **Crystal growth and characterization of Yb<sup>3+</sup>-doped LiLuF<sub>4</sub> for radiation-balanced lasers**, Azzurra Volpi, The Univ. of New Mexico (USA); Daniel Biner, Karl W. Krämer, Univ. Bern (Switzerland); Alexander R. Albrecht, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA); Markus P. Hehlen, Los Alamos National Lab. (USA) ..... [11298-10]
- 2:10 pm: **Enhancement of laser cooling efficiency in rare-earth-doped oxide at elevated high temperature** (*Invited Paper*), Yuta Nakayama, Yukihiko Harada, Takashi Kita, Kobe Univ. (Japan) ..... [11298-11]
- 2:40 pm: **Power scaling of mid-IR optical refrigeration and radiation-balanced lasers** (*Invited Paper*), Saeid Rostami, The Univ. of New Mexico (USA); Angel Flores, Roger Holten, Air Force Research Lab. (USA); Alexander R. Albrecht, Arash Mafi, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) ..... [11298-12]
- 3:10 pm: **Solid-state laser refrigeration of hydrothermal potassium lutetium fluoride microcrystals**, Xiaojing Xia, Anupum Pant, Alexander B. Bard, Matthew B. Lim, Peter J. Pauzauskie, Univ. of Washington (USA) ..... [11298-13]
- 3:30 pm: **Oxyfluoride glass-ceramics: a bright future for laser cooling**, Jyothis Thomas, Polytechnique Montréal (Canada); Thomas Meyneng, Yannick Ledemi, Ctr. d'optique, photonique et laser, Univ. Laval (Canada); Ando Rakotonandrasana, Denis Seletskiy, Polytechnique Montréal (Canada); Lauro Maia, Instituto de Física, Univ. Federal de Goiás (Brazil); Younès Messaddeq, Ctr. d'optique, photonique et laser, Univ. Laval (Canada); Raman Kashyap, Polytechnique Montréal (Canada) ..... [11298-14]
- Coffee Break ..... Wed 3:50 pm to 4:20 pm

### SESSION 4

LOCATION: ROOM 210 (LEVEL 2 SOUTH) ..... WED 4:20 PM TO 6:00 PM

#### Laser Cooling of Rare-Earths: Optical Fibers

Session Chair: Azzurra Volpi, The Univ. of New Mexico (USA)

- 4:20 pm: **Experimental observation of cooling in Yb-doped silica fibers** (*Invited Paper*), Jenny Maria Knall, Pierre-Baptiste Vigneron, Stanford Univ. (USA); Magnus Engholm, Mid Sweden Univ. (Sweden); Peter D. Dragic, Nanjie Yu, Univ. of Illinois (USA); John M. Ballato, Clemson Univ. (USA); Martin Bernier, Univ. Laval (Canada); Michel J. F. Digonnet, Stanford Univ. (USA) ..... [11298-15]
- 4:50 pm: **Observation of anti-Stokes fluorescence cooling of ytterbium-doped silica glass** (*Invited Paper*), Esmail Mobini, Saeid Rostami, Mostafa Peysokhan, Alexander R. Albrecht, The Univ. of New Mexico (USA); Stefan Kuhn, Sigrun Hein, Christian Hupel, Johannes Nold, Nicoletta Haarlammert, Thomas Schreiber, Ramona Eberhardt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany); Andreas Tünnermann, Fraunhofer-Institut für Angewandte Optik und Feinmechanik IOF (Germany) and Friedrich-Schiller-Universität Jena (Germany); Mansoor Sheik-Bahae, Arash Mafi, The Univ. of New Mexico (USA) ..... [11298-16]
- 5:20 pm: **Self-cooling experiment in a small core YAG-derived fiber**, Long Cheng, Laura Andre, Univ. of Michigan (USA); Nanjie Yu, Peter Dragic, Univ. of Illinois (USA); Thomas Hawkins, John Ballato, Clemson Univ. (USA); Stephen Rand, Univ. of Michigan (USA) ..... [11298-17]
- 5:40 pm: **Effect of the background absorption in achieving a radiation-balanced ZBLAN fiber laser**, Mostafa Peysokhan, Esmail Mobini, Arash Mafi, The Univ. of New Mexico (USA) ..... [11298-18]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

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Poster Setup: Wednesday 10:00 AM – 5:00 PM

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**Theoretical determination and experimental validation of opto-thermoelectric force on colloidal microparticles in surfactant solutions.** Pavana Siddhartha Kollipara, Linhan Lin, Yuebing Zheng, The Univ. of Texas at Austin (USA) . . . . . [11298-29]

**Perovskite quantum-dot photo-luminescence for non-contact thermometry and thermal imaging.** Jackson Kock, Mingyang Zhang, Alexander R. Albrecht, Azzurra Volpi, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) . . . . . [11298-30]

## THURSDAY 6 FEBRUARY

### SESSION 5

LOCATION: ROOM 210 (LEVEL 2 SOUTH) . . . . . THU 8:30 AM TO 10:10 AM

#### Novel Photonic Heat Engines

Session Chair: **Peter J. Pauzauskie**, Univ. of Washington (USA)

8:30 am: **Mirrors for efficient energy conversion in optoelectronics.** Zunaid Omaid, Luis M. Pazos-Outon, Eli Yablonovitch, Univ. of California, Berkeley (USA) . . . . . [11298-19]

8:50 am: **Room-temperature multi-phonon upconversion photoluminescence in monolayer semiconductor WS<sub>2</sub>** (*Invited Paper*), Pawel Hawrylak, Univ. of Ottawa (Canada); Joanna Jadczyk, Leszek Bryja, Maciej Bieniek, Joanna Kutrowska-Girzycka, Piotr Kapuscinski, Wrocław Univ. of Science and Technology (Poland) . . . . . [11298-20]

9:20 am: **Photonic refrigeration from time-modulated thermal emission** (*Invited Paper*), Siddharth Buddhiraju, Wei Li, Shanhui Fan, Stanford Univ. (USA) . . . . . [11298-21]

9:50 am: **Luminescent solar power: Quantum separation between free-energy and heat for cost-effective base-load solar energy generation.** Shimry Haviv, Natali Revivo, Nimrod Kruger, Carmel Rotschild, Technion-Israel Institute of Technology (Israel) . . . . . [11298-22]

Coffee Break. . . . . Thu 10:10 am to 10:40 am

### SESSION 6

LOCATION: ROOM 210 (LEVEL 2 SOUTH) . . . . . THU 10:40 AM TO 12:00 PM

#### Novel Laser Cooling Systems

Session Chair: **Michel J. F. Digonnet**, Stanford Univ. (USA)

10:40 am: **Evaluation of CsPbBr<sub>3</sub> nanocrystals for laser cooling** (*Invited Paper*), Masaru K. Kuno, Univ. of Notre Dame (USA) . . . . . [11298-23]

11:10 am: **Thermal decoherence and laser cooling of Kerr-microresonator solitons** (*Invited Paper*), Tara Drake, The Univ. of New Mexico (USA); Jordan Stone, Travis Briles, Univ. of Colorado Boulder (USA); Scott Papp, National Institute of Standards and Technology (USA) . . . . . [11298-24]

11:40 am: **Anti-Stokes photoluminescence and optical cooling of CdSeS/ZnS colloidal quantum dots embedded in dielectric waveguides.** Mark V. Reymatias, Gema J. Alas, Arjun Senthil, Sami A. Nazib, Troy A. Hutchins-Delgado, Dominic Bosomtwi, Shruti I. Gharde, Ushnik Ghosh, DeYannah J. Walker, Nathan J. Withers, Gennady A. Smolyakov, The Univ. of New Mexico (USA); Yuliya Kuznetsova, Picotek LLC (USA); Sergei A. Ivanov, Ctr. for Integrated Nanotechnologies, Los Alamos National Lab. (USA); Dale L. Huber, Ctr. for Integrated Nanotechnologies, Sandia National Labs. (USA); Marek Osiński, The Univ. of New Mexico (USA) . . . . . [11298-25]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:30 pm

### SESSION 7

LOCATION: ROOM 210 (LEVEL 2 SOUTH) . . . . . THU 1:30 PM TO 2:30 PM

#### Radiation Balanced Lasers

Session Chair: **Markus P. Hehlen**, Los Alamos National Lab. (USA)

1:30 pm: **Mode-scaling in Yb:YLF radiation-balanced disk lasers.** Azzurra Volpi, Jackson Kock, Junwei Meng, Alexander R. Albrecht, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) . . . . . [11298-26]

1:50 pm: **Analysis of tandem rare-earth-semiconductor radiation-balanced lasers.** Jacob B. Khurgin, Johns Hopkins Univ. (USA) . . . . . [11298-27]

2:10 pm: **Analysis of mid-IR radiation-balanced lasers in Tm- and Ho-doped crystals.** Saeid Rostami, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) . . . . . [11298-28]



## Industry Workshops

Wednesday • Moscone West Level 2

30-minute to full-day workshops open to all attendees

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# CONFERENCE 11299

LOCATION: ROOM 214 (LEVEL 2 SOUTH)

Tuesday–Wednesday 4–5 February 2020 • Proceedings of SPIE Vol. 11299

## AI and Optical Data Sciences

Conference Chair: **Bahram Jalali**, Univ. of California, Los Angeles (USA)

Conference Co-Chair: **Ken-ichi Kitayama**, The Graduate School for the Creation of New Photonics Industries (Japan)

Program Committee: **Michele Caselle**, Karlsruhe Institut für Technologie (Germany); **Claire Lifan Chen**, Lumentum (USA); **Mark A. Foster**, Johns Hopkins Univ. (USA); **Robin Hassel**, Acqiris SA (Switzerland); **Barmak Heshmat**, BRELYON, Inc. (USA); **Robert Alexander Huber**, Univ. zu Lübeck (Germany); **Yunshan Jiang**, Waymo, LLC (USA); **Koichiro Kishima**, Pinpoint Photonics (Japan); **Cejo K. Lonappan**, SiLC Technologies, Inc. (USA); **Ruben S. Luís**, National Institute of Information and Communications Technology (Japan); **Aydogan Ozcan**, Univ. of California, Los Angeles (USA); **YongKeun Park**, KAIST (Korea, Republic of); **Demetri Psaltis**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Varun Raghunathan**, Indian Institute of Science (India); **Natan T. Shaked**, Tel Aviv Univ. (Israel); **Nabeel Shirazi**, Xilinx, Inc. (USA); **Madhuri Suthar**, Univ. of California, Los Angeles (USA); **George C. Valley**, The Aerospace Corp. (USA); **Ming C. Wu**, Univ. of California, Berkeley (USA); **Lei Zhang**, The Hong Kong Polytechnic Univ. (Hong Kong, China); **Darko Zibar**, Technical Univ. of Denmark (Denmark)

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... TUE 8:30 AM TO 10:00 AM

#### AR/VR Sciences I

Session Chair: **Barmak Heshmat**, BRELYON, Inc. (USA)

8:30 am: **Dynamic holographic display with pupil tracking**, Hakan Ürey, Koç Univ. (Turkey) and CY Vision (USA); Ali Cem, Koç Univ. (Turkey); Erdem Ulusoy, Koç Univ. (Turkey) and CY Vision (USA); Mehmet K. Hedili, Seyedmahdi M. K. Kazempourradi, Koç Univ. (Turkey); Evan Carter, George Skolianos, Trevor K. Chan, Goksen G. Yaralioglu, CY Vision (USA) ..... [11299-1]

9:00 am: **Advanced digital optics using metasurface**, Reza Khorasaninejad, Harvard John A. Paulson School of Engineering and Applied Sciences (USA) ..... [11299-2]

9:30 am: **Notes on the design of freeform optics**, Rubén Mohedano, Pablo Benítez, Juan Carlos Miñano, Milena Nikolic, Dejan Grabovickic, Julio Chaves, Marina Buljan, Pablo Zamora, Limbak 4PI S.L. (Spain) . . [11299-3]

Coffee Break ..... Tue 10:00 am to 10:30 am

#### SESSION 2

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... TUE 10:30 AM TO 12:00 PM

#### AR/VR Sciences II

Session Chair: **Reza Khorasaninejad**, Harvard John A. Paulson School of Engineering and Applied Sciences (USA)

10:30 am: **Challenges and opportunities for occlusion-capable optical see-through head-mounted displays for augmented reality** (Keynote Presentation), Hong Hua, Austin Wilson, James C. Wyant College of Optical Sciences (USA) ..... [11299-4]

11:00 am: **Metaform optics for ultra-compact augmented-reality visor**, Arka Majumdar, Univ. of Washington (USA) ..... [11299-5]

11:30 am: **Holographic AR near to eye display with eyebox expansion and the contents synthesis**, Jae-Hyeung Park, Inha Univ. (Korea, Republic of) ..... [11299-6]

Lunch/Exhibition Break ..... Tue 12:00 pm to 1:00 pm

#### SESSION 3

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... TUE 1:00 PM TO 3:00 PM

#### Reservoir Computing

Session Chair: **Bahram Jalali**, Univ. of California, Los Angeles (USA)

1:00 pm: **Time delay reservoir computing with VCSEL** (Keynote Presentation), Jean Benoit Héroux, IBM Research - Tokyo (Japan); Gouhei Tanaka, Ryosho Nakane, The Univ. of Tokyo (Japan); Naoki Kanazawa, Seiji Takeda, Hidetoshi Numata, Daiju Nakano, IBM Research - Tokyo (Japan); Akira Hirose, The Univ. of Tokyo (Japan) ..... [11299-7]

1:30 pm: **Optical reservoir computer using speckles in a multimode waveguide**, Uttam Paudel, Marta Luengo-Kovac, T. Justin Shaw, George C. Valley, The Aerospace Corp. (USA) ..... [11299-8]

2:00 pm: **Time-multiplexed photonic reservoir computing**, Guy Van der Sande, Krishan Harkhoe, Jaël Pauwels, Guy Verschaffel, Vrije Univ. Brussel (Belgium) ..... [11299-9]

2:30 pm: **Optical reservoir computing for high-dimensional spatio-temporal chaotic systems prediction**, Mushegh Rafayelyan, Jonathan Dong, Yongqi Tan, Lab. Kastler Brossel, Ecole Normale Supérieure, Univ. de Recherche Paris Sciences et Lettres, CNRS (France) and Sorbonne Univ. (France) and Collège de France (France); Florent Krzakala, Lab. de physique de l'ENS (France) and Univ. de Recherche Paris Sciences et Lettres (France) and Sorbonne Univ. (France); Sylvain Gigan, Lab. Kastler Brossel, Ecole Normale Supérieure, Univ. de Recherche Paris Sciences et Lettres, CNRS (France) and Sorbonne Univ. (France) and Collège de France (France) ..... [11299-10]

Coffee Break ..... Tue 3:00 pm to 3:30 pm

#### SESSION 4

LOCATION: ROOM 214 (LEVEL 2 SOUTH) ..... TUE 3:30 PM TO 6:30 PM

#### Photonic Hardware Accelerators

Session Chair: **Achuta Kadambi**, Univ. of California, Los Angeles (USA)

3:30 pm: **Decision making using classical and quantum light** (Keynote Presentation), Makoto Naruse, Nicolas Chauvet, The Univ. of Tokyo (Japan); Serge Huant, Institut NEÉL (France) and Univ. Grenoble Alpes (France) and CNRS (France); Satoshi Sunada, Kanazawa Univ. (Japan); Atsushi Uchida, Saitama Univ. (Japan); Hirokazu Hori, Univ. of Yamanashi (Japan) [11299-11]

4:00 pm: **Electro-optic perceptron towards 10<sup>18</sup> MAC/J-efficient photonic neural networks**, Rubab Amin, Mario Miscuglio, The George Washington Univ. (USA); Bhavin J. Shastri, Paul R. Prucnal, Princeton Univ. (USA); Volker J. Sorger, The George Washington Univ. (USA) ..... [11299-12]

4:30 pm: **Femtojoule-per-bit optoelectronic functions based on photonic nanostructures**, Kengo Nozaki, Shinji Matsuo, Takuro Fujii, Koji Takeda, Eiichi Kuramochi, Akihiko Shinya, Masaya Notomi, NTT Nanophotonics Ctr., NTT Basic Research Labs. (Japan) ..... [11299-13]

5:00 pm: **Silicon photonics for neuromorphic computing and machine learning**, Bhavin J. Shastri, Viraj Bangari, Bicky A. Marquez, Queen's Univ. (Canada); Alexander N. Tait, National Institute of Standards and Technology (USA); Hsuan-Tung Peng, Thomas Ferreira de Lima, Paul R. Prucnal, Princeton Univ. (USA) ..... [11299-14]

5:30 pm: **All-optical photonic integrated neural networks: a first take**, Mario Miscuglio, The George Washington Univ. (USA); Teo Ting Yu, Singapore Univ. of Technology and Design (Singapore); Armin Mehrabian, The George Washington Univ. (USA); Robert Simpson, Singapore Univ. of Technology and Design (Singapore); Volker J. Sorger, The George Washington Univ. (USA) . . . . . [11299-15]

6:00 pm: **A scalable optical neural network architecture using coherent detection**, Alexander Sludds, Liane Bernstein, Ryan Hamerly, Marin Soljacic, Dirk R. Englund, Massachusetts Institute of Technology (USA) . . . . . [11299-16]

**WEDNESDAY 5 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 214 (LEVEL 2 SOUTH) . . . . . WED 8:30 AM TO 10:30 AM**

**Optical Computing**

Session Chair: **Ken'ichi Kitayama**, The Graduate School for the Creation of New Photonics Industries (Japan)

8:30 am: **Improved optical cryptosystem based on phase-shifting interferometry in a joint transform correlator**, Yi Xiong, Chenggen Quan, National Univ. of Singapore (Singapore) . . . . . [11299-17]

9:00 am: **Synchronously-pumped OPO coherent ising machine: benchmarking and prospects**, Ryan Hamerly, Massachusetts Institute of Technology (USA); Takahiro Inagaki, NTT Basic Research Labs. (Japan); Peter L. McMahon, Cornell Univ. (USA); Davide Venturelli, NASA Ames Research Ctr. (USA); Alireza Marandi, Caltech (USA); Dirk R. Englund, Massachusetts Institute of Technology (USA); Yoshihisa Yamamoto, Stanford Univ. (USA) . . . [11299-18]

9:30 am: **Photonic convolutional processor for network edge computing**, Mario Miscuglio, The George Washington Univ. (USA); Puneet Gupta, Aydin Babakhani, Chee Wei Wong, Univ. of California, Los Angeles (USA); Hamed Dalir, Omega Optics, Inc. (USA); Tarek El-Ghazawi, Volker J. Sorger, The George Washington Univ. (USA) . . . . . [11299-19]

10:00 am: **Metamaterial-based analog computing (Keynote Presentation)**, Nader Engheta, Univ. of Pennsylvania (USA) . . . . . [11299-20]

Coffee Break . . . . . Wed 10:30 am to 11:00 am

**SESSION 6**

**LOCATION: ROOM 214 (LEVEL 2 SOUTH) . . . . . WED 11:00 AM TO 1:00 PM**

**Computational Imaging**

Session Chair: **Madhuri Suthar**, Univ. of California, Los Angeles (USA)

11:00 am: **Computation and photography: how the mobile phone became a camera (Keynote Presentation)**, Peyman Milanfar, Google (USA) . . . . . [11299-21]

11:30 am: **Origins and mitigations of automotive pulsed lidar artifacts**, Mark Shand, Waymo, LLC (USA) . . . . . [11299-22]

12:00 pm: **Learning-based computational imaging**, Ryoichi Horisaki, Osaka Univ. (Japan) . . . . . [11299-23]

12:30 pm: **Optical-coherence-tomography-based algorithm for handwriting forensic analysis**, Anderson Zanardi de Freitas, Lucas A. S. Ribeiro, Osvaldo Negrini Neto, Jorge S. E. Sarkis, Andressa N. Siqueira, Instituto de Pesquisas Energéticas e Nucleares (Brazil) . . . . . [11299-24]

Lunch/Exhibition Break . . . . . Wed 1:00 pm to 2:00 pm

**SESSION 7**

**LOCATION: ROOM 214 (LEVEL 2 SOUTH) . . . . . WED 2:00 PM TO 4:00 PM**

**Deep Learning**

Session Chair: **David B. Borlaug**, The Aerospace Corp. (USA)

2:00 pm: **Machine-learning with a small training set for classification of quantitative phase images of cancer cells (Keynote Presentation)**, Natan T. Shaked, Tel Aviv Univ. (Israel) . . . . . [11299-25]

2:30 pm: **Class-specific differential detection in diffractive optical neural networks**, Jingxi Li, Deniz Mengu, Yi Luo, Yair Rivenson, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [11299-26]

3:00 pm: **Particulate sensing using optical fibres and deep learning**, Ben Mills, James Grant-Jacob, Saurabh Jain, Yunhui Xie, Benita MacKay, Michael McDonnell, Matthew Praeger, Matthew Loxham, David Richardson, Robert Eason, Univ. of Southampton (United Kingdom) . . . . . [11299-27]

3:30 pm: **Rapid laser pest control system with 3D small object detection**, Sumesh Nair, Chia-Ying Chang, Feng-Chun Hsu, Ching-Chieh Su, Shean-Jen Chen, National Chiao Tung Univ. (Taiwan) . . . . . [11299-28]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

**Poster Setup: Wednesday 10:00 AM – 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Optical machine-learning with incoherent light and a single-pixel detector**, Shuming Jiao, Yang Gao, Jun Feng, Ting Lei, Zhenwei Xie, Xiao-Cong Yuan, Shenzhen Univ. (China) . . . . . [11299-29]

**Scalable coherent photonic digital-to-analog converters**, Shota Kita, Nippon Telegraph and Telephone Corp. (Japan); Guangwei Cong, National Institute of Advanced Industrial Science and Technology (Japan); Kengo Nozaki, Kenta Takata, Akihiko Shinya, Nippon Telegraph and Telephone Corp. (Japan); Noritsugu Yamamoto, Koji Yamada, National Institute of Advanced Industrial Science and Technology (Japan); Masaya Notomi, Nippon Telegraph and Telephone Corp. (Japan) . . . . . [11299-30]

**Saliency-driven airport detection via global contrast analysis and geometric feature extraction for remote-sensing images**, Yang Sun, Libao Zhang, Beijing Normal Univ. (China) . . . . . [11299-31]

**Residential area detection based on weakly-supervised learning and cosaliency analysis for multi-source optical remote-sensing images**, Libao Zhang, Yang Sun, Beijing Normal Univ. (China) . . . . . [11299-32]

**Artificial intelligence inverse design of ultra-flat meta-optics with experimental efficiencies exceeding 99% in the visible**, Arturo Burguete Lopez, Maksim Makarenko, Fedor Getman, Andrea Fratallocchi, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11299-33]

**Machine-learning-based receivers in optical communication**, Osama Hassan, Jingxi Li, Tingyi Zhou Zhou, Aydogan Ozcan, Bahram Jalali, Univ. of California, Los Angeles (USA) . . . . . [11299-34]

**Electronic polarization-division demultiplexing based on artificial neural networks in optical communication systems**, Yuichiro Kurokawa, Takeru Kyono, Moriya Nakamura, Meiji Univ. (Japan) . . . . . [11299-35]

**Quantum-well design of deep-UV LEDs and lasers using machine learning for optical sensing and metrology**, Chenxin Xiong, Yi Lu, King Abdullah Univ. of Science and Technology (Saudi Arabia); Dongjun Qu, Soochow Univ. (China); Xiangliang Zhang, Rongyu Lin, Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11299-36]

**Designing a task-specific microscope using a deep neural network to improve image classification accuracies**, Kanghyun Kim, Pavan Chandra Konda, Roarke Horstmeyer, Duke Univ. (USA) . . . . . [11299-37]

**Comparison between optoelectronic reservoir computing and LSTM**, Yijie Zhang, Alex Echeberria, Tingyi Zhou Zhou, Bahram Jalali, Univ. of California, Los Angeles (USA) . . . . . [11299-38]

**Automatic nano-optical inspection technology for hyperspectral imaging of MoS<sub>2</sub> thin films based on CNN**, Teng-Fan Wang, Graduate Institute of Opto-Mechatronics, National Chung Cheng Univ. (Taiwan) . . . . . [11299-39]

**Computational-complexity comparison of time- and frequency-domain artificial neural networks for optical nonlinearity compensation**, Takeru Kyono, Moriya Nakamura, Meiji Univ. (Japan) . . . . . [11299-40]

**Overfitting of artificial-neural-network-based nonlinear equalizer for multilevel signals in optical communication systems**, Kai Ikuta, Yuta Otsuka, Moriya Nakamura, Meiji Univ. (Japan) . . . . . [11299-41]

OPTO

# CONFERENCE 11300

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH)

Wednesday–Thursday 5–6 February 2020 • Proceedings of SPIE Vol. 11300

## Vertical-Cavity Surface-Emitting Lasers XXIV

Conference Chairs: **Luke A. Graham**, Dallas Quantum Devices (USA); **Chun Lei**, Lumentum (USA)

Program Committee: **Kent D. Choquette**, Univ. of Illinois (USA); **Aaron James Danner**, National Univ. of Singapore (Singapore); **Martin Grabherr**, Priolas GmbH (Germany); **James K. Guenter**, Finisar Corp. (USA); **Anders Larsson**, Chalmers Univ. of Technology (Sweden); **James A. Lott**, Technische Univ. Berlin (Germany); **M. V. Ramana Murty**, Broadcom Inc. (USA); **Krassimir Panajotov**, Vrije Univ. Brussel (Belgium); **Darwin K. Serkland**, Sandia National Labs. (USA); **Jean-Francois Seurin**, Princeton Optronics, Inc. (USA); **Noriyuki Yokouchi**, Furukawa Electric Co., Ltd. (Japan); **Jongseung Yoon**, The Univ. of Southern California (USA); **Mial E. Warren**, TriLumina Corp. (USA)

### WEDNESDAY 5 FEBRUARY

#### SESSION 1

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . WED 8:00 AM TO 9:55 AM

#### Commercial High-Power VCSELS

Session Chair: **Luke A. Graham**, Dallas Quantum Devices (USA)

- 8:00 am: **Performance, manufacturability, and qualification advances of high-power VCSEL arrays at TriLumina Corporation** (*Invited Paper*), Thomas R. Fanning, John Maynard, Christopher J. Helms, Lei Yang, David Podva, Jeff Earls, Jacob U. Lopez, Gianluca Bacchin, James Foresi, Mial E. Warren, TriLumina Corp. (USA) . . . . . [11300-1]
- 8:35 am: **Application of 2D matrix-addressable VCSEL arrays with micropatterned lensplates for the solid-state LIDAR sensors**, Chan M. Lim, Jung Hoonil, Changmo Jeong, Heesun Yoon, Jongkyu Jung, Jaihi Cho, Philhyun Jung, Dongju Jang, Juseong Jeong, SOS Lab. Co., Ltd. (Korea, Republic of) . . . . . [11300-2]
- 8:55 am: **13xx-nm VCSEL arrays on GaAs for 3D sensing applications**, Sabeur Siala, Array Photonics, Inc. (USA) . . . . . [11300-3]
- 9:15 am: **Lasertel VCSEL development progress for automotive lidar**, Jean Michel Maillard, Lasertel, Inc. (USA) . . . . . [11300-4]
- 9:35 am: **Quality control optical characterization of NIR VCSEL-based light sources for 3D imaging applications**, Pierre M. Boher, Thierry Leroux, ELDIM (France) . . . . . [11300-5]
- Coffee Break . . . . . Wed 9:55 am to 10:20 am

#### SESSION 2

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) .WED 10:20 AM TO 12:20 PM

#### Single-Mode Applications

Session Chair: **James Guenter**, Finisar Corp. (USA)

- 10:20 am: **Narrow-linewidth VCSELS based on multi-mirror cavities** (*Invited Paper*), Darwin K. Serkland, Theodore J. Morin, Sandia National Labs. (USA); Haley M. So, Columbia Univ. (USA); Gregory M. Peake, Michael G. Wood, Alejandro J. Griñe, C. Ryan Tait, Chris P. Hains, Kent M. Geib, Sandia National Labs. (USA) . . . . . [11300-6]
- 10:50 am: **Zero-order-free 2D beam pattern projecting on-chip lasers** (*Invited Paper*), Kazuyoshi Hirose, Yoshitaka Kurosaka, Yu Takiguchi, Takahiro Sugiyama, Soh Uenoyama, Yoshiro Nomoto, Hiroki Kamei, Hamamatsu Photonics K.K. (Japan) . . . . . [11300-7]
- 11:20 am: **Manufacture of VCSELS for caesium-based miniature atomic clocks**, Samuel Shutts, Curtis Hentschel, David Hayes, Sara-Jayne Gillgrass, Josie Nabielek, Craig P. Allford, Cardiff Univ. (United Kingdom); Dimitrios Zouris, Mohsin Haji, National Physical Lab. (United Kingdom); Iain Eddie, Compound Semiconductor Technologies Global Ltd. (United Kingdom); Mohamed Missous, Ioannis Kostakis, ICS Ltd. (United Kingdom); Wyn Meredith, Compound Semiconductor Ctr. Ltd. (United Kingdom); Peter Smowton, Cardiff Univ. (United Kingdom) . . . . . [11300-8]
- 11:40 am: **Strain-controlled impurity-induced disordered apertures for high-power single-mode VCSELS**, Patrick Su, Kevin Pikul, Fu-Chen Hsiao, Thomas O'Brien Jr., John M. Dallesasse, Univ. of Illinois (USA) . . . . . [11300-9]
- 12:00 pm: **76X-nm VCSELS with wide tuning range designed for TDLAS**, Martin Grabherr, Priolas GmbH (Germany) . . . . . [11300-10]
- Lunch/Exhibition Break . . . . . Wed 12:20 pm to 1:40 pm

#### SESSION 3

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . WED 1:40 PM TO 3:10 PM

#### High-Speed VCSELS: Commercial

Session Chair: **Chun Lei**, Lumentum (USA)

- 1:40 pm: **Polarization-stable 940nm VCSELS for sparing** (*Invited Paper*), Petter Westbergh, Sonia Quadery, Haiquan Yang, Hao Chen, Frank Flens, Richard Chan, Tsurugi Sudo, Finisar Corp. (USA); Dan Kuchta, IBM Thomas J. Watson Research Ctr. (USA) . . . . . [11300-11]
- 2:10 pm: **25 to 40 Gbps data transmission with small VCSEL arrays**, Nasibeh Haghighi, Philip A. Moser, Technische Univ. Berlin (Germany); Martin Zorn, JENOPTIK Optical Systems GmbH (Germany); James A. Lott, Technische Univ. Berlin (Germany) . . . . . [11300-12]
- 2:30 pm: **1x4 VCSEL arrays with uniform spectral and noise properties by using rotationally asymmetric oxide aperture for 400 Gbit/s applications**, Daisuke Inoue, Ryosuke Kubota, Takeshi Aoki, Takashi Ishizuka, Masaki Yanagisawa, Hajime Shoji, Sumitomo Electric Industries, Ltd. (Japan) . . . . . [11300-13]
- 2:50 pm: **100Gb/s PAM4 oxide VCSEL development progress at Broadcom**, Jingyi Wang, Ramana Murty, Broadcom Inc. (USA); Zheng-Wen Feng, Sumtro-Joyo Taslim, Aadi Sridhara, Broadcom, Inc. (Singapore); Xinle Cai, Broadcom Inc. (Singapore); Ann Harren, Broadcom Inc. (USA); Nelvin Leong, Gim-Hong Koh, Broadcom, Inc. (Singapore); An-Nien Cheng, David Dolfi, Broadcom Inc. (USA); Jason Chu, Broadcom, Inc. (Singapore); Laura Giovane, Broadcom Inc. (USA) . . . . . [11300-14]
- Coffee Break . . . . . Wed 3:10 pm to 3:40 pm

#### SESSION 4

LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . . WED 3:40 PM TO 5:30 PM

#### High-Speed VCSELS: Experimental

Session Chair: **Martin Grabherr**, Priolas GmbH (Germany)

- 3:40 pm: **Quantum-dot oxide-confined 850-nm VCSELS with extreme temperature stability operating at 25 Gbit/s up to 180°C** (*Invited Paper*), Nikolay Ledentsov Jr., VI Systems GmbH (Germany); Lukasz Chorchos, Warsaw Univ. of Technology (Poland) and VI Systems GmbH (Germany); Nikolay Cherkashin, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales (France) and CNRS (France); Jörg-Reinhardt Kropp, Vladimir P. Kalosha, Vitaly Shchukin, VI Systems GmbH (Germany); Zuhaib Khan, Chen-Lung Cheng, Jin-Wei Shi, National Central Univ. (Taiwan); Jaroslaw P. Turkiewicz, Warsaw Univ. of Technology (Poland); Nikolay Ledentsov, VI Systems GmbH (Germany) . . . . . [11300-15]
- 4:10 pm: **Coherence control of 2x1 VCSEL arrays for high-speed digital modulation**, Kent D. Choquette, Harshil Dave, Katherine Lakomy, Univ. of Illinois (USA) . . . . . [11300-16]
- 4:30 pm: **Comparison of 850-nm VCSEL oxide aperture designs**, Niels Heermeier, Marcin Gebiski, Nasibeh Haghighi, Philip Moser, Technische Univ. Berlin (Germany); Ping-Show Wong, Majid Riaziat, OEpic Semiconductors Inc. (USA); James A. Lott, Technische Univ. Berlin (Germany) . . . . . [11300-17]
- 4:50 pm: **Oxidation-stress-induced birefringence in vertical-cavity surface-emitting lasers**, Lukasz Chorchos, Warsaw Univ. of Technology (Poland) and VI Systems GmbH (Germany); Nikolay Ledentsov Jr., Oleg Makarow, Jörg-Reinhardt Kropp, Vitaly Shchukin, Vladimir P. Kalosha, VI Systems GmbH (Germany); Arkadiusz Lewandowski, Jaroslaw P. Turkiewicz, Warsaw Univ. of Technology (Poland); Nikolay Ledentsov, VI Systems GmbH (Germany) . . . . . [11300-18]
- 5:10 pm: **High-performance As/P MOCVD platform for emerging photonics applications**, Ronald A. Arif, Mark McKee, Eric Armour, Weimin Dong, Alex Zhang, Bojan Mitrovic, Drew Hanser, Ajit Paranjpe, Veeco Instruments Inc. (USA) . . . . . [11300-19]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Wednesday 10:00 AM – 5:00 PM**

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**Novel red-emitting VCSELs**, Ana Cutuk, Lena Engel, Michael Zimmer, Mona Stadler, Roman Bek, Michael Jetter, Peter Michler, Univ. Stuttgart (Germany) . . . . . [11300-24]

**Large-signal equivalent circuit model for datacom VCSELs**, Alexander Grabowski, Johan S. Gustavsson, Anders G. Larsson, Zhongxia Simon He, Chalmers Univ. of Technology (Sweden) . . . . . [11300-29]

**894nm high orthogonal polarization suppression ratio vertical-cavity surface-emitting lasers**, Ming Li, Institute of Semiconductors (China); Qihua Wang, Beijing Univ. of Technology (China); Pingping Qiu, Institute of Semiconductors (China); Yiyang Xie, Beijing Univ. of Technology (China); Qiang Kan, Institute of Semiconductors (China) . . . . . [11300-30]

**Lens bonding in VCSEL packages for optoelectronic applications**, Tim Cloppenburg, DELO Industrie Klebstoffe GmbH & Co. KGaA (Germany) . . . . . [11300-32]

**Spectrally resolved modes in real-world VCSELs with non-regular shapes of broad oxide-confined apertures**, Tomasz G. Czystanowski, Lodz Univ. of Technology (Poland); Adam Brejnak, Institute of Electron Technology (Poland); Łukasiewicz Research Network (Poland); Marcin Gebbski, Lodz Univ. of Technology (Poland); James A. Lott, Technische Univ. Berlin (Germany); Jan Muszalski, Institute of Electron Technology (Poland), Łukasiewicz Research Network (Poland) . . . . . [11300-33]

**THURSDAY 6 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . . THU 8:30 AM TO 10:30 AM**

**VCSELs in Novel Material Systems**

Session Chair: **Kent D. Choquette**, Univ. of Illinois (USA)

8:30 am: **Tunable room-temperature continuous-wave mid-infrared VCSELs** (*Invited Paper*), Vijaysekhar Jayaraman, Praevium Research, Inc. (USA); Stephen Segal, Kevin Lascola, Fred Towner, Thorlabs Quantum Electronics (USA); Borys Kolasa, Anthony Cazabat, Christopher Burgner, Praevium Research, Inc. (USA); Feng Xie, Thorlabs Quantum Electronics (USA); Chad Lindblad, Praevium Research, Inc. (USA) . . . . . [11300-20]

9:00 am: **Are blue and ultraviolet VCSELs a reality or just a dream?** (*Invited Paper*), Åsa Haglund, Filip Hjort, Chalmers Univ. of Technology (Sweden); Johannes Enslin, Munise Cobet, Technische Univ. Berlin (Germany); Michael A. Bergmann, Ehsan Hashemi, Chalmers Univ. of Technology (Sweden); Tim Kolbe, Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik (Germany); Johan S. Gustavsson, Jörgen Bengtsson, Tim Wernicke, Chalmers Univ. of Technology (Sweden); Michael Kneissl, Technische Univ. Berlin (Germany) . . . . . [11300-21]

9:30 am: **Design and growths of GaN-based zero-contrast grating reflectors**, Onoriode N. Ogidi-Ekoko, Wen Liang, Haotian Xue, Justin C. Goodrich, Hanlin Fu, Jiaheng Wu, Nelson Tansu, Lehigh Univ. (USA) . . . . . [11300-22]

9:50 am: **High-quality AlInN/GaN DBRs by in-situ curvature monitoring for GaN-based VCSELs**, Kei Hiraiwa, Wataru Muranaga, Sho Iwayama, Kazuki Kiyohara, Tetsuya Takeuchi, Satoshi Kamiyama, Motoaki Iwaya, Meijo Univ. (Japan); Isamu Akasaki, Meijo Univ. (Japan) and Nagoya Univ. (Japan) . . . . . [11300-23]

10:10 am: **Impact of top mirror power reflectance on 980-nm VCSEL performance**, Magdalena Marciniak, Marcin Gebbski, Lodz Univ. of Technology (Poland) and Technische Univ. Berlin (Germany); Artur Broda, Jan Muszalski, Institute of Electron Technology (Poland); Tomasz G. Czystanowski, Lodz Univ. of Technology (Poland); James A. Lott, Technische Univ. Berlin (Germany) . . . . . [11300-25]

Coffee Break. . . . . Thu 10:30 am to 11:00 am

**SESSION 6**

**LOCATION: ROOM 151 (UPPER MEZZANINE SOUTH) . THU 11:00 AM TO 12:10 PM**

**MEMs and High-Contrast Grating Devices**

Session Chair: **James A. Lott**, Technische Univ. Berlin (Germany)

11:00 am: **MEMs-HCG VCSELs for emerging sensing and datacoms applications** (*Invited Paper*), Dalila Ellafi, Bandwidth10 Inc. (USA); Michael Yang, Hung Kai Chen, Bandwidth10 Inc. (Taiwan); Neelanjan Bandyopadhyay, Sam Sangho Kim, Bandwidth10 Inc. (USA); Mike Huang, Bandwidth10 Inc. (Taiwan); Chris Chase, Bandwidth10 Inc. (USA) . . . . . [11300-26]

11:30 am: **Widely tunable electrically pumped 1050nm MEMS-VCSELs** (*Invited Paper*), Vijaysekhar Jayaraman, Christopher Burgner, John Carter, Iana Borova, Anthony Cazabat, Nate Bramham, Chad Lindblad, Praevium Research, Inc. (USA) . . . . . [11300-27]

11:50 am: **Progress in MHCG VCSELs**, Marcin Gebbski, Lodz Univ. of Technology (Poland); Majid Riaziat, OEpic Semiconductors Inc. (USA); Martin Zorn, JENOPTIK Optical Systems GmbH (Germany); James A. Lott, Technische Univ. Berlin (Germany); Tomasz G. Czystanowski, Lodz Univ. of Technology (Poland) . . . . . [11300-28]



# CONFERENCE 11301

LOCATION: ROOM 306 (LEVEL 3 SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11301

## Novel In-Plane Semiconductor Lasers XIX

Conference Chairs: **Alexey A. Belyanin**, Texas A&M Univ. (USA); **Peter M. Smowton**, Cardiff Univ. (United Kingdom)

Program Committee: **Yasuhiko Arakawa**, The Univ. of Tokyo (Japan); **Mikhail A. Belkin**, Walter Schottky Institut (Germany); **Dan Botez**, Univ. of Wisconsin-Madison (USA); **Federico Capasso**, Harvard John A. Paulson School of Engineering and Applied Sciences (USA); **Gary A. Evans**, Southern Methodist Univ. (USA); **Mariangela Gioannini**, Politecnico di Torino (Italy); **Michael Kneissl**, Technische Univ. Berlin (Germany); **Sophie Lange**, Microsoft Research Cambridge (United Kingdom); **Kei-May Lau**, Hong Kong Univ. of Science and Technology (Hong Kong, China); **Luke F. Lester**, Virginia Polytechnic Institute and State Univ. (USA); **Shinji Matsuo**, NTT Device Technology Labs. (Japan); **Luke J. Mawst**, Univ. of Wisconsin-Madison (USA); **Jerry R. Meyer**, U.S. Naval Research Lab. (USA); **Roberto Paiella**, Boston Univ. (USA); **Katrin Paschke**, Ferdinand-Braun-Institut (Germany); **Richard V. Penty**, Univ. of Cambridge (United Kingdom); **Johann Peter Reithmaier**, Univ. Kassel (Germany); **Haisheng Rong**, Intel Corp. (USA); **Gary M. Smith**, MIT Lincoln Lab. (USA); **Nelson Tansu**, Lehigh Univ. (USA); **Miriam S. Vitiello**, Istituto Nanoscienze (Italy); **Qi Jie Wang**, Nanyang Technological Univ. (Singapore); **Wanhua Zheng**, Institute of Semiconductors, CAS (China)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 306 (LEVEL 3 SOUTH) . . . . . MON 1:30 PM TO 3:20 PM

#### Nitride and Visible Lasers

Session Chair: **Michael Kneissl**, Technische Univ. Berlin (Germany)

- 1:30 pm: **Semipolar III-nitride distributed-feedback laser diode with Indium tin oxide surface grating (Invited Paper)**, Haojun Zhang, Daniel Cohen, Philip Chan, Matthew Wong, Yi Chao Chow, Shlomo Mehari, Daniel Becerra, Shuji Nakamura, Steven DenBaars, Univ. of California, Santa Barbara (USA) . . . . . [11301-1]
- 2:00 pm: **InGaN/AlGaInN quantum wells for low-threshold laser active region**, Hanlin Fu, Damir Borovac, Justin Goodrich, Onoriode Ogidi-Ekoko, Nelson Tansu, Lehigh Univ. (USA) . . . . . [11301-2]
- 2:20 pm: **Off-the-shelf laser diodes with narrow-line emission at visible wavelengths by integration of distributed feedback (DFB) surface grating**, Jorge A. Holguin-Lerma, Tien Khee Ng, Boon S. Ooi, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11301-3]
- 2:40 pm: **Single-mode 200mW 660nm to 690nm red laser diode for sensing and medical application**, Masato Hagimoto, Shintaro Miyamoto, Kyohei Watanabe, Yuki Kimura, Haruki Fukai, Satoshi Kawanaka, Ushio Opto Semiconductors, Inc. (Japan) . . . . . [11301-4]
- 3:00 pm: **First realization of a hybrid integrated diode laser in the visible spectral range**, Kees Franken, Albert van Rees, Youwen Fan, Univ. of Twente (Netherlands); Dimitri Gekus, Ronald Dekker, Douwe Geuzebroek, LioniX International BV (Netherlands); Carsten Fallnich, Westfälische Wilhelms-Universität Münster (Germany); Peter van der Slot, Klaus-Jochen Boller, Univ. of Twente (Netherlands) . . . . . [11301-71]
- Coffee Break. . . . . Mon 3:20 pm to 3:50 pm

#### SESSION 2

LOCATION: ROOM 306 (LEVEL 3 SOUTH) . . . . . MON 3:50 PM TO 5:50 PM

#### Materials Development

Session Chair: **Nelson Tansu**, Lehigh Univ. (USA)

- 3:50 pm: **Band structure engineering of type-II GaAsBi/GaNAs heterostructures for telecom laser applications**, Christopher A. Broderick, Tyndall National Institute (Ireland); Stephen J. Sweeney, Univ. of Surrey (United Kingdom); Eoin P. O'Reilly, Tyndall National Institute (Ireland); Judy M. Rorison, Univ. of Bristol (United Kingdom) . . . . . [11301-5]
- 4:10 pm: **Fabrication of a laser diode at 1600 nm with InAs quantum dots using a digital embedding method on an InP(311)B substrate**, Kouichi Akahane, National Institute of Information and Communications Technology (Japan); Hiroyuki Yamamoto, Aoyama Gakuin Univ. (Japan); Atsushi Matsumoto, Toshiba Umezawa, National Institute of Information and Communications Technology (Japan); Hideyuki Sotobayashi, Aoyama Gakuin Univ. (Japan); Naokatsu Yamamoto, National Institute of Information and Communications Technology (Japan) . . . . . [11301-6]
- 4:30 pm: **Increasing gain in p-modulation-doped InAs quantum-dot lasers**, Lydia Jarvis, Ben Maglio, Craig Allford, Zhibo Li, Sam Shutts, Cardiff Univ. (United Kingdom); Huiwen Deng, Siming Chen, Mingchu Tang, Huiyun Liu, Univ. College London (United Kingdom); Peter M. Smowton, Cardiff Univ. (United Kingdom) . . . . . [11301-7]
- 4:50 pm: **On the differences in dynamical properties of quantum-dot lasers with and without p-doping in the active region and tunneling injection quantum wells**, Sven Bauer, Vitalii Sichkovskiy, Florian Schnabel, Anna Sengül, Johann Peter Reithmaier, Univ. Kassel (Germany); Ori Eyal, Igor Khanonkin, Gadi Eisenstein, Technion-Israel Institute of Technology (Israel) . . . . . [11301-8]
- 5:10 pm: **Integrated laser-modulator with a universal InGaAs/InAs tunnel coupled quantum-well on quantum-dot medium**, Vadim Tokranov, Michael Yakimov, SUNY Polytechnic Institute (USA); Shilpa Pradhan, Alexander Parfenov, Intellisense Systems Inc. (USA); Serge Oktyabrsky, SUNY Polytechnic Institute (USA) . . . . . [11301-9]
- 5:30 pm: **Lasing characteristics and material design parameters for InP(311)B InAs quantum-dot lasers**, Iain M. Butler, Univ. of Glasgow (United Kingdom) and Queen's Univ. Belfast (United Kingdom); David T. D. Childs, Richard A. Hogg, Univ. of Glasgow (United Kingdom); Kouichi Akahane, Atsushi Matsumoto, Naokatsu Yamamoto, National Institute of Information and Communications Technology (Japan) . . . . . [11301-10]

TUESDAY 4 FEBRUARY

SESSION 3

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... TUE 8:10 AM TO 10:00 AM

QD and Lasers on Silicon

Session Chair: **Kei-May Lau**, Hong Kong Univ. of Science and Technology (Hong Kong, China)

8:10 am: **Temperature-induced single-to-double branch transformation of operating characteristics in semiconductor lasers with a low-dimensional active region**, Zinaida N. Sokolova, Nikita A. Pikhtin, Sergey O. Slipchenko, Ioffe Institute (Russian Federation); Levon V. Asryan, Virginia Polytechnic Institute and State Univ. (USA) ..... [11301-11]

8:30 am: **CW performance of QD lasers on silicon including carrier transport in the SCH barrier**, Marco Saldutti, Alberto Tibaldi, Federica Cappelluti, Francesco Bertazzi, Mariangela Gioannini, Politecnico di Torino (Italy) ..... [11301-12]

8:50 am: **Optical self-injection stabilization of a passively mode-locked quantum dot on silicon laser**, Dominik Auth, Technische Univ. Darmstadt (Germany); Songtao Liu, Justin Norman, John E. Bowers, Univ. of California, Santa Barbara (USA); Stefan Breuer, Technische Univ. Darmstadt (Germany) ..... [11301-13]

9:10 am: **Time domain traveling wave model of optical feedback tolerant hybrid laser design for silicon photonics applications**, Lorenzo Luigi L. Columbo, Politecnico di Torino (Italy); Jock Bovington, Dominic Siriani, Sebastian Romero-Garcia, Cisco Systems, Inc. (USA); Mariangela Gioannini, Politecnico di Torino (Italy) ..... [11301-14]

9:30 am: **Heterogeneous integration of III-V based photonics (Invited Paper)**, Brian Corbett, Fatih Atar, Megan O'Brien, James O'Callaghan, Brendan Roycroft, Tyndall National Institute (Ireland) ..... [11301-15]

Coffee Break ..... Tue 10:00 am to 10:30 am

SESSION 4

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... TUE 10:30 AM TO 12:00 PM

Lasers on Silicon

Session Chair: **Haisheng Rong**, Intel Corp. (USA)

10:30 am: **Small threshold current continuous-wave operation of photonic-crystal lasers on Si waveguides (Invited Paper)**, Koji Takeda, Shinji Matsuo, NTT Device Technology Labs. (Japan) ..... [11301-16]

11:00 am: **Room-temperature CW operation of GaSb laser diodes grown on on-axis (001) Si substrates**, Marta Rio Calvo, Jean Baptiste Rodriguez, Laurent Cerutti, Laura Monge Bartolome, Michael Bahriz, Eric Tournié, Univ. de Montpellier (France) ..... [11301-17]

11:20 am: **Towards a photonic band edge laser using hexagonal-SiGe nanowire arrays**, David Busse, Walter Schottky Institut, Technische Univ. München (Germany); Elham Fadaly, Victor T. van Lange, Technische Univ. Eindhoven (Netherlands); Jens Réne Suckert, Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Univ. Jena (Germany); Alain Dijkstra, Marvin van Tilburg, Technische Univ. Eindhoven (Netherlands); Claudia Rödl, Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Univ. Jena (Germany); Philipp Staudinger, IBM Research - Zürich (Switzerland); Marcel A. Verheijen, Sebastian Kölling, Technische Univ. Eindhoven (Netherlands); Dorian Ziss, Institut für Halbleiter- und Festkörperphysik, Johannes Kepler Univ. Linz (Austria); Jürgen Furthmüller, Friedrich-Schiller-Univ. Jena (Germany); Friedhelm Bechstedt, Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Univ. Jena (Germany); Julian Stangl, Institut für Halbleiter- und Festkörperphysik, Johannes Kepler Univ. Linz (Austria); Heinz Schmid, IBM Research - Zürich (Switzerland); Silvana Botti, Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Univ. Jena (Germany); Erik P. A. M. Bakkers, Jos E. M. Haverkort, Technische Univ. Eindhoven (Netherlands); Jonathan J. Finley, Walter Schottky Institut, Technische Univ. München (Germany) ..... [11301-18]

11:40 am: **Demonstration of current-dependent degradation of quantum-dot lasers grown on silicon: role of defect diffusion processes**, Matteo Buffolo, Fabio Samparisi, Lorenzo Rovere, Carlo De Santi, Univ. degli Studi di Padova (Italy); Daehwan Jung, Justin Norman, John E. Bowers, Univ. of California, Santa Barbara (USA); Robert W. Herrick, Intel Corp. (USA); Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini, Univ. degli Studi di Padova (Italy) ..... [11301-19]

Lunch/Exhibition Break ..... Tue 12:00 pm to 1:30 pm

SESSION 5

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... TUE 1:30 PM TO 3:10 PM

Material Design for Short Pulse

Session Chair: **Johann Peter Reithmaier**, Univ. Kassel (Germany)

1:30 pm: **Design and realisation of InP mode-locked lasers emitting in the 730nm wavelength range**, Reem Alharbi, Zhibo Li, Craig Allford, Sam Shutts, Cardiff Univ. (United Kingdom); Andrey Krysa, The Univ. of Sheffield (United Kingdom); Peter M. Smowton, Cardiff Univ. (United Kingdom) ..... [11301-20]

1:50 pm: **High-power laser diodes with ultra-narrow waveguides for pulse operation**, Nikita Pikhtin, Dmitrii Veselov, Yulia Bobretsova, Vyacheslav Golovin, Dmitry Nikolaev, Sergey Slipchenko, Peter S. Kop'ev, Ioffe Institute (Russian Federation) ..... [11301-21]

2:10 pm: **Investigation of 48 emitter DBR laser bars under nanosecond high-peak current excitation**, Heike Christopher, Andreas Klehr, Jörg Fricke, Armin Liero, Hans Wenzel, Andrea Knigge, Günther Tränkle, Ferdinand-Braun-Institut (Germany) ..... [11301-22]

2:30 pm: **Novel ultra-short light pulse emitters utilizing multiple wide quantum wells**, Valentin Mitev, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland); Nicolas Torcheboeuf, Laurent Balet, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland); Philippe Renevey, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland); Michel Krakowski, Patrick Resneau, Alexandre Larrue, Jean-Pierre Legoec, Yannick Robert, Eric Vinet, Michel Garcia, Olivier Parillaud, Bruno Gérard, III-V Lab. (France); Dmitri Boiko, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) ..... [11301-23]

2:50 pm: **Electrical injection locking dynamics of a quantum dash frequency-comb laser**, Dominik Auth, Technische Univ. Darmstadt (Germany); Johannes Hillbrand, Gottfried Strasser, Technische Univ. Wien (Austria); Abderrahim Ramdane, Quentin Gaimard, Ctr. de Nanosciences et de Nanotechnologies (France); Benedikt Schwarz, Technische Univ. Wien (Austria); Stefan Breuer, Technische Univ. Darmstadt (Germany) ..... [11301-24]

Coffee Break ..... Tue 3:10 pm to 3:40 pm

SESSION 6

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... TUE 3:40 PM TO 5:30 PM

Datacom and Telecom

Session Chair: **Shinji Matsuo**, NTT Device Technology Labs. (Japan)

3:40 pm: **Directly-modulated lasers for 100-Gbaud Nyquist PAM4 transmission (Invited Paper)**, Yasuhiro Matsui, Finisar Corp. (USA) . [11301-25]

4:10 pm: **Demonstration of 1.3µm wavelength range super structure grating DBR laser with wide wavelength tuning range of over 30 nm by introducing carrier confinement layers**, Takahiko Shindo, Naoki Fujiwara, Yoshitaka Ohiso, NTT Device Innovation Ctr., Nippon Telegraph and Telephone Corp. (Japan); Tomonari Sato, Hideaki Matsuzaki, NTT Device Technology Labs., Nippon Telegraph and Telephone Corp. (Japan) ..... [11301-26]

4:30 pm: **Numerical investigations of ultrafast switching using Fano lasers**, Thorsten S. Rasmussen, Jesper Mørk, Technical Univ. of Denmark (Denmark) ..... [11301-27]

4:50 pm: **Self-consistent modeling of single section QD comb sources**, Lorenzo L. Columbo, Mariangela Gioannini, Paolo Bardella, Politecnico di Torino (Italy); Weng W. Chow, Sandia National Labs. (USA) ..... [11301-28]

5:10 pm: **External optical self-injection stabilization of an InP generic foundry platform based passively mode-locked ring laser**, Dominik Auth, Christoph Weber, Technische Univ. Darmstadt (Germany); Mu-Chieh Lo, Univ. College London (United Kingdom); Patrick Fiala, Pascal Sauer, Technische Univ. Darmstadt (Germany); Guillermo Carpintero, Univ. Carlos III de Madrid (Spain); Stefan Breuer, Technische Univ. Darmstadt (Germany) ..... [11301-29]

OPTO

# CONFERENCE 11301

## WEDNESDAY 5 FEBRUARY

### SESSION 7

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... WED 8:10 AM TO 10:00 AM

#### Photonic Bandgap and Microcavity

Session Chair: **Luke J. Mawst**, Univ. of Wisconsin-Madison (USA)

8:10 am: **Analysis by a simple coupled-bloch-mode approach of various PhC laser cavities**, Marco Saldutti, Politecnico di Torino (Italy); Jesper Mørk, Technical Univ. of Denmark (Denmark); Mariangela Gioannini, Politecnico di Torino (Italy) ..... [11301-30]

8:30 am: **Properties of laterally coupled photonic crystal surface-emitting laser two-dimensional arrays**, Aleksandr Boldin, Daehyun Kim, Richard J. E. Taylor, Ben King, Univ. of Glasgow (United Kingdom); Adam McKenzie, Compound Semiconductor Technologies Global Ltd. (United Kingdom) and Univ. of Glasgow (United Kingdom); Nasser Babazadeh, The Univ. of Sheffield (United Kingdom); Pavlo Ivanov, Univ. of Glasgow (United Kingdom); Jonathan R. Orchard, Compound Semiconductor Technologies Global Ltd. (United Kingdom); Neil D. Gerrard, David T. D. Childs, Richard A. Hogg, Univ. of Glasgow (United Kingdom) ..... [11301-31]

8:50 am: **Advances in regrown all-semiconductor photonic crystal surface-emitting lasers**, Adam F. McKenzie, Univ. of Glasgow (United Kingdom) and Compound Semiconductor Technologies Global Ltd. (United Kingdom); Ben C. King, Zijun Bian, Univ. of Glasgow (United Kingdom); Jonathan R. Orchard, Neil D. Gerrard, Compound Semiconductor Technologies Global Ltd. (United Kingdom); Richard J. E. Taylor, David T. D. Childs, Donald A. MacLaren, Richard A. Hogg, Univ. of Glasgow (United Kingdom) . . . . [11301-32]

9:10 am: **940nm 400mW transverse single-mode laser diode with RISA structure**, Jeong-Geun Kwak, Quantum Semiconductor International Inc. (Korea, Republic of) ..... [11301-33]

9:30 am: **Integrated ultra-narrow linewidth stimulated Brillouin scattering (SBS) lasers and their applications** (*Invited Paper*), Daniel J. Blumenthal, Univ. of California, Santa Barbara (USA) . . . . . [11301-34]

Coffee Break. . . . . Wed 10:00 am to 10:30 am

### SESSION 8

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... WED 10:30 AM TO 12:10 PM

#### Topological Lasers, Laser Arrays, and Metasurfaces

Session Chair: **Alexey Belyanin**, Texas A&M Univ. (USA)

10:30 am: **Topological and supersymmetric laser arrays** (*Invited Paper*), Mercedeh Khajavikhan, The Univ. of Southern California (USA); Mohammad Hokmabadi, Jae Hyuck Choi, Demetrios Christodoulides, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11301-35]

11:00 am: **Towards the experimental demonstration of topological Haldane lattice in microring laser arrays**, Yuzhou G. Liu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Pawel Jung, Warsaw Univ. of Technology (Poland) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Midya Parto, William E. Hayenga, Demetrios N. Christodoulides, Mercedeh Khajavikhan, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11301-36]

11:20 am: **Towards electrically pumped topological insulator lasers**, Jaehyuck Choi, William Hayenga, Midya Parto, Yuzhou Liu, Demetrios Christodoulides, Mercedeh Khajavikhan, Univ. of Central Florida (USA) . . . . . [11301-37]

11:40 am: **Frequency-agile metasurface quantum-cascade lasers** (*Invited Paper*), Christopher A. Curwen, Univ. of California, Los Angeles (USA); John L. Reno, Sandia National Labs. (USA); Benjamin S. Williams, Univ. of California, Los Angeles (USA) . . . . . [11301-38]

Lunch/Exhibition Break . . . . . Wed 12:10 pm to 1:40 pm

### SESSION 9

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... WED 1:40 PM TO 3:20 PM

#### QCL Frequency Combs and Mode Locking

Session Chair: **Giacomo Scalari**, ETH Zurich (Switzerland)

1:40 pm: **Ultrafast gain dynamics in quantum cascade lasers: new coherent phenomena and their applications** (*Keynote Presentation*), Federico Capasso, Harvard John A. Paulson School of Engineering and Applied Sciences (USA) . . . . . [11301-39]

2:20 pm: **Frequency-comb generation in ring-injection lasers by defect engineering** (*Invited Paper*), Marco Piccardo, Harvard Univ. (USA); Benedikt Schwarz, Maximilian Beiser, Technische Univ. Wien (Austria); Dmitry Kazakov, Harvard Univ. (USA); Yongrui Wang, Texas A&M Univ. (USA); Michele Tamagnone, Wei Ting Chen, Alexander Y. Zhu, Harvard Univ. (USA); Alexey Belyanin, Texas A&M Univ. (USA); Federico Capasso, Harvard Univ. (USA) . . . . . [11301-40]

2:50 pm: **Understanding frequency-modulated combs** (*Invited Paper*), Benedikt Schwarz, Nikola Opacak, Technische Univ. Wien (Austria) . [11301-41]

Coffee Break. . . . . Wed 3:20 pm to 3:50 pm

### SESSION 10

LOCATION: ROOM 306 (LEVEL 3 SOUTH) ..... WED 3:50 PM TO 5:50 PM

#### QCL Frequency Combs, Mode Locking, and Spectroscopy Applications

Session Chair: **Marco Piccardo**, Harvard Univ. (USA)

3:50 pm: **Broadband THz and mid-IR quantum-cascade-laser frequency combs** (*Invited Paper*), Giacomo Scalari, Andres Forrer, Matthew Singley, David Stark, Filippos Kapsalidis, Mattias Beck, Jerome Faist, ETH Zurich (Switzerland) . . . . . [11301-42]

4:20 pm: **Phase analysis and full phase control of chip-scale infrared frequency combs** (*Invited Paper*), Luigi Consolino, Francesco Cappelli, Saverio Bartalini, Paolo De Natale, Istituto Nazionale di Ottica (Italy) . . . . . [11301-43]

4:50 pm: **Real-time measurement of self-mode-locked pulses in in terahertz quantum cascade lasers by intra-cavity self-detection**, Hua Li, Wenjian Wan, Ziping Li, J. C. Cao, Key Lab. of Terahertz Solid State Technology (China); Sylvie Lepilliet, Jean-François Lampin, Institut d'Electronique de Microélectronique et de Nanotechnologie, CNRS (France); Lorenzo Columbo, Politecnico di Torino (Italy); Massimo Brambilla, Politecnico di Bari (Italy); Stefano Barbieri, Institut d'Electronique de Microélectronique et de Nanotechnologie, CNRS (France) . . . . . [11301-44]

5:10 pm: **Stabilization of frequency comb interband cascade lasers by time-delayed optical self-injection**, Dominik Auth, Technische Univ. Darmstadt (Germany); Mahmood Bagheri, Clifford Frez, Jet Propulsion Lab. (USA); Chadwick L. Canedy, Igor Vurgaftman, Jerry R. Meyer, U.S. Naval Research Lab. (USA); Stefan Breuer, Technische Univ. Darmstadt (Germany) . . . . . [11301-45]

5:30 pm: **Realization of GaSb-based DFB lasers and gain chips for the 1.9µm to 3µm spectral regime for molecular spectroscopy**, Martin Honsberg, Sensor Photonics GmbH (Germany); Tobias Milde, Sacher Lasertechnik GmbH (Germany); Sebastian Schmidtman, Sensor Photonics GmbH (Germany); Christian Assmann, Morten Hoppe, Sacher Lasertechnik GmbH (Germany); Joachim R. Sacher, Sacher Lasertechnik GmbH (Germany) and Sensor Photonics GmbH (Germany) . . . . . [11301-46]

### POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST ..... WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Ultra-short passive external cavity optical self-injection of a semiconductor quantum well laser**, Pascal Sauer, Dominik Auth, Christoph Weber, Technische Univ. Darmstadt (Germany); Stefan Meinecke, Kathy Lüdge, Technische Univ. Berlin (Germany); Andreas Klehr, Andrea Knigge, Ferdinand-Braun-Institut (Germany); Stefan Breuer, Technische Univ. Darmstadt (Germany) . . . . . [11301-61]

**Comparison between interferometric and piezoelectric readout of tuning fork vibrations in quartz-enhanced photoacoustic spectroscopy**, Pietro Patimisco, Politecnico di Bari (Italy); Sheng Zhou, Vrije Univ. Amsterdam (Netherlands); Stefano dello Russo, Andrea Zifarelli, Univ. degli Studi di Bari Aldo Moro (Italy); Angelo Sampaolo, Marilena Giglio, Politecnico di Bari (Italy); Hubert Rossmadl, Verena Mackowiak, Thorlabs GmbH (Germany); Alex Cable, Thorlabs, Inc. (USA); Davide Iannuzzi, Vrije Univ. Amsterdam (Netherlands); Vincenzo Spagnolo, Politecnico di Bari (Italy). . . . . [11301-62]

**Comparison of self-mode-locking in monolithic and external cavity diode laser at 1550 nm**, Mohammad Ali Alloush, Amer Bassal, Carsten Brenner, Ruhr-Univ. Bochum (Germany); Catherine Fortin, Karim Mekhazni, Piero Gamarra, Cosimo Calo, III-V Lab. (France); Martin R. Hofmann, Ruhr-Univ. Bochum (Germany). . . . . [11301-63]

**High-power semiconductor lasers with surface diffraction grating (1050nm)**, Sergey O. Slipchenko, Vasily Zolotarev, Andrei Leshko, Aleksandr Podoskin, Viktor Shamakhov, Vladimir Kapitonov, Peter Kop'ev, Nikita Pikhtin, Ioffe Institute (Russian Federation). . . . . [11301-64]

**High-power 1020-1080nm tunable laser diodes based on Littrow geometry external resonator**, Sergey O. Slipchenko, Aleksandr Podoskin, Marina Rastegaeva, Natalia Voronkova, Dmitrii Veselov, Yulia Bobretsova, Dmitry Romanovich, Nikita Pikhtin, Peter Kop'ev, Ioffe Institute (Russian Federation). . . . . [11301-65]

**Second-order distributed feedback quantum cascade lasers with non-rectangular grating shape**, Enrique Sanchez Cristobal, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); H. Shu, Univ. of Central Florida (USA); M. Suttinger, R. Go, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Arkady Lyakh, Univ. of Central Florida (USA). . . . . [11301-66]

**Modal gain, dispersion, and line-width enhancement factor of broad-area quantum-dot lasers**, Matteo Angelozzi, Paolo Bardella, Politecnico di Torino (Italy); Dominik Auth, Christoph Weber, Technische Univ. Darmstadt (Germany); Artem V. Savelyev, St. Petersburg Academic Univ. (Russian Federation); Vladimir V. Korenev, Mikhail V. Maximov, Alexey E. Zhukov, St. Petersburg Academic Univ. (Russian Federation) and Saint-Petersburg State Polytechnical Univ. (Russian Federation); Stefan Breuer, Technische Univ. Darmstadt (Germany). . . . . [11301-67]

**Synchronization of two passively mode-locked quantum-dot lasers by mutual optical injection**, Dominik Auth, Christoph Weber, Technische Univ. Darmstadt (Germany); Iraklis H. Simos, Univ. of West Attica (Greece); Christos Simos, Univ. of Thessaly (Greece); Luke F. Lester, Virginia Polytechnic Institute and State Univ. (USA); Stefan Breuer, Technische Univ. Darmstadt (Germany). . . . . [11301-68]

**Passive mode-locking of p-doped monolithic semiconductor quantum-dot lasers emitting at 1250 nm**, Dominik Auth, Technische Univ. Darmstadt (Germany); Vladimir V. Korenev, Artem V. Savelyev, Mikhail V. Maximov, Alexey E. Zhukov, St. Petersburg Academic Univ. (Russian Federation); Stefan Breuer, Technische Univ. Darmstadt (Germany). . . . . [11301-69]

**All-fiber optical-self-injection stabilization of a frequency-comb quantum-dash laser**, Christoph Weber, Technische Univ. Darmstadt (Germany); Božtjan Batagelj, Univ. of Ljubljana (Slovenia); Patrick Fiala, Dominik Auth, Technische Univ. Darmstadt (Germany); Quentin Gaimard, Abderrahim Ramdane, Ctr. de Nanosciences et de Nanotechnologies, CNRS (France); Uros Dragonja, Univ. of Ljubljana (Slovenia); Stefan Breuer, Technische Univ. Darmstadt (Germany). . . . . [11301-70]

**THURSDAY 6 FEBRUARY**

**SESSION 11**

**LOCATION: ROOM 306 (LEVEL 3 SOUTH) . . . . . THU 8:00 AM TO 10:10 AM**

**High Power/High Brightness**

Session Chair: **Gary M. Smith**, MIT Lincoln Lab. (USA)

8:00 am: **A brief history of kilowatt-class diode-laser bars**, Paul A. Crump, Günther Tränkle, Ferdinand-Braun-Institut (Germany). . . . . [11301-47]

8:20 am: **Tapered amplifiers for high-power MOPA setups between 750 nm and 2000 nm**, Marc T. Kelemen, Juergen Gilly, Lukas Ogródowski, Patrick Friedmann, Coherent, Inc. (Germany). . . . . [11301-48]

8:40 am: **Micro-integrated dual-wavelength ridge-waveguide master oscillator power amplifier with an optical output power of 0.5 W at 785 nm**, André Müller, Martin Maiwald, Bernd Sumpf, Ferdinand-Braun-Institut (Germany). . . . . [11301-49]

9:00 am: **Energy barrier layers for high-power semiconductor lasers of 1550 nm spectral range**, Nikita Pikhtin, Dmitrii Veselov, Yulia Bobretsova, Lyudmila Vavilova, Kirill Bakhvalov, Vyacheslav Golovin, Sergey Slipchenko, Peter S. Kop'ev, Ioffe Institute (Russian Federation). . . . . [11301-50]

9:20 am: **Surface Bragg gratings for high-brightness lasers** (*Invited Paper*), Jörg Fricke, Hans Wenzel, Olaf Brox, Paul Crump, Bernd Sumpf, Katrin Paschke, Mathias Matalla, Götz Erbert, Andrea Knigge, Günther Tränkle, Ferdinand-Braun-Institut (Germany). . . . . [11301-51]

9:50 am: **Wavelength-stabilized near-field laser**, Vitaly A. Shchukin, Nikolay Ledentsov, VI Systems GmbH (Germany). . . . . [11301-52]

Coffee Break. . . . . Thu 10:10 am to 10:40 am

**SESSION 12**

**LOCATION: ROOM 306 (LEVEL 3 SOUTH) . . . . . THU 10:40 AM TO 12:10 PM**

**QCLs: Novel Design and Integration**

Session Chair: **Benedikt Schwarz**, Technische Univ. Wien (Austria)

10:40 am: **High performance and control of THz quantum cascade lasers** (*Invited Paper*), Martin Kainz, Sebastian Schönhuber, Michael Jaidl, Gottfried Strasser, Maxwell Andrews, Juraj Darmo, Karl Unterrainer, Technische Univ. Wien (Austria). . . . . [11301-53]

11:10 am: **III-V mid-infrared quantum-cascade laser photonic-integrated circuits** (*Invited Paper*), Seungyong Jung, TransWave Photonics, LLC (USA); Kevin Zhang, The Univ. of Texas at Austin (USA); Feng Xie, Yae Okuno, Christopher Pinzone, Kevin Lascola, Thorlabs Quantum Electronics (USA); Mikhail A. Belkin, Walter Schottky Institut, Technische Univ. München (Germany) and The Univ. of Texas at Austin (USA). . . . . [11301-54]

11:40 am: **InAs/AlSb quantum-cascade lasers monolithically integrated on silicon** (*Invited Paper*), Alexei N. Baranov, Zeineb Loghmani, Michael Bahriz, Ariane Meguekam, Laurent Cerutti, Jean-Baptiste Rodriguez, Marta Rio Calvo, Guilhem Boissier, Eric Tournié, Roland Teissier, Univ. de Montpellier (France). . . . . [11301-55]

Lunch/Exhibition Break . . . . . Thu 12:10 pm to 1:40 pm

**SESSION 13**

**LOCATION: ROOM 306 (LEVEL 3 SOUTH) . . . . . THU 1:40 PM TO 3:30 PM**

**Mid-IR Lasers**

Session Chair: **Mikhail A. Belkin**, Walter Schottky Institut (Germany)

1:40 pm: **The GaSb-based Y-branch DBR and photonic crystal lasers** (*Invited Paper*), Leon Shterengas, Jiang Jiang, Takashi Hosoda, Stony Brook Univ. (USA); Aaron Stein, Brookhaven National Lab. (USA); Alexey Belyanin, Texas A&M Univ. (USA); Ruiyan Liu, Wonjae Lee, Gela Kipshidze, Gregory Belenky, Stony Brook Univ. (USA). . . . . [11301-56]

2:10 pm: **high-brightness GaSb-based quantum-well lasers with an unstable resonator**, Chi Yang, Ron Kaspi, Alan H. Paxton, Chunte A. Lu, Air Force Research Lab. (USA). . . . . [11301-57]

2:30 pm: **Narrow-linewidth Interband-cascade lasers for high-resolution spectroscopy**, Simone Borri, Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy); Mario Siciliani de Cumis, Agenzia Spaziale Italiana (Italy); Silvia Viciani, Francesco D'Amato, Paolo De Natale, Istituto Nazionale di Ottica, Consiglio Nazionale delle Ricerche (Italy). . . . . [11301-58]

2:50 pm: **Surface-emitting quantum-cascade lasers with second-order metal/semiconductor gratings for high continuous-wave performance**, Jae Ha Ryu, Chris Sigler, Colin Boyle, Jeremy D. Kirch, Univ. of Wisconsin-Madison (USA); Don Lindberg, Tom Earles, Intraband, LLC (USA); Dan Botez, Luke J. Mawst, Univ. of Wisconsin-Madison (USA). . . . . [11301-59]

3:10 pm: **High-power taper resonator mid-IR QCLs: design, fabrication, and beam quality**, Kamil Pierscinski, Aleksandr Kuzmich, Dorota Pierscinska, Grzegorz Sobczak, Piotr Gutowski, Krzysztof Chmielewski, Maciej Bugajski, Institute of Electron Technology, Lukaszewicz Research Network (Poland). . . . . [11301-60]



# CONFERENCE 11302

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH)

Monday–Thursday 3–6 February 2020 • Proceedings of SPIE Vol. 11302

## Light-Emitting Devices, Materials, and Applications XXIV

*Conference Chairs:* **Jong Kyu Kim**, Pohang Univ. of Science and Technology (Korea, Republic of); **Michael R. Krames**, Arkesso, LLC (USA); **Martin Strassburg**, OSRAM Opto Semiconductors GmbH (Germany)

*Program Committee:* **Jim R. Bonar**, Facebook Technologies, LLC (USA); **Yong-Hoon Cho**, KAIST (Korea, Republic of); **Aurelien David**, Soraa, Inc. (USA); **Amélie Dussaigne**, CEA-LETI (France); **Kolja Haberland**, LayTec AG (Germany); **Michael Heuken**, AIXTRON SE (Germany); **Christoph G. A. Hoelen**, Signify N.V. (Netherlands); **Soo Min Lee**, Veeco Compound Semiconductor Inc. (USA); **Yun-Li Li**, National Taiwan Univ. (Taiwan); **Tien-Chang Lu**, National Chiao Tung Univ. (Taiwan); **Hee Jin Kim**, Lumileds, LLC (USA); **Juanita N. Kurtin**, OSRAM Opto Semiconductors (USA); **Matteo Meneghini**, Univ. degli Studi di Padova (Italy); **Sungwon D. Roh**, LG Innotek (Korea, Republic of); **Klaus P. Streubel**, OSRAM GmbH (USA); **Tetsuya Takeuchi**, Meijo Univ. (Japan); **Rie Togashi**, Tokyo Univ. of Agriculture and Technology (Japan); **Li-Wei Tu**, National Sun Yat-Sen Univ. (Taiwan); **Marie Anne van de Haar**, Seaborough Research B.V. (Netherlands); **Dong-Sing Wu**, National Chung Hsing Univ. (Taiwan); **Erin C. Young**, Univ. of California, Santa Barbara (USA)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) MON 10:30 AM TO 12:30 PM

#### Micro LED Display

Session Chairs: **Michael R. Krames**, Arkesso, LLC (USA); **Jim R. Bonar**, Facebook Technologies, LLC (USA)

- 10:30 am: **Emissive displays with transfer-printed microscale LEDs and ICs (Invited Paper)**, Christopher A. Bower, X-Celeprint (USA) . . . . . [11302-1]
- 11:00 am: **Development of microLED display and future opportunities (Invited Paper)**, Yun-Li Li, PlayNitride Inc. (Taiwan) . . . . . [11302-2]
- 11:30 am: **Mojo vision microLEDs for AR/VR hardware (Invited Paper)**, Paul S. Martin, Mojo Vision Inc. (USA) . . . . . [11302-3]
- 12:00 pm: **Full-color LED integration based on adhesive bonding for micro-LED display applications (Invited Paper)**, Dong-Seon Lee, Gwangju Institute of Science and Technology (Korea, Republic of) . . . [11302-4]
- Lunch Break . . . . . Mon 12:30 pm to 2:00 pm

#### SESSION 2

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . MON 2:00 PM TO 3:20 PM

#### Novel Electroluminescent Semiconductor Materials and Devices for SSL I

Session Chair: **Martin Strassburg**, OSRAM Opto Semiconductors GmbH (Germany)

- 2:00 pm: **First-principles studies of radiative and nonradiative recombination in halide perovskites (Invited Paper)**, Chris G. Van de Walle, Univ. of California, Santa Barbara (USA) . . . . . [11302-5]
- 2:30 pm: **Fabrication of high-performance perovskite optoelectronic devices (Invited Paper)**, Zhanhua Wei, Huaqiao Univ. (China) . . . . . [11302-6]
- 3:00 pm: **High-intensity photodegradation of all-inorganic lead halide perovskite nanocrystals**, Peter Shaw, Thomas M. Mercier, Antonios G. Kanaras, Pavlos G. Lagoudakis, Martin D. B. Charlton, Univ. of Southampton (United Kingdom) . . . . . [11302-7]
- Coffee Break. . . . . Mon 3:20 pm to 3:50 pm

#### SESSION 3

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . MON 3:50 PM TO 5:40 PM

#### LED Applications and Solid-State Lighting

Session Chair: **Jong Kyu Kim**, Pohang Univ. of Science and Technology (Korea, Republic of)

- 3:50 pm: **Frontiers in LED technology for breakthrough integrated solutions (Invited Paper)**, Oleg B. Shchekin, Willem Sillevs-Smitt, Lumileds, LLC (USA); Dirk Vanderhaeghen, Lumileds Germany GmbH (Germany) . . . . . [11302-8]
- 4:20 pm: **Challenges and improvements in LED-pumped luminescent concentrators**, Christoph G. A. Hoelen, Dominique Bruls, Dany Benoy, Jannie Baken, Dick de Boer, Jan Jansen, Ludo Haenen, Barry Mos, Joan Yu, Simon Kadijk, Eric van Grunsven, Signify Netherlands B.V. (Netherlands) . . . . . [11302-9]
- 4:40 pm: **Limitations to emission spot size in laser lighting**, Ole Bjarlin Jensen, Anastasiia Krasnoshchoka, Anders K. Hansen, Anders Thorseth, DTU Fotonik (Denmark); Dominik Marti, DTU Health Tech (Denmark); Xu Jian, Henan Polytechnic Univ. (China); Paul M. Petersen, DTU Fotonik (Denmark) . [11302-10]
- 5:00 pm: **Analysis and design of extreme intensity irradiation devices for research applications**, Nicola Trivellin, Alberto Pizzolato, Matteo Meneghini, Fabrizio Dughiero, Enrico Zanoni, Gaudenzio Meneghesso, Univ. degli Studi di Padova (Italy) . . . . . [11302-11]
- 5:20 pm: **OpticStudio TrueFreeform™ optimization for complex illumination systems**, Katsumoto Ikeda, Zemax Japan Co., Ltd. (Japan); Shawn Gay, Zemax, LLC (USA) . . . . . [11302-12]

**TUESDAY 4 FEBRUARY**

**SESSION 4**

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . TUE 8:00 AM TO 10:00 AM

**Nanomaterials and Nanostructures for LEDs**

Session Chair: **Aurelien David**, Soraa, Inc. (USA)

8:00 am: **Crystal growth and optical property in core-shell structure consisting of GaN nanowire and GaInN/GaN multi-quantum shell (MQS)** (*Invited Paper*), Satoshi Kamiyama, Lu Weifang, Tetsuya Takeuchi, Motoaki Iwaya, Isamu Akasaki, Meijo Univ. (Japan) . . . . . [11302-13]

8:30 am: **GaN  $\mu$ LED technology: fabrication, analysis, and applications** (*Invited Paper*), Andreas Waag, Epitaxy Competence Ctr. ec2, Lab. for Emerging Nanometrology (LENA), Technische Univ. Braunschweig (Germany); Jan Güllink, Daria Bezshlyakh, Syed Asad Ali Zaidi, Lab. for Emerging Nanometrology (LENA), Technische Univ. Braunschweig (Germany); Klaas Stempel, Epitaxy Competence Ctr. ec2, Technische Univ. Braunschweig (Germany); Hendrik Spende, Lab. for Emerging Nanometrology (LENA), Technische Univ. Braunschweig (Germany); Steffen Bornemann, Jana Hartmann, Epitaxy Competence Ctr. ec2, Technische Univ. Braunschweig (Germany); Hergo-Heinrich Wehmann, Technische Univ. Braunschweig (Germany); Olga Casals, Joan Daniel Prades, Institut de Nanociència i Nanotecnologia, Univ. de Barcelona (Spain); Mariel Jama, Adrian Avramescu, Martin Strassburg, Hans-Jürgen Lugaer, OSRAM Opto Semiconductors GmbH (Germany) . . . . . [11302-14]

9:00 am: **Self-assembled and selective-area growth of GaN nanorods by liquid-target reactive magnetron sputter epitaxy** (*Invited Paper*), Ching-Lien Hsiao, Elena Alexandra Serban, Justinas Palisaitis, Muhammad Junaid, Lars Hultman, Per O. Å. Persson, Jens Birch, Linköping Univ. (Sweden) . . . . . [11302-15]

9:30 am: **Nanostructured light-emitting diodes through 3D mold** (*Invited Paper*), Je Won Kim, Namseoul Univ. (Korea, Republic of) . . . [11302-16]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

**SESSION 5**

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . TUE 10:30 AM TO 12:20 PM

**2D Optoelectronics Materials**

Session Chair: **Debdeep Jena**, Cornell Univ. (USA)

10:30 am: **Wafer scale hexagonal BN for flexible GaN-based optoelectronic devices** (*Invited Paper*), Abdallah Ougazzaden, Georgia Tech - CNRS (France) . . . . . [11302-82]

11:00 am: **Molecular beam epitaxy, characterization, and deep ultraviolet light emission of h-BN** (*Invited Paper*), David Laleyan, Ping Wang, Zetian Mi, Univ. of Michigan (USA) . . . . . [11302-18]

11:30 am: **Scalable growth of atomically thin BN: an ultra-wide band gap material** (*Invited Paper*), Michael Snure, Gene Siegel, Stefan Badescu, Air Force Research Lab. (USA) . . . . . [11302-19]

12:00 pm: **Improvements in structural and optical properties of wafer-scale hexagonal boron nitride film by post-growth annealing**, Seung Hee Lee, Hokyong Jeong, Seokho Moon, Dong Yeong Kim, Jiye Kim, Jong Kyu Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11302-20]

Lunch/Exhibition Break . . . . . Tue 12:20 pm to 2:00 pm

**SESSION 6**

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . TUE 2:00 PM TO 3:30 PM

**LED Manufacturing/Epitaxial Growth**

Session Chair: **Martin Strassburg**, OSRAM Opto Semiconductors GmbH (Germany)

2:00 pm: **Future perspectives on MOVPE tools for optoelectronic materials** (*Invited Paper*), Michael Heuken, AIXTRON SE (Germany) . . . . . [11302-21]

2:30 pm: **Challenges and opportunities of MOVPE and THVPE/HVPE for nitride light-emitting device** (*Invited Paper*), Koh Matsumoto, Taiyo Nippon Sanso Corp. (Japan) . . . . . [11302-22]

3:00 pm: **Recent progress and future in MOCVD technology** (*Invited Paper*), Soo Min Lee, Ronald Arif, Eric Armour, Bojan Mitrovic, Mark McKee, Drew Hanser, Ajit Paranjpe, Veeco Instruments Inc. (USA) . . . . . [11302-23]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

**SESSION 7**

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . TUE 4:00 PM TO 5:40 PM

**Novel Electroluminescent Semiconductor Materials and Devices for SSL II**

Session Chair: **Hee Jin Kim**, Lumileds, LLC (USA)

4:00 pm: **Light-emitting diodes based on MOCVD-grown  $WS_2$  monolayers in a scalable p-n junction architecture** (*Invited Paper*), Gerd Bacher, Dominik Andrzejewski, Yannick Beckmann, Henrik Myja, Ruth Oliver, Univ. Duisburg-Essen (Germany); Michael Heuken, RWTH Aachen Univ. (Germany) and AIXTRON SE (Germany); Annika Grundmann, Holger Kalisch, Andrei Vescan, RWTH Aachen Univ. (Germany); Tilmar Kümmell, Univ. Duisburg-Essen (Germany) . . . . . [11302-24]

4:30 pm: **Nitride LEDs and lasers with buried tunnel junctions** (*Invited Paper*), Debdeep Jena, Cornell Univ. (USA) . . . . . [11302-25]

5:00 pm: **Phosphor-free white-light emitter consisting of monolithic-stacked dual-color InGaN tunnel-junction light-emitting diode with high-color-rendering index and tunable color temperature**, Yen-Kuang Kuo, Jih-Yuan Chang, National Changhua Univ. of Education (Taiwan); Ya-Hsuan Shih, National Cheng Kung Univ. (Taiwan) . . . . . [11302-26]

5:20 pm: **Efficient and stable single-layer organic light-emitting diodes based on thermally activated delayed fluorescence**, Gert-Jan Wetzelaer, Naresh B. Kotadiya, Paul W. M. Blom, Max-Planck-Institut für Polymerforschung (Germany) . . . . . [11302-27]

**WEDNESDAY 5 FEBRUARY**

**SESSION 8**

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . WED 8:00 AM TO 10:20 AM

**Efficiency Challenges in III-Nitride LEDs**

Session Chairs: **Aurelien David**, Soraa, Inc. (USA); **Michael R. Krames**, Arkesso, LLC (USA)

8:00 am: **Semiconductors intracenter photonics: red LED using Eu-doped GaN with control of photon fields** (*Invited Paper*), Yasufumi Fujiwara, Shuhei Ichikawa, Dolf Timmerman, Delphine Lebrun, Jun Tatebayashi, Osaka Univ. (Japan) . . . . . [11302-28]

8:30 am: **Electrically controlled RGB color tunability in a single GaN-based LED material through manipulation of  $Eu^{3+}$  emission** (*Invited Paper*), Brandon J. Mitchell, West Chester Univ. (USA); Volkmar Dierolf, Lehigh Univ. (USA); Yasufumi Fujiwara, Osaka Univ. (Japan) . . . . . [11302-29]

9:00 am: **Recombination physics in III-nitrides and device implication from micro-LEDs to long-wavelength emitters** (*Invited Paper*), Aurelien David, Soraa, Inc. (USA) . . . . . [11302-30]

9:30 am: **InGaN-based quantum wells on  $ScAlMgO_4$  substrates toward long-wavelength emitters** (*Invited Paper*), Takuya Ozaki, Mitsuru Funato, Yoichi Kawakami, Kyoto Univ. (Japan) . . . . . [11302-31]

10:00 am: **Dependence of degradation on InGaN quantum well position: a study based on color coded structures**, Alessandro Caria, Nicola Renzo, Carlo De Santi, Francesco Dalla Torre, Gaudenzio Meneghesso, Enrico Zanoni, Matteo Meneghini, Univ. degli Studi di Padova (Italy) . . . . . [11302-32]

Coffee Break . . . . . Wed 10:20 am to 10:40 am

OPTO

# CONFERENCE 11302

## SESSION 9

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) .WED 10:40 AM TO 12:30 PM

### NIR/IR-Emitting LEDs

Session Chair: **Changmin Lee**, SLD Laser (USA)

10:40 am: **Surface-emitting superluminescent diodes with integrated micromirrors** (*Invited Paper*), Bernd Witzigmann, Univ. Kassel (Germany); Bruno Jentzsch, Alvaro Gomez-Iglesias, Alexander Tonkikh, OSRAM Opto Semiconductors GmbH (Germany) . . . . . [11302-33]

11:10 am: **Tunable spectral asymmetry at the facets of a chirped tapered quantum dot superluminescent diode**, Adam F. Forrest, Institute of Photonics and Quantum Sciences, Heriot-Watt Univ. (United Kingdom); Paolo Bardella, Politecnico di Torino (Italy); Michel Krakowski, III-V Lab. (France); Maria Ana Cataluna, Institute of Photonics and Quantum Sciences, Heriot-Watt Univ. (United Kingdom) . . . . . [11302-34]

11:30 am: **Progress in high-power broadband GaSb-based superluminescent diodes emitting at 2-3  $\mu\text{m}$** , Nouman Zia, Jukka Viheriala, Eero Koivusalo, Antti Aho, Mircea Guina, Tampere Univ. (Finland) . . . [11302-35]

11:50 am: **Design and optimisation of GaAs-based metamorphic heterostructures for applications in mid-infrared light-emitting diodes and semiconductor lasers**, Christopher A. Broderick, Reza Arkani, Tyndall National Institute (Ireland); Eva Repiso, Peter J. Carrington, Anthony Krier, Lancaster Univ. (United Kingdom); Eoin P. O'Reilly, Tyndall National Institute (Ireland) . . . . . [11302-36]

12:10 pm: **Fast-responding mid-IR light emitter using suspended multilayer graphene**, Takaaki Nagata, Takeo Fujii, Tenkai Nakamura, Tatsuaaki Sasaki, Yoshinobu Ito, Motohiro Suyama, Hamamatsu Photonics K.K. (Japan) . . . . . [11302-37]

Lunch/Exhibition Break . . . . . Wed 12:30 pm to 2:00 pm

## SESSION 10

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . .WED 2:00 PM TO 3:30 PM

### Light-Based Sensors and Communication

Session Chair: **Bernd Witzigmann**, Univ. Kassel (Germany)

2:00 pm: **Advanced LiFi technology: laser light** (*Invited Paper*), Changmin Lee, SLD Laser (USA); Mohamed Sufyan Islam, Adrian Sparks, Stefan Videv, The Univ. of Edinburgh (United Kingdom); Melvin McLaurin, Binith Shah, SLD Laser (USA); Harald Haas, The Univ. of Edinburgh (United Kingdom); James Raring, SLD Laser (USA) . . . . . [11302-38]

2:30 pm: **Bidirectional data transfer in VLC links**, Paula Louro, Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa (Portugal) and Ctr. of Technology and Systems, UNINOVA (Portugal) . . . . . [11302-39]

2:50 pm: **Laser-based transmitter enabling high-speed Li-Fi beyond 10 Gbps**, Chao Shen, King Abdullah Univ. of Science and Technology (Saudi Arabia) and SaNoor Technologies Inc. (Saudi Arabia); Hala H. AlHashim, SaNoor Technologies Inc. (Saudi Arabia) and Imam Abdulrahman Bin Faisal Univ. (Saudi Arabia); Jie Hu, SaNoor Technologies Inc. (Saudi Arabia); Boon S. Ooi, King Abdullah Univ. of Science and Technology (Saudi Arabia) and SaNoor Technologies Inc. (Saudi Arabia) . . . . . [11302-40]

3:10 pm: **Automotive LiDAR pollution detection system based on total internal reflection techniques**, Manuel Trierweiler, Robert Bosch GmbH (Germany) and Karlsruher Institut für Technologie (Germany); Tobias Peterseim, Robert Bosch GmbH (Germany); Cornelius Neumann, Karlsruher Institut für Technologie (Germany) . . . . . [11302-41]

Coffee Break . . . . . Wed 3:30 pm to 4:00 pm

## SESSION 11

LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . .WED 4:00 PM TO 6:20 PM

### Novel Substrates and UV/DUV LEDs and their Applications

Session Chair: **Masafumi Jo**, RIKEN Ctr. for Brain Science (Japan)

4:00 pm: **Recent progress of thick GaN and InGaN growth via HVPE and THVPE** (*Invited Paper*), Hisashi Murakami, Yoshinao Kumagai, Akinori Koukitu, Tokyo Univ. of Agriculture and Technology (Japan) . . . . . [11302-42]

4:30 pm: **Short-wavelength UVC LEDs enabled by aluminum-nitride substrates** (*Invited Paper*), Leo J. Schowalter, Crystal IS, Inc. (USA) and Asahi Kasei Corp. (Japan) . . . . . [11302-43]

5:00 pm: **Advances in in-situ metrology during epitaxy of UV-LEDs and related optical devices** (*Invited Paper*), Kolja Haberland, LayTec AG (Germany) . . . . . [11302-44]

5:30 pm: **Transmission electron microscopy studies on elementary mechanisms reducing the dislocation density in AlN templates** (*Invited Paper*), Martin Albrecht, L. Cancellara, Leibniz-Institut für Kristallzüchtung (Germany); Sylvia Hagedorn, Sebastian Walde, Ferdinand-Braun-Institut (Germany); D. Jaeger, Evatec Ltd. (Switzerland); Shun Washiyama, North Carolina State Univ. (USA); Toni Markurt, Leibniz-Institut für Kristallzüchtung (Germany); Ramon Collazo, North Carolina State Univ. (USA); Markus Weyers, Ferdinand-Braun-Institut (Germany) . . . . . [11302-81]

6:00 pm: **Investigation of the size-dependent optical characteristics of ultraviolet micro light-emitting diodes for the mobile gas sensor application**, Young Chul Sim, Incheol Cho, Minkyu Cho, Inkyu Park, Yong-Hoon Cho, KAIST (Korea, Republic of) . . . . . [11302-45]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Emission efficiency improvement of Blue PHOLED by using co-host EML structure**, Hyung Bo Shim, Samsung Display Co., Ltd. (Korea, Republic of); Sang Soo Kim, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [11302-62]

**High-precision color uniformity based on 4D transformation for micro-LED**, Taegyung Lim, Kwangdon Kim, Chanyul Kim, SAMSUNG Electronics Co., Ltd. (Korea, Republic of) . . . . . [11302-63]

**Advanced optical characterization of automotive interior materials for premium visual quality**, Steffen Reichel, Karlheinz Blankenbach, Kristina Koop, Hochschule Pforzheim (Germany); Franziska Hertlein, BMW AG (Germany) . . . . . [11302-64]

**Experimental and theoretical investigation of Mn-doped CsPbCl<sub>3</sub> with orange light emission**, Nivedita Pandey, Abhishek Kumar, Suryansh Dongre, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11302-65]

**Green light emission in CsPbBr<sub>3</sub> quantum dots: theoretical and experimental insight**, Abhishek Kumar, Nivedita Pandey, Suryansh Dongre, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) . . . . . [11302-66]

**Microcavity effects in BLUE PHOLED through ETL thickness control based on ITO/Ag/ITO anode**, Young Jae Park, Dong Pil Park, SangSoo Kim, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [11302-67]

**Strong crystal field splitting and polarization dependence observed in the emission from Eu<sup>3+</sup> ions doped into GaN**, Seth Copelman, West Chester Univ. (USA); Hayley Austin, Lehigh Univ. (USA); Yasufumi Fujiwara, Osaka Univ. (Japan); Volkmar Dierolf, Lehigh Univ. (USA); Brandon J. Mitchell, West Chester Univ. (USA) . . . . . [11302-68]

**Optimization of low-cost cladding layers hybridized with ITO for edge-emitting lasers**, Lih-Ren Chen, National Chiao Tung Univ. (Taiwan) . [11302-69]

**Characterization of micro-pixelated InGaP/AlGaInP quantum well structures**, Younes Boussadi, Névine Rochat, CEA-LETI, Univ. Grenoble Alpes (France); Jean-Paul Barnes, CEA-DRF, Univ. Grenoble Alpes (France); Badhise Ben Bakir, CEA-LETI, Univ. Grenoble Alpes (France); Philippe Ferrandis, Institut Matériaux Microélectronique Nanosciences de Provence, Aix-Marseille Univ., CNRS (France) and Univ. de Toulon (France); Bruno Masenelli, Institut des Nanotechnologies de Lyon, Univ. de Lyon (France); Christophe Licitra, CEA-LETI, Univ. Grenoble Alpes (France) . . . . . [11302-70]

**Dicing of composite substrate for thin-film AlGaInP power LEDs by wet etching**, Ray-Hua Horng, Shreekant H. Sinha, Fu-Gow Tarntair, National Chiao Tung Univ. (Taiwan); Hsiang-An Feng, Cheng-Yu Chung, Chia-Wei Tu, Ingentec Corp. (Taiwan); Dong-Sing Wu, National Chung Hsing Univ. (Taiwan) . . . . . [11302-71]

**Growth and photoluminescence properties of P-doped  $\beta$ -FeSi<sub>2</sub>**, Kensuke Akiyama, Ryo Takahashi, Kanagawa Institute of Industrial Science and Technology (Japan); Hiroshi Funakubo, Tokyo Institute of Technology (Japan) . . . . . [11302-72]

**Modified single-crystal phosphors for high-power LED white-light applications**, Tsung-Xian Lee, National Taiwan Univ. of Science and Technology (Taiwan) . . . . . [11302-73]

**Increase efficiency using hole-blocking layer between electrode and HIL in QD-LED**, Sung-Jae Park, Suk-Ho Song, Won-Hyeok Park, Sang-Soo Kim, Jang-Kun Song, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [11302-74]

**Reconstruction method of gradient-index field with background-oriented schlieren**, Hiroshi Ohno, Toshiba Corp. (Japan) . . . . . [11302-75]

**Electroluminescence from h-BN by using Al<sub>2</sub>O<sub>3</sub>/h-BN multiple heterostructure**, Seung Hee Lee, Hokyong Jeong, Dong Yeong Kim, Seokho Moon, Jong Kyu Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11302-76]

**Self-protective GaInN-based light-emitting diodes with VO<sub>2</sub> nanowires**, Jong Won Lee, Jeonghyeon Park, Jong Kyu Kim, Pohang Univ. of Science and Technology (Korea, Republic of); Jaehee Cho, Chonbuk National Univ. (Korea, Republic of) . . . . . [11302-77]

**Analytical model for an optimized design of AlGaIn-based deep ultraviolet light-emitting diodes**, Jong Won Lee, Jeonghyeon Park, Dong Yeong Kim, Jong Kyu Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11302-78]

**A RGBi LED study on the visual perception of interior lighting based on autonomous car**, Seok-Jun Yang, JVIS USA, LLC (USA) . . . . . [11302-80]

**Efficiency of QLED devices corresponding to ZnO dispersion by solvent**, Jae-Peel Chung, Sung-Jae Park, Jang-Kun Song, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [11302-83]

## THURSDAY 6 FEBRUARY

### SESSION 12

**LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . THU 8:00 AM TO 10:10 AM**

#### UV/DUV LEDs and Their Applications

Session Chair: **Tetsuya Takeuchi**, Meijo Univ. (Japan)

8:00 am: **Progress in AlGaIn UVC LEDs by improving light extraction efficiency** (*Invited Paper*), Masafumi Jo, Noritoshi Maeda, Hideki Hirayama, RIKEN (Japan) . . . . . [11302-46]

8:30 am: **Ultraviolet LEDs: steps towards high efficiency and high reliability** (*Invited Paper*), Jens Rass, Neysha Lobo-Ploch, Tim Kolbe, UVphotonics NT GmbH (Germany) and Ferdinand-Braun-Institut (Germany); Johannes Glaab, Jan Ruschel, Hyun Kyong Cho, Arne Knauer, Christoph Stölmacker, Katrin Hilbrich, Andreas Thies, Stefan Hochheim, Sylvia Hagedorn, Ferdinand-Braun-Institut (Germany); Christian Kuhn, Frank Mehnke, Tim Wernicke, Institut für Festkörperphysik, Technische Univ. Berlin (Germany); Markus Weyers, Sven Einfeldt, Ferdinand-Braun-Institut (Germany); Michael Kneissl, Institut für Festkörperphysik, Technische Univ. Berlin (Germany) . . . . . [11302-47]

9:00 am: **Deep UV LED modules: highly efficient and reliable package concepts** (*Invited Paper*), Frank Gindele, Alexander Neumeier, Christian Rakobrandt, SCHOTT AG (Germany) . . . . . [11302-48]

9:30 am: **Hermetic SMD-type reflector cavity packaging for DUV LEDs**, Ulli Hansen, Simon Maus, Oliver Gyenge, MSG Lithoglas GmbH (Germany) . . . . . [11302-49]

9:50 am: **Electron-blocking-layer-free deep ultraviolet light-emitting diode**, Yi Lu, Zhongjie Ren, Hsin-Hung Yao, Che-Hao Liao, Xiaohang Li, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11302-50]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

### SESSION 13

**LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . THU 10:40 AM TO 12:00 PM**

#### Quantum-Dot Based LEDs

Session Chair: **Juanita N. Kurtin**, OSRAM Opto Semiconductors Inc. (USA)

10:40 am: **Quantum-dot color conversion for next-generation displays** (*Invited Paper*), Jason Hartlove, Nanosys, Inc. (USA) . . . . . [11302-55]

11:10 am: **Enhanced color conversion by colloidal quantum dots embedded in lateral photonic crystal structures** (*Invited Paper*), Heonsu Jeon, Tae-Yun Lee, Seoul National Univ. (Korea, Republic of); Kyungtaek Min, Korea Polytechnic Univ. (Korea, Republic of) . . . . . [11302-56]

11:40 am: **Light-emitting devices based on type-II InP/ZnO quantum dots**, Onuralp Karatum, Houman Bahmani Jalali, Sadra Sadeghi, Rustamzhan Melikov, Shashi Bhushan Srivastava, Sedat Nizamoglu, Koç Univ. (Turkey) . . . . . [11302-57]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:30 pm

### SESSION 14

**LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . THU 1:30 PM TO 3:40 PM**

#### Wavelength Conversion Materials and Components

Session Chair: **Marie Anne van de Haar**, Seaborough Research B.V. (Netherlands)

1:30 pm: **Saturation mechanisms in LED phosphors** (*Invited Paper*), Freddy Rabouw, Utrecht Univ. (Netherlands); Marie Anne van de Haar, Mohamed Tachikirt, Seaborough Research B.V. (Netherlands); Andries Meijerink, Utrecht Univ. (Netherlands); Michael Krames, Arkeso, LLC (USA) . . . . . [11302-51]

2:00 pm: **Towards blue excitable line emitters** (*Invited Paper*), Anne Berends, Marie Anne van de Haar, Michael Krames, Seaborough Research B.V. (Netherlands) . . . . . [11302-52]

2:30 pm: **Paving the way to the high-performance red phosphor SALON** (*Invited Paper*), Gregor J. Hoerder, Hubert Huppertz, University of Innsbruck (Austria) . . . . . [11302-79]

3:00 pm: **Static ceramic phosphor assemblies for high-power high-luminance SSL-light sources for digital projection and specialty lighting**, Volker Hagemann, Albrecht Seidl, Günter Weidmann, SCHOTT AG (Germany) . . . . . [11302-53]

3:20 pm: **Static phosphor plate system for high-power laser projector applications**, Kenneth K. Li, Optonomus Technologies Inc. (USA); Yung Peng Chang, Taiwan Color Optics, Inc. (Taiwan) . . . . . [11302-54]

Coffee Break . . . . . Thu 3:40 pm to 4:00 pm

### SESSION 15

**LOCATION: ROOM 155 (UPPER MEZZANINE SOUTH) . . . THU 4:00 PM TO 5:30 PM**

#### Novel Technologies for LED Design and Fabrication

Session Chair: **Je Won Kim**, Namseoul Univ. (Korea, Republic of)

4:00 pm: **Photonic-crystal-based control of directionality in GaN based LEDs** (*Invited Paper*), Thomas M. Mercier, Chirenjeevi Krishnan, Martin D. B. Charlton, Pavlos G. Lagoudakis, Univ. of Southampton (United Kingdom) . . . . . [11302-58]

4:30 pm: **Design considerations for an improved thermal management of LED arrays**, Peer-Phillip Ley, Jeanne Johnson, Roland Lachmayer, Leibniz Univ. Hannover (Germany) . . . . . [11302-59]

4:50 pm: **Coupling of WGM modes of two ZnO microspheres in contact: experiment and simulation**, Chia-Liang Liu, Graduate Institute of Electronics Engineering, National Taiwan Univ. (Taiwan) and Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); Ching-Hang Chien, Yia-Chung Chang, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan) . . . . . [11302-60]

5:10 pm: **Laser-excited phosphor light recycling using parabolic reflectors**, Kenneth K. Li, Optonomus Technologies Inc. (USA) . . . . . [11302-61]

OPTO

# CONFERENCE 11303

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY)

Monday–Wednesday 3–5 February 2020 • Proceedings of SPIE Vol. 11303

## Emerging Liquid Crystal Technologies XV

Conference Chairs: **Liang-Chy Chien**, Kent State Univ. (USA); **Dirk J. Broer**, Technische Univ. Eindhoven (Netherlands)

Conference Co-Chair: **Igor Muševič**, Jožef Stefan Institute (Slovenia)

Program Committee: **Etienne Brasselet**, Univ. de Bordeaux (France); **Cheng-Huan Chen**, National Chiao Tung Univ. (Taiwan); **Vladimir G. Chigrinov**, Foshan Univ. (China); **Michael J. Escuti**, North Carolina State Univ. (USA); **Antônio M. Figueiredo Neto**, Univ. de São Paulo (Brazil); **Jun-ichi Fukuda**, Kyushu Univ. (Japan); **Tigran Galstian**, Ctr. d'Optique, Photonique et Laser (Canada); **Linda S. Hirst**, Univ. of California, Merced (USA); **Hirotsugu Kikuchi**, Kyushu Univ. (Japan); **Heinz S. Kitzerow**, Univ. Paderborn (Germany); **Jan P. F. Lagerwall**, Univ. du Luxembourg (Luxembourg); **Byoungho Lee**, Seoul National Univ. (Korea, Republic of); **Chia-Rong Lee**, National Cheng Kung Univ. (Taiwan); **Yi-Hsin Lin**, National Chiao Tung Univ. (Taiwan); **Akihiro Mochizuki**, i-CORE Technology, LLC (USA); **Kristiaan Neyts**, Univ. Gent (Belgium); **Toshiaki Nose**, Akita Prefectural Univ. (Japan); **Masanori Ozaki**, Osaka Univ. (Japan); **Miha Ravnik**, Univ. of Ljubljana (Slovenia); **Ivan I. Smalyukh**, Univ. of Colorado Boulder (USA); **Nelson V. Tabiryan**, BEAM Engineering for Advanced Measurements Co. (USA); **Timothy J. White**, Univ. of Colorado Boulder (USA); **Michael Wittek**, Merck KGaA (Germany); **Shin-Tson Wu**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Jun Yamamoto**, Kyoto Univ. (Japan); **Tae-Hoon Yoon**, Pusan National Univ. (Korea, Republic of)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and ZhejiangUniv. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . MON 1:30 PM TO 3:20 PM

#### Liquid Crystal Lenses and Microlens Arrays

Session Chairs: **Yi-Hsin Lin**, National Chiao Tung Univ. (Taiwan); **Chia-Rong Lee**, National Cheng Kung Univ. (Taiwan)

- 1:30 pm: **Applications of liquid crystals in brain study (Invited Paper)**, Tigran Galstian, Arutyun Bagramyan, Loic Tabourin, Ctr. d'optique, photonique et laser (Canada). . . . . [11303-1]
- 2:00 pm: **Modal liquid crystal lens fabricated with ultra-thin ITO film (Invited Paper)**, Chi-Yen Huang, Che Ju Hsu, National Changhua Univ. of Education (Taiwan); Kaushlendra Agrahari, Univ. of Lucknow (India); Pravinraj Selvaraj, National Changhua Univ. of Education (Taiwan); Wei Fan Chiang, National Cheng Kung Univ. (Taiwan); Chia Yi Huang, Tunghai Univ. (Taiwan); Rajiv Manohar, Univ. of Lucknow (India). . . . . [11303-2]
- 2:30 pm: **Modeling liquid-crystal lenses (Invited Paper)**, Viktor Y. Reshetnyak, Taras Shevchenko National Univ. of Kyiv (Ukraine); Yi-Hsin Lin, Yu-Jen Wang, National Chiao Tung Univ. (Taiwan). . . . . [11303-3]
- 3:00 pm: **Optical phase modulations based on orthogonal molecular orientations of liquid crystals on adjacent micro-domains**, Yi-Hsin Lin, Guo-Lin Hu, Chia-Hao Kuo, National Chiao Tung Univ. (Taiwan). . . . . [11303-4]
- Coffee Break. . . . . Mon 3:20 pm to 3:50 pm

#### SESSION 2

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . MON 3:50 PM TO 5:40 PM

#### Phase and Spatial Light Modulators

Session Chair: **Etienne Brasselet**, Univ. de Bordeaux (France)

- 3:50 pm: **Pancharatnam-Berry flat micro-optical elements enabled by plasmonic photopatterning of liquid crystals (Invited Paper)**, Qi-Huo Wei, Kent State Univ. (USA) . . . . . [11303-5]
- 4:20 pm: **Finite element method for 3D optical modeling of liquid crystal on silicon spatial light modulator**, Po-Ju Chen, Technische Univ. Delft (Netherlands) and HOLOEYE Photonics AG (Germany); Philip Engel, HOLOEYE Photonics AG (Germany); H. Paul Urbach, Technische Univ. Delft (Netherlands) . . . . . [11303-7]
- 4:40 pm: **Fast flexoelectro-optic liquid-crystal phase-only modulators**, Xiuze Wang, Julian Fells, Taimoor Ali, Jia-De Lin, Univ. of Oxford (United Kingdom); Chris Welch, Georg Mehl, The Univ. of Hull (United Kingdom); Martin Booth, Univ. of Oxford (United Kingdom); Timothy Wilkinson, Univ. of Cambridge (United Kingdom); Stephen M. Morris, Steve J. Elston, Univ. of Oxford (United Kingdom) . . . . . [11303-8]
- 5:00 pm: **Electrically-tunable freeform liquid-crystal phase modulators**, Yu-Jen Wang, Yi-Hsin Lin, National Chiao Tung Univ. (Taiwan); Ozan Cakmakci, Google (USA); Victor Y. Reshetnyak, Taras Shevchenko National Univ. of Kyiv (Ukraine) . . . . . [11303-9]
- 5:20 pm: **Controlling light with hyperbolic metamaterial director profiles**, Anja Pusovnik, Miha Ravnik, Univ. of Ljubljana (Slovenia) . . . . . [11303-10]

### TUESDAY 4 FEBRUARY

#### SESSION 3

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 8:30 AM TO 9:50 AM

#### Polymer and Liquid Crystal Composites

Session Chair: **Tae-Hoon Yoon**, Pusan National Univ. (Korea, Republic of)

- 8:30 am: **Simple-structure thermoresponsive PNLCs for smart windows (Invited Paper)**, Hiroshi Kakiuchida, National Institute of Advanced Industrial Science and Technology (Japan); Akifumi Ogiwara, Kobe City College of Technology (Japan) . . . . . [11303-11]
- 9:00 am: **Bio-inspired photo-actuation based on cholesteric liquid-crystal elastomers with photosensitive derivatives (Invited Paper)**, Chia-Rong Lee, National Cheng Kung Univ. (Taiwan) . . . . . [11303-12]
- 9:30 am: **Water condensation on a liquid crystal and polymer film (Invited Paper)**, Yi-Hsin Lin, Manjunath Somarapalli, Pei-Cih Lin, National Chiao Tung Univ. (Taiwan). . . . . [11303-13]
- Coffee Break. . . . . Tue 9:50 am to 10:20 am

**SESSION 4**

**LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . TUE 10:20 AM TO 12:30 PM**

**Photo-Patterning and Photoalignment**

Session Chair: **Akihiro Mochizuki**, i-CORE Technology, LLC (USA)

10:20 am: **Generation and characterization of point defect array in nematic liquid crystal** (*Invited Paper*), Jieh-Wen Tsung, Bo-Yao Chen, Ya-Zi Wang, National Chiao Tung Univ. (Taiwan) . . . . . [11303-14]

10:50 am: **Dynamic optical elements from fully solid liquid crystalline films** (*Invited Paper*), Timothy J. White, Brian Donovan, Joselle McCracken, Hayden Fowler, Univ. of Colorado Boulder (USA) . . . . . [11303-15]

11:20 am: **Fast switching of an asymmetrically surface-anchored liquid crystal cell for high-performance display application**, Tae-Hoon Yoon, Yeongyu Choi, Seung-Won Oh, Su-Min Do, Pusan National Univ. (Korea, Republic of) . . . . . [11303-16]

11:40 am: **Novel photo vertical alignment materials for low pre-tilt angle and low-temperature cure process application**, Fumitaka Sugiyama, Takashi Okada, Koichi Miyachi, Hiroaki Tokuhisa, JSR Corp. (Japan) [11303-17]

12:00 pm: **Bistable liquid-crystal phase grating device for smart window and window display applications** (*Invited Paper*), Jae-Won Huh, Tae-Hoon Choi, Jae-Hyeon Woo, Jin-Hun Kim, Su-Min Do, Jeong-Ho Seo, Tae-Hoon Yoon, Pusan National Univ. (Korea, Republic of) . . . . . [11303-18]

Lunch/Exhibition Break . . . . . Tue 12:30 pm to 1:40 pm

**SESSION 5**

**LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 1:40 PM TO 3:40 PM**

**Lasers, Filters, and Other Optical Components**

Session Chair: **Tigran Galstian**,  
Ctr. d'optique, photonique et laser (Canada)

1:40 pm: **Electric field tuning of ferroelectric liquid-crystal microlaser** (*Invited Paper*), Anna V. Ryzhkova, Jožef Stefan Institute (Slovenia); R. Pratibha, Raman Research Institute (India); Maryam Nikkhou, Igor Mušević, Jožef Stefan Institute (Slovenia) . . . . . [11303-19]

2:10 pm: **Influence of liquid crystal molecular stacking structure on in-plane, out-of-plane retardation switching** (*Invited Paper*), Akihiro Mochizuki, i-CORE Technology, LLC (USA) . . . . . [11303-20]

2:40 pm: **Improved terahertz phase sensing by using liquid-crystal phase shifter** (*Invited Paper*), Ryota Ito, Michinori Honma, Toshiaki Nose, Akita Prefectural Univ. (Japan) . . . . . [11303-21]

3:10 pm: **Advanced antenna design using radio frequency liquid crystals and LCD manufacturing** (*Invited Paper*), Ryan Stevenson, Kymeta Corp. (USA) . . . . . [11303-22]

Coffee Break . . . . . Tue 3:40 pm to 4:00 pm

**SESSION 6**

**LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 4:00 PM TO 6:10 PM**

**Diffraction, Light-Field, Chiral, and Holographic Optical Elements**

Session Chair: **Liang-Chy Chien**, Kent State Univ. (USA)

4:00 pm: **Near-zero laser speckle liquid-crystal device** (*Invited Paper*), John E. Harden, Liang-Chy Chien, Kent State Univ. (USA); Kai-Han Chang, Thomas Seder, General Motors Research and Development (USA) . . [11303-23]

4:30 pm: **Holographic optical elements using blue-phase liquid crystals** (*Invited Paper*), Hiroyuki Yoshida, SeongYong Cho, Masanori Ozaki, Osaka Univ. (Japan) . . . . . [11303-24]

5:00 pm: **A flexible defect-mode laser** (*Invited Paper*), Taimoor Ali, Jia-De Lin, Steve J. Elston, Stephen M. Morris, Univ. of Oxford (United Kingdom) . . . . . [11303-25]

5:30 pm: **Electrically-tunable holographic polymer stabilized liquid-crystal reflection gratings**, Kyung Min Lee, Vincent Tondiglia, Air Force Research Lab. (USA); Timothy J. White, Univ. of Colorado Boulder (USA); Timothy J. Bunning, Michael E. McConney, Air Force Research Lab. (USA) . . . . . [11303-26]

5:50 pm: **Tunable liquid-crystal beam-steering device based on Pancharatnam phase**, Comrun Yousefzadeh, Advanced Materials and Liquid Crystal Institute, Kent State Univ. (USA); Andre van Rynbach, Air Force Research Lab. (USA); Philip J. Bos, Advanced Materials and Liquid Crystal Institute, Kent State Univ. (USA) . . . . . [11303-27]

**WEDNESDAY 5 FEBRUARY**

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Wednesday 10:00 AM – 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Fast-switching chiral nematic liquid-crystal devices with polymer-sustained twisted vertical alignment**, Kai-Han Chang, Vinay Joshi, Liang-Chy Chien, Kent State Univ. (USA) . . . . . [11303-28]

**Command electro-optical switching of photoaligned liquid crystal on photopatterned graphene electrode**, Andrii Varanytsia, Kent State Univ. (USA); Nan Liu, Zhenan Bao, Stanford Univ. (USA); Liang-Chy Chien, Kent State Univ. (USA) . . . . . [11303-29]

**All-optical cryptography through metasurface based on phase changeable nanoantenna**, ByoungHo Lee, Chulsoo Choi, Sang-Eun Mun, Jangwoon Sung, Seoul National Univ. (Korea, Republic of) . . . . . [11303-30]

**Mechano-thermo-chromic device with supersaturated salt hydrate crystal for next-generation smart window applications**, Jinhyeong Kwon, Korea Institute of Industrial Technology (Korea, Republic of); Hyunmin Cho, Inho Ha, Seoul National Univ. (Korea, Republic of); Habeom Lee, Pusan National Univ. (Korea, Republic of); Sukjoon Hong, Hanyang Univ. (Korea, Republic of); Seung Hwan Ko, Seoul National Univ. (Korea, Republic of) . . . . . [11303-31]

**Fabrication of self-assembled nanoparticle cluster array using the surface affinity difference of isotropic droplets in nematic medium**, Jun-Seo Lee, Bomi Lee, Jang-Kun Song, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [11303-32]

**Self-assembly of arbitrarily size- and shape-controllable nanoparticle cluster by tuning the size and shape of patterned ITO**, Jun-Seo Lee, Bomi Lee, Jang-Kun Song, Sungkyunkwan Univ. (Korea, Republic of) . . . [11303-35]

**Cell thickness effect on electro-optic response in polymer stabilized cholesteric liquid crystals with negative dielectric anisotropy**, Ecklin Crenshaw, Kyung Min Lee, Air Force Research Lab. (USA); Timothy J. White, Univ. of Colorado Boulder (USA); Timothy J. Bunning, Michael E. McConney, Air Force Research Lab. (USA) . . . . . [11303-33]

**Liquid crystal light shutter with yellow light filtered-out for reduced eye glare**, Tae-Hoon Yoon, Ho-Jin Sohn, Jae-Won Huh, Seung-Won Oh, Jeong-Ho Seo, Yeongyu Choi, Pusan National Univ. (Korea, Republic of) . . . . . [11303-34]

**Light field imaging with partially coherent light**, Alessandro Grosso, Datalogic IP Tech S.r.l. (Italy) and Ecole Polytechnique Fédérale de Lausanne (Switzerland); Toralf Scharf, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [11303-36]

**Enhanced flexoelectric anisotropy of nematic liquid crystal with hydrogen-bonded dimer**, Jimin Park, Jongyoon Kim, Jahyeon Koo, Kwang-Un Jeong, Ji-Hoon Lee, Chonbuk National Univ. (Korea, Republic of) . . . . . [11303-37]

**The reflective Fresnel lens in azo-dye-doped cholesteric liquid crystals fabricated by photoalignment**, Bing-Yau Huang, Tzu-Yeh Chen, Chie-Tong Kuo, National Sun Yat-sen Univ. (Taiwan) . . . . . [11303-38]

**Grating-coupled surface plasmon polaritons (SPPs) with liquid crystals for sensing applications**, Alaeddin S. Abuabed, Univ. of Central Oklahoma (USA); Mohammed Ibrahim, Univ. of Technology Baghdad (Iraq) . . . [11303-39]

**Plasmonic nanogap-enhanced liquid-crystal optical sensors**, Alaeddin S. Abuabed, Univ. of Central Oklahoma (USA); Mohammed Ibrahim, Univ. of Technology Baghdad (Iraq) . . . . . [11303-40]

**Generating hybrid vector vortex and scalar vortex by adjusting electric field on patterned LC cell**, Doyeon Lee, Jang-Kun Song, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [11303-41]

**OPTO**

# CONFERENCE 11304

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY);

LOCATION: WEDNESDAY PM, ROOM 213 (LEVEL 2 SOUTH)

Wednesday–Thursday 5–6 February 2020 • Proceedings of SPIE Vol. 11304

## Advances in Display Technologies X

Conference Chairs: **Jiun-Haw Lee**, National Taiwan Univ. (Taiwan); **Qiong-Hua Wang**, Beihang Univ. (China); **Tae-Hoon Yoon**, Pusan National Univ. (Korea, Republic of)

Program Committee: **Karlheinz Blankenbach**, Hochschule Pforzheim (Germany); **Pierre M. Boher**, ELDIM (France); **Liangcai Cao**, Tsinghua Univ. (China); **Liang-Chy Chien**, Kent State Univ. (USA); **Tien-Lung Chiu**, Yuan Ze Univ. (Taiwan); **Nobuyuki Hashimoto**, Citizen Watch Co., Ltd. (Japan); **Yi-Pai Huang**, Apple Inc. (USA); **ByoungHo Lee**, Seoul National Univ. (Korea, Republic of); **Sin-Doo Lee**, Seoul National Univ. (Korea, Republic of); **Akihiro Mochizuki**, i-CORE Technology, LLC (USA); **Michael Wittek**, Merck KGaA (Germany)

### WEDNESDAY 5 FEBRUARY

#### SESSION 1

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . WED 8:00 AM TO 10:20 AM

#### AR and VR Displays

Session Chair: **Qiong-Hua Wang**, Beihang Univ. (China)

8:00 am: **Key issues and technologies for AR/VR head-mounted displays** (*Keynote Presentation*), ByoungHo Lee, Seoul National Univ. (Korea, Republic of) . . . . . [11304-1]

8:40 am: **Sampling requirements and visual artifacts of head-mounted light-field displays** (*Invited Paper*), Hong Hua, Hekun Huang, Wyant College of Optical Sciences (USA) . . . . . [11304-2]

9:10 am: **Optical techniques for enhancing visibilities of floating volume images in 3D AR displays** (*Invited Paper*), Hak-Rin Kim, Kyungpook National Univ. (Korea, Republic of) . . . . . [11304-3]

9:40 am: **Holographic waveguide-type 3D AR display using the full-color holographic optical element mirror array**, Nyamsuren Darkhanbaatar, Munkh-Uchral Erdenebat, Chang-Won Shin, Ki-Chul Kwon, Jong-Rae Jeong, Nam Kim, Chungbuk National Univ. (Korea, Republic of) . . . . . [11304-4]

10:00 am: **Projection-type integral 3D display using mirrors facing each other for a wide viewing angle with a downsized system**, Masahiko Yasui, The Univ. of Tokyo (Japan); Yoshihiro Watanabe, Tokyo Institute of Technology (Japan); Masatoshi Ishikawa, The Univ. of Tokyo (Japan) . . . . . [11304-5]

Coffee Break . . . . . Wed 10:20 am to 10:50 am

#### SESSION 2

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . WED 10:50 AM TO 12:30 PM

#### Optics for AR/VR Displays

Session Chair: **ByoungHo Lee**, Seoul National Univ. (Korea, Republic of)

10:50 am: **Triple-coating surface waveguide for augmented reality to achieve large field-of-view** (*Invited Paper*), Guo Dung J. Su, Jian-Lin Wu, National Taiwan Univ. (Taiwan) . . . . . [11304-6]

11:20 am: **Wavelength-multiplexed multi-focal-plane see-through near-eye displays** (*Invited Paper*), Tao Zhan, Junyu Zou, Matthew Lu, GuanJun Tan, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Enguo Chen, Fuzhou Univ. (China) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Shin-Tson Wu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [11304-7]

11:50 am: **Super-resolution foveated imaging system for near-eye display (NED) using tilting concave mirror**, Jia Chee Leong, Gyohyun Koo, Yong Hyub Won, KAIST (Korea, Republic of) . . . . . [11304-8]

12:10 pm: **Depth enhancement of integral imaging AR display with an electrochromic microlens array**, CheolJoong Kim, Dooseub Shin, Gyohyun Koo, Yong Hyub Won, KAIST (Korea, Republic of) . . . . . [11304-9]

Lunch/Exhibition Break . . . . . Wed 12:30 pm to 1:35 pm

#### SESSION 3

LOCATION: ROOM 213 (LEVEL 2 SOUTH) . . . . . WED 1:35 PM TO 3:25 PM

#### NOTE ROOM CHANGE

#### AR/VR Displays using DMDs or other SLM Devices

Joint Session with 11294 and 11304

Session Chairs: **Alex Lyubarsky**, Texas Instruments Inc. (USA); **Hong Hua**, Wyant College of Optical Sciences (USA)

1:35 pm: **Quality evaluation of hologram based on digital and analog types of spatial light modulators** (*Invited Paper*), Hoang Yan Lin, Chih-Hao Chuang, National Taiwan Univ. (Taiwan); Chien-Yu Chen, National Taiwan Univ. of Science and Technology (Taiwan) . . . . . [11294-10]

2:05 pm: **Projector-based augmented reality with simultaneous 3D inspection using a single DMD**, Marc-Antoine Drouin, Jonathan Boisvert, Michel Picard, Guy Godin, Louis-Guy Dicaire, National Research Council Canada (Canada) . . . . . [11294-19]

2:25 pm: **Augmented reality, 3D measurement, and thermal imagery for computer-assisted manufacturing**, Marc-Antoine Drouin, Jonathan Boisvert, Guy Godin, Michel Picard, Louis-Guy Dicaire, National Research Council Canada (Canada) . . . . . [11294-20]

2:45 pm: **Optical calibration and distortion correction for a volumetric augmented reality display**, Kishore Rathinavel, Hanpeng Wang, Henry Fuchs, The Univ. of North Carolina at Chapel Hill (USA) . . . . . [11294-21]

3:05 pm: **Spatial light modulators with large phase-modulation: application to encode lenses with very short focal lengths**, Ignacio Moreno, Univ. Miguel Hernández (Spain); Jeffrey A. Davis, Benjamin K. Gutierrez, Don M. Cottrell, San Diego State Univ. (USA) . . . . . [11304-11]

Coffee Break . . . . . Wed 3:25 pm to 3:55 pm

#### SESSION 4

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . WED 3:55 PM TO 5:15 PM

#### NOTE ROOM CHANGE

#### 3D and Projection Displays

Session Chair: **Hak-Rin Kim**, Kyungpook National Univ. (Korea, Republic of)

3:55 pm: **See-through integral imaging 2D/3D convertible display system** (*Invited Paper*), Han-Le Zhang, Beihang Univ. (China) and Sichuan Univ. (China); Huan Deng, Sichuan Univ. (China); Min-Yang He, Beihang Univ. (China) and Sichuan Univ. (China); Da-Hai Li, Sichuan Univ. (China); Qiong-Hua Wang, Beihang Univ. (China) . . . . . [11304-12]

4:15 pm: **Volumetric technology: enabling near-work compatible AR displays**, Roberts Zabels, Kri's Osmanis, Ugis Gertners, Rendijs Smukulis, Martin? Narels, Ilmars Osmanis, Lightspace Technologies, SIA (Latvia) . . . . . [11304-13]

4:35 pm: **Real-time content creation and transmission of a 3D Internet TV system based on integral imaging using GPU parallel processing**, Md. Ashrafal Alam, Fairuz Nower Khan, Amit Hasan Khan, Ashrafal Jannat, Noor E. Nisa, BRAC Univ. (Bangladesh); Nam Kim, Chungbuk National Univ. (Korea, Republic of) . . . . . [11304-15]

4:55 pm: **Speckle size calculation in laser-based display system and the effect of optical waveguides on the reduction of the speckle perceptivity**, Hadi Baghsiahi, David Selviah, Univ. College London (United Kingdom) . . . . . [11304-16]

**POSTERS-WEDNESDAY**

**LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM**

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup: Wednesday 10:00 AM – 5:00 PM**

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**An extended depth-of-field projection method using a high-speed projector with a synchronized oscillating variable focus lens.** Hongjin Xu, Tokyo Institute of Technology (Japan); Lihui Wang, The Univ. of Tokyo (Japan); Yoshihiro Watanabe, Tokyo Institute of Technology (Japan); Masatoshi Ishikawa, The Univ. of Tokyo (Japan). . . . . [11304-29]

**LED-based automotive exterior displays and interior signage for autonomous cars.** Karlheinz Blankenbach, Hochschule Pforzheim (Germany); Robert Isele, BMW Group (Germany); Daniel Ochs, Steffen Reichel, Hochschule Pforzheim (Germany) . . . . . [11304-30]

**Effects of different solutions used to purify perovskite CsPbBr<sub>3</sub> quantum dots.** Zong-Liang Tseng, Ming Chi Univ. of Technology (Taiwan) . . . . [11304-31]

**Triplet-polaron quench in partially doped blue fluorescent organic light-emitting diodes.** Bo-An Fan, Chia-Hsun Chen, Graduate Institute of Photonics and Optoelectronics, National Taiwan Univ. (Taiwan); Zheng-Chen Hsiao, Man-Kit Leung, National Taiwan Univ. (Taiwan); Chi-Feng Lin, National United Univ. (Taiwan); Tien-Lung Chiu, Yuan Ze Univ. (Taiwan); Jiun-Haw Lee, Graduate Institute of Photonics and Optoelectronics, National Taiwan Univ. (Taiwan). . . . . [11304-32]

**Efficient blue phosphorescent organic light-emitting diode with long triplet lifetime TADF host.** Tse-Ying Chen, National Taiwan Univ. of Science and Technology (Taiwan); Tien-Lung Chiu, Yuan Ze Univ. (Taiwan). . . [11304-34]

**Sensing and memorising liquids with polarity interactive ferroelectric display.** Euihyuk Kim, Cheolmin Park, Yonsei Univ. (Korea, Republic of). . . . . [11304-35]

**Efficiency improvement and lifetime elongation of green phosphorescent organic light-emitting diode with thermally stable host.** Sheng-Chieh Lin, Graduate Institute of Photonics and Optoelectronics, National Taiwan Univ. (Taiwan); Yu-Chieh Cheng, National Taiwan Univ. (Taiwan); Tien-Lung Chiu, Yuan Ze Univ. (Taiwan); Chi-Feng Lin, National United Univ. (Taiwan); Man-Kit Leung, National Taiwan Univ. (Taiwan); Jiun-Haw Lee, Graduate Institute of Photonics and Optoelectronics, National Taiwan Univ. (Taiwan). . . . . [11304-36]

**Synthesis of computer-generated hologram using Fourier Ptychographic approach.** Jaebum Cho, Dukho Lee, Jinsoo Jeong, Byoungghyo Lee, Byoungjo Lee, Seoul National Univ. (Korea, Republic of) . . . . . [11304-37]

**Fork pattern grating film with controllable diffraction order of output stage using polarization state.** Jiseon Yang, Doyeon Lee, Jang-Kun Song, Sungkyunkwan Univ. (Korea, Republic of) . . . . . [11304-38]

**Human eye color discrimination threshold in laser display system.** Cong Wang, Yuwei Fang, Linxiao Deng, Chun Gu, Lixin Xu, Univ. of Science and Technology of China (China) . . . . . [11304-39]

**Retinal image generation method for retinal projection type super multi-view 3D head-mounted display.** Junya Kohno, Kosuke Suga, Kayo Yoshimoto, Hideya Takahashi, Osaka City Univ. (Japan) . . . . . [11304-40]

**Control method of active parallax barrier and binocular image for glasses-free stereoscopic display according to viewing position.** Hiroyuki Nakamura, Tomoya Kitada, Goro Hamagishi, Kayo Yoshimoto, Osaka City Univ. (Japan); Takuya Matsumoto, Kaoru Kusafuka, KYOCERA Corp. (Japan); Hideya Takahashi, Osaka City Univ. (Japan) . . . . . [11304-41]

**Various patterns of 3D grating with LC by photo-alignment technology.** Hee Young Lee, Doyeon Lee, Jang-Kun Song, Sungkyunkwan Univ. (Korea, Republic of). . . . . [11304-42]

**White quantum-dot light-emitting diodes with heterogeneous multi-emitting layers of organic molecules and inorganic QDs.** Jiwan Kim, Kyonggi Univ. (Korea, Republic of); Yong-Hoon Kim, Sungkyunkwan Univ. (Korea, Republic of); Min Suk Oh, Korea Electronics Technology Institute (Korea, Republic of) . . . . . [11304-43]

**Foveated high-resolution light-field system based on integral imaging for near-eye displays.** Gyohyun Koo, Dooseub Shin, Jia Chee Leong, Yong Hyub Won, KAIST (Korea, Republic of). . . . . [11304-44]

**Time-multiplexing auto-stereoscopic three-dimensional display to enhance angular-resolution.** Tae-Hyun Lee, Min-Kyu Park, Kyung-Il Joo, Kyungpook National Univ. (Korea, Republic of); Yang-Su Kim, Gwangju Science, Electronics and Telecommunications Research Institute (Korea, Republic of); Hak-Rin Kim, Kyungpook National Univ. (Korea, Republic of) . . . . . [11304-45]

**High-efficiency blue fluorescence organic light-emitting diodes based on anthracene derivative.** Hung Yi Lin, National Taiwan Univ. (Taiwan); Jian Haur Lee, Chin Ti Chen, Institute of Chemistry - Academia Sinica (Taiwan); Chia Hsun Chen, National Taiwan Univ. (Taiwan); Tien-Lung Chiu, Yuan Ze Univ. (Taiwan); Chi-Feng Lin, National United Univ. (Taiwan); Jiun Haw Lee, National Taiwan Univ. (Taiwan) . . . . . [11304-46]

**Reduction of time-dependent phase fluctuations for a compact phase-only LCoS SLM using an integrated driver and multi-voltage digital drive scheme.** Tobias Reusch, Philip Engel, Jean-Christophe Olaya, Andre Klauss, Friedemann Gädeke, HOLOEYE Photonics AG (Germany) . . . . . [11304-47]

**High-performance ionic polymer mechanotransducer for soft tactile feedback.** Yongchan Kim, Changhyeon Cho, Soongsil Univ. (Korea, Republic of); So Young Kim, Hanbin Choi, Do Hwan Kim, Hanyang Univ. (Korea, Republic of); Hojin Lee, Soongsil Univ. (Korea, Republic of) . . . . . [11304-48]

**3D surface reconstruction using Talbot effect and Fourier transform of phase objects.** Mauricio Ortiz-Gutiérrez, Univ. Michoacana de San Nicolás de Hidalgo (Mexico); Mario Pérez Cortés, Univ. Autónoma de Yucatán (Mexico); Juan Carlos Ibarra-Torres, Univ. de Guadalajara (Mexico); Arturo Olivares-Pérez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico). . . . . [11304-49]

**Active capacitive sensor circuit using photo-patternable ionic polymer gate dielectric based solution-processed coplanar a-InGaZnO TFTs.** Changhyeon Cho, Yongchan Kim, Soongsil Univ. (Korea, Republic of); So Young Kim, Do Hwan Kim, Hanyang Univ. (Korea, Republic of); Hojin Lee, Soongsil Univ. (Korea, Republic of) . . . . . [11304-50]

**Corrugation or grating patterns as the light outcoupling structures of organic light-emitting diode.** Byung Doo Chin, Dankook Univ. (Korea, Republic of); Sung Min Jo, LG Display (Korea, Republic of); Ohyoung Kim, Seok-Ho Hwang, Dankook Univ. (Korea, Republic of) . . . . . [11304-51]

**Assessment of spatial perception for a multi-layer volumetric display: the effect of exocentric and egocentric distance on relative depth judgements.** Tatjana Pladere, University of Latvia (Latvia); Mara Delesa-Velina, Vita Konosonoka, Karola Panke, Gunta Krumina, Univ. of Latvia (Latvia) . . . . . [11304-52]

**THURSDAY 6 FEBRUARY**

**SESSION 5**

**LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . THU 8:00 AM TO 10:30 AM**

**LED, TFT, and LCD**

Session Chair: **Tien-Lung Chiu, Yuan Ze Univ. (Taiwan)**

8:00 am: **MicroLED display: the next-generation display technology** (*Invited Paper*), Yun-Li Charles Li, PlayNitride Inc. (Taiwan). . . . . [11304-17]

8:30 am: **High-efficiency micro-LED displays with indistinguishable color shift** (*Invited Paper*), Fangwang Gou, En-Lin Hsiang, Guanjun Tan, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Pei-Ting Chou, Yun-Li Li, PlayNitride Inc. (Taiwan); Yi-Fen Lan, Shin-Tson Wu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . [11304-18]

9:00 am: **Control of polymer aggregation structures for ultra-thin foldable liquid-crystal displays** (*Invited Paper*), Takahiro Ishinabe, Tohoku Univ. (Japan). . . . . [11304-19]

9:30 am: **Flexible p-type SnO TFTs with stable electrical performance against mechanical bending strains** (*Invited Paper*), I-Chun Cheng, Shu-Ming Hsu, Wei-Chen Lin, Jian-Zhang Chen, National Taiwan Univ. (Taiwan). . . . . [11304-20]

10:00 am: **Achieving 1um pixel pitch display for electronic holography** (*Invited Paper*), Chi-Sun Hwang, Yong-Hae Kim, Ji Hun Choi, Jae-Eun Pi, Gi Heon Kim, Jong-Heon Yang, Chi-Young Hwang, Hee-Ok Kim, Won-Jae Lee, Jinwoong Kim, Electronics and Telecommunications Research Institute (Korea, Republic of); Kwang-Heum Lee, Sang-Hee Ko Park, KAIST (Korea, Republic of); Joo Yeon Kim, Electronics and Telecommunications Research Institute (Korea, Republic of). . . . . [11304-21]

Coffee Break. . . . . Thu 10:30 am to 11:00 am

OPTO

# CONFERENCE 11304

## SESSION 6

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . THU 11:00 AM TO 12:30 PM

### OLED Physics

Session Chair: **Yongtaek Hong**,  
Seoul National Univ. (Korea, Republic of)

11:00 am: **A universal host for efficient hybrid white OLEDs** (*Invited Paper*), Tien-Lung Chiu, Chun-Ming Chang, Yuan Ze Univ. (Taiwan); Jau-Jiun Huang, Man-Kit Leung, Jiun-Haw Lee, National Taiwan Univ. (Taiwan) . . . . . [11304-22]

11:30 am: **Development of carrier transport and exciton diffusion model for OLEDs by considering tail states model and triplet conversion at hetero-interface** (*Invited Paper*), Yuh-Renn Wu, Jun-Yu Huang, National Taiwan Univ. (Taiwan); Mei-Tan Wang, Guan-Yu Chen, Jung-Yu Li, Shih-Pu Chen, Industrial Technology Research Institute (Taiwan) . . . . . [11304-23]

12:00 pm: **Voltage reduction of triplet-triplet annihilation upconversion organic light-emitting diode** (*Invited Paper*), Chia-Hsun Chen, Graduate Institute of Photonics and Optoelectronics, National Taiwan Univ. (Taiwan); Man-Kit Leung, National Taiwan Univ. (Taiwan); Jiun-Haw Lee, Graduate Institute of Photonics and Optoelectronics, National Taiwan Univ. (Taiwan); Tien-Lung Chiu, Yuan Ze Univ. (Taiwan); Chi-Feng Lin, National United Univ. (Taiwan) . . . . . [11304-24]

Lunch/Exhibition Break . . . . . Thu 12:30 pm to 2:00 pm

## SESSION 7

LOCATION: ROOM 104 (LEVEL 1 SOUTH LOBBY) . . . . . THU 2:00 PM TO 4:00 PM

### OLED Applications

Session Chair: **Yuh-Renn Wu**, National Taiwan Univ. (Taiwan)

2:00 pm: **Inkjet and transfer printed electrodes for all-solution-processed OLEDs** (*Invited Paper*), Yongtaek Hong, Geonhee Kim, Byeongmoon Lee, Jongjang Park, Seoul National Univ. (Korea, Republic of) . . . . . [11304-25]

2:30 pm: **Highly efficient, transparent, and near-infrared organic up-conversion devices** (*Invited Paper*), Shun-Wei Liu, Ming Chi Univ. of Technology (Taiwan); Chih-Chien Lee, National Taiwan Univ. of Science and Technology (Taiwan); Sajal Biring, Ming Chi Univ. of Technology (Taiwan) . . . . . [11304-26]

3:00 pm: **Organic light-emitting fibers-based approach: toward weavable and addressable textile displays** (*Invited Paper*), Kyung Cheol Choi, Yong Ha Hwang, Seonil Kwon, KAIST (Korea, Republic of) . . . . . [11304-27]

3:30 pm: **Recent progress of core technologies for stretchable OLEDs** (*Invited Paper*), MunPyo Hong, Sang Il Kim, Ho Won Yoon, Yun Sung Jang, Seung Min Shin, Dong Hyun Kim, Dae Keun Choi, Jung Hyun Kim, Chang Jin Yun, Tae Sang Park, Byoung Ho Cheong, Jiho Kim, Seung Yoon Ryu, Keungwon Rhie, Korea Univ. (Korea, Republic of); Taiho Park, Pohang Univ. of Science and Technology (Korea, Republic of); Yongjin Kim, Jun Yeop Song, Korea Institute of Machinery & Materials (Korea, Republic of); Gerhard Domann, Michael Popall, Joohwan Kim, Fraunhofer-Institut für Silicatforschung ISC (Germany); In Hye Kang, Byoung Sung Bae, Hoseo Univ. (Korea, Republic of); Do Hyun Kim, Pohang Univ. of Science and Technology (Korea, Republic of) . . . . . [11304-28]

## Photonics West Industry Stage

Tuesday - Thursday • Hall DE

Keynotes and panels open to all attendees

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# CONFERENCE 11305

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY)

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## Ultra-High-Definition Imaging Systems III

Conference Chairs: **Seizo Miyata**, Tokyo Univ. of Agriculture and Technology (Japan); **Toyohiko Yatagai**, Utsunomiya Univ. Ctr. for Optical Research & Education (Japan); **Yasuhiro Koike**, Keio Univ. (Japan)

Program Committee: **Liangcai Cao**, Tsinghua Univ. (China); **Janglin Chen**, Industrial Technology Research Institute (Taiwan); **Ray T. Chen**, The Univ. of Texas at Austin (USA); **Toshio Chiba**, Kairos Co., Ltd. (Japan); **Namho Hur**, Electronics and Telecommunications Research Institute (Korea, Republic of); **Azusa Inoue**, Keio Univ. (Japan); **Norihiko Ishii**, NHK Japan Broadcasting Corp. (Japan); **Toru Iwane**, Nikon Corp. (Japan); **Bahram Javidi**, Univ. of Connecticut (USA); **Kyuheon Kim**, Kyung Hee Univ. (Korea, Republic of); **Gauthier Lafruit**, Univ. Libre de Bruxelles (Belgium); **ByoungHo Lee**, Seoul National Univ. (Korea, Republic of); **Shiuan-Huei Lin**, National Chiao Tung Univ. (Taiwan); **Wolfgang Osten**, Institut für Technische Optik (Germany); **No-Cheol Park**, Yonsei Univ. (Korea, Republic of); **Ifor D. W. Samuel**, Univ. of St. Andrews (United Kingdom); **Mark Schubert**, Hollywood Post Alliance (USA); **Okihito Sugihara**, Utsunomiya Univ. (Japan); **Xiaodi Tan**, Fujian Normal Univ. (China); **Kenkichi Tanioka**, Medical Imaging Consortium (Japan); **Din Ping Tsai**, Research Ctr. for Applied Sciences - Academia Sinica (Taiwan); **Kenji Yamamoto**, National Institute of Information and Communications Technology (Japan); **Hiromasa Yamashita**, Kairos Co., Ltd. (Japan); **Whitney R. White**, Chromis Fiber Optics Inc. (USA)

### MONDAY 3 FEBRUARY

#### OPTO PLENARY SESSION

LOCATION: ROOM 207/215 (SOUTH LEVEL TWO) . . . . MON 8:00 AM TO 10:05 AM

- 8:00 am: **Welcome and Opening Remarks**  
**Sailing He**, KTH Royal Institute of Technology (Sweden) and Zhejiang Univ. (China); **Yasuhiro Koike**, Keio Univ. (Japan)
- 8:05 am: **The future of optical components and materials in the fibre (Plenary)**  
**David N. Payne**, Optoelectronics Research Ctr., Univ. of Southampton (United Kingdom)
- 8:45 am: **Efficient light emission from hexagonal SiGe (Plenary)**  
**Erik P. A. M. Bakkers**, Eindhoven Univ. of Technology (Netherlands)
- 9:25 am: **Product design for the next wave of computing (Plenary)**  
**Trond Wuellner**, Google (USA)

Coffee Break. . . . . Mon 10:05 am to 10:30 am

#### SESSION 1

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . MON 10:30 AM TO 12:10 PM

##### Storage

Session Chair: **Yasuhiro Koike**, Keio Univ. (Japan)

- 10:30 am: **Holographic memory for cold data storage in data centers (Invited Paper)**, Toyohiko Yatagai, Utsunomiya Univ. (Japan). . . . . [11305-1]
- 10:55 am: **Four-channel information record by polarization holography (Invited Paper)**, Xiaodi Tan, Fujian Normal Univ. (China); Jinliang Zang, Beijing Institute of Technology (China); Zhiyun Huang, Lili Zhu, Yuanying Zhang, Yuhong Ren, Peiliang Qi, Chenhao Wu, Fujian Normal Univ. (China); Fenglan Fan, Hebei Normal Univ. for Nationalities (China); Ying Liu, Beihang Univ. (China). . . . . [11305-2]
- 11:20 am: **Co-extruded multilayer optical data storage media (Invited Paper)**, Kenneth D. Singer, Case Western Reserve Univ. (USA); Irina Shiyankovskaya, Folio Photonics Inc. (USA). . . . . [11305-3]
- 11:45 am: **Improving method of noise robustness in holographic data storage using pixel amplitude function (Invited Paper)**, Daisuke Barada, Utsunomiya Univ. (Japan). . . . . [11305-4]
- Lunch Break. . . . . Mon 12:10 pm to 1:40 pm

#### SESSION 2

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . MON 1:40 PM TO 3:05 PM

##### Display I

Session Chair: **ByoungHo Lee**, Seoul National Univ. (Korea, Republic of)

- 1:40 pm: **Organic electronics for next-generation imaging systems (Invited Paper)**, Bernard Kippelen, Georgia Institute of Technology (USA). . . . . [11305-5]
- 2:05 pm: **Proposal and analysis of random depolarization film for real-color displays with polarized sunglasses**, Mariko Udono, Yasuhiro Koike, Keio Univ. (Japan). . . . . [11305-7]
- 2:25 pm: **Design of transparent random depolarization films with sufficient depolarization effect**, Shizuki Sasaki, Mariko Udono, Keio Univ. (Japan); Yasuhiro Koike, Keio Photonics Research Institute, Keio Univ. (Japan) [11305-8]
- 2:45 pm: **Proposal of birefringence-free polymer with high heat resistance for real-color vehicle-mounted display**, Kohei Watanabe, Keio Univ. (Japan); Yasuhiro Koike, Keio Photonics Research Institute, Keio Univ. (Japan) [11305-9]
- Coffee Break. . . . . Mon 3:05 pm to 3:35 pm

#### SESSION 3

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . MON 3:35 PM TO 5:25 PM

##### Transmission I

Session Chair: **Partha P. Banerjee**, Univ. of Dayton (USA)

- 3:35 pm: **Multi-gigabit data transmission using multimode optical fibers for next-generation automotive optical network (Invited Paper)**, Okihito Sugihara, Utsunomiya Univ. (Japan). . . . . [11305-10]
- 4:00 pm: **Development of low-noise plastic optical fiber for broadcast and communication in UHD era (Invited Paper)**, Azusa Inoue, Yasuhiro Koike, Keio Univ. (Japan). . . . . [11305-11]
- 4:25 pm: **Indoor optical wiring based on low-noise plastic optical fiber for 4K/8K era**, Kota Nishiyama, Keio Univ. (Japan); Azusa Inoue, Yasuhiro Koike, Keio Photonics Research Institute, Keio Univ. (Japan). . . . . [11305-27]
- 4:45 pm: **Proposal of controlling noise reduction effect of plastic optical fiber by copolymerization method**, Takeru Akashi, Keio Univ. (Japan); Azusa Inoue, Yasuhiro Koike, Keio Photonics Research Institute, Keio Univ. (Japan). . . . . [11305-26]
- 5:05 pm: **Stabilization of multilevel transmission using graded-index plastic optical fiber**, Fumihide Kobayashi, Keio Univ. (Japan); Azusa Inoue, Yasuhiro Koike, Keio Photonics Research Institute, Keio Univ. (Japan). . . . . [11305-12]

OPTO

# CONFERENCE 11305

## TUESDAY 4 FEBRUARY

### SESSION 4

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 8:20 AM TO 10:15 AM

#### Imaging System

Session Chair: **Toyohiko Yatagai**,

Utsunomiya Univ. Ctr. for Optical Research & Education (Japan)

8:20 am: **Recent progress in photonics polymer for ultra-high-definition imaging system** (*Invited Paper*), Yasuhiro Koike, Keio Univ. (Japan) . [11305-15]

8:45 am: **Application of complex field imaging sensor to additive manufacturing** (*Invited Paper*), Behzad Bordbar, Partha P. Banerjee, Univ. of Dayton (USA) . . . . . [11305-16]

9:10 am: **A laser backlight LCD with a narrow bezel** (*Invited Paper*), Shinichi Komura, Hiroaki Kijima, Ken Onoda, Koichi Okuda, Japan Display, Inc. (Japan) . . . . . [11305-17]

9:35 am: **The hardware and software of a new high-resolution 2D scanner designed for artwork and industrial applications**, Hadi Baghsiahi, David R. Selviah, Univ. College London (United Kingdom) . . . . . [11305-18]

9:55 am: **Nonmechanical three-dimensional beam steering using liquid lens and liquid prism**, Junsik Lee, Jooho Lee, Gyu Suk Jung, Yong Hyub Won, KAIST (Korea, Republic of) . . . . . [11305-33]

Coffee Break . . . . . Tue 10:15 am to 10:40 am

### SESSION 5

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 10:40 AM TO 12:35 PM

#### Display II

Session Chair: **Kenneth D. Singer**, Case Western Reserve Univ. (USA)

10:40 am: **Three-dimensional digital imaging methods for holographic display** (*Invited Paper*), Zehao He, Liangcai Cao, Rujia Li, Yunhui Gao, Tsinghua Univ. (China) . . . . . [11305-19]

11:05 am: **Ultra-high-definition holography for near-eye display** (*Invited Paper*), Byoungcho Lee, Jinsoo Jeong, Seoul National Univ. (Korea, Republic of); Dongheon Yoo, Seoul National Univ. (Kosovo, Republic of) . . . . . [11305-20]

11:30 am: **Digitally designed holographic optical elements for large-size light field display** (*Invited Paper*), Boaz Jessie Jackin, National Institute of Information and Communications Technology (Japan) . . . . . [11305-21]

11:55 am: **High-resolution holographic display system by holographic printer with UHD spatial light modulator**, Jinsoo Jeong, Chanhyung Yoo, Jaebum Cho, Juhyun Lee, Byoungcho Lee, Seoul National Univ. (Korea, Republic of) . . . . . [11305-22]

12:15 pm: **Research on key parameters of reflective off-axis digital holography experiment**, Zhang Yishu, Xi'an Univ. of Science and Technology (China) . . . . . [11305-23]

Lunch/Exhibition Break . . . . . Tue 12:35 pm to 2:00 pm

### SESSION 6

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 2:00 PM TO 3:30 PM

#### Transmission II

Session Chair: **Xiaodi Tan**, Fujian Normal Univ. (China)

2:00 pm: **Investigation of ROF noise reduction for home network system using POF** (*Invited Paper*), Yasuto Ishimaru, Seiki Teraji, Yuichi Tsujita, Satoshi Ito, Nitto Denko Corp. (Japan); Yuichi Hiraoka, Maspro Denkoh Corp. (Japan); Azusa Inoue, Yasuhiro Koike, Keio Univ. (Japan) . . . . . [11305-24]

2:25 pm: **Ballpoint-pen interconnect innovation for real-time 4K/8K video transmission using GI POF** (*Invited Paper*), Tetsuya Toma, Keio Univ. (Japan) . . . . . [11305-14]

2:50 pm: **Development of multi-fiber interconnect using graded-index plastic optical fiber**, Haruka Minami, Keio Univ. (Japan); Azusa Inoue, Yasuhiro Koike, Keio Photonics Research Institute, Keio Univ. (Japan) [11305-25]

3:10 pm: **Low-noise radio-over-plastic-optical-fiber link for indoor broadband 5G communication**, Kenta Muramoto, Keio Univ. (Japan); Azusa Inoue, Yasuhiro Koike, Keio Photonics Research Institute, Keio Univ. (Japan) . . . . . [11305-13]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

### SESSION 7

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 4:00 PM TO 5:10 PM

#### 8K

Session Chair: **Liangcai Cao**, Tsinghua Univ. (China)

4:00 pm: **8K ultra-high-definition medical application: development of new endoscope and microscope** (*Invited Paper*), Hiromasa Yamashita, Kairos Co., Ltd. (Japan) . . . . . [11305-28]

4:25 pm: **Future challenges of UHDTV technology and expectations for R&D in photonics** (*Invited Paper*), Takayuki Yamashita, NHK Science & Technology Research Labs. (Japan) . . . . . [11305-29]

4:50 pm: **A proposal of sensor-based phase detection method in 3-CMOS 8K 240-fps imaging**, Kodai Kikuchi, Toshio Yasue, Ryohei Funatsu, Kohei Tomioka, Tomoki Matsubara, Takayuki Yamashita, NHK Japan Broadcasting Corp. (Japan) . . . . . [11305-30]

## WEDNESDAY 5 FEBRUARY

### POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPPosterGuidelines>

**Optimizing focal plane configuration for multifocal head-mounted displays via the learning-based algorithm**, Dongheon Yoo, Jaebum Cho, Byoungcho Lee, Seoul National Univ. (Korea, Republic of) . . . . . [11305-31]

**Optical separation of data pages with crosstalk in holographic data storage using a holographic optical element**, Naoya Taniguchi, Daisuke Barada, Toyohiko Yatagai, Utsunomiya Univ. (Japan) . . . . . [11305-32]

# CONFERENCE 11306

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY)

Wednesday 5 February 2020 • Proceedings of SPIE Vol. 11306

# Practical Holography XXXIV: Displays, Materials, and Applications

Conference Chair: **Hans I. Bjelkhagen**, Glyndwr Univ. (United Kingdom), Hansholo Consulting Ltd. (United Kingdom)

Program Committee: **Maria Isabel Azevedo**, Univ. de Aveiro (Portugal); **David Brotherton-Ratcliffe**, Geola Technologies Ltd. (United Kingdom); **Gerald L. Heidt**, Wasatch Photonics, Inc. (USA); **Michael A. Klug**, Magic Leap, Inc. (USA); **Alkiviadis Lembessis**, The Hellenic Institute of Holography (Greece); **Deanna McMillen**, EOTech, Inc. (USA); **Martina L. Mrongovius**, RMIT Univ. (Australia), Ctr. for the Holographic Arts (USA), Academy of Media Arts, Cologne KHM (Germany); **Hiroshi Yoshikawa**, Nihon Univ. (Japan)

Conference Co-Sponsor:



## TUESDAY 4 FEBRUARY

### TECHNICAL EVENT

LOCATION: INTERCONTINENTAL HOTEL, INTERCONTINENTAL B (5TH FLOOR)  
7:30 PM TO 9:00 PM

### Holography Technical Event

Session Chair: **Hans I. Bjelkhagen**, Glyndwr Univ. (United Kingdom), Hansholo Consulting Ltd. (United Kingdom)

The Holography Technical Group is involved with the whole record of research, engineering, recording materials, and applications of holography. The main fields of interest are display holograms, commercial and artistic, holographic optical elements (HOEs), holographic interferometry and holographic non-destructive testing (HNDT), computer-generated holography (CGH), electro and digital holography, holographic microscopy, and holographic data storage (HDS).

This meeting will focus on recent developments and directions, in particular, in regard to new materials, color display holography, digital holography, CGHs and HOEs.

## WEDNESDAY 5 FEBRUARY

### SESSION 1

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . WED 8:30 AM TO 9:50 AM

### Materials and Processes

Session Chair: **Hans I. Bjelkhagen**, Glyndwr Univ. (United Kingdom), Hansholo Consulting Ltd. (United Kingdom)

8:30 am: **Holographic wavefront printing for fabrication of reflection holograms with arbitrary recording wavefronts**, Johannes Hofmann, Robert Bosch GmbH (Germany) and Karlsruher Institut für Technologie (Germany); Reinhold Fliess, Robert Bosch GmbH (Germany); Wilhelm Stork, Karlsruher Institut für Technologie (Germany). . . . . [11306-1]

8:50 am: **Ensuring reliable single-frequency laser performance for holography and other interferometric techniques in production environments**, Theresa D. McGovern, Magnus Rådmark, Gunnar Elgcróna, Håkan Karlsson, Cobolt AB (Sweden). . . . . [11306-2]

9:10 am: **Dispersion compensation for full-color virtual-imaging systems with a holographic off-axis mirror**, Fumiaki Watanabe, Tokyo Institute of Technology (Japan); Tomoya Nakamura, Tokyo Institute of Technology (Japan) and Japan Science and Technology Agency (Japan); Shiho Torashima, Shunsuke Igarashi, Tokyo Institute of Technology (Japan); Shinji Kimura, NTT DoCoMo, Inc. (Japan) and Tokyo Institute of Technology (Japan); Yuji Aburakawa, NTT DoCoMo, Inc. (Japan); Masahiro Yamaguchi, Tokyo Institute of Technology (Japan). . . . . [11306-3]

9:30 am: **Unexplained complex colour shifts within single- and dual-wavelength holograms**, Vivian Amos Sureshkumar, Martin J. Richardson, De Montfort Univ. (United Kingdom). . . . . [11306-4]

Coffee Break. . . . . Wed 9:50 am to 10:20 am

### SESSION 2

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . WED 10:20 AM TO 12:40 PM

### Applications

Session Chair: **Hans I. Bjelkhagen**, Glyndwr Univ. (United Kingdom), Hansholo Consulting Ltd. (United Kingdom)

10:20 am: **Holographic micro-mirror arrays as projection screens for transparent display applications**, Reinhold Fliess, Robert Bosch GmbH (Germany); Johannes Hofmann, Robert Bosch GmbH (Germany) and Karlsruher Institut für Technologie (Germany). . . . . [11306-5]

10:40 am: **A medical visualization framework and pipeline for holographic MRI**, Marcus A. Gordon, OCAD Univ. (Canada) and York Univ. (Canada); Michael L. Page, Mario Garingo, Adriana Menghi, Jawa El Khash, OCAD Univ. (Canada); Trevor D. McKee, Univ. Health Network (Canada). . . . . [11306-6]

11:00 am: **Digital holography for evaluation of the refractive index distribution externally induced in semiconductors**, Vira R. Besaga, Nils C. Gerhardt, Martin R. Hofmann, Ruhr-Univ. Bochum (Germany). . . . . [11306-7]

11:20 am: **Depth measurement using engineered point spread function with coded aperture**, Beomjun Kim, Daerak Heo, Hosung Jeon, Minwoo Jung, Kyungpook National Univ. (Korea, Republic of); Hwi Kim, Korea Univ. (Korea, Republic of); Joonku Hahn, Kyungpook National Univ. (Korea, Republic of). . . . . [11306-8]

11:40 am: **In-depth particle localization with common-path digital holographic microscopy**, Krisztian Neutsch, Lena Schnitzler, Jiawei Sun, Marlon J. Tranelis, Martin R. Hofmann, Nils C. Gerhardt, Ruhr-Univ. Bochum (Germany). . . . . [11306-9]

12:00 pm: **Open-source 3D-printed digital inline holographic microscope for low-cost cellular imaging**, Stephan Amann, Max von Witzleben, Stefan Breuer, Technische Univ. Darmstadt (Germany). . . . . [11306-10]

12:20 pm: **Expanding possibilities how to apply Bayfol HX® film into recording stacks and optical parts**, Friedrich-Karl Bruder, Sven Hansen, Christel Manecke, Richard Meisenheimer, Lena Pitzer, Thomas Rölle, Covestro AG (Germany). . . . . [11306-11]

Lunch/Exhibition Break . . . . . Wed 12:40 pm to 2:00 pm

### SESSION 3

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . WED 2:00 PM TO 3:00 PM

### Exhibitions

Session Chair: **Seung-Hyun Lee**, Kwangwoon Univ. (Korea, Republic of)

2:00 pm: **Public engagement in science and technology using holography**, Pedro M. Pombo, Emanuel Santos, Univ. de Aveiro (Portugal). . . . . [11306-12]

2:20 pm: **Museum documentation of holograms using lightfield rendering**, Pengxiao Hao, Oliver Cossairt, Marc S. Walton, Northwestern Univ. (USA). . . . . [11306-13]

2:40 pm: **Memory and holographic space**, Maria Isabel Azevedo, Univ. de Aveiro (Portugal). . . . . [11306-14]

Coffee Break. . . . . Wed 3:00 pm to 3:30 pm



# CONFERENCE 11306

## SESSION 4

LOCATION: ROOM 105 (LEVEL 1 SOUTH LOBBY) . . . . . WED 3:30 PM TO 5:30 PM

### Digital Holography

Session Chair: **Seung-Hyun Lee**,  
Kwangwoon Univ. (Korea, Republic of)

- 3:30 pm: **Acceleration of phase-only hologram generation by sub-image preiteration**, Yookwang Kim, Wonjong Ryu, Yong Hyub Won, KAIST (Korea, Republic of) . . . . . [11306-15]
- 3:50 pm: **Effect of a rotational shear on imaging property in bimodal incoherent digital holography**, Teruyoshi Nobukawa, Yutaro Katano, Tetsuhiko Muroi, Nobuhiro Kinoshita, Norihiko Ishii, NHK Japan Broadcasting Corp. (Japan) . . . . . [11306-16]
- 4:10 pm: **Designing of diffractive arbitrarily shaped top-hat beam in non-paraxial systems**, Hiroto Sakai, Yu Takiguchi, Yoshiyuki Ohtake, Hamamatsu Photonics K.K. (Japan) . . . . . [11306-17]
- 4:30 pm: **Generalized phase-shifting color holography**, Minwoo Jung, Hosung Jeon, Beomjun Kim, Sungjin Lim, Joonku Hahn, Kyungpook National Univ. (Korea, Republic of) . . . . . [11306-18]
- 4:50 pm: **High-resolution binary hologram printing methods**, Hosung Jeon, Beomjun Kim, Minwoo Jung, Kyungpook National Univ. (Korea, Republic of); Hwi Kim, Korea Univ. (Korea, Republic of); Joonku Hahn, Kyungpook National Univ. (Korea, Republic of) . . . . . [11306-19]
- 5:10 pm: **Simplified content generation for holographic printer using computer-generated integral imaging**, Anar Khuderchuluun, Munkh-Uchral Erdenebat, Hui-Ying Wu, Ki-Chul Kwon, Chungbuk National Univ. (Korea, Republic of); Seok-Hee Jeon, Incheon National Univ. (Korea, Republic of); Nam Kim, Chungbuk National Univ. (Korea, Republic of) . . . . . [11306-21]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

*Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.*

**Poster Setup:** Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at  
<http://spie.org/PWPosterGuidelines>

- Holographic image reconstruction by magneto-optical light modulation device array**, Ryo Higashida, Nobuhiko Funabashi, Ken-ichi Aoshima, Masato Miura, Kenji Machida, NHK Japan Broadcasting Corp. (Japan) . . . . . [11306-22]
- Real-time holographic gratings recorded in Norland Optical Adhesive 65 and yellow eosin**, María G. Conde-Cuatzto, Benemérita Univ. Autónoma de Puebla (Mexico); Arturo Olivares-Pérez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Santa Toxqui-López, Benemérita Univ. Autónoma de Puebla (Mexico); Israel Fuentes-Tapia, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Mario A. Ambrosio-González, Univ. Autónoma Metropolitana (Mexico) . . . . . [11306-23]
- Measuring photoelastic dispersion coefficients in material samples with digital holography**, Sidney L. da Silva, Felipe M. Prado, Daniel J. Toffoli, Centro Estadual de Educação Tecnológica Paula Souza (Brazil); Niklaus U. Wetter, Instituto de Pesquisas Energéticas e Nucleares (Brazil) . . . . . [11306-24]
- Overlapping waves with random amplitude and phase**, Arturo Olivares-Pérez, Joan Manuel Villa-Hernández, Roxana María Herrán-Cuspinera, Rosaura Vallejo-Mendoza, Israel Fuentes-Tapia, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Santa Toxqui-López, Benemérita Univ. Autónoma de Puebla (Mexico); Mauricio Ortiz-Gutiérrez, Univ. Michoacana de San Nicolás de Hidalgo (Mexico); Jose Blas Ramón Ruiz-Limón, Ericka Lilianna Ponce-Lee, Instituto Nacional de Astrofísica (Mexico) . . . . . [11306-25]
- Tabletop optical system enlarging viewing-zone for displaying holographic aerial images**, Takahiro Kobayakawa, Yuji Sakamoto, Hokkaido Univ. (Japan) . . . . . [11306-26]
- Fast calculation by auto-optimized method in CGH video generation using GPU**, Hayato Sakai, Yuji Sakamoto, Hokkaido Univ. (Japan) . . . . . [11306-27]
- Copper-doped polymeric material for holographic recording**, Santa Toxqui-López, Benemérita Univ. Autónoma de Puebla (Mexico); Arturo Olivares-Pérez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); A. L. Padilla-Velasco, Benemérita Univ. Autónoma de Puebla (Mexico); Israel Fuentes-Tapia, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . . . [11306-28]
- Recording rainbow holograms of multiple objects at different depths**, Roxana María Herrán Cuspinera, Arturo Olivares-Pérez, Joan Manuel Villa-Hernández, Rosaura Vallejo-Mendoza, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) . . . . . [11306-29]
- Asymmetric public key cryptosystem using digital holographic encryption method**, Sang-Keun Gil, The Univ. of Suwon (Korea, Republic of); Seok-Hee Jeon, Incheon National Univ. (Korea, Republic of); Jong-Rae Jung, Suwon Science College (Korea, Republic of); Nam Kim, Chungbuk National Univ. (Korea, Republic of) . . . . . [11306-30]
- Fast increase of quality of optically reconstructed images in digital holography**, Pavel A. Cheremkhin, Nikolay N. Evtikhiev, Vitaly V. Krasnov, Vladislav G. Rodin, National Research Nuclear Univ. MEPhI (Russian Federation) . . . . . [11306-31]
- Generation speed enhancement for full-color computer-generated holography using multiple wavefront recording planes**, Yan-Ling Piao, Md. Shahinur Alam, Erkhembaatar Dashdavaa, Chungbuk National Univ. (Korea, Republic of); Sang-Keun Gil, The Univ. of Suwon (Korea, Republic of); Kwon-Yeon Lee, Sunchon National Univ. (Korea, Republic of); Nam Kim, Chungbuk National Univ. (Korea, Republic of) . . . . . [11306-32]
- Digital holographic microscope for recording in-vivo human eye retinal structures**, Stanislovas J. Zacharovas, Queensland Univ. of Technology (Australia) and De Monfort Univ. (United Kingdom); Marwan Suheimat, David Atchison, Queensland Univ. of Technology (Australia) . . . . . [11306-33]

# CONFERENCE 11307

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY)

Tuesday–Wednesday 4–5 February 2020 • Proceedings of SPIE Vol. 11307

## Broadband Access Communication Technologies XIV

Conference Chairs: **Benjamin B. Dingel**, Nasfinc Photonics, Inc. (USA); **Katsutoshi Tsukamoto**, Osaka Institute of Technology (Japan); **Spiros Mikroulis**, Huawei Technologies Co., Ltd. (Germany)

Program Committee: **Shlomi Arnon**, Ben-Gurion Univ. of the Negev (Israel); **Harald Haas**, The Univ. of Edinburgh (United Kingdom); **Atsushi Kanno**, National Institute of Information and Communications Technology (Japan); **Mohsen Kavehrad**, CRKC LLC (USA); **Nathaniel Libatique**, Ateneo de Manila Univ. (Philippines); **Nicholas Madamopoulos**, The City College of New York (USA); **Ken-ichi Sato**, Nagoya Univ. (Japan); **Atul K. Srivastava**, NTT Electronics America, Inc. (USA); **Manoj Thakur**, Univ. of Essex (United Kingdom); **Junwen Zhang**, CableLabs (USA)

Conference Cosponsors: CORNING  NTT Electronics

### TUESDAY 4 FEBRUARY

#### SESSION 1

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 8:30 AM TO 9:50 AM

#### 5G Optical Access Technologies: Systems, Transports, and Testbed

Session Chairs: **Katsutoshi Tsukamoto**, Osaka Institute of Technology (Japan); **Spiros Mikroulis**, Huawei Technologies Co., Ltd. (Germany)

8:30 am: **Optical access technologies for mobile fronthaul in 5G and beyond** (*Invited Paper*), Hiroyuki Uzawa, Kazuaki Honda, Hirotaka Nakamura, Jun Terada, Nippon Telegraph and Telephone Corp. (Japan) . . . . . [11307-1]

9:00 am: **Beyond 100G signal transmission in optical short reach for mobile fronthaul** (*Invited Paper*), Fan Li, Sun Yat-Sen Univ. (China) . . . . . [11307-2]

9:30 am: **University campus 5G testbed and use case deployments in the Philippines**, John Paul Mamaradlo, Neil Angelo Mercado, Nathaniel Joseph C. Libatique, Gregory L. Tangonan, Ateneo de Manila Univ. (Philippines); Ron Jowell Solis, Virginia Rodriguez, Nokia (Philippines); Benjamin Dingel, Nasfinc Photonics, Inc. (Philippines); Cesar Pineda, Vast Net Inc (Philippines); Czar Lopez, PLDT-SMART (Philippines) . . . . . [11307-3]

Coffee Break. . . . . Tue 9:50 am to 10:20 am

#### SESSION 2

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 10:20 AM TO 12:10 PM

#### 5G Photonics: Advanced Techniques, Devices, and Components

Session Chairs: **Spiros Mikroulis**, Huawei Technologies Co., Ltd. (Germany); **Benjamin B. Dingel**, Nasfinc Photonics, Inc. (USA)

10:20 am: **An end-to-end 5G automotive ecosystem for autonomous driving vehicles** (*Invited Paper*), Thiago Raddo, Bruno Cimoli, Technische Univ. Eindhoven (Netherlands); Bogdan Sirbu, Fraunhofer Institute for Reliability and Microintegration (Germany); Simon Rommel, Technische Univ. Eindhoven (Netherlands); Tolga Tekin, Fraunhofer Institute for Reliability and Microintegration (Germany); Idelfonso Tafur Monroy, Technische Univ. Eindhoven (Netherlands) . . . . . [11307-4]

10:50 am: **Real-time demonstration of analog-to-digital compressed (ADX) radio-over-fiber for fronthaul in 5G and beyond**, Paikun Zhu, The Graduate School for the Creation of New Photonics Industries (Japan); Yuki Yoshida, National Institute of Information and Communications Technology (Japan); Ken-ichi Kitayama, The Graduate School for the Creation of New Photonics Industries (Japan) and National Institute of Information and Communications Technology (Japan) . . . . . [11307-5]

11:10 am: **Adaptive and efficient data compression technologies in 5G digital mobile fronthaul networks** (*Invited Paper*), Mu Xu, Junwen Zhang, Haipeng Zhang, Zhensheng Jia, Alberto Campos, CableLabs (USA) . . . . . [11307-6]

11:40 am: **New radio access technologies for 5G with enhanced network reliability and channel capacity** (*Invited Paper*), You-Wei Chen, Gee-Kung Chang, Georgia Institute of Technology (USA) . . . . . [11307-7]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 1:30 pm

#### SESSION 3

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 1:30 PM TO 3:40 PM

#### 5G Photonics: Beamforming Technologies and Optical Components

Session Chairs: **Junwen Zhang**, CableLabs (USA); **Roberto Llorente**, Univ. Politècnica de València (Spain)

1:30 pm: **Software-defined beamforming enabled by spatial division multiplexing in the multicore fiber optical fronthaul** (*Invited Paper*), Roberto Llorente, Maria Morant, Univ. Politècnica de Valencia (Spain); Bogdan Sirbu, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Yigal Leiba, Siklu Communication Ltd. (Israel); Konstantina Kanta, Giannis Giannoulis, National Technical Univ. of Athens (Greece); Christophe Caillaud, Giancarlo Cerulo, Franck Mallecot, III-V Lab. (France); Thiago Raddo, Technische Univ. Eindhoven (Netherlands); Agapi Mesodiakaki, Marios Gatzianas, Aristotle Univ. of Thessaloniki (Greece); Dimitrios Apostolopoulos, Hercules Avramopoulos, National Technical Univ. of Athens (Greece); Idelfonso Tafur Monroy, Technische Univ. Eindhoven (Netherlands); Tolga Tekin, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Amalia Miliou, Nikos Pleros, Aristotle Univ. of Thessaloniki (Greece) . . . . . [11307-8]

2:00 pm: **An end-to-end 5G fiber wireless A-RoF/IFoF link based on a 60 GHz beamsteering antenna and an InP EML**, Christos Vagionas, Eugenio Ruggeri, George Kalfas, Aristotle Univ. of Thessaloniki (Greece); Bogdan Sirbu, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Yigal Leiba, Siklu Communication Ltd. (Israel); Konstantina Kanta, Giannis Giannoulis, National Technical Univ. of Athens (Greece); Christophe Caillaud, Giancarlo Cerulo, Franck Mallecot, III-V Lab. (France); Thiago Raddo, Technische Univ. Eindhoven (Netherlands); Agapi Mesodiakaki, Marios Gatzianas, Aristotle Univ. of Thessaloniki (Greece); Dimitrios Apostolopoulos, Hercules Avramopoulos, National Technical Univ. of Athens (Greece); Idelfonso Tafur Monroy, Technische Univ. Eindhoven (Netherlands); Tolga Tekin, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM (Germany); Amalia Miliou, Nikos Pleros, Aristotle Univ. of Thessaloniki (Greece) . . . . . [11307-9]

2:20 pm: **Integrating lasers into silicon photonics for 5G networks** (*Invited Paper*), Yossef Ehrlichman, Ibrahim G. Yalya, John E. Cunningham, John Simons, Ashok V. Krishnamoorthy, Axalume Inc. (USA) . . . . . [11307-10]

2:50 pm: **A multifunctional demultiplexer for optical frequency combs in broadband access networks** (*Invited Paper*), Prince M. Anandarajah, Dublin City Univ. (Ireland); Aleksandra Kaszubowska-Anandarajah, Trinity College Dublin (Ireland); Syed A. Tajammul, Prajwal D. Lakshmiyayasimha, Dublin City Univ. (Ireland) . . . . . [11307-11]

3:20 pm: **Dual-wavelength photonic beamformer for OFDM and single-carrier broadband wireless operating over 1-km 7-core fiber fronthaul**, Maria Morant, Univ. Politècnica de Valencia (Spain); Ailee M. Trinidad, Eduward Tangdiongga, Ton Koonen, Technische Univ. Eindhoven (Netherlands); Roberto Llorente, Univ. Politècnica de Valencia (Spain) . . . . . [11307-12]

Coffee Break. . . . . Tue 3:40 pm to 4:00 pm

OPTO

# CONFERENCE 11307

## SESSION 4

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . TUE 4:00 PM TO 5:40 PM

### Advanced Fiber and Optical Wireless Communication

Session Chairs: **Spiros Mikroulis**, Huawei Technologies Co., Ltd. (Germany); **Katsutoshi Tsukamoto**, Osaka Institute of Technology (Japan)

4:00 pm: **Modal delay and bandwidth measurements of few-mode fibers for short-distance communications** (*Invited Paper*), Kangmei Li, Xin Chen, Snigdharaj K. Mishra, Jason E. Hurley, Jeffery S. Stone, Ming-Jun Li, Corning Incorporated (USA) . . . . . [11307-13]

4:30 pm: **Non-line-of-sight beam-steered optical wireless communication** (*Invited Paper*), Zizheng Cao, Xuebing Zhang, Technische Univ. Eindhoven (Netherlands); Gerwin Osnabrugge, University of Twente (Netherlands); Juhao Li, Peking University (China); Ivo Vellekoop, University of Twente (Netherlands); A. M. J. Koonen, Technische Univ. Eindhoven (Netherlands) . . . . . [11307-14]

5:00 pm: **Channel characterization for optical extra-WBAN links considering local and global user mobility**, Oussama Haddad, Ali Khalighi, Ecole Centrale de Marseille (France); Stanislav Zvanovec, Czech Technical Univ. in Prague (Czech Republic) . . . . . [11307-15]

5:20 pm: **3.8-Gbit/s visible light communication (VLC) based on 443-nm superluminescent diode and bit-loading discrete-multiple-tone (DMT) modulation scheme**, Fangchen Hu, Fudan Univ. (China); Jorge A. Holguin-Lerma, Yuan Mao, Chao Shen, Xiaobin Sun, Meiwei Kong, Tien Khee Ng, Boon S. Ooi, King Abdullah Univ. of Science and Technology (Saudi Arabia); Nan Chi, Fudan Univ. (China) . . . . . [11307-16]

## WEDNESDAY 5 FEBRUARY

### SESSION 5

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) WED 9:00 AM TO 10:30 AM

### Optical Communications

Joint Keynote Session with Conferences 11307, 11308, and 11309

Session Chairs: **Benjamin B. Dingel**, Nasfina Photonics, Inc. (USA); **Guifang Li**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

9:00 am: **Novel applications of plasmonics and photonics devices to sub-THz wireless** (*Keynote Presentation*), Maurizio Burla, Claudia Hoessbacher, Wolfgang Heni, ETH Zurich (Switzerland); Christian Haffner, ETH Zurich (Switzerland) and Univ. of Maryland, College Park (USA) and National Institute of Standards and Technology (USA); Yuriy Fedoryshyn, Dominik Werner, Tatsuhiko Watanabe, Yannick Salamin, ETH Zurich (Switzerland); Hermann Massler, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany); David Hillerkuss, Huawei Technologies Duesseldorf GmbH (Germany); Delwin Elder, Larry Dalton, Univ. of Washington (USA); Juerg Leuthold, ETH Zurich (Switzerland) . . . [11307-17]

9:30 am: **Hollow-core fiber technology breakthroughs** (*Keynote Presentation*), Francesco Poletti, Univ. of Southampton (United Kingdom) . . . . . [11309-1]

10:00 am: **Optical data center network architectures and resource allocation** (*Keynote Presentation*), Lena Wosinska, Chalmers Univ. of Technology (Sweden) . . . . . [11308-1]

### BEST STUDENT PAPER AWARD CEREMONY

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . 10:30 AM TO 10:40 AM

Session Chairs: **Spiros Mikroulis**, Huawei Technologies Co., Ltd. (Germany); **Atul K. Srivastava**, NTT Electronics America, Inc. (USA); **Guifang Li**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

Coffee Break. . . . . Wed 10:40 am to 11:10 am

## SESSION 6

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . WED 11:10 AM TO 11:50 AM

### Optical Wireless Communication

Session Chairs: **Katsutoshi Tsukamoto**, Osaka Institute of Technology (Japan); **Spiros Mikroulis**, Huawei Technologies Co., Ltd. (Germany)

11:10 am: **Propagation dynamics of ultrabroadband terahertz beams with orbital angular momentum for wireless data transfer**, Maksim S. Kulya, ITMO Univ. (Russian Federation) and Tampere Univ. (Finland); Bogdan V. Sokolenko, Andrei A. Gorodetsky, Nikolay V. Petrov, ITMO Univ. (Russian Federation) . . . . . [11307-19]

11:30 am: **Indoor multi-user MIMO-OOFDM-IM aided hybrid visible light communication system**, Lei Zhao, Sun Yat-Sen Univ. (China); Kunyi Cai, Tencent (China); Ming Jiang, Sun Yat-Sen Univ. (China) . . . . . [11307-20]

### POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

Conference attendees are invited to attend the OPTO poster session on Wednesday evening. Come view the posters, enjoy light refreshments, ask questions, and network with colleagues in your field.

Poster Setup: Wednesday 10:00 AM – 5:00 PM

View poster presentation guidelines and set-up instructions at <http://spie.org/PWPosterGuidelines>

**Converged RoF-based mobile fronthaul and passive optical network with NOMA-CAP modulation format**, Samael Sarmiento, Univ. Politècnica de Catalunya (Spain); José Manuel Delgado Mendinueta, National Institute of Information and Communications Technology (Japan); José Antonio Altabás, Bifrost Communications ApS (Denmark) and Univ. de Zaragoza (Spain); Salvatore Spadaro, Univ. Politècnica de Catalunya (Spain); Satoshi Shinada, Hideaki Furukawa, National Institute of Information and Communications Technology (Japan); Juan José Vegas Olmos, Mellanox Technologies, Ltd. (Israel); José Antonio Lázaro, Univ. Politècnica de Catalunya (Spain); Naoya Wada, National Institute of Information and Communications Technology (Japan) . . . . . [11307-21]

**Performance evaluation and enhancement of dense wavelength division multiplexing passive optical network DWDM-PON cross-seeding system with Rayleigh backscattering mitigation**, Martina N. Wadie, Higher Technological Institute (Egypt); Ibrahim A. Elewah, American College of the Middle East (Kuwait); Moustafa H. Aly, Arab Academy for Science, Technology & Maritime Transport (Egypt) . . . . . [11307-22]

**Multicolor channel-compensated visible light communication technique and transceiver design**, Yong Up Lee, Kyeong-Yoon Kang, Hallym Univ. (Korea, Republic of) . . . . . [11307-23]

**Gbps Li-Fi link enabled by laser-based visible-light communication system**, Chao Shen, King Abdullah Univ. of Science and Technology (Saudi Arabia) and SaNoor Technologies Inc. (Saudi Arabia); Hala H. Alhashim, SaNoor Technologies Inc. (Saudi Arabia) and Imam Abdulrahman Bin Faisal Univ. (Saudi Arabia); Jie Hu, SaNoor Technologies Inc. (Saudi Arabia); Boon S. Ooi, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [11307-24]

**Indoor optical-based localization with sensor fusion**, M. Reza Aminikashani, The Pennsylvania State Univ. (USA); Mohsen Kavehrad, CRKC LLC (USA) . . . . . [11307-26]

# CONFERENCE 11308

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) AND

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY)

Wednesday–Thursday 5–6 February 2020 • Proceedings of SPIE Vol. 11308

# Metro and Data Center Optical Networks and Short-Reach Links III

Conference Chairs: **Atul K. Srivastava**, NTT Electronics America, Inc. (USA); **Madeleine Glick**, Columbia Univ. (USA); **Youichi Akasaka**, Fujitsu Labs. of America, Inc. (USA)

Program Committee: **Philippe P. Absil**, IMEC (Belgium); **Nicola Calabretta**, Technische Univ. Eindhoven (Netherlands); **Qixiang Cheng**, Columbia Univ. (USA); **Marija Furdek**, Chalmers Univ. of Technology (Sweden); **Fumio Futami**, Tamagawa Univ. (Japan); **Hideki Isono**, Fujitsu Optical Components Ltd. (Japan); **Yojiro Mori**, Nagoya Univ. (Japan); **Junichi Nakagawa**, Mitsubishi Electric Corp. (Japan); **Salvatore Spadaro**, Univ. Politècnica de Catalunya (Spain); **Ryuichi Sugizaki**, Furukawa Electric Co., Ltd. (Japan); **Michela Svaluto Moreolo**, Ctr. Tecnològic de Telecomunicacions de Catalunya (Spain)

Conference Cosponsors: **CORNING**  **NTTElectronics**

## WEDNESDAY 5 FEBRUARY

<b>SESSION 1</b> LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) WED 9:00 AM TO 10:30 AM <b>Optical Communications</b>
Joint Keynote Session with Conferences 11307, 11308, and 11309
Session Chairs: <b>Benjamin B. Dingel</b> , Nasfinc Photonics, Inc. (USA); <b>Guifang Li</b> , CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)
9:00 am: <b>Novel applications of plasmonics and photonics devices to sub-THz wireless</b> ( <i>Keynote Presentation</i> ), Maurizio Burla, Claudia Hoessbacher, Wolfgang Heni, ETH Zurich (Switzerland); Christian Haffner, ETH Zurich (Switzerland) and Univ. of Maryland, College Park (USA) and National Institute of Standards and Technology (USA); Yuriy Fedoryshyn, Dominik Werner, Tatsuhiko Watanabe, Yannick Salamin, ETH Zurich (Switzerland); Hermann Massler, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany); David Hillerkuss, Huawei Technologies Duesseldorf GmbH (Germany); Delwin Elder, Larry Dalton, Univ. of Washington (USA); Juerg Leuthold, ETH Zurich (Switzerland) . . . [11307-17]
9:30 am: <b>Hollow-core fiber technology breakthroughs</b> ( <i>Keynote Presentation</i> ), Francesco Poletti, Univ. of Southampton (United Kingdom) . . . [11309-1]
10:00 am: <b>Optical data center network architectures and resource allocation</b> ( <i>Keynote Presentation</i> ), Lena Wosinska, Chalmers Univ. of Technology (Sweden) . . . [11308-1]

<b>BEST STUDENT PAPER AWARD CEREMONY</b> LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . 10:30 AM TO 10:40 AM
Session Chairs: <b>Spiros Mikroulis</b> , Huawei Technologies Co., Ltd. (Germany); <b>Atul K. Srivastava</b> , NTT Electronics America, Inc. (USA); <b>Guifang Li</b> , CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

Coffee Break. . . . . Wed 10:40 am to 11:10 am

## SESSION 2 LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . WED 11:00 AM TO 12:30 PM

### NOTE ROOM CHANGE

### Datacenter Networks

Session Chairs: **Philippe P. Absil**, imec (Belgium); **Junichi Nakagawa**, Mitsubishi Electric Corp. (Japan)

11:00 am: **Scaling of port count for InP-based switches for data centre applications** (*Invited Paper*), Richard V. Penty, Adrian Wonfor, Ian White, Univ. of Cambridge (United Kingdom) . . . . . [11308-2]

11:30 am: **High-speed optical wireless links for datacenters** (*Invited Paper*), G. Cossu, E. Ertunc, L. Gilli, A. Messa, A. Sturmiolo, A. Wajahat, Ernesto Ciaramella, Scuola Superiore Sant'Anna (Italy) . . . . . [11308-3]

12:00 pm: **System aspects of the next-generation data-center networks based on 200G per lambda IMDD links** (*Invited Paper*), Jinlong Wei, Stefano Calabrò, Talha Rahman, Nebojsa Stojanovic, Huawei Technologies Duesseldorf GmbH (Germany) . . . . . [11308-4]

Lunch/Exhibition Break . . . . . Wed 12:30 pm to 2:00 pm

## SESSION 3 LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . WED 2:00 PM TO 3:30 PM

### Transponders and Modules for Optical Networks

Session Chairs: **Lena Wosinska**, Chalmers Univ. of Technology (Sweden); **Yojiro Mori**, Nagoya Univ. (Japan)

2:00 pm: **Single-lambda 100G-PAM4 QSFP28 transceiver for 80-km C-band transmission**, Zhen Qu, Yang Yue, Juniper Networks, Inc. (USA); Guodong Xie, Xinlai Liu, Molex, LLC (USA); Jian Yao, Weiyang Mo, Daniel Pudvay, Jason O'Neil, Winston Chang, Jon Anderson, Juniper Networks, Inc. (USA) . . . . . [11308-5]

2:20 pm: **High-speed optical devices and packaging techniques for data centers** (*Invited Paper*), Nobuo Ohata, Mizuki Shirao, Kiyotomo Hasegawa, Mitsubishi Electric Corp. (Japan) . . . . . [11308-6]

2:50 pm: **Latest standardization trend for high-speed optical transceivers with a view of beyond tera era**, Hideki Isono, Fujitsu Optical Components Ltd. (Japan) . . . . . [11308-7]

3:10 pm: **Highly spectrally efficient metro networks that adopt fiber-level granular routing on overlaid line-/ring-shaped virtual topologies**, Ryuta Shiraki, Yojiro Mori, Hiroshi Hasegawa, Nagoya Univ. (Japan); Ken-ichi Sato, The National Institute of Advanced Industrial Science and Technology (Japan); Paolo Monti, Chalmers Univ. of Technology (Sweden) . . . . . [11308-13]

Coffee Break. . . . . Wed 3:30 pm to 4:00 pm

OPTO

# CONFERENCE 11308

## SESSION 4

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . WED 4:00 PM TO 5:20 PM

### Transponders and Modules for Datacom

Session Chairs: **Qixiang Cheng**, Columbia Univ. (USA);  
**Youichi Akasaka**, Fujitsu Labs. of America, Inc. (USA)

4:00 pm: **Simplified optical transceivers for Stokes-vector transmission systems** (*Invited Paper*), Shota Ishimura, KDDI Research, Inc. (Japan); Samir Ghosh, Nanyang Technological University (Singapore); Yoshiaki Nakano, Takuo Tanemura, The Univ. of Tokyo (Japan) . . . . . [11308-8]

4:30 pm: **56 Gbaud PAM4 optical datacom link**, John Pertessis, Shubhashish Datta, Abhay M. Joshi, Discovery Semiconductors, Inc. (USA) . . . . . [11308-9]

4:50 pm: **Enabling low-cost high-volume production-compatible terabit transceivers with up to 1.6 Tbps capacity and 100Gbps per lane PAM-4 modulation for intra-datacenter optical interconnects up to 2km: The TERIPHC project approach** (*Invited Paper*), Panos Groumas, Christos Tsokos, National Technical Univ. of Athens (Greece); David de Felipe, Ute Troppe, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany); Romain Hersent, III-V Lab. (France); Paraskevas Bakopoulos, Boaz Atias, Mellanox Technologies, Ltd. (Israel); Jean-Yves Dupuy, III-V Lab. (France); Annachiara Pagano, Anna Chiado Piat, TelecomitaliaLAB (Italy); Simon Kibben, ficonTEC Service GmbH (Germany); Lefteris Gounaridis, Adam Raptakis, National Technical Univ. of Athens (Greece); Moritz Seyfried, ficonTEC Service GmbH (Germany); Martin Moehrl, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany); Christos Kouloumentas, National Technical Univ. of Athens (Greece); Norbert Keil, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut, HHI (Germany); Hercules Avramopoulos, National Technical Univ. of Athens (Greece) . . . . . [11308-10]

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

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Poster Setup: Wednesday 10:00 AM – 5:00 PM

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**Virtualization and protection for elastic optical networks**, João Abreu Sr., Marcelo Alencar, Univ. Federal da Bahia (Brazil); Karcus Day Rosario Assis, Univ. Federal do Recôncavo de Bahia (Brazil) . . . . . [11308-25]

**A study on 400ZR and flexible-grid spacing for data-center interconnect transmission**, Ahmad Abdo, Ciena Corp. (Canada); Khaled Maamoun, Univ. of Ottawa (Canada); Priyanth Mehta, Tim Creasy, Ciena Corp. (Canada); Claude D'Amours, Univ. of Ottawa (Canada) . . . . . [11308-26]

## THURSDAY 6 FEBRUARY

## SESSION 5

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . THU 8:10 AM TO 10:00 AM

### Optical Transport Systems

Session Chairs: **Ryuichi Sugizaki**, Furukawa Electric Co., Ltd. (Japan);  
**Nicola Calabretta**, Technische Univ. Eindhoven (Netherlands)

8:10 am: **Programmable transmission systems using coherent detection enabling multi-Tb/s interfaces for IT-communications convergence in optical network** (*Invited Paper*), Josep M. Fabrega, Laia Nadal, Michela Svaluto Moreolo, Ctr. Tecnològic de Telecomunicacions de Catalunya (Spain) . . . . . [11308-11]

8:40 am: **Quasi-Nyquist WDM networks using receiver-side quadrature duo-binary/quaternary spectrum shaping**, Kazuya Okamura, Yojiro Mori, Hiroshi Hasegawa, Ken-ichi Sato, Nagoya Univ. (Japan) . . . . . [11308-12]

9:00 am: **Upcoming applications driving the design of next-generation metro area networks: dealing with 5G backhaul/fronthaul and edge-cloud computing** (*Invited Paper*), David Larrabeiti, Univ. Carlos III de Madrid (Spain); Juan Pedro Fernandez-Palacios, Telefónica, S.A. (Spain); Gabriel Otero, Univ. Carlos III de Madrid (Spain); Michela Svaluto Moreolo, Laia Nadal, Josep M. Fabrega, Ctr. Tecnològic de Telecomunicacions de Catalunya (Spain); Pierpaolo Boffi, Alberto Gatto, Paola Parolari, Politecnico di Milano (Italy); Netsanet M. Tessema, Nicola Calabretta, Ripalta Stabile, Technische Univ. Eindhoven (Netherlands); Giorgio Parladori, Vincenzo Sestito, SM-Optics (Italy) . [11308-14]

9:30 am: **Multi-Tb/s sustainable MAN scenario enabled by VCSEL-based innovative technological solutions** (*Invited Paper*), Pierpaolo Boffi, Paola Parolari, Alberto Gatto, Mariangela Rapisarda, Politecnico di Milano (Italy); Michela Svaluto Moreolo, Laia Nadal, Josep Maria Fabrega, Ctr. Tecnològic de Telecomunicacions de Catalunya (Spain); Nicola Calabretta, Ripalta Stabile, Netsanet Tessema, Technische Univ. Eindhoven (Netherlands); David Larrabeiti, Univ. Carlos III de Madrid (Spain); Juan Pedro Fernandez-Palacios, Telefónica, S.A. (Spain); Gabriel Otero, Univ. Carlos III de Madrid (Spain); Christian Neumeyr, Vertilas GmbH (Germany); Giovanni DelRosso, Srivathsa Bhat, VTT Technical Research Ctr. of Finland Ltd. (Finland); Karen Solis-Trapala, EFFECT Photonics B.V. (Netherlands); Giorgio Parladori, SM Optics S.r.l. (Italy) [11308-15]  
Coffee Break . . . . . Thu 10:00 am to 10:30 am

## SESSION 6

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . THU 10:30 AM TO 12:20 PM

### Network Devices and Security

Session Chairs: **Fumio Futami**, Tamagawa Univ. (Japan);  
**Madeleine Glick**, Columbia Univ. (USA)

10:30 am: **Secure DPSK-based M-ary block-ciphered multicarrier optical communication** (*Invited Paper*), Takahiro Kodama, Kagawa Univ. (Japan); Gabriella Cincotti, Univ. degli Studi di Roma Tre (Italy) . . . . . [11308-16]

11:00 am: **Design considerations for multi-chip module silicon-photonics transceivers** (*Invited Paper*), Nathan C. Abrams, Qixiang Cheng, Madeleine Glick, Evgeny Manzhosov, Columbia Univ. (USA); Moises Jezzini, Padraic Morrissey, Peter O'Brien, Tyndall National Institute (Ireland); Keren Bergman, Columbia Univ. (USA) . . . . . [11308-17]

11:30 am: **Optical mitigation of DDoS attacks using silicon-photonics switches** (*Invited Paper*), Ryan Goodfellow, Information Sciences Institute (USA) . . . . . [11308-18]

12:00 pm: **High-speed and large-capacity integrated silicon photonics technologies** (*Invited Paper*), Yu Tanaka, Fujitsu Ltd. (Japan) . . . . . [11308-19]  
Lunch/Exhibition Break . . . . . Thu 12:30 pm to 1:50 pm

## SESSION 7

LOCATION: ROOM 103 (LEVEL 1 SOUTH LOBBY) . . . . . THU 1:50 PM TO 4:20 PM

### Photonics for Datacenter and Metro Networks

Session Chairs: **Michela Svaluto Moreolo**, Ctr. Tecnològic de Telecomunicacions de Catalunya (Spain);  
**Hideki Isono**, Fujitsu Optical Components Ltd. (Japan)

1:50 pm: **Polarization-dependent loss compensation technologies for digital coherent system** (*Invited Paper*), Guoxiu Huang, Hisao Nakashima, Yuichi Akiyama, Takeshi Hoshida, Fujitsu Ltd. (Japan); Zhenning Tao, Fujitsu R&D Center (China) . . . . . [11308-20]

2:20 pm: **Multimode-based short-reach optical communication systems: versatile design framework** (*Invited Paper*), André Richter, VPIphotonics GmbH (Germany); Eugene Sokolov, VPIphotonics (USA); Igor Koltchanov, VPIphotonics GmbH (Germany); Roza Navitskaya, Alexander Uvarov, VPI Development Ctr. (Belarus); Stefanos Dris, VPIphotonics GmbH (Germany); Jim Farina, VPIphotonics (USA) . . . . . [11308-21]

2:50 pm: **Optical nonlinearity compensation using artificial neural-network-based digital signal processing** (*Invited Paper*), Moriya Nakamura, Meiji Univ. (Japan) . . . . . [11308-22]

3:20 pm: **Multicore fiber technologies: toward practical use** (*Invited Paper*), Ryuichi Sugizaki, Furukawa Electric Co., Ltd. (Japan) . . . . . [11308-23]

3:50 pm: **Reducing the energy consumption and footprint of micro-ring resonator tuning systems** (*Invited Paper*), Maarten Hattink, Columbia Univ. (USA) . . . . . [11308-24]

# CONFERENCE 11309

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY)

Wednesday–Thursday 5–6 February 2020 • Proceedings of SPIE Vol. 11309

## Next-Generation Optical Communication: Components, Sub-Systems, and Systems IX

Conference Chairs: **Guifang Li**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Xiang Zhou**, Google (USA)

Program Committee: **Kazi S. Abedin**, OFS Fitel LLC (USA); **Jin-Xing Cai**, TE Connectivity Ltd. (USA); **Hwan Seok Chung**, Electronics and Telecommunications Research Institute (Korea, Republic of); **Benjamin B. Dingel**, Nasfina Photonics, Inc. (USA); **Ezra Ip**, NEC Labs. America, Inc. (USA); **Yongmin Jung**, Optoelectronics Research Ctr. (United Kingdom); **Inuk Kang**, LGS Innovations, LLC (USA); **Tsuyoshi Konishi**, Osaka Univ. (Japan); **Ming-Jun Li**, Corning Incorporated (USA); **Chao Lu**, The Hong Kong Polytechnic Univ. (Hong Kong, China); **Akihiro Maruta**, Osaka Univ. (Japan); **Takashi Sasaki**, Innovation Core SEI, Inc. (USA); **Siyuan Yu**, Univ. of Bristol (United Kingdom); **Yanjun Zhu**, FutureWei Technologies, Inc. (USA)

Conference Cosponsors: **CORNING**  **NTTElectronics**

### WEDNESDAY 5 FEBRUARY

<b>SESSION 1</b> LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) WED 9:00 AM TO 10:30 AM <b>Optical Communications</b>
Joint Keynote Session with Conferences 11307, 11308, and 11309
Session Chairs: <b>Benjamin B. Dingel</b> , Nasfina Photonics, Inc. (USA); <b>Guifang Li</b> , CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)
9:00 am: <b>Novel applications of plasmonics and photonics devices to sub-THz wireless</b> ( <i>Keynote Presentation</i> ), Maurizio Burla, Claudia Hoessbacher, Wolfgang Heni, ETH Zurich (Switzerland); Christian Haffner, ETH Zurich (Switzerland) and Univ. of Maryland, College Park (USA) and National Institute of Standards and Technology (USA); Yuriy Fedoryshyn, Dominik Werner, Tatsuhiro Watanabe, Yannick Salamin, ETH Zurich (Switzerland); Hermann Massler, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany); David Hillerkuss, Huawei Technologies Dueseldorf GmbH (Germany); Delwin Elder, Larry Dalton, Univ. of Washington (USA); Juerg Leuthold, ETH Zurich (Switzerland) . . . [11307-17]
9:30 am: <b>Hollow-core fiber technology breakthroughs</b> ( <i>Keynote Presentation</i> ), Francesco Poletti, Univ. of Southampton (United Kingdom) . . . [11309-1]
10:00 am: <b>Optical data center network architectures and resource allocation</b> ( <i>Keynote Presentation</i> ), Lena Wosinska, Chalmers Univ. of Technology (Sweden) . . . [11308-1]

### BEST STUDENT PAPER AWARD CEREMONY

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . 10:30 AM TO 10:40 AM

Session Chairs: **Spiros Mikroulis**, Huawei Technologies Co., Ltd. (Germany); **Atul K. Srivastava**, NTT Electronics America, Inc. (USA); **Guifang Li**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

### SESSION 2

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . WED 1:30 PM TO 4:00 PM

### SDM

Session Chairs: **Xiang Zhou**, Google (USA); **Guifang Li**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

- 1:30 pm: **Benefits of SDM concepts in submarine transmission** (*Invited Paper*), Oleg Sinkin, SubCom, LLC (USA) . . . . . [11309-2]
- 2:00 pm: **Collective measurement of DMD in 6-mode 19-core fiber using low-coherence digital holography**, Yuta Abe, Atsushi Okamoto, Kazuhisa Ogawa, Akihisa Tomita, Hokkaido Univ. (Japan); Daiki Soma, Yuta Wakayama, Takehiro Tsuritani, KDDI Research, Inc. (Japan) . . . . [11309-3]
- 2:15 pm: **Mode-division multiplexing using few-mode elliptical-core optical fibers** (*Invited Paper*), Giovanni Milione, NEC Labs. America, Inc. (USA) . . . . . [11309-4]
- 2:45 pm: **Optimizing quasi-adiabaticity and its application in photonic lantern devices**, Sugeet Sunder, Anurag Sharma, Indian Institute of Technology Delhi (India) . . . . . [11309-5]
- 3:00 pm: **Field test of high-density uncoupled multi-core fiber cable in outdoor test environment** (*Invited Paper*), Takehiro Tsuritani, Daiki Soma, Yuta Wakayama, KDDI Research, Inc. (Japan); Yuichi Miyagawa, Mikoto Takahashi, KDDI Corp. (Japan); Itsuro Morita, KDDI Research, Inc. (Japan); Koichi Maeda, Kohei Kawasaki, Toshikazu Matsuura, Masayoshi Tsukamoto, Ryuichi Sugizaki, Furukawa Electric Co., Ltd. (Japan) . . . . . [11309-6]
- 3:30 pm: **Mode-selective switch for ROADM using volume holograms and spatial light modulator**, Hotaka Hayashi, Atsushi Okamoto, Tomohiro Maeda, Taijun Shiba, Kazuhisa Ogawa, Akihisa Tomita, Hokkaido Univ. (Japan); Taketoshi Takahata, Optoquest Co., Ltd. (Japan); Satoshi Shinada, Yuta Goto, Naoya Wada, National Institute of Information and Communications Technology (Japan) . . . . . [11309-7]
- 3:45 pm: **Spatial mode exchange technique using volume holograms with a random optical diffuser to reduce modal cross-talks**, Zhang Shuanglu, Atsushi Okamoto, Taijun Shiba, Hotaka Hayashi, Kazuhisa Ogawa, Akihisa Tomita, Hokkaido Univ. (Japan); Taketoshi Takahata, OPTOQUEST Co., Ltd. (Japan); Satoshi Shinada, Yuta Goto, Naoya Wada, National Institute of Information and Communications Technology (NICT) (Japan) . . . . . [11309-8]

OPTO

# CONFERENCE 11309

## POSTERS-WEDNESDAY

LOCATION: MOSCONE CENTER, LEVEL 3 WEST . . . . . WED 6:00 PM TO 8:00 PM

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Poster Setup: Wednesday 10:00 AM – 5:00 PM

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**Optimization of waveguide photodetector with thin absorbing layer and large responsivity**, Joong-Seon Choe, Duk-Jun Kim, Won-Seok Han, Jong-Hoi Kim, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [11309-25]

**Next-generation millimeter-wave-over-fiber network based on FBMC with optical heterodyning technique**, Gour Chandra Mandal, Sidho-Kanho-Birsha Univ. (India) . . . . . [11309-26]

**Perovskite nanocrystals in block copolymer photonic crystal films for dual-responsive anticounterfeiting**, Hyowon Han, Cheolmin Park, Yonsei Univ. (Korea, Republic of) . . . . . [11309-27]

**Comparison of twin-SSB modulation schemes**, Ryoto Nakagawa, Yuya Takanashi, Moriya Nakamura, Meiji Univ. (Japan) . . . . . [11309-28]

**Abstracting network elements from mask layout to network management: a case study**, Enrico Ghillino, Synopsys, Inc. (USA); Pasquale Pasella, Politecnico di Torino (Italy); Remco Stoffer, Synopsys, Inc. (Netherlands); Dwight Richards, College of Staten Island (USA); Jigesh Patel, Pablo Mena, Rob Scarmozzino, Synopsys, Inc. (USA); Paolo Bardella, Emanuele Virgillito, Dario Pillori, Andrea Carena, Vittorio Curri, Politecnico di Torino (Italy) . . . . . [11309-29]

## THURSDAY 6 FEBRUARY

### SESSION 3

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . THU 8:45 AM TO 11:30 AM

### Fibers and Devices

Session Chairs: **Alan Pak Tao Lau**,

The Hong Kong Polytechnic Univ. (Hong Kong, China);

**Lu Chao**, The Hong Kong Polytechnic Univ. (Hong Kong, China)

8:45 am: **DCI systems with ultra-low loss and low dispersion fiber** (*Invited Paper*), Xiaojun Liang, John D. Downie, Ming-Jun Li, Hui Su, Jason Hurlley, James Himmelreich, Hao Dong, Corning Incorporated (USA); Sergejs Makovejs, Corning Incorporated (United Kingdom) . . . . . [11309-9]

9:15 am: **Bismuth-doped fiber amplifiers (BDFAs) to extend O-band transmission reach and capacity** (*Invited Paper*), Vitaly Mikhailov, Jiawei Luo, Man Yan, Gabriel S. Puc, Yingzhi Sun, Scott D. Shenk, Dulashko Yuriy, Robert S. Windeler, Paul S. Westbrook, Daryl Inniss, David J. DiGiovanni, OFS Fitel, LLC (USA) . . . . . [11309-10]

9:45 am: **Integrated Nyquist transmitter for data rates up to 100 Gbps**, Stefan Preußler, Technische Univ. Braunschweig (Germany); Hanjo Rhee, Sicoya GmbH (Germany); Thomas Schneider, Technische Univ. Braunschweig (Germany) . . . . . [11309-11]

10:00 am: **Carrierless coherent receivers based on phase retrieval** (*Invited Paper*), Yuki Yoshida, National Institute of Information and Communications Technology (Japan) . . . . . [11309-12]

10:30 am: **Joint-compensation of silicon photonics modulator in short reach coherent networks**, Ahmad Abdo, Mahdi Parvizi, Naim Ben-Hamida, Ciena Corp. (Canada); Claude D'Amours, Univ. of Ottawa (Canada) . . [11309-13]

10:45 am: **Integrated-optic spectrum synthesis circuit for manipulating 64 frequency components**, Koichi Takiguchi, Ritsumeikan Univ. (Japan) . . . . . [11309-15]

11:00 am: **Integrated ultra-high-performance graphene optical modulator**, Hamed Dalir, Omega Optics, Inc. (USA); Elham Heidari, Aref Asghari, The Univ. of Texas at Austin (USA); Volker J. Sorger, The George Washington Univ. (USA); Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [11309-16]

11:15 am: **Effects of all-optical wavelength conversion on signal quality under variable-channel spacing in elastic optical networks**, André Aguiar, INATEL (Brazil); Indayara B. Martins, Felipe Rudge Barbosa, Univ. Estadual de Campinas (Brazil) . . . . . [11309-17]

Lunch/Exhibition Break . . . . . Thu 11:30 am to 1:00 pm

## SESSION 4

LOCATION: ROOM 102 (LEVEL 1 SOUTH LOBBY) . . . . . THU 1:00 PM TO 3:45 PM

### Transmission Systems

Session Chairs: **Giovanni Milione**, NEC Labs. America, Inc. (USA); **Ming-Jun Li**, Corning Incorporated (USA)

1:00 pm: **Beyond 100-Tb/s ultra-wideband transmission in S, C, and L bands over single-mode fiber** (*Invited Paper*), Kyo Minoguchi, Fukutaro Hamaoka, Seiji Okamoto, Takeo Sasai, Kengo Horikoshi, Asuka Matsushita, Masanori Nakamura, Etsushi Yamazaki, Yoshiaki Kisaka, Nippon Telegraph and Telephone Corp. (Japan) . . . . . [11309-18]

1:30 pm: **Optimization of FEC implementation aided by high-throughput FPGA emulations** (*Invited Paper*), Yi Cai, ZTE (TX) Inc. (USA) . . . . . [11309-19]

2:00 pm: **Frequency offset estimation algorithm for a multi-subcarrier coherent fiber optical system**, Ryan Ramdial, McMaster Univ. (Canada); Xiaojun Liang, Corning Incorporated (USA); Shiva Kumar, McMaster Univ. (Canada); John D. Downie, William Wood, Corning Incorporated (USA) . . . . . [11309-20]

2:15 pm: **Applications of machine-learning in optical communications and networks** (*Invited Paper*), Faisal N. Khan, Qirui Fan, Alan Pak Tao Lau, Chao Lu, The Hong Kong Polytechnic Univ. (Hong Kong, China) . . . . . [11309-21]

2:45 pm: **What should be the margin of future optical transmission systems?**, Abhijit Mitra, Indraprastha Institute of Information Technology (India) and British Telecommunications plc (India); Anand Srivastava, Indraprastha Institute of Information Technology (India); Andrew Lord, British Telecommunications plc (United Kingdom); Bijoy Chand Chatterjee, South Asian Univ. (India) . . . . . [11309-22]

3:00 pm: **Calibration and monitoring of coherent optical transceiver imperfections** (*Invited Paper*), Yangyang Fan, Fujitsu Research and Development Center Co., Ltd. (China) . . . . . [11309-23]

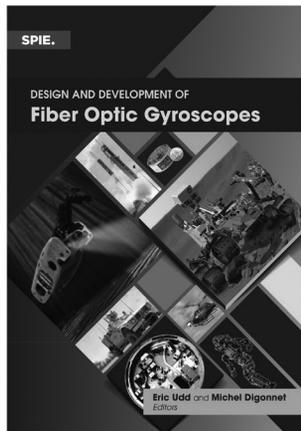
3:30 pm: **Trajectory redesign within a complex intersection for VLC ready connected cars.**, Manuel A. Vieira, Manuela Vieira, Paula Louro, Instituto Superior de Engenharia de Lisboa (Portugal) and Ctr. of Technology and Systems, UNINOVA (Portugal); Pedro Vieira, Instituto Superior de Engenharia de Lisboa (Portugal) and Instituto de Telecomunicações (Portugal) . . [11309-24]



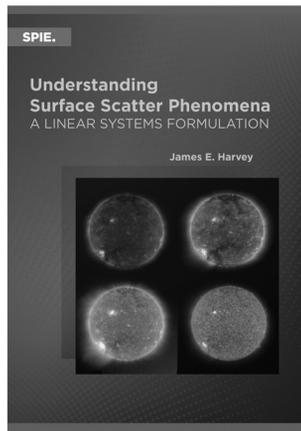
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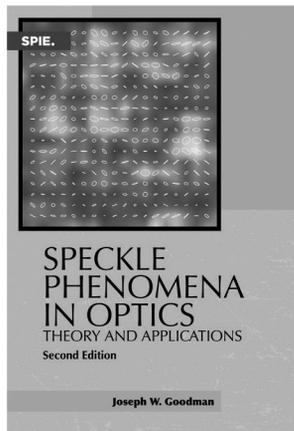
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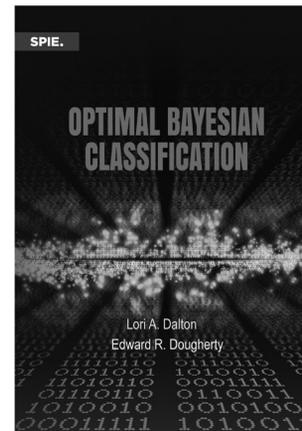
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Michel J. F. Digonnet**  
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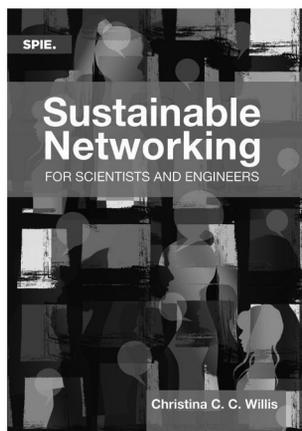
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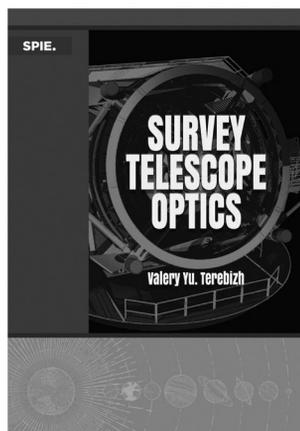
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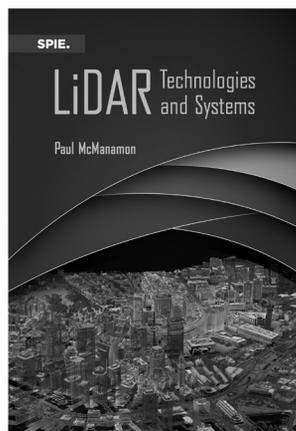
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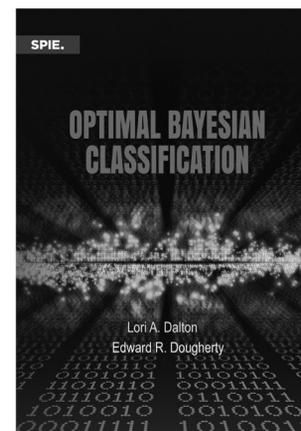
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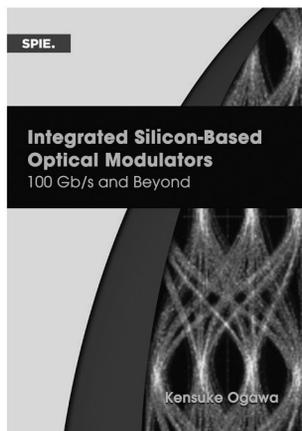
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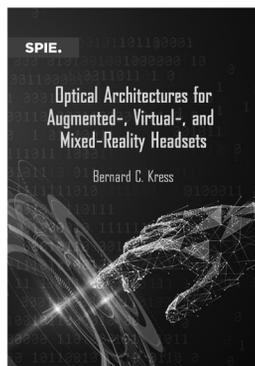
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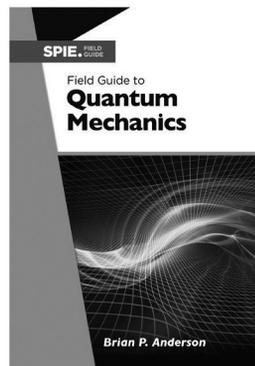
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**Zucker, Erik** 11262 Program Committee, 11262 S5 Session Chair, 11262 S6 Session Chair

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Photo credit: Nguyen Khanh Hoang



## International Day of Light

16 May

The International Day of Light is a global initiative highlighting to the citizens of the world the importance of light and light-based technologies in their lives, for their futures, and for the development of Society.

**SPIE supports the International Day of Light and its annual celebration on 16 May.**



### SPIE IDL GRANTS

SPIE will provide seed funding up to US\$3,000 to organizations creating Day of Light activities.



### IDL RESOURCES

SPIE encourages communities to plan their own annual celebration on 16 May and provides various resources to help create an event.



### SPIE PHOTO CONTEST

Amateur and professional photographers alike should submit photos demonstrating the vital role that light plays in our lives for a chance to win US\$2,500.



SPIE.

Learn more: [spie.org/idl](https://spie.org/idl)

# SPIE. AWARDS

SPIE is pleased to announce the 2020 winners of select SPIE Awards, honoring the best in optics and photonics for their significant achievements and contributions in advancing the science of light.



**Pablo Benítez**  
A.E. Conrady Award in  
Optical Engineering



**Sanjay Krishna**  
Aden and Marjorie  
Meinel Technology  
Achievement Award



**Nirmala Ramanujam**  
Biophotonics  
Technology Innovator  
Award



**Steven L. Jacques**  
Britton Chance  
Biomedical Optics  
Award



**James E. Miller**  
Chandra S. Vikram  
Award in Optical  
Metrology



**Pietro Ferraro**  
Dennis Gabor Award in  
Diffractive Optics



**Jessica Wade**  
Diversity Outreach  
Award



**Vivian E. Ferry**  
Early Career  
Achievement Award -  
Academic



**Gordon Wetzstein**  
Early Career  
Achievement Award -  
Academic



**Sona Hosseini**  
Early Career  
Achievement Award -  
Government/Industry



**Nishant Mohan**  
Early Career  
Achievement Award -  
Government/Industry



**Winfried Kaiser**  
Frits Zernike Award in  
Microlithography



**Oswald H. Siegmund**  
George W. Goddard  
Award in Space and  
Airborne Optics



**Tatiana Novikova**  
G.G. Stokes Award in  
Optical Polarization



**Ursula Keller**  
SPIE Gold Medal



**Alan R. Fry**  
Harold E. Edgerton  
Award in High-Speed  
Optics



**Harold L. Kundel**  
Harrison H. Barrett  
Award in Medical  
Imaging



**Kathleen Richardson**  
María J. Yzuel Educator  
Award



**John H. Lehman**  
Maria Goeppert-Mayer  
Award in Photonics



**Yuri S. Kivshar**  
Mozi Award



**John R. Rogers**  
Rudolf and Hilda  
Kingslake Award in  
Optical Design



**Gary J. Spiegel**  
Directors' Award



**Daniel Vukobratovich**  
President's Award



Nominate a colleague today | [spie.org/awards](https://spie.org/awards)

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# GENERAL INFORMATION

## Registration

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### ONSITE REGISTRATION AND BADGE PICK-UP HOURS

Moscone Center North and South Lobbies

**Recommended: Conference and course attendees should use South Lobby to pick up badges.**

Friday . . . . .31 January . . . 4:00 PM - 7:00 PM. . . . North Lobby ONLY

Saturday . . . . .1 February . . . 7:15 AM - 5:00 PM . . . . North and South

Sunday . . . . .2 February . . . 7:30 AM - 5:00 PM. . . . North and South

Monday . . . . .3 February . . . 7:30 AM - 5:00 PM. . . . North and South

Tuesday. . . . .4 February . . . 7:30 AM - 5:00 PM. . . . North and South

Wednesday . . .5 February . . . 7:30 AM - 5:00 PM. . . . North and South

Thursday. . . . .6 February . . . 7:30 AM - 4:00 PM. . . . North and South

### CONFERENCE REGISTRATION

Your conference registration fees include admission to all conference sessions, plenaries, panels, technical events, poster sessions, both BiOS Expo and Photonics West exhibition, industry sessions, welcome reception, and choice of online proceedings or online collections. Full conference registration includes access to the co-located SPIE AR, VR, MR event taking place 2-4 February.

### COURSE AND WORKSHOP REGISTRATION

Moscone Center South Lobby

Courses and workshops are priced separately. Course-only registration includes your selected course(s), course notes, coffee breaks, and admittance to the exhibition. Course prices include applicable taxes. Onsite, please go to Course Materials AFTER you pick up your badge.

Multiple facilities may be used for courses; allow yourself enough time to register, pick up your materials, and possibly walk to a nearby facility before your course begins.

If your course starts at 8:30 am, it is recommended that you arrive before 8:00 am to avoid peak registration times. Otherwise, you may not arrive to your course on time.

### EARLY REGISTRATION PRICING AND DATES

Conference registration prices increase by US\$150 (Students, \$50) and course prices increase \$75 after 17 January 2020. The online form will automatically display the increased prices.

### SPIE MEMBER, SPIE STUDENT MEMBER, AND STUDENT PRICING

- SPIE Members receive conference and course registration discounts. Discounts are applied at the time of registration.
- SPIE Student Members receive a 50% discount on all courses.
- Student registration rates are available only to undergraduate and graduate students who are enrolled full time and have not yet received their Ph.D. Post-docs may not register as students. A student ID number or proof of student status is required with your registration.

### PRESS REGISTRATION

For credentialed press and media representatives only. Visit [spie.org/press](http://spie.org/press) for details. Please email contact information, title, and organization to [media@spie.org](mailto:media@spie.org).

### SPIE Cashier

Moscone Center North and South Lobbies

Open during registration hours

### REGISTRATION PAYMENTS

If you are planning to register onsite, your credit card payment will be processed during registration. If you wish to pay with cash or check, register at the “Need to Register” stations; you will be directed to the Cashier once you have completed registration except for final payment. If you have already registered and wish to add a course, workshop or special event, you may do so at the “Need to Register” stations.

### RECEIPT AND CERTIFICATE OF ATTENDANCE

Preregistered attendees who need an SPIE-stamped receipt or attendees who need a Certificate of Attendance may obtain those at Badge Corrections and Receipts.

### BADGE CORRECTIONS

Badge corrections can be made at the Badge Corrections station. Please have your badge removed from the badge holder and marked with your changes before approaching the counter.

### REFUND INFORMATION

There is a US\$50 service charge for processing refunds. Requests for refunds must be received by 23 January 2020; all registration fees will be forfeited after this date. Membership dues, SPIE Digital Library subscriptions, or Special Events purchased are not refundable.

### U.S. GOVERNMENT CREDIT CARDS

U.S. Government credit card users: have your purchasing officer contact the credit card company and get prior authorization before attempting to register. Advise your purchasing agent that SPIE is considered a 5968 company for authorization purposes.

# GENERAL INFORMATION

## Onsite Services

### WIRELESS

All Moscone Lobbies and Conference Rooms

Complimentary wireless access is available throughout Moscone North and South buildings.

### SPIE CONFERENCE AND EXHIBITION APP

Search and browse the program, special events, participants, exhibitors, courses, and more. Build your personalized schedule and sync with the online MySchedule tool. Free Conference App available for iPhone and Android phones. Information about restaurants and food options also available on the App.

### SPIE BOOKSTORE

Moscone Center Exhibition Level

Stop by the SPIE Bookstore to browse the latest SPIE Press Books, proceedings, and educational materials. While there, get a t-shirt or educational toy to bring home to the family.

### SPIE EDUCATION SERVICES

Moscone Center South Lobby

Browse course offerings or learn more about SPIE courses available in portable formats such as online and customized, In-company courses.

### SPIE PRESS ROOM

North Lobby

Open during Registration hours

For Registered Press only. The Press Room provides meeting space, refreshments, access to exhibitor press releases, and Internet connections.

Press are urged to register before the meeting by emailing name, contact information, and name of publication to [media@spie.org](mailto:media@spie.org). Preregistration closes approximately 10 days before the start of the event.

### MOTHERS' LOUNGE

Moscone Center, North & South Lobby

Open during Registration hours

These lounges are lockable rooms intended for nursing mothers. Each lounge is equipped with comfortable furniture and power outlets. There is no storage, running water, or refrigeration available in the lounges.

### QUIET ROOM

Moscone Center, North Lobby, Room 115

Open during registration hours

The Quiet Room is intended for silent meditation, reflection, or prayer. No mobile device or computer use, and no food or beverages allowed. This is not a meeting space.

### SPIE LUGGAGE + COAT CHECK

Moscone Center North Lobby

Saturday through Thursday

Open during registration hours

Complimentary luggage, package, and coat storage are available. Please note posted hours; no late pickup available.

### BUSINESS CENTER

Moscone Center Exhibit Level, near Hall C

Tuesday through Thursday . . . . . 9:00 AM - 5:00 PM

The Moscone Business Center provides full service business needs for your convenience. Their services include photocopying, faxing, computer workstations, and printing services.

### RESTAURANT & CITY INFORMATION

Moscone Center South Lobby

Saturday through Wednesday . . . . . 9:00 AM - 5:00 PM

The San Francisco Travel Association will have Visitor's guides and maps available and sells the San Francisco CityPASS, Muni 1-, 3- and 7-Day Passports, cable car tickets, the Explorer Pass, Muni maps and hop-on-hop-off bus tickets. Staff are available to discuss city information including tips on local restaurants, the city's many attractions, sightseeing suggestions and transit information.

### CHILD CARE SERVICES

#### Sitters Unlimited

San Francisco Bay Area

408-452-0225

#### Rachael Osorio

Email: [rforosorio15@gmail.com](mailto:rforosorio15@gmail.com)

[www.bayareasittersunlimited.com](http://www.bayareasittersunlimited.com)

**Note:** SPIE does not imply an endorsement or recommendation of these services. They are provided on an "information only" basis for your further analysis and decision. Other services may be available.

### URGENT MESSAGE LINE

An urgent message line is available during registration hours: 415-978-3700

### LOST AND FOUND

Cashier – Moscone Center South Lobby

Found items will be kept at Cashier during the meeting and available only during registration hours. At the end of the meeting, unclaimed items will be given to Moscone Security Control, 415-974-4021

## Food and Beverage Services

### COMPLIMENTARY COFFEE

#### SATURDAY-SUNDAY

7:30 AM - 9:30 AM Moscone Center South conference room foyers

10:00 AM - 4:00 PM Exhibition Hall DE

#### MONDAY

7:30 AM - 4:00 PM Moscone Center South conference room foyers

#### TUESDAY-THURSDAY

7:30 AM - 9:30 AM Moscone Center South conference room foyers

10:00 AM - 4:00 PM Exhibition Halls ABC and Hall F

Please check the conference schedule for specific break times.

### FOOD & REFRESHMENTS FOR PURCHASE

Various Moscone Center Locations

Saturday through Thursday

There is a variety of food and drink options including hot and cold snacks, espresso, beverages, hot entrees, deli sandwiches, salads, and pastries are available for purchase. Cash and credit cards accepted.

### DINING HOURS IN THE EXHIBITION HALLS

Exhibition Hall DE

Saturday and Sunday . . . . . 10:00 AM - 4:00 PM

Exhibition Hall ABC & F

Tuesday through Thursday . . . . . 10:00 AM - 4:00 PM

## Author / Presenter Information

### SPEAKER CHECK-IN AND PREVIEW STATION

Moscone Center North Lobby  
Open during Registration hours

All presenters must upload their file(s) at least two hours before your session begins or the day before if you present in the first session. Authors are not able to present using their own devices. All conference rooms have a laptop, projector, screen, lapel microphone, and laser pointer.

### SPEAKERS ARE NOT ABLE TO PRESENT USING THEIR OWN LAPTOP OR OTHER DEVICE

#### 1. Upload in advance

All presenters must upload their presentation to LaunchPad before going to their conference room. There are two ways to upload your presentation.

Upload online: upload online to Launchpad <http://spieuploads.com> by **30 January at 5:00 PM Pacific Time**

Launchpad accepts all file types except LibreOffice, and there are no file size restrictions. Should you require assistance with uploading or presenting, technicians will be available at Speaker Check-In and throughout the meeting rooms to help.

**Upload at Photonics West:** Bring your USB device to Speaker Check-In at least two hours before your session begins or the day before if presenting in the first morning session.

#### 2. Preview your presentation onsite

All presenters are strongly encouraged to visit Speaker Check-In at least 2 hours prior to their presentation to preview their files through the SPIE presentation system, or the day before if presenting in first morning session.

## Poster Set-Up Instructions

To find out which poster session you are scheduled for, check the individual conference program online:

BIOS: <http://spie.org/BiOSConferences>

LASE: <http://spie.org/LASEConferences>

OPTO: <http://spie.org/OPTOConferences>

### Sunday Poster Session. . . . . 5:30 PM - 7:00 PM

Conferences: includes BIOS posters

Location: Moscone West, Level 3

Poster Setup: Sunday. . . . . 10:00 AM - 4:30 PM

### Monday Poster Session. . . . . 5:30 PM - 7:00 PM

Conferences: includes BIOS posters

Location: Moscone West, Level 3

Poster Setup: Sunday. . . . . 10:00 AM - 4:30 PM

### Tuesday Poster Session. . . . . 6:00 PM - 8:00 PM

Conferences: includes BIOS & LASE posters

Location: Moscone West, Level 3

Poster Setup: Sunday. . . . . 10:00 AM - 5:00 PM

### Wednesday Poster Session. . . . . 6:00 PM - 8:00 PM

Conferences: OPTO posters

Location: Moscone West, Level 3

Poster Setup: Sunday. . . . . 10:00 AM - 5:00 PM



### POSTER SET-UP INSTRUCTIONS

- Set up your poster during the setup hours listed for your poster session.
- Paper numbers will be placed on the poster boards in numerical order; please find your paper number and put up your poster in the designated space.
- Presenters who have not placed their poster(s) on their assigned board by 60 minutes prior to the session on the day of their presentation will be considered a “no show” and their manuscript will not be published.

### POSTER SESSION INSTRUCTIONS

- A poster author is required to stand by the poster during the scheduled poster session to answer questions from attendees.

### POSTER TEARDOWN INSTRUCTIONS

- Presenters must remove their posters immediately after the poster session. SPIE assumes no responsibility for posters and will not save abandoned posters.

### POSTER GUIDELINES

<http://spie.org/PWPPosterGuidelines>

## GENERAL INFORMATION



### EVENT LOCATION

#### The Moscone Center

747 Howard Street  
San Francisco, California 94103, USA

For directions and information about the center visit [Moscone.com](http://Moscone.com)

### AIRPORTS

San Francisco is serviced by two international airports:

San Francisco International Airport (SFO) is located approximately 15 miles from San Francisco downtown hotels (30-60 minute drive).

Oakland International Airport (OAK) is approximately 20 miles from San Francisco downtown hotels (30-50 minute drive).

### GROUND TRANSPORTATION

Visit our event travel webpage at [spie.org/PW-Travel](http://spie.org/PW-Travel) for links and resources to assist in planning the travel logistics for your visit to Photonics West in San Francisco, CA.

You will find resources for:

- Shuttles to and from the nearby airports (SFO, OAK, SJC)
- Public transportation
- Ride sharing
- Parking

### GETTING AROUND IN SAN FRANCISCO

Once you arrive in San Francisco there are many restaurants and sites to visit during your stay. These resources below will assist you in navigating this wonderful city.

**SFMTA**—San Francisco Municipal Transportation Agency runs a network of fuel-efficient Muni buses, light rail Metro trains and historic streetcars which cover all corners of the city. It's an affordable, easy way to see the all sights. Plan your route with their Trip Planner at [sfmta.com](http://sfmta.com)

**BART**—Bay Area Rapid Transit is a subway and rail line that runs throughout San Francisco and connects you cities across the bay. For Schedules and a Trip Planner visit [bart.gov](http://bart.gov)

Nearby BART Stations:

- Civic Center Station - Upper Market hotels
- Powell St. Station - Union Square, Moscone West hotels
- Montgomery St. Station - Financial District, Moscone North & South hotels
- Embarcadero Station - Lower Market hotels

**Taxi** stands are also located throughout the city. Map and directory can be found at [sfmta.com/taxi](http://sfmta.com/taxi)

### Cars & Parking

#### PARKING

Parking rates at Photonics West hotels range from \$30 (self) to \$60 (valet), rates subject to change. Please check with your individual hotel for specific parking rates.

[ParkingPanda.com](http://ParkingPanda.com) provides 100% guaranteed reserved parking spaces throughout San Francisco. To reserve a parking space around the Moscone Center, search for "Moscone Center Parking".

For more information visit [spie.org/PW-Travel](http://spie.org/PW-Travel)

#### CAR RENTAL



Hertz Car Rental is the official car rental agency for this event. To reserve a car, identify yourself as a Photonics West Conference attendee using the Hertz Meeting Code CV# 029B0025. Discount rates

apply for roundtrip rentals up to one week prior through one week after the conference dates. (Some one-way rentals qualify for the discount rates based on their pick-up and drop-off locations. Vehicles rented in Northern California can be returned to any corporate Hertz location within Northern California and vehicles rented in Southern California can be returned to any corporate Hertz location within Southern California). Note: When booking from International Hertz locations, the CV # must be entered with the letters CV before the number, i.e. **CV029B0025**.

#### BOOK HERTZ ONLINE

- In the United States call 1-800-654-2240
- In Canada call 1-800-263-0600, or 1-416-620-9620 in Toronto
- In Europe and Asia call a Hertz Reservation Center or travel agent
- Outside of these areas call 1-405-749-4434

### Paid registration includes online Proceedings

Available on the SPIE Digital Library as papers are published, usually by 3 weeks after the meeting. In the tables below, find product order numbers for use on the registration form.

- **Online Proceedings Volume**—access to a single conference proceedings volume.
- **Online Proceedings Collection**—access to multiple related proceedings volumes.

### Accessing your Proceedings

Visit <http://spiedigitallibrary.org>, sign in or create an account using the same email address you used to register. Access is also available through an organization's SPIE Digital Library account. Contact SPIE if you need assistance.

### Additional online proceedings for purchase

Available to conference attendees; add during registration or contact SPIE.

- Additional online collections: **\$175**
- Additional online volumes: **\$60**

### Print availability

Print volumes of Proceedings of SPIE can be purchased at <http://www.proceedings.com>

## Online Proceedings Collections

Conference Attendees: The price for additional online proceedings volumes is noted above. Order during registration.

Product Order Number	Volume Title/Volume Editors
DLC763	<b>Photonics West BIOS 2020: Photonic Therapeutics and Diagnostics</b> <i>Includes Volumes 11211, 11212, 11213, 11214, 11215, 11216, 11217, 11218, 11219, 11220, 11221, 11222, 11223, 11224</i>
DLC764	<b>Photonics West BIOS 2020: Clinical Technologies and Systems</b> <i>Includes Volumes 11228, 11229, 11230, 11231, 11232, 11233, 11234, 11235, 11236, 11237</i>
DLC765	<b>Photonics West BIOS 2020: Tissue Optics, Laser-Tissue Interaction, and Tissue Engineering</b> <i>Includes Volumes 11238, 11239, 11240, 11241, 11242, 11270</i>
DLC766	<b>Photonics West BIOS 2020: Biomedical Spectroscopy, Microscopy, and Imaging; and Neurophotonics, Neurosurgery, and Optogenetics</b> <i>Includes Volumes 11225, 11226, 11227, 11240, 11243, 11244, 11245, 11246, 11247, 11248, 11249, 11250, 11251, 11252, 11253</i>
DLC767	<b>Photonics West BIOS 2020: Nano/Biophotonics</b> <i>Includes Volumes 11254, 11255, 11256, 11257, 11258</i>
DLC768	<b>Photonics West LASE 2020: Laser Sources; and Nonlinear Optics and Beam Guiding</b> <i>Includes Volumes 11259, 11260, 11261, 11262, 11263, 11264, 11265, 11266</i>
DLC769	<b>Photonics West LASE 2020: Micro/Nano Applications; and Macro Applications</b> <i>Includes Volumes 11267, 11268, 11269, 11270, 11271, 11272, 11273</i>

Product Order Number	Volume Title/Volume Editors
DLC770	<b>Photonics West OPTO 2020: Optoelectric Materials and Devices</b> <i>Includes Volumes 11274, 11275, 11276, 11277, 11278, 11279, 11280, 11281, 11282</i>
DLC771	<b>Photonics West OPTO 2020: Photonic Integration</b> <i>Includes Volumes 11279, 11283, 11284, 11285, 11286, 11287</i>
DLC772	<b>Photonics West OPTO 2020: Nanotechnologies in Photonics; and MOEMS-MEMS in Photonics</b> <i>Includes Volumes 11235, 11248, 11288, 11289, 11290, 11291, 11292, 11293, 11294</i>
DLC773	<b>Photonics West OPTO 2020: Advanced Quantum and Optoelectronic Applications</b> <i>Includes Volumes 11288, 11291, 11295, 11296, 11297, 11298, 11299</i>
DLC774	<b>Photonics West OPTO 2020: Semiconductor Lasers, LEDs, and Applications</b> <i>Includes Volumes 11274, 11280, 11300, 11301, 11302</i>
DLC775	<b>Photonics West OPTO 2020: Displays and Holography</b> <i>Includes Volumes 11303, 11304, 11305, 11306</i>
DLC776	<b>Photonics West OPTO 2020: Optical Communications: Devices and Systems</b> <i>Includes Volumes 11272, 11279, 11285, 11286, 11307, 11308, 11309</i>

## Online Proceedings Volumes

Conference Attendees: The price for additional online proceedings volumes is noted above. Order during registration.

Product Order Number	Volume Title
DL 11211	<b>Photonics in Dermatology and Plastic Surgery 2020</b> , Bernard Choi, Haishan Zeng
DL 11212	<b>Therapeutics and Diagnostics in Urology 2020</b> , Hyun Wook Kang
DL 11213	<b>Imaging, Therapeutics, and Advanced Technology in Head and Neck Surgery and Otolaryngology 2020</b> , Brian J. F. Wong, Justus F. Ilgner
DL 11214	<b>Endoscopic Microscopy XV</b> , Melissa J. Suter, Guillermo J. Tearney, Thomas D. Wang
DL 11215	<b>Diagnostic and Therapeutic Applications of Light in Cardiology 2020</b> , Kenton W. Gregory, Laura Marcu
DL 11216	<b>Multiscale Imaging and Spectroscopy</b> , Kristen C. Maitland, Darren M. Roblyer, Paul J. Campagnola
DL 11217	<b>Lasers in Dentistry XXVI</b> , Peter Rechmann, Daniel Fried
DL 11218	<b>Ophthalmic Technologies XXX</b> , Fabrice Manns, Per G. Söderberg, Arthur Ho
DL 11219	<b>Visualizing and Quantifying Drug Distribution in Tissue IV</b> , Conor L. Evans, Kin Foong Chan
DL 11220	<b>Optical Methods for Tumor Treatment and Detection: Mechanisms and Techniques in Photodynamic Therapy XXIX</b> , David H. Kessel, Tayyaba Hasan
DL 11221	<b>Mechanisms of Photobiomodulation Therapy XV</b> , Michael R. Hamblin, James D. Carroll, Praveen Arany
DL 11222	<b>Molecular-Guided Surgery: Molecules, Devices, and Applications VI</b> , Summer L. Gibbs, Sylvain Gioux
DL 11223	<b>Photonic Diagnosis, Monitoring, Prevention, and Treatment of Infections and Inflammatory Diseases 2020</b> , Tianhong Dai, Mei X. Wu, Jürgen Popp
DL 11224	<b>Optics and Ionizing Radiation</b> , Brian W. Pogue
DL 11225	<b>Clinical and Translational Neurophotonics 2020</b> , Steen J. Madsen, Victor X. D. Yang, Nitish V. Thakor
DL 11226	<b>Neural Imaging and Sensing 2020</b> , Qingming Luo, Jun Ding, Ling Fu
DL 11227	<b>Optogenetics and Optical Manipulation 2020</b> , Samarendra K. Mohanty, Anna W. Roe, E. Duco Jansen
DL 11228	<b>Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XXIV</b> , Joseph A. Izatt, James G. Fujimoto
DL 11229	<b>Advanced Biomedical and Clinical Diagnostic and Surgical Guidance Systems XVIII</b> , Anita Mahadevan-Jansen
DL 11230	<b>Optics and Biophotonics in Low-Resource Settings VI</b> , David Levitz, Aydogan Ozcan
DL 11231	<b>Design and Quality for Biomedical Technologies XIII</b> , Jeeseong Hwang, Gracie Vargas
DL 11232	<b>Multimodal Biomedical Imaging XV</b> , Fred S. Azar, Xavier Intes, Qianqian Fang
DL 11233	<b>Optical Fibers and Sensors for Medical Diagnostics and Treatment Applications XX</b> , Israel Gannot
DL 11234	<b>Optical Biopsy XVIII: Toward Real-Time Spectroscopic Imaging and Diagnosis</b> , Robert R. Alfano, Stavros G. Demos, Angela B. Seddon
DL 11235	<b>Microfluidics, BioMEMS, and Medical Microsystems XVIII</b> , Bonnie L. Gray, Holger Becker
DL 11236	<b>Biomedical Vibrational Spectroscopy 2020: Advances in Research and Industry</b> , Wolfgang Petrich, Zhiwei Huang
DL 11237	<b>Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables</b> , Babak Shadgan, Amir H. Gandjbakhche
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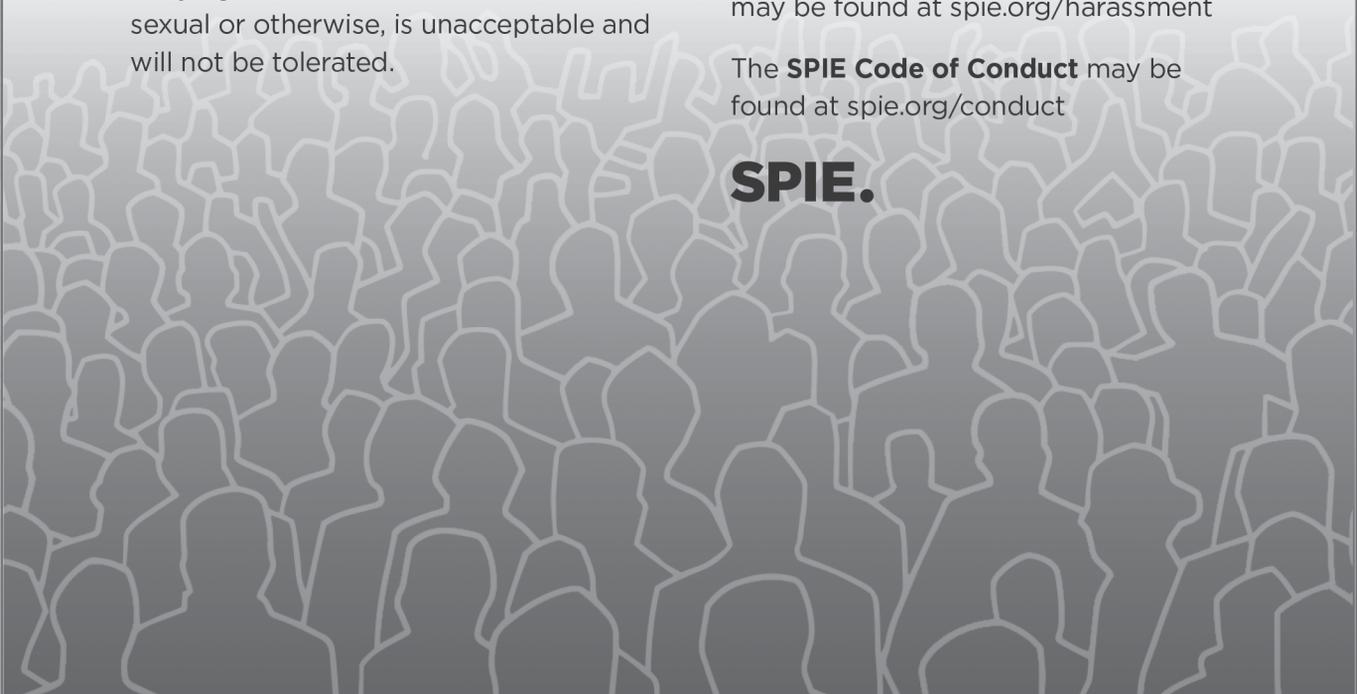
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