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# ***Optoelectronic Integrated Circuits XI***

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**El-Hang Lee**

*Editors*

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# Contents

vii	<i>Conference Committee</i>
ix	<i>Introduction</i>

---

## SESSION 1 OPTICAL INTERCONNECTS I

---

- 7219 02 **Optical proximity communication (Invited Paper)** [7219-01]  
I. Shubin, J. E. Cunningham, X. Zheng, J. Simons, Sun Microsystems, Inc. (United States);  
D. Feng, H. Liang, C.-C. Kung, M. Asghari, Kotura Inc. (United States); A. V. Krishnamoorthy,  
Sun Microsystems, Inc. (United States)
- 7219 03 **Chirped waveguide gratings for low-cost silicon photonic wire packaging and other applications (Invited Paper)** [7219-02]  
C. Li, X. Chen, The Chinese Univ. of Hong Kong (Hong Kong, China); Z. Sheng, Zhejiang Univ. (China); H. K. Tsang, The Chinese Univ. of Hong Kong (Hong Kong, China)

---

## SESSION 2 OPTICAL INTERCONNECTS II

---

- 7219 04 **Optical interconnects for board level applications (Invited Paper)** [7219-03]  
R. Dangel, R. Beyeler, N. Meier, T. Lamprecht, F. Horst, D. Jubin, J. Weiss, B. J. Offrein, IBM Research GmbH (Switzerland)
- 7219 05 **Polymer multimode waveguide optical and electronic PCB manufacturing (Invited Paper)** [7219-04]  
D. R. Selviah, Univ. College London (United Kingdom)

---

## SESSION 3 OEIC RESONATORS

---

- 7219 06 **Advanced coupled-micro-resonator architectures for dispersion and spectral engineering applications (Invited Paper)** [7219-05]  
V. Van, Univ. of Alberta (Canada)
- 7219 07 **Polysilane optical waveguide devices using photo-bleaching effect (Invited Paper)** [7219-06]  
S. Kobayashi, Chitose Institute of Science and Technology (Japan); T. Suda, Photonic Science Technology, Inc. (Japan); T. Ishiguro, D. Motoyoshi, Y. Yamabayashi, Chitose Institute of Science and Technology (Japan)
- 7219 09 **Tunable laser oscillation with optical switches and grating on polysilane optical waveguides** [7219-09]  
D. Motoyoshi, S. Oki, Chitose Institute of Science and Technology (Japan); T. Suda, Photonic Science Technology, Inc. (Japan); Y. Yamabayashi, S. Kobayashi, Chitose Institute of Science and Technology (Japan)

---

**SESSION 4 TRENDS IN PICs, OEICs, AND PVICs**

---

- 7219 0A **Optonomechanical self-adaptive photonic devices based on light forces: a path to robust high-index-contrast nanophotonic circuits (Invited Paper)** [7219-10]  
M. A. Popović, Massachusetts Institute of Technology (United States); P. T. Rakich, Sandia National Labs. (United States)
- 7219 0C **CIGS photovoltaic integrated circuits from solution-deposited precursors (Invited Paper)** [7219-12]  
L. Eldada, HelioVolt Corp. (United States)

---

**SESSION 5 PHOTONIC CRYSTALS AND METAMATERIALS**

---

- 7219 0E **High speed OEIC with offset drift compensation for bluray disc system** [7219-33]  
J. Y. Ko, Samsung Electro-Mechanics (Korea, Republic of); K. Baek, Chungang Univ. (Korea, Republic of); S. Kim, Korea Univ. (Korea, Republic of)
- 7219 0G **Ultra-small photonic crystal zero-cell laser cavities** [7219-15]  
H.-S. Ee, H.-G. Park, Korea Univ. (Korea, Republic of)

---

**SESSION 6 ALL-OPTICAL OEICs**

---

- 7219 0H **All-optical switches and bistable devices using high-Q photonic crystal nanocavities (Invited Paper)** [7219-16]  
T. Tanabe, A. Shinya, E. Kuramochi, H. Taniyama, M. Notomi, NTT Corp. (Japan)
- 7219 0I **Advanced photonic integrated technologies for optical routing and switching (Invited Paper)** [7219-17]  
M. L. Mašanović, E. Burmeister, M. M. Dummer, B. Koch, S. C. Nicholes, B. Jevremović, K. Nguyen, V. Lal, J. E. Bowers, L. A. Coldren, D. J. Blumenthal, Univ. of California, Santa Barbara (United States)
- 7219 0K **Monolithically integrated 4×4 SOA switch fabricated using quantum well intermixing** [7219-19]  
R. Millett, K. Hinzer, T. Hall, Univ. of Ottawa (Canada); M. Poirier, Santur Corp. (Canada); H. Schriemer, Univ. of Ottawa (Canada)

---

**SESSION 7 SENSING OEICs**

---

- 7219 0M **Optoelectronic integration of silicon photonic wire biosensors (Invited Paper)** [7219-21]  
A. Densmore, S. Janz, D.-X. Xu, M. Vachon, P. Waldron, J. H. Schmid, J. Lapointe, T. Mischki, G. Lopinski, A. Delâge, P. Cheben, R. Ma, National Research Council Canada (Canada)
- 7219 0N **Improved sensitivity of portable bio-sensor systems using lock-in detection method** [7219-22]  
H.-H. Son, I.-I. Jung, Chung-Ang Univ. (Korea, Republic of); D. G. Kim, Korea Photonics Technology Institute (Korea, Republic of); D.-G. Kim, Y.-W. Choi, Chung-Ang Univ. (Korea, Republic of)

- 7219 0O **Flow sensor based on monolithic integration of organic light-emitting diodes (OLEDs) and CMOS circuits** [7219-23]  
S. Reckziegel, D. Kreye, T. Puegner, U. Vogel, M. Scholles, C. Grillberger, K. Fehse, Fraunhofer Institute for Photonic Microsystems (Germany)

---

**POSTER SESSION**

---

- 7219 0Q **Design of compact silicon optical modulator using photonic crystal MZI structure** [7219-25]  
T. Y. Han, H.-S. Lee, S.-G. Park, B.-H. O, S.-G. Lee, E.-H. Lee, Inha Univ. (Korea, Republic of)
- 7219 0R **Characterization and optimization of residual layer thickness during UV imprint process for singlemode waveguide fabrication** [7219-26]  
S. An, H.-S. Lee, S.-G. Park, B.-H. O, S.-G. Lee, E.-H. Lee, Inha Univ. (Korea, Republic of)
- 7219 0S **Triple wavelength OEIC with improved optical responsivity** [7219-27]  
D. H. Park, Sungkyunkwan Univ. (Korea, Republic of); C. D. Go, H. W. Jeong, K. S. Kwon, SAMSUNG Electro-Mechanics Co., Ltd. (Korea, Republic of); B.-S. Kim, Sungkyunkwan Univ. (Korea, Republic of)
- 7219 0U **An ultra-low-power ambient light sensor for portable devices** [7219-29]  
S.-I. Cho, Y.-J. Kim, Korea Univ. (Korea, Republic of); J.-H. Lee, The Univ. of Texas at Austin (United States); K.-H. Baek, Chung-Ang Univ. (Korea, Republic of); S. Kim, Korea Univ. (Korea, Republic of)
- 7219 0X **Design and fabrication of mode size adapter using hybrid imprint lithography** [7219-32]  
S.-H. Sim, H.-H. Kim, S.-K. Yang, H.-J. Park, S.-J. Kim, B.-H. O, S.-G. Lee, E.-H. Lee, S.-G. Park, Inha Univ. (Korea, Republic of)

*Author Index*



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- 1 Optical Interconnects I  
**Alexei L. Glebov**, OptiGrate Corporation (United States)
- 2 Optical Interconnects II  
**El-Hang Lee**, Inha University (Korea, Republic of)
- 3 OEIC Resonators  
**Wenhua Lin**, Enablence, Inc. (United States)

- 4 Trends in PICs, OEICs, and PVICs  
**El-Hang Lee**, Inha University (Korea, Republic of)
- 5 Photonic Crystals and Metamaterials  
**Louay A. Eldada**, HelioVolt Corporation (United States)
- 6 All-Optical OEICs  
**Louay A. Eldada**, HelioVolt Corporation (United States)
- 7 Sensing OEICs  
**El-Hang Lee**, Inha University (Korea, Republic of)

## Introduction

This volume features contributions from scientists and engineers in the general area of optoelectronic integrated circuits (OEIC). The joint session between the OEIC conference and the Photonics Packaging, Integration, and Interconnects conference this year resulted in valuable contributions in the areas of board-level, chip-to-board, and intra-chip interconnects.

Optical, electronic, and biological devices are integrated to address the issues of cost, space, performance, and reliability. Demands for greater bandwidths have driven the telecom and datacom research communities to realize complex OEICs such as transceivers, low chirp optical sources, switching systems, and multi-channel optical distribution systems. The integration of multi-wavelength laser arrays, monitoring photodiodes, and drivers is becoming a reality in the communications arena. Other emerging OEIC application areas include all-optical packet switching, neural systems, optical computing, optical storage, smart pixel arrays, projection displays, imaging, scanning, printing, medical diagnosis, and chemical/biological sensing. In keeping with the latest global economic demands for the use of integration to achieve low cost solutions in critical areas, we cover in this volume the emerging field of photovoltaic integrated circuits (PVIC) that are used in solar modules to address the need for renewable energy that is cost competitive with fossil-fuel-generated energy.

The increased level of integration in recent years has resulted in an increased level of miniaturization. The scientific and technological issues and challenges concerning the micro/nano/quantum-scale integration of optoelectronic devices, circuits, components, modules, subsystems and systems include the size effect, proximity effect, energy confinement effect, microcavity effect, single photon effect, optical interference effect, high field effect, nonlinear effect, noise effect, quantum optical effect, and chaotic noise effects. Optical alignment between miniature devices, minimizing interconnection and coupling losses, and maintaining the stability of optical interfaces, are some of the important issues that are receiving careful consideration.

Papers in these proceedings include discussions of the physics, theory, design, modeling, simulation, and scaling of a wide range of OEICs with regard to their optical, electrical, thermal, and mechanical properties; the integration of different optoelectronic structure types including dots, wells, planar, free space, one-dimensional, two-dimensional and three-dimensional photonics crystals; the integration of different functions including lasers, amplifiers, detectors, sensors, solar cells, modulators, isolators, circulators, electrically actuated/all-optical switches, attenuators, couplers, multi/demultiplexers, filters, wavelength converters, polarization controllers, chromatic/polarization mode dispersion compensators, intra-chip/chip-to-board/board-level optical interconnects, and

control electronics; the fabrication, processing, and manufacturing techniques (UV/deep UV/x-ray/e-beam lithography, casting, molding, embossing, etching, passivation, etc.) as well as the packaging, assembly, reliability and qualification of monolithic and hybrid OEICs in a variety of materials (semiconductors, silica, polymers, ferroelectrics, magnetics, metals, biomaterials, etc.). Some papers describe the refinement of existing schemes and processes, while others introduce novel concepts and new designs. Papers from academic and research institutions push the state of the art in miniaturization, level of integration, and performance figures of merit, and papers from the industry emphasize design criteria and manufacturing methods that result in practical OEICs that can be deployed commercially today or in the near future.

Although this volume cannot include all the recent important work in the vast field of OEICs, it does cover a significant cross-section of the advances happening globally in areas where OEICs are making an impact, and it provides a roadmap to the future of OEICs by presenting the cutting-edge work and the visions of leading experts who are actively inventing the future.

**Louay A. Eldada**  
**El-Hang Lee**