Advance Program

Monday, 11 August 2008

ALL SESSIONS TO BE HELD IN RUNDER SAAL

08.15 - 10.00
Session M1: NANO PARTICLES & NANOWIRES
Session Chair: Hans Zappe, *University of Freiburg, Freiburg, Germany*

08.15 - 08.30 **Introduction and Welcome**

M1.1 08.30 - 09.00 (Plenary)

Advances in Quantum Dots and 2D/3D Photonic Crystal Nanocavity based on Micro-Machining Technology, Y. Arakawa*, University of Tokyo, Tokyo, Japan*

BIO: Yasuhiko Arakawa received B.S., M.S., and PhD degrees in the electrical engineering form the University of Tokyo, in 1975, 1977, 1980, respectively. In 1980, he started his academic carrier by joining the University of Tokyo as an assistant professor and was promoted to a full professor in 1993. He is now Professor of Research Center for Advanced Science and technology, the University of Tokyo. He is also the Director, Institute for Nano Quantum Information Electronics, The University of Tokyo. He is a Fellow member of IEEE.

His main achievement includes proposal of the concept of quantum dots and quantum do lasers (82), pioneering theoretical work on quantum effects on lasing dynamics in semiconductor lasers (84), discovery of exciton-polariton Rabi-vacuum oscillation in semiconductor nanocavity (92), discovery of continuum in density of states in quantum dots by PLE (92), the achievement of high temperature stability in high speed quantum dot lasers (04) , the first demonstration of single photon sources at telecommunication wavelength(04) and the highest operation temperature of 200K achieved in all-solid single photon sources by using GaN quantum dots (06).

He is the recipient of many awards including IEEE William Streifer Award, Leo Esaki Prize, Fujiwara Prize, IBM Science Award, ISCS Quantum Device Award and The Wall Street Journal Technology Award 2006. He is authors of more than 400 papers in scientific journals and invited speakers at more than 200 international conferences.

ABSTRACT: We discuss recent advances in quantum dots for nanophotonics and quantum information devices, including high-performance quantum dot lasers and single photon emitters. Moreover, controlled light emission from quantum dots embedded in 2D/3D photonic crystal nanocavity is demonstrated.

M1.2 09.00 - 09.15

Spectral Reflectance Measurement of Two–Dimensional Photonic Nanocavities with Embedded Quantum Dots, W. C. Stumpf, T. Asano, T. Kojima, M. Fujita, Y. Tanaka and S. Noda*, Kyoto University, Kyoto, Japan*

The resonant wavelength spectra of photonic crystal nanocavities containing quantum dots measured by reflectivity are consistent with photoluminescence. The reflectance method provides Q-value estimation of both active and passive nanocavities in good agreement with theory.

M1.3 09.15 - 09.30

Synthesis and Characterization of ZnO Nanorod Arrays and Their Integration into Polymer Solar Cells, J.-S. Huang, C.-Y. Chou, C.-Y. Lee and C.-F. Lin*, National Taiwan University, Taipei, Taiwan, R.O.C.*

ZnO nanorod arrays (ZNAs), grown from aqueous solutions, were integrated into polymer solar cells. Morphological, crystalline and optical properties of ZNAs were studied. Infiltration-improved polymer/ZNAs solar cells by adding fullerene were assembled and characterized.

M1.4 09.30 - 09.45

Parallel Assembly of Nanowires Using Lateral-Field Optoelectronic Tweezers, A. T. Ohta, S. L. Neale, H.-Y. Hsu, J. K. Valley and M. C. Wu*, University of California - Berkeley, Berkeley, CA, USA*

We report on the parallel manipulation and assembly of nanowires using paired virtual optical tips projected on lateral-field optoelectronic tweezers. Precise position and angular control has been demonstrated on four 80-nm-diameter silver nanowires.

M1.5 09.45 - 10.00

Sub-30nm Alignment Accuracy between Layered Photonic Nanostructures using Optimized Nanomagnet Arrays, A. J. Nichol and G. Barbastathis*, Massachusetts Institute of Technology, Cambridge, MA, USA*

We present a method to align nanopatterned film membranes by using the attractive force between arrays of nanomagnets. Experimental results show layers of nanophotonic features magnetically self-aligned to better than 30nm accuracy.

10.00 - 10.30 **COFFEE BREAK**

10.30 - 12.00

Session M2: MICROFLUIDICS AND BIOSENSORS
Session Chair: Lih Y. Lin, *University of Washington, Seattle, WA, USA*

M2.1 10.30 - 11.00 (Invited)

How Can We use Nanophotonics to Help in Combating Climate Change? H. V. Demir, *Bilkent University, Bilkent, Ankara, Turkey*

As emerging technologies enabled by nanophotonics to combat climate change, we present our new hybrid nanophotonic devices and systems that incorporate combinations of nanostructures in hybrid architectures including white LEDs, photovoltaic scintillators, and photocatalytic nanocomposites.

M2.2 11.00 - 11.15

Low-Power Consumption Integrated Laser Doppler Blood Flowmeter with a Built-in Silicon Microlens, Y. Kimura, A. Onoe, *Pioneer Corporation, Tsurugashima, Saitama, Japan*, E. Higurashi, *University of Tokyo, Tokyo, Japan* and R. Sawada, *Kyushu University, Fukuoka, Japan*

We propose a new structure for the integrated laser Doppler blood flowmeter. This structure has a reduced rate of optical power loss in the sensor, resulting in significantly low power consumption.

M2.3 11.15 - 11.30

Reconfigurable Liquid Micro-Lens System for Variable Fiber Coupling, R. P. Shaik, W. Moench, H. Krause and H. Zappe, *University of Freiburg, Freiburg, Germany*

A system capable of both two-dimensional lateral positioning and focusing of a liquid micro-lens for variable fiber coupling is presented. Lateral positioning and focus adjustment is accomplished by electrowetting-on-dielectrics. Measurements of optical-power coupled to the fiber as a function of the applied voltage are presented.

M2.4 11.30 - 11.45

High Resolution Integrated Microfluidic Fabry-Perot Refractometer in Silicon, R. St-Gelais, J. Masson, and Y.-A. Peter, *École Polytechnique de Montréal, Montréal, QC, Canada*

We present a high resolution, robust and low cost bulk refractive index sensor integrated with a silicon microfluidic system. A sensitivity of 920nm/RIU (Refractive Index Units) and a high resolution of less than 10^{-3} are obtained and are in good agreement with optical simulations.

M2.5 11.45 - 12.00

Pulsed Laser Triggered High Speed Microfluidic Switch, T.-H. Wu, *University of California - Los Angeles, Los Angeles, CA, USA*, L. Gao, *Zhejiang University, Hangzhou, China*, K. Wei and P.-Y. Chiou, *University of California - Los Angeles, Los Angeles, CA, USA*

We report a high speed microfluidic switch capable of achieving a switching time of 70 μsec. The switching mechanism is realized by exciting dynamic vapor bubbles with focused laser pulses in a microfluidic PDMS channel.

12.00 - 14.00 LUNCH BREAK

14.00 - 15.30

Session M3: WAVEGUIDE DEVICES
Session Chair: Hon K. Tsang, *Chinese University of Hong Kong, Shatin, NT, Hong Kong*

M3.1 14.00 - 14.30 (Invited)

Optical Interconnects & Nanophotonics, B.-J. Offrein, *IBM Research, Rueschlikon, Switzerland*

Optical interconnect technology will play an increasingly important role in servers and supercomputers. High density and low-cost optical packaging concepts are required. We review optical interconnects for board-level and chip-level communication.

M3.2 14.30 - 14.45

Silicon Microring Resonator Connected with Submicorn Comb Actuator, K. Hane, *Tohoku University, Sendai, Miyagi, Japan*

A 500nm wide 260nm thick 63.4μm long silicon microring waveguide was suspended in air by connecting to a comb actuator. The airgap between the microring and the input/output waveguides was adjusted. Transmittance from the input to the drop waveguides was varied from 0% to 50%.

M3.3 14.45 - 15.00

Four Port Nanophotonic Couplers for Dense, Planar Integrated Optics, D. L. MacFarlane, M. Peshave, W. Zhou, N. Sultana, *University of Texas at Dallas, Richardson, TX, USA*, M. P. Christensen, N. R. Huntoon and G. A. Evans, *Southern Methodist University, Dallas, TX, USA*

Four port (4x4) couplers will be useful components for dense, planar photonic integration. A compact, high efficiency implementation based on evanescent coupling across a nanoscale gap is discussed.

M3.4 15.00 - 15.15

A Novel Etching-Oxidation Fabrication Method for 3D Nano Structures on Silicon and Its Application to SOI Symmetric Waveguide and 3D Taper Spot Size Converter, L.-H. Li, A. Higo, M. Kubota, M. Sugiyama, and Y. Nakano, *University of Tokyo, Tokyo, Japan*

A novel etching and oxidation method utilizing space effect of dry etching for three dimensional silicon structure is presented. SOI symmetric waveguide with thick SiO_2 cladding and 3D taper spot size converter are fabricated.

M3.5 15.15 - 15.30

Coupled-Ring Reflector Laser Diodes Composed of Squared Ring Waveguides, S. Kim, Y. Chung, *Kwangwoon University, Seoul, Korea*, D. G. Kim, *Chung-Ang University, Seoul, Korea*, Y. T. Byun, *Korea Institute of Science and Technology, Seoul, Korea* and N. Dagli, *University of California - Santa Barbara, Santa Barbara, CA, USA*

Coupled-ring reflector laser diodes composed of squared ring waveguides are fabricated and it is demonstrated that the laser diodes exhibit single mode operation and 15 nm tuning range with SMSR exceeding 25 dB.

16.00 - 16.30 COFFEE BREAK

16.00 - 17.30
Session M4: LIGHT SOURCES AND DISPLAYS
Session Chair: Joseph J. Talghader, *University of Minnesota, Minneapolis, MN, USA*

M4.1 16.00 - 16.30 (Invited)

MEMS-based Pico Projector Display, W. O. Davis, R. Sprague and J. Miller, *Microvision Inc., Redmond, WA, USA*

A Pico-projector display engine using a MEMS scanning mirror and laser light sources has a combination of features and performance characteristics that make it suitable for integration into portable electronics.

M4.2 16.30 - 16.45

High-Efficiency MEMS Tuneable Gratings for External Cavity Lasers and Microspectrometers, R. Lockhart, M. Tormen, P. Niedermann, T. Overstolz, A. Hoogerwerf, and R.P. Stanley, *Centre Suisse d'Electronique et de Microtechnique, Neuchâtel, Switzerland*

Optical characterization of a second generation MEMS tuneable blazed grating with a 1x1mm active area has demonstrated high-efficiency wavelength filtering with reflected outputs >90% and tuning over 25nm in the near-infrared (NIR).

M4.3 16.45 - 17.00

Optical Wavelength Selection and Amplification by Silica Microcavities and Erbium Doped Fiber, S. Bergeron, S. Saidi, and Y.-A. Peter, *École Polytechnique de Montréal, Montréal, QC, Canada*

Circular silica micro disk resonators can be coupled to erbium doped fiber to create a desired emission spectrum. This approach could lead to very compact multiple wavelength lasers. We demonstrate here a selective erbium emission at a single wavelength using a silica microcavity.

M4.4 17.00 - 17.15

Micropatterned Complex Optical Surface for Wide Angle Illumination, S.-K. Chae, H. Jung, and K.-H. Jeong, *Korea Advanced Institute of Science and Technology, Daejeon, Korea*

A direct-type LED based Back-Light-Unit (BLU) in LCD displays requires wide angle illumination with high uniformity. As a single lens surface, a micropatterned complex optical surface can provide wide angle LED illumination angle over 150° by designing the micropattern arrays on the hemispherical surface.

M4.5 17.15 - 17.30

Large Linear Micromirror Array for UV Femtosecond Laser Pulse Shaping, S. Waldis, *University of Neuchatel, Neuchatel, Switzerland*, S. M. Weber, *University of Geneva, Geneva, Switzerland*, W. Noell, *University of Neuchatel, Neuchatel, Switzerland*, J. Extermann, D. Kiselev, L. Bonacina, J.-P. Wolf, *University of Geneva, Geneva, Switzerland* and N. F. de Rooij, *University of Neuchatel, Neuchatel, Switzerland*

We present a micromirror device for femtosecond laser pulse shaping. It utilizes vertical comb drives and is capable of binary amplitude and continuous phase modulation and will be used for investigating biomolecules in the UV.

19.00 - 20.30 WELCOME RECEPTION - HISTORISCHE KAUFHAUS

Tuesday, 12 August 2008

08.30 - 10.00

Session Tu1: BIOMEDICAL MICROSYSTEMS
Session Chair: Yves-Alain Peter, *École Polytechnique de Montréal, Montréal, QC, Canada*

Tu1.1 08.30 - 09.00 (Plenary)

Cooling and Amplifying Micro-Mechanical Motion with Light, K. J. Vahala, *California Institute of Technology, Pasadena, CA, USA*

BIO: Kerry Vahala is Ted and Ginger Jenkins Professor of Information Science and Technology and Professor of Applied Physics at Caltech. He also received his Ph. D. (85) in Applied Physics at Caltech. His research on micro-resonators has led to wafer-based devices operating in the Q regime above 100 million and has also provided low-loss methods for coupling directly to optical fiber. These devices have enabled micro-scale Raman and Parametric sources as well as cavity QED on-a-chip systems. His current research is focused on a range of opto-mechanical phenomena associated with radiation pressure in microresonators. Vahala is a Fellow of the Optical Society of America, was the first recipient of the Richard P. Feynman Hughes Fellowship, and is also a recipient of an Alexander Von Humboldt Research Award. He received both the Presidential Young Investigator and Office of Naval Research Young Investigator Awards; and has been a topical editor for the Journal of the Optical Society of America and Photonics Technology Letters. He was also program co-chair for CLEO 99 and General Chair for CLEO 2001.

ABSTRACT: The physics of cooling and amplifying mechanical motion using optical forces is reviewed. Optomechanical oscillation to microwave rates will be described, as well as progress towards optomechanical cooling to the quantum ground state. Possible future directions of this emerging subject of cavity optomechanics are discussed.

Tu1.2 09.00 - 09.15

MEMS based Dual-Axes Confocal Clinical Endoscope for Real Time *in vivo* Imaging, W. Piyawattanametha, M. J. Mandella, H. Ra, J. T. C. Liu, E. Garai, G. S. Kino, O. Solgaard and C. H. Contag, *Stanford University, Stanford, CA, USA*

We demonstrate a MEMS scanner based dual-axes confocal endoscope in a 5.5 mm diameter package for clinical use. The microscope achieves full-width-half-maximum transverse and axial resolutions of 5 μm and 7 μm, respectively. The maximum imaging rate is 10 frames/second.

Tu1.3 09.15 - 09.30

Tunable Multi-Micro-Lens System for High Lateral Resolution Endoscopic Optical Coherence Tomography, K. Aljasem, A. Seifert and H. Zappe, *University of Freiburg, Freiburg, Germany*

An enhanced design and optical characterization of a tunable lens-system for an endoscopic probe was achieved. An improvement of the optical design giving 15μm transversal resolution along 9mm tuning range enables high resolution OCT.

Tu1.4 09.30 - 09.45

Resonant Cantilever Bio Sensor with Integrated Grating Readout, H. I. Ocakli, A. Öztürk, N. Özber, H. Kavakli, E. Alaca and H. Urey, *Koc University, Istanbul, Turkey*

Microcantilever based biosensor is fabricated and tested. The main features are the simple single mask fabrication, grating based sensitive optical readout, magnetic thin-film actuation, and suitability for parallel array operation. Sub-picogram mass detection sensitivity demonstrated.

Tu1.5 09.45 - 10.00

Design and Fabrication of Parylene-Hinged Slow-Scan Optical Scanner for OCT Endoscope Application, M. Nakada, K. Takahashi, A. Higo, H. Fujita and H. Toshiyoshi, *University of Tokyo, Tokyo, Japan*

We report a new design and fabrication of parylene-hinged electrostatic optical scanner made by the SOI-MEMS process technology. Parylene is a CVD-processed organic material of small elastic constant, and it was found to be suitable to make a low-voltage MEMS scanner of low resonant frequency.

10.00 - 10.30 COFFEE BREAK

10.30 - 12.00

Session Tu2: PERIODIC-STRUCTURE DEVICES
Session Chair: Olav Solgaard, *Stanford University, Stanford, CA, USA*

Tu2.1 10.30 - 11.00 (Invited)

Photonic Crystal Biosensors and Tunable Resonant Optical Devices, B. T. Cunningham, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*

Narrow bandwidth resonances produced by replica-molded photonic crystal slabs are manipulated and tuned by adsorption of biomolecules, attachment of cells, application mechanical stress, and electro-optical modulation of refractive index.

Tu2.2 11.00 - 11.30 (Invited)

Ultrahigh Sensitivity Slot-Waveguide Biosensor on a Highly Integrated Chip for Simultaneous Diagnosis of Multiple Diseases, D. Hill, B. Sanchez, A. Griol, *Universidad Politécnica de Valencia, Valencia, Spain*, L. Vivien, D. Marris-Morini, E. Cassan, *Institut d'Electronique Fondamentale, Orsay, France*, A. Kazmierczak, F. Dortu, D. Giannone, *Multitel a.s.b.l, Mons, Belgium*, K. Gylfason, H. Sohlström, *Royal Institute of Technology, Stockholm, Sweden*, M. J. Bañuls, V. González-Pedro, A. Maquieira, *Universidad Politécnica de Valencia, Valencia, Spain*, C. Angulo Barrios, M. Holgado and R. Casquel, *Universidad Politécnica de Madrid, Madrid, Spain*

Here we review some recent photonic related developments from the FP6-IST-SABIO project (026554) such as a demonstration of label-free optical biosensing with slot-waveguides and tolerance analysis of high efficiency silicon nitride surface grating couplers.

Tu2.3 11.30 - 11.45

Nanostructured Effective-Index Micro-Optical Devices based on Blazed 2-D Sub-Wavelength Gratings with Uniform Features on a Variable-Pitch, D. L. Dickensheets, *Montana State University, Bozeman, MT, USA*, H.-P. Herzig, *University of Neuchatel, Neuchatel, Switzerland*, W. Nakagawa, *Montana State University, Bozeman, MT, USA*, K. Suter, *University of Neuchatel, Neuchatel, Switzerland* and U. Staufer, *Delft University of Technology, Delft, The Netherlands*

Sub-wavelength two-dimensional gratings are formed by etching holes into silicon using DRIE followed by thermal oxidation. Smoothly graded effective index blazing is possible using uniform holes on a variable grating pitch, exhibiting minimal etch lag.

Tu2.4 11.45 - 12.00

Characterization of Silicon-on-Insulator Waveguide Chirped Grating for Coupling to a Vertical Optical Fiber, X. Chen, C. Li, and H. K. Tsang, *Chinese University of Hong Kong, Shatin, NT, Hong Kong*

We compare experimentally the performance of a linearly chirped waveguide grating with a uniform grating for coupling light to a vertical fiber. The measurements show the chirped grating reduces reflection and coupling loss by 2dB.

12.00 - 14.00 LUNCH BREAK

14.00 - 15.30
Session Tu3: MICROFABRICATION
Session Chair: J. Andrew Yeh, *National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

Tu3.1 14.00 - 14.30 (Invited)

Microspectrometer: From Ideas to Product, H.-P. Herzig, T. Scharf and O. Manzardo, *University of Neuchatel, Neuchatel, Switzerland*

Spectroscopy with miniaturized systems is one of the fastest developing fields and enters now industrial applications. We will discuss near infrared sensing systems based on MEMS spectrometers starting from concepts, explain prototypes and show final product.

Tu3.2 14.30 - 14.45

Fabrication of Aberration-Corrected Tunable Micro-Lenses, D. Mader, A. Seifert and H. Zappe, *University of Freiburg, Freiburg, Germany*

A novel fabrication method for tunable liquid-filled pneumatic multi-chamber lens systems for correcting chromatic and spherical aberrations is presented. A three-chamber lens system will demonstrate the potential of the process.

Tu3.3 14.45 - 15.00

Three-Dimensional Integration of Optical Multi-Chips using Surface-Activated Bonding for High-Density Microsystems Packaging, E. Higurashi, D. Chino, T. Suga, *University of Tokyo, Tokyo, Japan* and R. Sawada, *Kyushu University, Fukuoka, Japan*

Three-dimensional integration of optical multi-chips was successfully performed using Au-Au surface-activated bonding (bonding temperature: 150 °C). The size of the fully integrated microsystems is 2.6 mm × 2.6 mm × 1 mm thick. The design and fabrication process allows chip-scale and wafer-level packaging.

Tu3.4 15.00 - 15.15

Pulsed Thermal Excitation of Luminescent Microparticles for Radiation Dosimetry, M. Manfred, N. Gabriel, M. Mah, *University of Minnesota, Minneapolis, MN, USA*, E. Yukihara, *Oklahoma State University, Stillwater, OK, USA* and J. J. Talghader, *University of Minnesota, Minneapolis, MN, USA*

A technique using temperature pulses was used to measure thermoluminescence in aluminum oxide particles. This technique could lead to the development of a personal dosimetry badge which provides quick feedback if a “radiation event” occurs.

Tu3.5 15.15 - 15.30

Widely Tunable Fabry-Perot Optical Filter using Fixed-Fixed Beam Actuators, J. Milne, J. M. Dell, A. J. Keating, L. Schuler and L. Faraone, *University of Western Australia, Crawley, WA, Australia*

Wide spectral tuning from 1620 nm to 2425 nm has been achieved in a MEMS-based tunable Fabry-Pérot filter. Fixed-fixed beam actuators were used to extend the tuning beyond the inherent limit of a parallel plate actuator.

15.30 - 16.00 COFFEE BREAK

16.00 - 17.45

Session Tu4: Scanners and Applications
Session Chair: Akio Higo, *University of Tokyo, Tokyo, Japan*

Tu4.1 16.00 - 16.30 (Invited)

Impact of High Optical Power on Optical MEMS, O. B. Spahn, L. M. Phinney, C. Wong, W. D. Cowan, D. P. Adams, *Sandia National Laboratories, Albuquerque, NM, USA* and G. D. Grossetete, *L & M Technologies, Albuquerque, NM, USA*

We investigate effects of high optical power incident on surfaces of optical MEMS. Experimental data and theoretical predictions of MEMS surfaces during and after laser exposure will be presented. We will also show data that illustrates various mitigation strategies for these phenomena.

Tu4.2 16.30 - 16.45

A High-Power Handling MEMS Optical Scanner for Display Applications, Y. Ohira, *University of Tokyo, Tokyo, Japan*

This paper reports a design and fabrication technique of high-power handling MEMS optical scanner for laser 3-D image display application. The MEMS scanner is designed to control the reflection of high-power YAG-laser beam of 5W (0.5mW/pulse) by the optomechanical combination.

Tu4.3 16.45 - 17.00

Fast and High-Precision 3D Tracking and Position Measurement with MEMS Micromirrors, V. Milanović and W. K. Lo, *Mirrorcle Technologies, Inc., Albany, CA, USA*

We demonstrate fast-motion 3D tracking of an object with two scanning micromirror sub-systems in a 20 kHz loop, while obtaining its precise XYZ co-ordinates. While tracking human hand motion we obtain 3D position information at 0.22m to 5m distance with 16-bit precision.

Tu4.4 17.00 - 17.15

***In-situ* Single Cell Electroporation using Optoelectronic Tweezers,** J. K. Valley, *University of California - Berkeley, Berkeley, CA, USA*

Optoelectronic Tweezers are used to achieve light-induced, in-situ electroporation of HeLa cells. By controlling electrical bias, patterned light induces either single cell movement or electroporation. Fluorescent dye and dielectrophoretic response are used to monitor electroporation.

Tu4.5 17.15 - 17.30

Large Area High-Reflectivity Broadband Monolithic Silicon Photonic Crystal Mirror MEMS Scanner, I. W. Jung, S. Basu Mallick and O. Solgaard, *Stanford University, Stanford, CA, USA*

We present a MEMS scanner with a large-area ultra-flat monolithic-silicon 2-D photonic crystal mirror with broad-band high reflectivity (>90%) in the 1550nm wavelength band. The monolithic photonic crystal mirror is generated as an integrated part of the MEMS scanner fabrication process.

Tu4.6 17.30 - 17.45

3D Imaging using Resonant Large-Aperture MEMS Mirror Arrays and Laser Distance Measurement, V. Hinkov, S. Schwarzer, *Fraunhofer Institute for Physical Measurement, Freiburg, Germany*, T. Sandner, M. Wildenhain, *Fraunhofer-Institut, Dresden, Germany*, H. Hoefler, *Fraunhofer Institute for Physical Measurement, Freiburg, Germany*, T. Klose, *Fraunhofer-Institut, Dresden, Germany*, H. Woelfelschneider, *Fraunhofer Institute for Physical Measurement, Freiburg, Germany* and H. Schenk, *Fraunhofer-Institut, Dresden, Germany*

We present a system concept for a scanning laser radar employing a newly developed MEMS mirror array. The array solution permits large reception apertures while preserving outstanding reliability, high scanning speed, compact size and small system weight. We show first results using a single-mirror protoype.

Wednesday, 13 August 2008

08.30 - 10.00

Session W1: Metamaterials and Photonic Crystals
Session Chair: Sailing He, *Royal Institute of Technology, Stockholm, Sweden, and Zhejiang University, Hangzhou, China*

W1.1 08.30 - 09.00 (Plenary)

Photonic Metamaterials: Optics Starts Walking on Two Feet, M. Wegener and S. Linden, *University of Karlsruhe, Karlsruhe, Germany*

BIO: After completing his PhD in physics in 1987 at Johann Wolfgang Goethe-Universität Frankfurt (Germany), he spent two years as a postdoc at AT&T Bell Laboratories in Holmdel (U.S.A.). From 1990-1995 he was C3-Professor at Universität Dortmund (Germany), since 1995 he is C4-Professor at Universität Karlsruhe (TH). Since 2001 he has a joint appointment at Institut für Nanotechnologie of Forschungszentrum Karlsruhe GmbH. Since 2001 he is also the coordinator of the DFG-Center for Functional Nanostructures (CFN) in Karlsruhe. His research interests comprise ultrafast optics, nonlinear optics, near-field optics, photonic crystals, and photonic metamaterials. This research has led to various awards and honors, among which are the DFG Leibniz Award 2000, the European Union René Descartes Prize 2005, and the Carl Zeiss Research Award 2006. Since 2006, he is also a member of Leopoldina, the German Academy of Sciences.

ABSTRACT: We review recent progress in the field of metamaterials for photonics. Examples are artificial magnetism at optical frequencies, negative phase and group velocities, and enhanced nonlinear phenomena.

W1.2 09.00 - 09.30 (Invited)

Tunable Plasmonic Nanostructures, O. J. F. Martin, H. Fischer, *Swiss Federal Institute of Technology Lausanne, Lausanne, Switzerland*, G. Leveque, *Tyndall National Institute, Cork, Ireland*, and A. Christ, *Carl Zeiss AG, Oberkochen, Germany*

We discuss different composite plasmonic nanostructures, which optical properties can be tuned by displacing some of their parts at the nanoscale. The actuation of these structures with MEMs will define new optical functionalities.

W1.3 09.30 - 09.45

Clarification of Electromagnetic Responses in Split-Ring Resonators from Electric Excitation, C.-Y. Chen and T.-J. Yen*, National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

We demonstrate the electric and magnetic responses from split-ring resonators (SRR). Our quantitative spectroscopic measurements validate in both polarization dependence and multiple resonant characteristics, facilitating to design the desired responses of SRR for practical applications.

W1.4 09.45 - 10.00

Large-Area Monolithic Photonic Crystal Mirrors with High Reflectivity in the 1250-1650nm Band Patterned by Optical Lithography, I. W. Jung, S. Basu Mallick and O. Solgaard*, Stanford University, Stanford, CA, USA*

We present large area (500μm x 500μm) monolithic silicon 2-D photonic crystals for applications as high-reflectivity, broad-band mirrors in the near-IR spectrum. The mirrors have high reflectivity (>90%) with broad bands that cover the 400nm near-IR band from 1250nm-1650nm.

10.00 - 10.30 COFFEE BREAK

10.30 - 12.00
Session W2: ADAPTIVE OPTICS
Session Chair: David L. Dickensheets, *Montana State University, Bozeman, MT, USA*

W2.1 10.30 - 11.00 (Invited)

Applications of LCoS-based Adaptive Optical Elements in Microscopy, A. Hermerschmidt*, HOLOEYE Photonics AG, Berlin-Adlershof, Germany*, J. Haffner, T. Haist and W. Osten*, University of Stuttgart, Stuttgart, Germany*

Liquid crystal on silicon (LCoS)-based spatial light modulators (SLMs) are versatile adaptive optical elements. In microscopy, among their applications are aberration sensing and correction in wide-field microscopy without an additional wavefront sensor, and also holographic optical tweezers utilizing GPU-based fast implementations of tailored computational algorithms.

W2.2 11.00 - 11.15

MEMS Deformable Mirrors for Adaptive Optics using Single Crystal PMN-PT, H. Park and D. A. Horsley*, University of California - Davis, Davis, CA, USA*

A MEMS-based deformable mirror constructed from electrostrictive single-crystal PMN-PT is presented. A stroke exceeding 10 microns and high operating bandwidth assure that the DM can be a promising wavefront corrector for use in adaptive optics.

W2.3 11.15 - 11.30

A Varifocal Micromirror with Pure Parabolic Surface using Bending Moment Drive, R. Hokari*, Tohoku University, Sendai, Miyagi, Japan*

We propose a method to generate a pure parabolic surface of varifocal micromirror by applying a bending moment to the circumference of the micromirror. The deviation from the ideal paraboloid was smaller than 5nm with the focal lengths from the infinity to 24mm.

W2.4 11.30 - 11.45

Simulation and Characterization of Tunable Achromatic Micro-Lenses, P. Waibel, D. Mader, D. Lämmle, A. Seifert and H. Zappe*, University of Freiburg, Freiburg, Germany*

Simulation and measurements of achromatic tunable multi-chamber micro-lenses are presented. By using three liquid-filled chambers, separated by silicone membranes, the lens system is tunable in focal length by adjusting the pressures inside the chambers.

W2.5 11.45 - 12.00

Optical Scanner with Deformable Mirror Fabricated from SOI Wafer, T. Sasaki*, Tohoku University, Sendai, Miyagi, Japan*

An optical scanner with a deformable mirror is fabricated using SOI wafer.The mirror is rotated by the comb actuator and it is also deformed by an electrostatic force independently.The rotation angle of the mirror is 12 degrees at 80V.

12.00 - 14.00 LUNCH BREAK

Foyer 2

14.00 - 16.00

Session P: POSTER SESSION

P1 A Micromachined Vibratory Sub-Wavelength Diffraction Grating Laser Scanner, Y. Du, G. Zhou, K. K. L. Cheo, Q. Zhang, *National University of Singapore, Singapore*, H. Feng, *Institute of Microelectronics, Singapore* and F. S. Chau, *National University of Singapore, Singapore*

A novel MEMS based in-plane vibratory sub-wavelength diffraction grating scanner is reported. Diffraction efficiency of more than 75%, optical scan angle of 13.7° and scanning frequency of 20.35 kHz are experimentally achieved.

P2 ZnO Nanorod-based Polymer Solar Cells with Optimized Electrodes, C.-Y. Chou, J.-S. Huang, C.-Y. Lee and C.-F. Lin, *National Taiwan University, Taipei, Taiwan, R.O.C.*

The selection of electrodes in ZnO nanorod-based polymer solar cells was investigated. Increases in the work function of metal electrode result in the increases in open-circuit voltage up to 120 mV, leading to improved performance.

P3 Wafer Level Batch Fabrication and Assembly of Small Form Factor Optical Pickup Head, S.-Y. Hsiao, C.-C. Lee, *National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*, Y. Chiu, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.*, H.-F. Shih, *National Chung-Hsing University, Taichung, Taiwan, R.O.C.*, J.-C. Chiou, H.-P. D. Shieh, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.* and W. Fang, *National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

A MEMS batch assembly process for fabricating small form factor optical pickup head is proposed to minimize the complexity of assembly. A silicon optical bench with a packaged laser diode and crystalline-plane mirrors is demonstrated.

P4 Evaluation of X-ray Reflectivity of a MEMS X-ray Optic, I. Mitsuishi, *Japan Aerospace Exploration Agency, Sagamihara, Kanagawa, Japan*, Y. Ezoe, *Tokyo Metropolitan University, Tokyo, Japan*, M. Koshiishi, M. Mita, Y. Maeda, N. Y. Yamasaki, K. Mitsuda, *Japan Aerospace Exploration Agency, Sagamihara, Kanagawa, Japan*, T. Shirata, T. Hayashi, *Tokyo Metropolitan University, Tokyo, Japan*, T. Takano, and R. Maeda, *National Institute of Advanced Industrial Science and Technology, Tsukuba, Ibaraki, Japan*

X-ray reflectivity of an ultra light-weight X-ray optic using MEMS technologies was measured in two different energies(0.28 keV and 1.49 keV). The obtained reflectivities can be understood by considering the mirror surface structures.

P5 Design and Fabrication of CMOS-Integrated Thermoelectric IR Microsensors, R. Chen, *National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

This work presents a thermoelectric infrared microsensor which is designed and fabricated with TSMC CMOS-MEMS processes. The proposed device can achieve the responsivity of 432.3 V/W and time constant of 2.49 ms at 1 atm.

P6 Performance Improvement of a Two-Axis Radial-Vertical-Combdrive Scanner by Using a Symmetric Spring Design, T.-L. Hsieh, Y.-T. Chang, S.-J. Chiou, J.-C. Tsai, *National Taiwan University, Taipei, Taiwan, R.O.C.*, D. Hah, *Louisiana State University, Baton Rouge, LA, USA* and M. C. Wu, *University of California - Berkeley, Berkeley, CA, USA*

A symmetric cross-bar spring structure is employed to improve the performance of a two-axis gimbal-less micromirror driven by radial vertical combdrive actuators. The mechanical rotation angles are +/-5.33 deg. (50.7V) and +/-6.04 deg. (52.8V).

P7 Assembly of Micro Mirrors on SOI Wafers using SU-8 Mechanisms and One-Push Operation, Y. Chiu, W.-Z. Huang, J.-W. Wu, J.-C. Chiou and H.-P. D. Shieh, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.*

Micro mirrors are assembled on silicon-on-insulator wafers using one-push operation. The proposed technique can reduce the overall complexity of micro system assembly by using automated equipments. Novel SU-8 mechanisms are also demonstrated.

P8 Spatially Resolved Optical Characterization of Photonic Crystal Slabs using Direct Evaluation of Photonic Modes, Y. Nazirizadeh, U. Geyer, U. Lemmer, *University of Karlsruhe, Karlsruhe, Germany* and M. Gerken, *Christian-Albrechts University at Kiel, Kiel, Germany*

Transmission measurements with crossed polarization filters are performed in a confocal microscope setup for spatially resolved evaluation of photonic crystal modes. The homogeneity of samples fabricated with electron-beam lithography and laser interference lithography is investigated.

P9 Micro-Mirror Array for Multi-Object Spectroscopy in Cryogenic Environment, S. Waldis, *University of Neuchatel, Neuchatel, Switzerland*, F. Zamkotsian, P. Lanzoni, *Laboratoire d'Astrophysique de Marseille, Marseille, France*, W. Noell, M. Canonica and N. F. de Rooij, *University of Neuchatel, Neuchatel, Switzerland*

Micro-mirror arrays for multi-object spectroscopy have been designed and fabricated, using bulk and surface micromachining. The mirrors could be successfully actuated before, during and after cryogenic cooling, below 100K. Interferometric characterization in cryogenic environment is presented, meeting the high surface quality requirements.

P10 Low Operation Voltage Non Self-Emissive MEMS Color Filter Pixels, C.-Y. Lo, *University of Tokyo, Tokyo, Japan*, J. Hast, O.-H. Huttunen, J. Petäjä, J. Hiitola-Keinänen, A. Maaninen, H. K. Kopola, *VTT Technical Research Center of Finland, Oulu, Finland*, H. Fujita and H. Toshiyoshi, *University of Tokyo, Tokyo, Japan*

Air grooves were designed in spacer layer to reduce up to 50% of operation voltage of non self-emissive MEMS color filter pixels for future commercialization. A seesaw effect was established and used to explain and to design an optimized spacer coverage.

P11 White-Light Electroluminescence from ZnO Nanowires/Polyfluorene Heterojunction Diodes, C.-Y. Lee, J.-S. Huang, S.-H. Hui, W.-F. Su and C.-F. Lin, *National Taiwan University, Taipei, Taiwan, R.O.C.*

The characteristics of a nanocomposite consisting of the blue-emitting polymer polyfluorene and ZnO nanowires are reported. The electroluminescence spectrum of the white light emission is from about 400 nm to 750 nm.

P12 Stabilization of Temperature Characteristics of Micromirror for Low-Voltage Driving using Thin Film Torsion Bar of Tensile Poly-Si, M. Sasaki, *Toyota Technological Institute, Nagoya, Aichi, Japan*, M. Fujishima, K. Hane and H. Miura, *Tohoku University, Sendai, Miyagi, Japan*

Tense poly-Si film is used for the thin film torsion bar. The coefficient of thermal expansion is same with that of substrate. Stabilization of the temperature performance and the low-voltage driving (5.5deg. 5V) are realized.

P13 Simulation-based Design of a MEMS X-ray Optic for X-ray Astronomy, M. Koshiishi, *Japan Aerospace Exploration Agency, Sagamihara, Kanagawa, Japan*, Y. Ezoe, *Tokyo Metropolitan University, Tokyo, Japan*, I. Mitsuishi, M. Mita, K. Mitsuda, *Japan Aerospace Exploration Agency, Sagamihara, Kanagawa, Japan*, T. Takano, and R. Maeda, *National Institute of Advanced Industrial Science and Technology, Tsukuba, Ibaraki, Japan*

An ultra light-weight X-ray optic using MEMS technologies was designed for X-ray astronomy. Numerical simulation was utilized to estimate allowable fabrication accuracies. Obtained X-ray images with a fabricated optic were consistent with the design.

P14 Fabrication of Sub-Micrometer Si Spheres with Atomic-Scale Surface Smoothness using Homogenized KrF Excimer Laser Reformation System, S.-C. Hung, S.-C. Shiu and C.-F. Lin, *National Taiwan University, Taipei, Taiwan, R.O.C.*

Fabrication process of sub-micrometer Si spheres with atomic-scale surface smoothness on SOI wafers using excimer laser reformation system is presented. Rods with diameters of 360 nm transformed to spheres with diameters of 450 nm.

P15 Space Instruments based on MOEMS Technology, B. Guldimann, *European Space Agency, Noordwijk, The Netherlands*

A summary of current and possible future activities of the European Space Agency (ESA) related to optical MEMS technologies with a strong emphasis on the instrument aspects is presented.

P16 Polymer Biochips with Micro-Optics for LIF Detection, H. Hosseinkhannazer, J. N. McMullin and L. Kostiuk, *University of Alberta, Edmonton, AB, Canada*

We present the design, fabrication and experimental testing of polydimethylsiloxane (PDMS) biochips with integrated waveguides that have liquid or UV-cured polyepoxyacrylate (PEA) cores. The use of inexpensive micro/nanofabrication methods and materials results in biochips suitable for laser-induced fluorescence detection applications.

P17 3D Modeling of Photonic Devices using Dynamic Thermal Electron Quantum Medium Finite-Different Time-Domain (DTEQM-FDTD) Method, E. H. Khoo, *Institute of High Performance Computing, Singapore*

This paper reports on the modeling of the semiconductor photonic devices using 3D DTEQM-FDTD. The model includes the essential dynamics physics and is computational efficient. The model is applicable to a wide range of atomic and molecular media for photonic devices.

P18 High-Density Piezoelectric Actuator Array for MEMS Deformable Mirrors Composed of PZT Thin Films, I. Kanno, S. Tsuda and H. Kotera, *Kyoto University, Kyoto, Japan*

A piezoelectric MEMS DM composed of PZT thin films has been fabricated. A 61-element hexagonal actuator array was formed on the backside of the mirror surface and more than 1um displacement could be generated by applying 10V.

P19 Monolithic Integration of a Tunable Photodetector Based on InP/Airgap Fabry-Pérot Filters, T. Kusserow, R. Zamora, J. Sonksen, N. Dharmarasu, H. H. Hillmer, *University of Kassel, Kassel, Germany*, T. Nakamura, T. Hayakawa, and B. Vengatesan, *Canare Electric Co. Ltd., Nagoya, Aichi, Japan*

The fabrication of a tunable photodetector for the near IR is presented. The device is based on the monolithic integration of a pin-photodiode structure and a InP/air-gap DBR Fabry-Perot filter. Special process steps regarding the integration have been investigated to assure high performance.

P20 Polarization Singularities and Local Field Symmetries in Photonic Crystals, H. Schriemer and J. F. Wheeldon, *University of Ottawa, Ottawa, ON, Canada*

We show that the local state of polarization of a two-dimensional photonic crystal exhibits distinct polarization singularities that map to the stabilizer groups of field symmetry image points for a particular eigenmode.

P21 Polymer Deformable Membrane Mirrors for Focus Control using SU-8 2002, E. Dunbar, M. Leone, S. Lukes and D. L. Dickensheets, *Montana State University, Bozeman, MT, USA*

Large stroke deformable membrane mirrors are designed for primary focus control and compensation of focus-induced spherical aberration. SU-8 2002 epoxy membranes 2 μm thick and up to 1 cm diameter, with symmetric aluminum coatings, are described.

P22 Mechanically Coupled Comb Drive MEMS Stages, A. Arslan, Ç. Ataman, S. Holmstrom, *Koc University, Istanbul, Turkey*, K. Hedsten, *Chalmers University of Technology, Gothenburg, Sweden*, H. R. Seren, H. Urey, *Koc University, Istanbul, Turkey* and P. Enoksson, *Chalmers University of Technology, Gothenburg, Sweden*

An electrostatic large clear-aperture in-plane scanner with a novel actuation principle is presented for fast and large stroke scanning applications. 9 μm resonant deflection at 11.51 KHz with 100 Vpp excitation is observed.

P23 Photonic Crystal Rods utilizing Fano Resonance for Tunable Filter Applications, X. Y. Chew, G. Zhou, H. Yu, and F.S. Chou, *National University of Singapore, Singapore*

A novel approach of utilizing the fano resonances of photonic crystal rods to achieve high-Q filter capabilities. Here we present the optimization of peaks attenuation and Q-factor properties by permutation of rod dimensions.

P24 A Glass Cantilever Beam Sensor Combined with a Spherical Reflecting Mirror for Sensitivity Enhancement, C.-D. Liao and J.-C. Tsai, *National Taiwan University, Taipei, Taiwan, R.O.C.*

The incorporation of a micro spherical reflecting mirror (MSRM) onto a cantilever beam sensor magnifies the optical deflection angle and therefore enhances the sensitivity of an optical sensing system.

P25 A Micromirror Scanner with Vertical Combs Tilted by Assembly Process, J.-H. Lee, M.-H. Jun, S.-S. Yun, M. G. Kim and S.-K. Lee*, Gwangju Institute of Science and Technology, Gwangju, Korea*

We have developed a simple assembly technology to realize the tilted vertical combs for electrostatic micromirror scanners. The in-plane vertical comb electrodes are easily transformed into out-of-plane tilted comb by asymmetrical pushing down the levers of the spring that is attached to the micro mirror.

P26 Design and Fabrication of Etched Diffraction Grating Demultiplexers based on α-Si Nanowire Technology, J. Song*, Royal Institute of Technology, Stockholm, Sweden*

Silicon nanowire waveguides and related etched diffraction grating (EDG) demultiplexers are studied by α-Si-on-SiO_2 technology. Compact EDG demultiplexers with 10 nm spacing for both echelle and total-internal-reflection (TIR) facets have been fabricated and characterized.

P27 Planar Centering Mechanism for Dielectrically Liquid Lens, C.-W. G. Tsai*, National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

Two types of planar centering mechanism with shape edge were fabricated and demonstrated their performance in this paper, which effectively reduce the tilt angle of dielectrically liquid lens to 0.2°.

P28 The Two-Axis Magnetostatic-Drive Single-Crystal-Si Micro Scanner Driven by Back-side Electroplating Ni Film, C.-P. Hsu, W. Fang, W.-C. Chen and T.-L. Tang*, National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

A simple 2-mask process to realize a two-axis micro scanning mirror is presented. The scanning mirror is made of single-crystal-silicon, and Ni is electroplated at the backside of scanner to induce the magnetostatic driving force.

P29 All-Optical Ultra-Compact Photonic Crystal Controllable Logic Gate, P. Andalib and N. Granpayeh*, K.N.Toosi University of Technology, Tehran, Iran*

In this paper, we propose an all-optical photonic crystal controllable logic gate based on nonlinear ring resonator. Simulation and analysis have been done by finite difference time domain and plane wave expansion method.

P30 Conductive Pattern Forming Method on Vertical Wall using Spray Coating and Angled Exposure Technologies, H. Morii*,* F. Oohira*, Kagawa University, Kanagawa, Japan*, M. Sasaki*, Toyota Technological Institute, Nagoya, Aichi, Japan*, T. Ochi and A. Yuzuriha*, AOI Electronics Co. Ltd., Takamatsu, Japan*

A novel conductive pattern forming method on the vertical wall using a resist spray coating and an angled exposure technologies is described. This method makes it possible to decrease the chip package size.

P31 A Novel Lens Formation Technology to Implement a 3D Spherical Polymer Lens, C.-C. Lee, S.-Y. Hsiao*,* and W. Fang*, National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

This study presents a novel lens formation technology to implement a 3D polymer lens in buffer liquid. The integration of such 3D polymer lens on SiOB and the application for barcode scanner are also demonstrated.

P32 Fabrication of 2D and 3D Photonic Quasi-Crystals with High Rotation Symmetry by Holographic Lithography Technique, C. C. Hsu, N. D. Lai and J. H. Lin*, National Chung Cheng University, Chia Yi, Taiwan, R.O.C.*

We demonstrate using a double-exposure three-beam and/or three-beam-plus-one interference technique, one can easily and efficiently fabricate 2D and/or 3D quasi-periodic structures. Using the multi-surface prism, our fabrication technique becomes a compact and robust way to produce different kinds of structures, periodic or quasi-periodic.

P33 Fabrication of Wall-Coated Cs Vapor Cells for a Chip-Scale Atomic Clock, M. Hasegawa, P. Dziuban, L. Nieradko, A. Douahi*,* C. Gorecki*,* and V. Giordano*, University of Franche-Comte, Besançon, France*

Cesium vapor microcells incorporating a Cs dispenser were fabricated. An organosilane monolayer was successfully applied to the microcells'walls as an anti-relaxation coating to improve the relaxation time of Cs atoms.

P34 The Torque-Enhancement Design for Magnetostatic Scanner, T.-L. Tang, W.-C. Chen, R. Chen, and W. Fang*, National Tsing Hua University, Hsinchu, Taiwan, R.O.C.*

This study presents two designs to enhance the magnetostatic torque to drive the scanner, (1) the lever arm, and (2) the ferromagnetic material pattern with higher length to width ratio.

P35 Six Port Waveguide Filter based on Circular Photonic Crystal, E. H. Khoo*, Institute of High Performance Computing, Singapore*

This paper reports a six port circular photonic crystal waveguide filter. The combined band structure provide the filtering function. This device distributes lightwaves with six different frequencies to six different output ports channels. It is useful for multiplexing optical signal in photonic circuits.

P36 Towards Integration of Glass Microlens with Silicon Comb-Drive X-Y Microstage, K. Laszczyk, S. Bargiel, C. Gorecki*, University of Franche-Comte, Besancon, France* and J. Krezel*, Warsaw University of Technology, Warsaw, Poland*

We present the design and the fabrication of a silicon X-Y microstage and a new concept of its integration with a glass microlens to obtain an optical 2D scanner for the miniaturized microscope on-chip.

P37 Optical Add/drop Filter Based on Dual Curved Photonic Crystal Resonator, P. Andalib and N. Granpayeh*, K.N.Toosi University of Technology, Tehran, Iran*

In this paper we propose a novel ultra compact photonic crystal resonator and investigate add/drop filter based on it. Simulation and analysis have been done by finite difference time domain and plane wave expansion method.

17.00 - 22.00 **BANQUET**

Bus leaves Konzerthaus at 17.00

Thursday, 14 August 2008

08.30 - 10.00

Session TH1: DETECTORS AND IMAGING SYSTEMS
Session Chair: Hakan Urey, *Koc University, Istanbul, Turkey*

Th1.1 08.30 - 09.00 (Invited)

Cavity-Optomechanics in Nanoscale Photonic Crystals, O. J. Painter, *California Institute of Technology, Pasadena, CA, USA*

ABSTRACT NOT AVAILABLE

Th1.2 09.00 - 09.15

CMOS-SOI-MEMS Transistor (TMOS) for Infrared Imaging, L. Gitelman, Z. Gutman, S. Bar-Lev, S. Stolyarova and Y. Nemirovsky, *Technion, Haifa, Israel*

This paper presents a novel uncooled micromachined infrared sensor for imaging applications. The sensor is implemented as isolated MOS transistor using standard CMOS-SOI technology following by MEMS post processing, using RIE and DRIE etching techniques.

Th1.3 09.15 - 09.30

Mid-Infrared Tunable Resonant Cavity Enhanced Detectors Employing Vertically Moving Comb Drive Actuated MEMS Micromirrors, N. Quack, P. Rust, S. Blunier, J. Dual, F. Felder, M. Arnold, M. Rahim, M. Fill and H. Zogg, *Swiss Federal Institute of Technology Zurich, Zurich, Switzerland*

Tunable Resonant Cavity Enhanced Detectors (RCED) for the mid-infrared employing vertically moving, comb-drive actuated micromirrors are presented. A wide tuning range of 0.7μm and a low order configuration have been achieved with a micromirror displacement range of 2.5μm and a reduced the optical cavity length.

Th1.4 09.30 - 09.45

A Dynamic Subwavelength Pitch Grating Modulator for Continuous Time-of-Flight Ranging with Optical Mixing, J. Roels, *Ghent University, Gent, Belgium*, W. van der Tempel, D. Van Nieuwenhove, R. Grootjans, M. Kuijk, *Vrije University Brussels, Brussels, Belgium*, D. J. Van Thourhout and R. G. Baets, *Ghent University, Gent, Belgium*

Since continuous Time-Of-Flight ranging systems based on electrical mixing run into fundamental limits we designed an optical MEMS (de)modulator/mixer. With our dynamic (MHz range) subwavelength pitch diffraction grating we demonstrated TOF ranging with optical mixing.

Th1.5 09.45 - 10.00

Radiation Heat Transfer Dominated Microbolometers, A. S. Gawarikar, R. P. Shea, A. Mehdaoui, and J. J. Talghader, *University of Minnesota, Minneapolis, MN, USA*

Radiation heat transfer limited thermal conductance represents the ultimate lower limit of the thermal isolation achievable in a microbolometer. A microbolometer structure with radiation limited thermal conductance has been fabricated and its operation demonstrated.

10.00 - 10.30 COFFEE BREAK

10.30 - 12.00

Session TH2: NANOFABRICATION AND CHARACTERIZATION
Session Chair: Hans-Peter Herzig, *University of Neuchatel, Neuchatel, Switzerland*

Th2.1 10.30 - 11.00 (Invited)

Near-Field Scanning Nanophotonic Microscopy, J. X. J. Zhang, K. Hoshino and A. Gopal, *University of Texas at Austin, Austin, TX, USA*

We fabricated nanoscale light emitting diodes (NANO-LED) at the tip of silicon probes. Simultaneous optical and topographical images were acquired using the probes with the Nano-LED in a standard near-field scanning optical microscope.

Th2.2 11.00 - 11.15

The Dependence of Poly-Crystalline SiC Mid-Infrared Optical Properties on Deposition Conditions, J. Provine, *Stanford University, Stanford, CA, USA*, C. S. Roper, *University of California - Berkeley, Berkeley, CA, USA*, J. A. Schuller, M. L. Brongersma, *Stanford University, Stanford, CA, USA*, R. Maboudian, *University of California - Berkeley, Berkeley, CA, USA* and R. T. Howe, *Stanford University, Stanford, CA, USA*

We report on experimental measurements of the optical properties of thin films of LPCVDpoly-SiC. Near and far field measurements in the mid-IR show strong dependence upon the deposition conditions including doping levels, ratio of Dichlorosilane, and anneals performed on the film.

Th2.3 11.15 - 11.30

Impact of an Air Barrier on the Electron States of Etch-Released Quantum Heterostructures, J. D. Makowski, *University of Minnesota, Minneapolis, MN, USA*, M. J. Saarinen, *Tampere University of Technology, Tampere, Finland*, C. J. Palmstrom, *University of California - Santa Barbara, Santa Barbara, CA, USA* and J. J. Talghader, *University of Minnesota, Minneapolis, MN, USA*

This work demonstrates photoluminescence from released heterostructure cantilevers. Upon exposing the quantum well to air, the peak intensity blue shifts by 5~nm while exposed wells encapsulated with ALD aluminum oxide do not exhibit this shift.

Th2.4 11.30 - 11.45

Bandgap Tuning of Photonic Crystals by Polymer Swelling, W. Moench, P. Waibel and H. Zappe*, University of Freiburg, Freiburg, Germany*

Polymer swelling is studied as a novel method for bandgap tuning of photonic crystals (PCs). We present experimental studies of swelling of one-dimensional PCs and theoretical simulations of swelling of three-dimensional PCs in the presence of organic solvents.

Th2.5 11.45 - 12.00

Formation of a Nitrified Hafnium Oxide Buffer Layer on Silicon Substrate and GaN Quantum Well Crystal Growth for GaN-Si Hybrid Optical MEMS, H. Sameshima*, Tohoku University, Sendai, Miyagi, Japan*

We study the growth of GaN on Si substrate with a nitrified HfO_2 to integrate GaN light source and MEMS monolithically. Photoluminescence of GaN quantum well grown on the nitrified HfO_2 is better. A hybrid GaN grating on Si was fabricated.

END OF PROGRAM