

# Advance Program

## Nanophotonics

**Monday, 12 January 2009**

**ALL SESSIONS TO BE HELD IN KUFSTEIN**

**08.30 - 10.00**

**Session MA1: PHOTONIC CRYSTAL I**

**Session Chair:** Min Qiu, *Royal Institute of Technology, Stockholm, Sweden*

**MA1.1 08.30 - 09.15 (Plenary)**

**Photonic Band Gap Materials: Light Trapping Crystals**, S. John, *University of Toronto, Toronto, ON, Canada*

We describe recent progress in the fabrication of 3D photonic band gap materials and the applications of their light-trapping capabilities.

**MA1.2 09.15 - 09.45 (Invited)**

**Plane-Wave Transfer-Matrix Method and Its Application to Photonic Crystal Devices**, Z.-Y. Li, *Chinese Academy of Sciences, Beijing, China*

Plane-wave transfer-matrix method can handle band diagrams of photonic crystal and its surface, optical spectra for dielectric and metallic crystals, and scattering and coupling of Bloch modes and guided modes at surface and interface.

**MA1.3 09.45 - 10.00**

**Observation of Stimulated Emission and Lasing in Quantum-wire Photonic-crystal Nanocavities**, K. A. A. Atlasov, K. F. Karlsson, P. Gallo, A. Rudra, B. Dwir and E. Kapon, *École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*

Low-threshold lasing is experimentally achieved for the first time in semiconductor photonic-crystal nanocavities embedding site-controlled quantum wires. The effect is established via direct observation of the stimulated emission in the time domain.

**10.00 - 10.30**

**COFFEE BREAK**

**10.30 - 12.30**

**Session MA2: APPLICATIONS OF NANOPHOTONICS I**

**Session Chair:** Ali Adibi, *Georgia Institute of Technology, Atlanta, GA, USA*

**MA2.1 10.30 - 11.00 (Invited)**

**Nanophotonic Interconnection Networks in Multicore Embedded Computing**, K. Bergman, *Columbia University, New York, NY, USA*

We develop a multilayer optical network simulation environment that uniquely captures physical nanoscale silicon photonic device models. The network-on-chip scalability and performance are evaluated in the context of device characteristics and associated energy consumption.

**MA2.2 11.00 - 11.30 (Invited)**

**Scalable Coarse WDM Transceiver Modules for Satellite Applications**, P. S. Guilfoyle, M. T. Harris, U. Retnasingham, S. Mahnkopf, T. J. Eustis, D. Kumar, and D. A. Loudereback, *OptiComp Corporation, Zephyr Cove, NV, USA*

A scalable coarse WDM optical transceiver specifically designed for satellite applications will be presented. The transceiver can be upgraded in both data rate and number of wavelengths, giving the transceiver the potential of achieving 120 Gbit/s in a single fiber.

**MA2.3 11.30 - 12.00 (Invited)**

**Nanostructured LED's for Solid-State Lighting**, R. Windisch, N. Linder, C. Wiesmann and K. Streubel, *Osram Opto Semiconductors GmbH, Regensburg, Germany*

Nanostructures are often applied to LEDs for enhanced performance, but they have to compete with conventional light extraction technologies. The paper compares the obtainable results and classifies the technologies with respect to solid-state lighting applications.

**MA2.4 12.00 - 12.15**

**Characterization of a New 90° Phase Shift for QAM-QPSK Photonic Vectorial Modulators/Demodulators**, J. Blasco, V. Herrero, A. Martinez, A. Griol, P. Rodriguez and J. Marti, *Universidad Politécnica de Valencia, Valencia, Spain*

We report the simulation, fabrication and characterization of a new architecture of a 90° phase shifter of QAM-QPSK photonic vectorial modulators/demodulators based on RR. The structure was fabricated with SOI technology and the RR parameters were optimized for WDM.

**MA2.5 12.15 - 12.30**

**Numerical Investigation of a SiGe HBT Electro-Optic Modulator**, S. Deng, Z. Huang, J.-R. Guo, J. McDonald and R. Kraft, *Rensselaer Polytechnic Institute, Troy, NY, USA*

We analyzed an electro-optic modulator consisting of a heterojunction bipolar transistor (HBT) with graded SiGe composition in the base. Simulation shows single mode operation is attainable with an interaction length  $L_p$  of 40.8  $\mu\text{m}$ .

**12.30 – 14.00****LUNCH BREAK - Restaurant Guggeryllis****14.00 - 15.30**

**Session MA3: PHOTONIC CRYSTAL II**

**Session Chair:** TBD

**MA3.1 14.00 - 14.15**

**Sharp Asymmetric Fano Resonance with a Side-Coupled Photonic Crystal Microcavity**, Q. Li, J. Wang, *Royal Institute of Technology, Stockholm, Sweden*, L. O'Faolain, T. F. Krauss, *University of St. Andrews, St. Andrews, Fife, UK* and M. Qiu, *Royal Institute of Technology, Stockholm, Sweden*

We present a photonic-crystal microcavity with a sharp asymmetric Fano resonance. The obtained intrinsic Q of the cavity is around 700000.

**MA3.2 14.15 - 14.30**

**Broad Resonance for Improving Imaging Quality of a Photonic Crystal Lens**, W. Jiang, *Rutgers University, Piscataway, NJ, USA*

We employ a semi-analytic theory to compute the modulation transfer function and optimize the design of a photonic crystal lens. With a unique broad resonance, the isotropy of the image field is significantly enhanced.

**MA3.3 14.30 - 14.45**

**Discrimination of Higher-Order Modes in Photonic-Crystal VCSEL**, T. G. Czystanowski, *Technical University of Lodz, Lodz, Poland*

Self-consistent modeling of threshold characteristics of an InP-based 1300-nm AlInGaAs photonic-crystal vertical-cavity surface-emitting diode laser is presented. It shows that a shallow photonic crystal deteriorates the VCSEL characteristics, however deeper, optimized etching assures low threshold.

**MA3.4 14.45 - 15.00**

**High-Q Optical Filter Based on Photonic Crystal Surface-Mode Microcavity**, J. Wang, *Royal Institute of Technology, Stockholm, Sweden*

An optical filter based on a side-coupled two-dimensional photonic crystal surface mode cavity on crystalline silicon-on-insulator (SOI) structure is presented. The measured system Q and intrinsic Q factor are 6900 and 13700, respectively.

**MA3.5 15.00 - 15.15**

**Vertically Stacked Square Lattice Photonic Crystals for Large Angle Optical Beam Steering**, R. T. Chen, X. Dou, X. Chen, *University of Texas at Austin, Austin, TX, USA*, M. Y. Chen, X. Wang and W. Jiang, *Omega Optics Inc., Austin, TX, USA*

In this paper, we reported the fabrication of 2-D square lattice photonic crystals structures targeted at beam steering application using double exposure holographic interference method. Computer simulation gives the electric field distribution patterns and SEM images show the developed photonic crystals on the glass substrate.

**MA3.6 15.15 - 15.30**

**Enhancement of Nonlinearity in Nonlinear Photonic Crystal Ring Resonators for All-Optical Switching**, T. Ahmadi Tameh, B. Memarzadeh Isfahani, A. R. Maleki Javan and N. Granpayeh, *K.N.Toosi University of Technology, Tehran, Iran*

In this paper three different structures of all optical switches based on nonlinear photonic crystal ring resonators are proposed and compared. The procedure of enhancement of nonlinearity is shown and the optimal structure is proposed.

**15.30 – 16.00****COFFEE BREAK****16.00 - 17.45**

**Session MA4: SILICON PHOTONICS**

**Session Chair:** Keren Bergman, *Columbia University, New York, NY, USA*

**MA4.1 16.00 - 16.30 (Invited)**

**Efficient Wavelength Conversion via Four-Wave Mixing in Sub-Micron Silicon Rib Waveguides**, H. Rong W. A. Mathlouthi, I. Hsieh and M. Paniccia, *Intel Corporation, Santa Clara, CA, USA*

We report a wavelength conversion efficiency of -5.5 dB via four-wave-mixing in a low-loss 2.5 cm long sub-micron silicon-on-insulator rib waveguide. The impact of non-linear absorption and waveguide dimensions on the conversion efficiency is studied.

**MA4.2 16.30 - 16.45**

**All Optical Switching in Silicon-On-Insulator Photonic Wire Nano-Cavities**, M. Belotti, M. Galli, D. Gerace, L. C. Andreani, *University of Pavia, Pavia, Italy*, A. R. Md Zain, N. P. Johnson, M. Sorel and R. M. De La Rue, *University of Glasgow, Glasgow, Scotland, UK*

All-optical switching with a very low power is demonstrated on photonic crystal wire nano-cavities on silicon-on-insulator with large quality factors and high transmission in the telecom range.

**MA4.3 16.45 - 17.00**

**Silicon Cross-Slot Waveguides Insensitive to Polarization**, J. V. Galan Conejos, P. Sanchis Kilders, J. Garcia, A. Martinez, J. Blasco, J. M. Martinez, A. Brimont, and J. Marti, *Universidad Politécnica de Valencia, Valencia, Spain*

We present a slot waveguide configuration which simultaneously works for TE and TM polarizations. Simulation results are reported to achieve single-mode propagation and insensitivity to polarization. Dispersion is also analyzed by calculating the GVD parameter.

**MA4.4 17.00 - 17.15**

**Nonlinearity of Optimized Horizontal Slot Waveguides**, R. Hainberger and P. Muellner, *Austrian Research Centers GmbH - ARC, Vienna, Austria*

In this theoretical study, we show that the use of optimized horizontal silicon photonic slot waveguide structures could enable the realization of devices with a nonlinearity coefficient of more than  $2 \times 10^7$  1/(W\*km).

**MA4.5 17.15 - 17.30**

**Low Loss, Small Crosstalk Offset Crossing Structure of Si Wire Waveguide**, D. Tanaka, *Keio University, Yokohama, Kanagawa, Japan*

Low loss, small crosstalk offset crossing structure of Si wire waveguide is proposed. The transmission loss of 0.018 dB, and the crosstalk of -49.1 dB are achieved with a crossing angle of 20 degrees.

**MA4.6 17.30 - 17.45**

**All Optical Switch Using Stimulated Raman Scattering and Free Carrier Absorption in Silicon**, M. Khorasaninejad and S. S. Saini, *University of Waterloo, Waterloo, ON, Canada*

In this paper we propose an all optical switch in Silicon on Insulator (SOI) waveguides based on two nonlinear phenomena, Stimulated Raman Scattering (SRS), and Free Carrier Absorption (FCA). About 13 dB extinction ratio is achieved.

**18.30 – 20.00**

**WELCOME RECEPTION - CASINEUM**

**Tuesday, 13 January 2009**

**08.30 - 10.00**

**Session TUA1: PLASMONICS I**

**Session Chair:** Ray T. Chen, *University of Texas at Austin, Austin, TX, USA*

**TuA1.1 08.30 - 09.15 (Plenary)**

**Nanophotonic Functionalities through Plasmonics**, A. V. Anatoly, *Queens University of Belfast, Belfast, UK*

Plasmonic waveguides, crystals and metamaterials will be overviewed and their applications discussed. Coupling light to plasmonic excitations on nanostructured metal films and surfaces allows passive and active functionalities to be achieved on the sub-wavelength scale.

**TuA1.2 09.15 - 09.45 (Invited)**

**Plasmonic Nanoguides**, S. I. Bozhevolnyi, *University of Southern Denmark, Odense, Denmark*

Surface-plasmon (SP) based waveguiding configurations are considered, and subwavelength photonic components utilizing SP modes propagating along channels cut into and dielectric ridges deposited onto gold films are overviewed, demonstrating first examples of ultra-compact plasmonic components.

**TuA1.3 09.45 - 10.00**

**Active Components for Integrated Plasmonic Circuits**, A. Krasavin, P. Bolger, A. V. Zayats, *Queens University of Belfast, Belfast, UK*, T. Holmgaard, Z. Chen, *Aalborg University, Aalborg, Denmark*, S. I. Bozhevolnyi, *University of Southern Denmark, Odense, Denmark*, L. Markey and A. Dereux, *Université de Bourgogne, Dijon, France*

We present a comprehensive study of highly efficient and compact passive and active components for integrated plasmonic circuit based on dielectric-loaded surface plasmon polariton waveguides.

**10.00 – 10.30**

**COFFEE BREAK**

**10.30 - 12.30**

**Session TUA2: PLASMONICS II**

**Session Chair:** Sergey I. Bozhevolnyi, *University of Southern Denmark, Odense, Denmark*

**TuA2.1 10.30 - 11.00 (Invited)**

**Surface Plasmons for Micro- and Nano-Optical Manipulation**, R. Quidant and M. Righini, *Institut de Ciències Fotoniques, Barcelona, Spain*

Recent advances achieved in the use of surface plasmons for integrated optical manipulation are reviewed. We demonstrate efficient and parallel trapping at a surface, with low laser intensity, of micro- and nano-objects.

**TuA2.2 11.00 - 11.30 (Invited)**

**Fabricating Plasmonic Components for Nanophotonics**, A. Boltasseva, R. Bakker, Z. Liu, H.-K. K. Yuan, A. V. Kildishev, V. M. Shalaev, *Purdue University, West Lafayette, IN, USA*, R. B. Nielsen, C. Jeppesen, and A. Kristensen, *Technical University of Denmark, Lyngby, Denmark*

We report on experimental realization of different metal-dielectric structures that are used as surface plasmon polariton waveguides and as plasmonic metamaterials. Fabrication approaches based on different lithographic and deposition techniques are discussed.

**TuA2.3 11.30 - 11.45**

**Silver Nanoparticle Impregnated Polycarbonate Substrates for Plasmonic Applications**, A. Peacock, L. Lagonigro, *University of Southampton, Southampton, Hampshire, UK*, T. Hasell, *University of Nottingham, Nottingham, UK*, S. Rohmoser, *University of Southampton, Southampton, UK*, S. Howdle, *University of Nottingham, Nottingham, UK*, P. J. A. Sazio and P. Lagoudakis, *University of Southampton, Southampton, UK*

We present a new class of plasmonic substrates where silver nanoparticles are impregnated into a polycarbonate host. The substrates are shown to be exceptional candidates for SERS and metal enhanced fluorescence applications.

**TuA2.4 11.45 - 12.00**

**Polarization Independent Lensing and Superbeaming in Plasmonic Crystals and Applications to Focal Plane Arrays**, D. Crouse, *City College of New York/CUNY, New York, NY, USA*

In this work, important but as yet overlooked polarization behavior of superbeaming and anomalous transmission in plasmonic crystals are studied. It is shown that polarization independent superbeaming and anomalous transmission can be achieved and applied to devices.

**TuA2.5 12.00 - 12.15**

**Investigation of Coupling Parameters and the Effect of Edges in Nano-plasmonic Waveguides**, M. Rasouli Disfani and M. S. Abrishamian, *K.N.Toosi University of Technology, Tehran, Iran*

In this paper, enhancement of coupling and transport of energy in two 2-dimensional plasmonic waveguides, with finite and infinite number of nanoparticles, are investigated. Furthermore, the effect of edges on highly field localization and coupling between plasmons are studied.

**TuA2.6 12.15 - 12.30**

**Compacted Splitter based on the Interlaced Metallic Particle Arrays**, X. Chen, H. Yu, F. Wang, Q. Zhou, J. Yang, M. Wang and X. Jiang, *Zhejiang University, Hangzhou, Zhejiang, China*

We propose ultra-short 1x2 and 1x3 power splitters with nanometer sized. The power splitters are designed by utilizing surface plasmon polaritons for the localization of electromagnetic energy in sub-wavelength interlaced metallic particle arrays.

12.30 – 14.00

LUNCH BREAK - *Restaurant Guggeryllis*

14.00 - 15.30

**Session TUA3: PHOTONIC CRYSTAL III****Session Chair:** Min Gu, *Swinburne University of Technology, Hawthorn, VIC, Australia***TuA3.1 14.00 - 14.15**

**Patterning of Photonic Quasi-Crystals on GaN LEDs**, A. Z. Khokhar, D. S. Macintyre, F. Rahman, R. M. De La Rue, N. P. Johnson, *University of Glasgow, Glasgow, Scotland, UK*, M. Charlton, *University of Southampton, Southampton, UK*, I. M. Watson, C. Xiong, P. Kelm, H. Zhang, E. Gu and M. D. Dawson, *University of Strathclyde, Glasgow, Scotland, UK*

The fabrication of 2-Dimensional (2D) Photonic Quasi Crystals (PQCs) on Gallium Nitride (GaN) Light emitting diodes (LEDs) is described. Fabrication was achieved using electron beam lithography (EBL) and, separately, by Nano-Imprint lithography (NIL).

**TuA3.2 14.15 - 14.30**

**Spurious-Free Dynamic Range (SFDR) Improvement in a True-Time-Delay System based on Highly Dispersive Photonic Crystal Fiber**, H. Subbaraman, *University of Texas at Austin, Austin, TX, USA*, M. Y. Chen, *Omega Optics Inc., Austin, TX, USA* and R. T. Chen, *University of Texas at Austin, Austin, TX, USA*

Spurious Free Dynamic Range improvement of a true-time-delay system based on highly dispersive photonic crystal fibers is achieved using a high power EDFA. The system exhibits a SFDR of 114 dB measured in a 1-Hz bandwidth.

**TuA3.3 14.30 - 14.45**

**Nested Photonic Crystal Cavity for On-Chip Wavelength Conversion**, A. Khorshidahmad and A. G. Kirk, *McGill University, Montréal, QC, Canada*

We propose a nested photonic crystal cavity configuration for on chip wavelength conversion based on adiabatic tuning of the resonator whereby dynamic switching between two cavity structures significantly extends the achievable frequency conversion range.

**TuA3.4 14.45 - 15.00**

**Lateral Current Injection Photonic Crystal Emitters**, C. Long, A. V. Giannopoulos and K. D. Choquette, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*

We report the first lateral current injected photonic crystal light emitting diodes. The devices utilize a transverse junction that is created using selective ion implantation. Electrical and spectral properties showing the influence of the photonic crystal are reported.

**TuA3.5 15.00 - 15.15**

**Photonic Crystals in Lithium Niobate by Ion-Beam Enhanced Etching**, H. Hartung, R. Geiss, T. Gischkat, F. Schrempel, R. Iliw, T. Pertsch, F. Lederer, W. Wesch, E. B. Kley and A. Tunnermann, *Friedrich-Schiller University- Jena, Jena, Germany*

A photonic crystal defect waveguide fabricated in a freestanding LiNbO<sub>3</sub> membrane is presented. The three dimensional patterning was done by means of ion-beam enhanced etching.

**TuA3.6 15.15 - 15.30**

**Hybrid Photonic Crystal Fiber Coupler Infiltrated with Liquid Crystals**, D. J. J. Hu, P. Shum, *Nanyang Technological University, Singapore*, C. Lu, *Hong Kong Polytechnic University, Hong Kong*, X. Sun, *Beijing Institute of Remote Sensing Equipment, Beijing, China*, G. Ren, X. Yu and G. Wang, *Nanyang Technological University, Singapore*

We theoretically investigate the thermally tunable photonic crystal fiber (PCF) coupler infiltrated with nematic liquid crystals. The thermo-optical responsive NLC offers thermal tunability of the fiber coupler. The proposed design can find promising sensor applications.

**15.30 – 16.00****COFFEE BREAK****16.00 - 17.45****Session TuA4: APPLICATIONS OF NANOPHOTONICS II****Session Chair: TBD****TuA4.1 16.00 - 16.30 (Invited)**

**Nanophotonics for Life**, M. Gu, *Swinburne University of Technology, Hawthorn, VIC, Australia*

We report on our recent nanophotonics developments with gold nanorods, medically-safe two-photon-induced cancer therapy and multi-dimensional optical data storage.

**TuA4.2 16.30 - 17.00 (Invited)**

**Lab-on-a-Chip Sensing using Ultra-Compact Si Nanophotonic Structures**, A. Adibi, A. A. Eftekhar, B. Momeni, M. Soltani and S. Yegnanarayanan, *Georgia Institute of Technology, Atlanta, GA, USA*

The combination of Si-based ultra-high Q micro-resonators and ultra-compact photonic crystal on-chip spectrometers has enabled highly-sensitive lab-on-a-chip sensing structures with orders-of-magnitude smaller size compared to conventional bulk sensing systems. Details of the design along with their experimental demonstrations will be presented.

**TuA4.3 17.00 - 17.15**

**Annular Holes and Their Arrays for Light Extraction from High Refractive Index Substrates**, J.-S. Bouillard, W. Dickson, J. Einsle, *Queens University of Belfast, Belfast, UK*, S. Gutiérrez Rodrigo, S. Carretero, L. Martin-Moreno, *Universidad De Zaragoza, Zaragoza, Spain*, F. Garcia-Vidal, *Universidad Autónoma de Madrid, Madrid, Spain* and A. V. Zayats, *Queens University of Belfast, Belfast, UK*

Transmission through Annular Aperture Arrays has been studied in detail on glass and high refractive index GaP substrate. The optimisation of the geometry of annular apertures and the nature of the transmission enhancement will be discussed.

**TuA4.4 17.15 - 17.30**

**Domain-Inversion-Equivalent EO Polymer based Y-fed Directional Coupler Modulator with High Linearity**, B. Lee, C. Lin, *University of Texas at Austin, Austin, TX, USA*, X. Wang, *Omega Optics Inc., Austin, TX, USA*, R. T. Chen, *University of Texas at Austin, Austin, TX, USA*, J. Luo, and A. K.-Y. Y. Jen, *University of Washington, Seattle, WA, USA*

A novel Y-branch directional coupler modulator (YDCM) with high linearity based on domain-inverted modulation was fabricated and tested. A two-tone test was performed to demonstrate the improvement of linearity of four-domain YDCM over two-domain YDCM.

**TuA4.5 17.30 - 17.45**

**Multi-Point In-Line Refractometry Using Tilted Fiber Bragg Gratings**, C. Caucheteur, *Faculté Polytechnique de Mons, Mons, Belgium*

Tilted fiber Bragg gratings (TFBGs) are accurate refractometers but they are badly suited for quasi-distributed refractive index sensing when TFBGs are cascaded along a single optical fiber. We demonstrate here that a commercial OTDR can be used for this purpose.

**Wednesday, 14 January 2009****08.30 - 09.45****Session WA1: NANOSTRUCTURES I****Session Chair:** Anatoly V. Zayats, *Queens University of Belfast, Belfast, UK***WA1.1 08.30 - 09.15 (Plenary)****Nanoscale Nonlinear Optics**, R. M. Osgood, *Columbia University, New York, NY, USA*

This talk will review and describe new advances in nonlinear optics in nanostructured materials in a variety of material media and optical structures.

**WA1.2 09.15 - 09.45 (Invited)****Subwavelength-Diameter Optical Fibers: Connecting Fiber Optics with Near-Field Optics, Nonlinear Optics and Quantum Optics on the Micro/Nanoscale**, L. Tong, *Zhejiang University, Hangzhou, Zhejiang, China*

ABSTRACT NOT AVAILABLE

**WA1.3 09.45 - 10.00****NanoPen: Light-actuated Patterning of Nanoparticles**, A. Jamshidi, *University of California - Berkeley, Berkeley, CA, USA*, P. J. Schuck, *Lawrence Berkeley National Laboratory, Berkeley, CA, USA*, P. J. Pauzauskie, *Lawrence Livermore National Laboratory, Livermore, CA, USA*, J. K. Valley, H.-Y. Hsu, A. T. Ohta, S. L. Neale and M. C. Wu, *University of California - Berkeley, Berkeley, CA, USA*

We introduce NanoPen, a novel technique for flexible, real-time reconfigurable, and large-scale light-actuated patterning of single or multiple nanoparticles such as metallic spherical nanoparticles, semiconducting and metallic nanowires, and carbon nanotubes.

**10.00 – 10.30****COFFEE BREAK****10.30 - 12.00****Session WA2: METAMATERIALS****Session Chair:** Richard M. Osgood, *Columbia University, New York, NY, USA***WA2.1 10.30 - 11.00 (Invited)****Photonic Metamaterials: Recent Progress**, M. Wegener and S. Linden, *University of Karlsruhe, Karlsruhe, Germany*

After briefly reviewing the tremendous progress in the emerging field of (e.g., magnetic or negative-index) photonic metamaterials, we focus on the remaining two major challenges: Fabrication of truly three-dimensional structures and reduction of losses.

**WA2.2 11.00 - 11.30 (Invited)****Nanophotonics at Sandia National Laboratories**, F. B. McCormick, *Sandia National Laboratories, Albuquerque, NM, USA*

Sandia National Laboratories is leveraging the extensive CMOS, MEMS, compound semiconductor, and nanotechnology fabrication and test resources at Sandia National Laboratories to explore new science and technology in photonic crystals, plasmonics, metamaterials, and silicon photonics.

**WA2.3 11.30 - 11.45****Double-Negative Polarization-Independent Fishnet Metamaterial Operating in the Visible Spectrum**, C. Garcia-Meca, R. Ortuño, F. Rodriguez-Fortuño, J. Marti and A. Martinez, *Universidad Politécnica de Valencia, Valencia, Spain*

We present a fishnet metamaterial design whose dimensions have been engineered to enhance a second-order magnetic resonance appearing at visible wavelengths. Both negative permittivity and permeability are achieved in this spectral range.

**WA2.4 11.45 - 12.00****Negative Index Metamaterial through High-Order Plasmon Resonances on U-Shaped Nanowires**, F. Rodriguez-Fortuño, C. Garcia-Meca, R. Ortuño, *Universidad J. Marti and A. Martinez, Universidad Politécnica de Valencia, Valencia, Spain*

Second- and third-order standing-wave slow-plasmon resonances on gold u-shaped nanowires are modelled and used to achieve a negative index metamaterial at far infrared frequencies which can be stacked showing backward phase propagation.

**12.30 – 14.00****LUNCH BREAK - Restaurant Guggeryllis****14.00 - 15.30****Session WA3: RESONATORS****Session Chair:** Frederick B. McCormick, *Sandia National Laboratories, Albuquerque, NM, USA*

**WA3.1 14.00 - 14.15**

**Ultra-High Quality Factor Silicon Nitride Planar Microdisk Resonators for Integrated Photonics in the Visible Range: A New Coupling Scheme**, E. Shah Hosseini and A. Adibi, *Georgia Institute of Technology, Atlanta, GA, USA*

Ultra-high quality ( $Q > 4E6$ ) microdisk resonators are demonstrated in a silicon nitride platform in visible with integrated in-plane coupling waveguides. Critical coupling to the microdisk mode is demonstrated using a pedestal and also a curved waveguide.

**WA3.2 14.15 - 14.30**

**Interferometrically-Coupled Traveling-Wave Resonators For Nonlinear Optics Applications**, A. H. Atabaki, Q. Li, S. Yegnanarayanan, M. Chamanzar, E. Shah Hosseini, A. A. Eftekhar, M. Soltani, B. Momeni and A. Adibi, *Georgia Institute of Technology, Atlanta, GA, USA*

A traveling-wave resonator structure with interferometric-coupling scheme is shown to have the capability of supporting both over-coupled and critically-coupled modes, simultaneously. This device is demonstrated in SOI with an integrated microheater to tune its coupling. The application of this device for nonlinear optics is discussed.

**WA3.3 14.30 - 14.45**

**Metal Nanoantennas and Dielectric Microresonators for Solid-State Quantum Optics**, T. Hanke, T. Thomay, B. Wild, K. Beha, J. Korger, M. Tomas, A. Zuschlag, V. Knittel, F. Sotier, M. Kahl, J. Merlein, A. Halm, M. Hagner, A. Leitenstorfer and R. Bratschitsch, *University of Konstanz, Konstanz, Germany*

We fabricate and optically investigate metal nanoantennas and pillar microresonators for efficient coupling of light from the far field into single nanoemitters, such as semiconductor quantum dots, diamond nanocrystals, or molecules.

**WA3.4 14.45 - 15.00**

**Sub-Wavelength Imaging of Optical Modes in Silicon Microdisk Cavities using a Near-field Probing Technique**, A. A. Eftekhar, M. Soltani, S. Yegnanarayanan and A. Adibi, *Georgia Institute of Technology, Atlanta, GA, USA*

We demonstrate sub-wavelength near-field imaging of the optical modes in high Q silicon microdisks. Mode profiles with a spatial resolution of ~20nm are obtained by characterizing the perturbative effects of a small scanning AFM tip.

**WA3.5 15.00 - 15.15**

**Spectral Characteristics of Coupled Silica Disc Microresonators**, C. Schmidt, A. Chipouline, T. Käsebier, *Friedrich-Schiller University- Jena, Jena, Germany*, L. Deych, *City University of New York, New York, NY, USA*, E. B. Kley, *Friedrich-Schiller University- Jena, Jena, Germany*, A. Tuennermann, *Fraunhofer-Institut, Jena, Germany* and T. Pertsch, *Friedrich-Schiller University- Jena, Jena, Germany*

A spectral response of coupled silica disc microresonators is investigated and light intensity distribution among the coupled discs is measured. The latter depends on the resonance frequencies of each of the resonators and excitation condition.

**WA3.6 15.15 - 15.30**

**Improved Mach-Zehnder Interferometer with Ring-Resonator-Based Two-Beam Interferometer**, F. Wang, X. Wang, S. Xiao, H. Yu, X. Jiang, M. Wang and J. Yang, *Zhejiang University, Hangzhou, Zhejiang, China*

An optical switch based on the Mach-Zehnder interferometer (MZI) with a micro-ring resonator as the two-beam interferometer is proposed. The improved MZI can always obtain a low crosstalk, even with seriously unbalanced interfering beams.

**15.30 – 16.00****COFFEE BREAK****16.00 - 17.15****Session WA4: NANOSTRUCTURES II****Session Chair:** Limin Tong, *Zhejiang University, Hangzhou, Zhejiang, China***WA4.1 16.00 - 16.15**

**Dense ( $10^{10} \text{ cm}^{-2}$ ) Arrays of Ordered Quantum Dots with Narrow ( $< 10 \text{ meV}$ ) Photoluminescence Spectra**, A. Surrente, M. Felici, P. Gallo, B. Dwir, A. Rudra and E. Kapon, *École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*

Dense Currently looks like ( $10^{10} \text{ cm}^{-2}$ ) quantum dots (QDs) were grown in inverted pyramidal recesses by OMCVD. The high uniformity of the QD array is demonstrated by micro-photoluminescence spectra having linewidth as small as 6.5 meV and AFM measurements.

**WA4.2 16.15 - 16.30**

**Optical Anisotropy of Semiconductor Nanowires**, S. L. Diedenhofen, O. L. Muskens, *FOM Institute, Eindhoven, The Netherlands*, E. P. A. M. Bakkens, *Philips Research Laboratories, Eindhoven, The Netherlands* and J. Gómez Rivas, *FOM Institute, Eindhoven, The Netherlands*

A novel class of optically anisotropic materials is presented. Layers of semiconductor nanowires fabricated in a bottom-up process exhibit a large in-plane birefringence and show quarter-wavelength retardation for a wavelength of 690 nm. These nanowire metamaterials are promising materials for optical gas- and biosensing.

**WA4.3 16.30 - 16.45**

**Valence Band Engineering and Polarization Switching in Quantum Dots Grown in Inverted Pyramids**, V. Troncale, K. F. Karlsson, *École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*, E. Pelucchi, *Tyndall National Institute, Cork, Ireland*, A. Rudra, B. Dwir and E. Kapon, *École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*

Control on the degree of valence band mixing is experimentally achieved in the particular GaAs/AlGaAs quantum Dot-in-Dot (DiD) structure. The effect is reflected by the tunable polarization of the emitted photons.

**WA4.4 16.45 - 17.00**

**Silicon Nano-Membranes for Efficient Large Angle Optical Beam Steering**, A. Hosseini, *University of Texas at Austin, Austin, TX, USA*

In this paper, we present a silicon nano-membranebased phased array structure for large angle optical beam steering. The new array structure allows for over  $\pm 60^\circ$  optical beam scanning with minimal degradation in the side-lobe-level and diffraction efficiency.

**WA4.5 17.00 - 17.15**

**Analysis of Scattering in Photonics Polymer Doped with Optically Anisotropic Cylinder Particles**, Y. Kato, *Keio University, Yokohama, Kanagawa, Japan*, A. Tagaya, *Japan Science and Technology Agency, Kawasaki, Japan* and Y. Koike, *Keio University, Kawasaki, Japan*

Using a polymer film doped with optically anisotropic particles, angular distribution difference of the scattering light is demonstrated depending on the oscillating direction of incident light. Analysis on particle size difference was studied as well.

***END OF PROGRAM***