PHOTONICS WEST

The world’s largest photonics technologies event, consisting of three conferences and two world-class exhibitions.

BIOS  LASE  OPTO

The Moscone Center
San Francisco, California, USA

Conferences + Courses: 1–7 February 2019
Photonics West Exhibition: 5–7 February 2019
BIOS Expo: 1–2 February 2019

spie.org/pwprogram
MONDAY 10 FEBRUARY

OPTO PLENARY SESSION .......................... 8:00 AM TO 10:05 AM
Welcome and Opening Remarks, Connie J. Chang-Hasnain, Univ. of California, Berkeley (USA); Graham T. Reed, Optoelectronics Research Ctr. (United Kingdom)
Hyperscale data center applications of optoelectronics (Plenary Presentation), Katharine Schmidtke, Facebook Inc. (USA)
Two decades of progress for photonic crystals: from the realization of complete 3D crystals to the state of the art for society 5.0 (Plenary Presentation), Susumu Noda, Kyoto Univ. Graduate School of Engineering (Japan)
Deep-learning optics (Plenary Presentation), Aydogan Ozcan, University of California, Los Angeles (USA)
On pages 6-7 for details.

SESSION 1 .................. MON 10:30 AM TO 12:30 PM
Fabrication Technology
Session Chair: Graham T. Reed, Optoelectronics Research Ctr. (United Kingdom)
Bulk CMOS photonic/electronic integration (Invited Paper), Vladimir Marko Stojanovic, Univ. of California, Berkeley (USA) .... [10923-1]
Rapid device prototyping using the CORNERSTONE platform (Invited Paper), Callum G. Littlejohns, Ying Tran, Han Du, Stevan Stankovic, Xingzhao Yan, Univ. of Southampton (United Kingdom); Graham J. Sharp, Marc Sorel, Univ. of Glasgow (United Kingdom); Roger Webb, Jonathon England, Univ. of Surrey (United Kingdom); Harold Chong, Frederic Y. Gardes, David J. Thomson, Goran Z. Mashanovich, Graham T. Reed, Univ. of Southampton (United Kingdom) .... [10923-2]
Alignment-tolerant interfacing of a photonic integrated circuit using backside etched silicon microlenses, Jeroen Missinne, Ctr. for Microsystems Technology (Belgium) and Univ. Gent (Belgium) and IMEC (Belgium); Nuria Teigell Benet, Univ. Gent (Belgium) and IMEC (Belgium); Nivesh Mangal, IMEC (Belgium); Jing Zhang, Anton Vasiliev, Univ. Gent (Belgium); Joris Van Campenhout, Bradley Snyder, IMEC (Belgium); Günther Roelkens, Univ. Gent (Belgium); Geert Van Steenberge, Ctr. for Microsystems Technology (Belgium) .... [10923-3]
High-yield parallel transfer print integration of III-V substrate-illuminated C-band photodiodes on silicon photonic integrated circuits, Grigoriy Muliuk, Jing Zhang, Jeroen Goyvaerts, Sulakshna Kumari, Univ. Gent (Belgium); Brian Corbett, Tyndall National Institute (Ireland); Dries Van Thourhout, Gunther Roelkens, Univ. Gent (Belgium) .... [10923-4]
Challenges and solutions for high-speed integrated silicon photonics, Thomas Y. L. Ang, Ching Eng Png, Soon Thor Lim, Jun Rong Ong, A*STAR Institute of High Performance Computing (Singapore) .... [10923-5]
Lunch Break .................. Mon 12:30 pm to 2:00 pm

SESSION 2 .................. MON 2:00 PM TO 3:30 PM
Silicon Waveguides I
Session Chair: Jonathan D. B. Bradley, McMaster Univ. (Canada)
Engineering sub-wavelength silicon waveguides for sensing applications in the near-infrared and mid-infrared band (Invited Paper), Juan Gonzalo Wanguemert-Pérez, Alejandro Sánchez-Postigo, Abdelfettah Hadji-Elhouati, Univ. de Málaga (Spain); Jonas Leuermann, Ctr. de Nanomedicina y Biotecnología (Spain); Carlos Pérez-Armenta, Faysal El Mokhtari Mounir, Daniel Pereira-Martín, José Manuel Luque-González, Alejandro Ortega-Moflux, Robert Halir, Itigo Molina-Fernández, Univ. de Málaga (Spain); Pavel Cheben, Jens H. Schmid, Dan-Xia Xu, National Research Council Canada (Canada); Jiří Čtyroký, Institute of Photonics and Electronics (Czech Republic); Jorid Soler-Penades, Milos Nedeljkovic, Goran Z. Mashanovich, Optoelectronics Research Ctr. (United Kingdom) .... [10923-6]
Suspended low-loss germanium waveguides for the mid-infrared, Ahmed Osman, Milos Nedeljkovic, Jorid S. Penades, Yangbo Wu, Zhiho Qu, Ali Z. Khokhar, Goran Z. Mashanovich, Univ. of Southampton (United Kingdom) .... [10923-7]
Direct thermo-optical tuning of silicon photonic devices, Paul Chevalier, Harvard Univ. (USA); Lara Koeher, Harvard Univ. (USA) and Ecole Polytechnique (France); Euijae Shim, Columbia Univ. (USA); Boris Desiatov, Amirmahsan Shams-Ansari, Marco Piccardo, Marko Loncar, Harvard Univ. (USA); Michal Lipson, Alexander Gaeta, Columbia Univ. (USA); Federico Capasso, Harvard Univ. (USA) .... [10923-8]
Trimming of silicon-on-insulator devices via localised laser annealing, Vera Biryukova, Graham J. Sharp, Charalampos Kilitis, Sarah Ruddell, Marc Sorel, Univ. of Glasgow (United Kingdom) .... [10923-9]

SESSION 3 .................. MON 4:00 PM TO 6:00 PM
Amplified Silicon Photonics
Session Chair, Andrew P. Knights, McMaster Univ. (Canada)
On-chip amplifiers and lasers on the Al2O3 integrated photonics platform (Invited Paper), Sonia M. Garcia-Blanco, Carlijn I. van Emmerik, Jinfeng Mu, Michiel de Goede, Meindert Dijkstra, Lantian Chang, Univ. Twente (Netherlands) .... [10923-10]
Antimonide-based optoelectronic devices grown on Si substrates (Invited Paper), Eric Tournié, Laurent Cerutti, Jean-Baptiste Rodriguez, Jean-Philippe Perez, Philippe Christol, Roland Teissier, Alexei N. Baranov, Univ. de Montpellier (France) .... [10923-11]
Silicon waveguide integrated with a tellurium oxide whispering gallery resonator on chip, Henry C. Franks, Dawson B. Bonneville, Daniel Su, Jonathan D. B. Bradley, McMaster Univ. (Canada) .... [10923-12]
1.3μm u-bend traveling wave SOA devices for high efficiency coupling to silicon photonics, Jukka Viheriälä, Heidi Tuorila, Tampere Univ. of Technology (Finland); Matteo Cherchi, Timo Aalto, VTT Technical Research Ctr. of Finland Ltd. (Finland); Mircea Guina, Tampere Univ. of Technology (Finland) .... [10923-13]
Hydrogen passivation and microstructure fabrication in erbium silicates for optical amplification applications around 1.5 μm, Devika Vipin, Mengbing Huang, SUNY Polytechnic Institute (USA) .... [10923-14]
Integrated Optical Emission

Session Chair: Iain F. Crowe,
The Univ. of Manchester (United Kingdom)

Single-mode lasing in strained Ge microbridges (Invited Paper),
Francesco Taro Armand Pilol, Alexey Lysota, Paul Scherrer Institut (Switzerland); Vincent Reboud, CEA-LETI (France) and Univ. Grenoble Alpes (France); Vincent Calvo, Nicolas Pauc, CEA-INAC (France) and Univ. Grenoble Alpes (France); Julie Widelz, Jean-Michel Hartmann, Alexei Chehnokov, CEA-LETI (France) and Univ. Grenoble Alpes (France); Jérome Faist, Institute for Quantum Electronics, ETH Zürich (Switzerland); Hans Sigg, Paul Scherrer Institut (Switzerland).

Distributed feedback lasers integrated on Si substrates for chip-scale atomic systems, Kevin Gallacher, Ross W. Millar, Douglas J. Paul, Univ. of Glasgow (United Kingdom); Gary Ternet, Francesco Miranda, Kelvin Nanotechnology Ltd. (United Kingdom); Ian Oxtoby, Optocap Ltd. (United Kingdom); Kai Bongs, Michael Holynski, The Univ. of Birmingham (United Kingdom); Stefan O. Robbie, M Squared Lasers Ltd. (United Kingdom).

Enhanced light emission from a Si optical beam-steering device consisting of asymmetric photonic crystal waveguide, Hiroyuki Ito, Yuma Kusunoki, Daichi Akiyama, Hiroshi Abe, Yoshishiko Baba, Yokohama National Univ. (Japan).

Photonic crystal laser with an integrated modulator for optical interconnects,
Praveen Kumar J. Singaravelu, Ganga Chinna Rao Devarapu, Sharon M. Butler, Cork Institute of Technology (Ireland); Alexandros A. Liles, Univ. of St. Andrews (United Kingdom); Robert Sheehan, Liam O’Toalaion, Stephen P. Hegarty, Andrea P. Bakoz, Cork Institute of Technology (Ireland).

BGaAs alloys for III-V integration on silicon,
Christopher R. Fitch, Univ. of Surrey (United Kingdom); Peter Ludwig, NASP III/V GmbH (Germany); Wolfgang Stolz, Philips-Universität Marburg (Germany) and NASP III/V GmbH (Germany); Stephen J. Sweeney, Univ. of Surrey (United Kingdom).

Lunch/Exhibition Break

SESSION 10 ........... WED 1:50 PM TO 3:30 PM

Device Technology

Session Chair: Graham T. Reed,
Optoelectronics Research Ctr. (United Kingdom)

Generation of O-band PAM-4 signal using a silicon modulator driven by two binary sequences, Lucas Deliel, Ctr. de Nano sciences et de Photonic integrated circuits

Model and design of silicon photonics dual-coupler nested coupled cavities. Rabab A. Shalaby, Mahmoud A. Selim, George A. Adib, Ain Shams Univ. (Egypt); Yasser M. Sabry, Ain Shams Univ. (Egypt) and Si-Ware Systems (Egypt).

Silicon photonics dual-coupler nested coupled cavities

Gas sensing devices using doped silicon material at mid-infrared region, Sarah Shafaay, Mohamed A. Swillam, The American Univ. in Cairo (Egypt).

WEDNESDAY POSTER SESSION ........... 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. 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.

Two-dimensional subwavelength grating-based waveguide-to-fiber coupler, Anamika Singh, K.J. Somaiya Institute of Engineering & Information Technology (India); Ritu Raj Singh, Indian Institute of Technology (Indian School of Mines), Dhanbad (India).

Concatenated silicon etalon tunable filter for hyperspectral imaging in the near infrared, Hadar Pinhas, Amir Shemer, Omer Wagner, Yossi Danan, Yafit Fieger, Yonathan Ramon, Meir Danino, Moshe Sirivani, Zeev Zalevsky, Bar-Ilan Univ. (Israel).

Nested silicon-on-insulator Vernier effect microring resonators, Mustafa Hammoud, Ayaj Mistry, Lukas Christoskowi, Nicolas A. F. Jaeger, The Univ. of British Columbia (Canada).

Compound period grating coupler for double beam generation and steering, Dachuan Wu, Wei Guo, Yasha Yi, Univ. of Michigan (USA).

Optimization of silicon on waveguides for mid-infrared applications at 4.28 μm, Mina Labib, Diaa Khalil, Michael Gad, Yasser M. Sabry, Ain Shams Univ. (Egypt).

A novel 350nm CMOS optical receiver based on current assistance, Sven Boulanger, Maarten Kuijl, Vrije Univ. Brussel (Belgium).

Low-loss coupling interfaces between InP-based emitters and SiN$_4$-based photonic integrated circuits, Dimitrios Chatzitheocharis, Dimitria Ketzaki, George Dabos, Konstantinos Vyrskinos, Ctr. for Interdisciplinary Research and Innovation, Aristotle Univ. of Thessaloniki (Greece).

Novel silicon-on-insulator Michelson interferometer for optical filtering and wavelength demultiplexing applications, Abdelrahman E. Aflfi, The Univ. of British Columbia (Canada); Raghi Samir El Shamy, Mohamed Badr, Mohamed El-Rayany, Mohamed A. Swillam, The American Univ. in Cairo (Egypt).

Electro-optical modulation using silicon-on-insulator Michelson interferometer with electro-optical polymer, Aya A. Osama, Raghi Samir El Shamy, The American Univ. in Cairo (Egypt); Abdelrahman E. Aflfi, The Univ. of British Columbia (Canada); Mohamed A. Swillam, The American Univ. in Cairo (Egypt).

Optical logical gate using slot waveguide, Mostafa Abdalsalam, Mohamed A. Swillam, The American Univ. in Cairo (Egypt).

A compact silicon-on-insulator gas sensor, Mohamed El-Rayany, Raghi Samir El Shamy, Mohamed A. Swillam, The American Univ. in Cairo (Egypt).

Dynamic tuning of silicon-based nanoantennas, Hosamedin I. Mekawy, Yehea Ismail, Mohamed A. Swillam, The American Univ. in Cairo (Egypt).

Silicon photonics dual-coupler nested coupled cavities

Gas sensing devices using doped silicon material at mid-infrared region, Sarah Shafaay, Mohamed A. Swillam, The American Univ. in Cairo (Egypt).

MODULATION linearity analysis of depletion-type Si ring modulator, Young Kwan Jo, Byung-Min Yu, Yonsei Univ. (Korea, Republic of).

Gas sensing devices using doped silicon material at mid-infrared region, Sarah Shafaay, Mohamed A. Swillam, The American Univ. in Cairo (Egypt).
The depletion-type Si ring modulator (RM) is of great interest among many Si photonic devices for optical interconnect applications because it has a small size, low power consumption, and large modulation bandwidth. Although the major application of the Si RM are digital optical interconnect systems, there is another application of importance, namely microwave photonics in which the modulation linearity is a key performance parameter. We investigate the modulation linearity performance in terms of spurious-free dynamic range (SFDR) of a RM device fabricated by IHP Si PIC foundry. The device has 8-um radius, 290-nm coupling gap and the nominal peak doping concentration of $7 \times 10^{17}$ cm$^{-3}$ for p-region and $3 \times 10^{18}$ cm$^{-3}$ for n-region. The measured SFDR is 78.7 dB-Hz$^{2/3}$. The major sources of non-linearity of this device are the nonlinear free-carrier plasma dispersion effect in PN junction as well as the nonlinear resonance characteristics. We also perform the numerical simulation of RM SFDR using key device parameters extracted from measurement. The simulation results match well with the measurement results. With this numerical model, we are able to identify the exact cause of RM nonlinearity and come up with suggestions for improving RM linearity.

**Keywords:** Si ring modulator, modulation linearity, SFDR