Advance Program

Wednesday, 19 September 2007

08.45 - 09.45
Session PLE1: **PLENARY SESSION I**
Session Chair: Kazumi Wada, *University of Tokyo, Tokyo, Japan*

08.45 - 09.00 Opening Remarks and Welcome

PLE1.1 09.00 - 09.45
MIRAI's Optical Interconnection Project and Its Related Topics, K. Ohashi, *NEC Corporation, Tsukuba, Ibaraki, Japan*

ABSTRACT NOT AVAILABLE

09.45 - 10.15 COFFEE BREAK

10.15 - 12.30
Session WA: **WAVEGUIDES AND FILTERS**
Session Chair: Graham T. Reed, *University of Surrey, Guildford, Surrey, UK*

WA1 10.15 - 10.45 (Invited)
Ultra-Compact Optical Filters in Silicon-on-Insulator and Their Applications, W. Bogaerts, P. Dumon, J. Brouckaert, K. De Vos, D. Taillaert, D. J. Van Thourhout and R. G. Baets, *Ghent University, Gent, Belgium*

We present ultra-compact wavelength filters in SOI photonic wires: Mach-Zehnder lattice filters and ring resonators, as well as demultiplexers such as AWGs, and planar concave gratings. We also discuss devices for WDM communication and sensing. The circuits were fabricated with CMOS Technology.

WA2 10.45 - 11.00

Polarization Beam Splitter and Rotator for Polarization-Independent Silicon Photonic Circuit, H. Fukuda, K. Yamada, T. Tsuchizawa, T. Watanabe, H. Shinojima, and S.-I. Itabashi, *NTT Corporation, Atsugi-shi, Kanagawa, Japan*

We propose a novel polarization beam splitter and rotator for a polarization-independent silicon photonic circuit. The measured extinction ratio of splitter and simulated one of rotator are 23 and 20 dB, respectively.

WA3 11.00 - 11.15

Wavelength Independent SOI Polarization Splitter based on Zero-Order Arrayed Waveguide Gratings, W. N. Ye, D.-X. Xu, S. Janz, P. Waldron, J. Caballero, P. Cheben, *National Research Council, Ottawa, ON, Canada* and G. Tarr, *Carleton University, Ottawa, ON, Canada*

Novel Zero-order arrayed waveguide grating (AWG)based polarization splitters in the silicon-on-insulator platform are reported and experimentally demonstrated. These passive devices employ the cladding-induced stress for achieving the polarization splitting function.

WA4 11.15 - 11.30

SOI Delay Interferometer with Tuned Polarization Dependent Wavelength Shift for 40 Gbit/s DPSK Demodulation, K. Voigt, L. Zimmermann, G. Winzer, T. Mitze, J. Bruns, K. Petermann, *Technical University Berlin, Berlin, Germany* and C. Schubert, *Fraunhofer-Institut, Berlin, Germany*

An SOI Delay Interferometer (DI) manufactured in 4 μm rib waveguide technology with tuned Polarization Dependent Wavelength (PDWL) shift is presented. CW device performance & DPSK demodulation functionality in a 40 Gbit/s testbed are demonstrated.

WA5 11.30 - 11.45

Planar Concave Grating Demultiplexer with Distributed Bragg Reflection Facets, J. Brouckaert, W. Bogaerts, P. Dumon, S. Kumar Selvaraja, G. Roelkens, D. J. Van Thourhout and R. G. Baets, *Ghent University, Gent, Belgium*

We present measurement results of a 4-channel silicon-on-insulator grating demultiplexer fabricated in a CMOS-line. On-chip loss is reduced below 4.5dB over a broad wavelength range by replacing each facet by a second order Bragg reflector.

WA6 11.45 - 12.00

Microring Resonator-Coupled Multimode-Interference-based Crossing in 2x2 Cross-Grid Array Filters, F. Xu and A. W. Poon, *Hong Kong University of Science and Technology, Kowloon, Hong Kong*

We demonstrate microring resonator-coupled multimode-interference-based crossings in 2x2 cross-grid array filters in silicon-on-insulator. Our experiments reveal a Q of ~14,000 and an extinction ratio of ~15 dB in the drop-port spectrum via cascaded microring-coupled crossings.

WA7 12.00 - 12.15

Coupled Spiral-Shaped Microdisk Resonators with Asymmetric Non-Evanescent Coupling, X. Luo, J. Y. Lee and A. W. Poon, *Hong Kong University of Science and Technology, Kowloon, Hong Kong*

We demonstrate coupled spiral-shaped microdisk resonators with asymmetric non-evanescent coupling between the two microdisks in silicon nitride. Initial experiments reveal reciprocal throughput-port transmissions with high-Q. Simulations show input-direction-dependent drop-port transmissions and asymmetric mode-field distributions.

WA8 12.15 - 12.30

Silicon-on-Insulator Grating Duplexer for Fiber-to-the-Home Transceivers, G. Roelkens, D. J. Van Thourhout and R. G. Baets, *Ghent University, Gent, Belgium*

We present the design of an ultra-compact duplexing structure in the silicon-on-insulator material system based on a diffractive grating structure. This device has a 10μmx10μm footprint and combines fiber-to-chip interfacing and duplexing operation.

12.30 - 14.00 LUNCH BREAK

14.00 - 16.00

Session WB: OE AND III-V INTEGRATION
Session Chair: Jung Hoon Shin, *Korea Advanced Institute of Science and Technology, Daejeon, Korea*

WB1 14.00 - 14.30 (Invited)

A 40 GHz Mode Locked Silicon Evanescent Laser, B. R. Koch, A. W. Fang, H.-H. Chang, H. Park, Y.-H. Kuo, J. E. Bowers, *University of California - Santa Barbara, Santa Barbara, CA, USA*, R. Jones, M. Paniccia, *Intel Corporation, Santa Clara, CA, USA*, O. Cohen, and O. Raday, *Intel Corporation, Jerusalem, Israel*,

We demonstrate a mode locked silicon evanescent laser (ML-SEL) which generates a 39.2 GHz pulse stream without requiring any RF drive signal. This passively mode locked laser outputs 3.7 ps, nearly transform limited pulses and have 18 dB extinction ratio.

WB2 14.30 - 14.45

A 1550nm, 10Gbps Monolithic Optical Receiver in 130nm CMOS with Integrated Ge Waveguide Photodetector, G. Masini, J. Witzens, C. Gunn, *Luxtera, Inc., Carlsbad, CA, USA*, and G. Capellini, *University of Rome 3, Roma, Italy*

We introduce the world's first, high-speed optical receiver using Ge waveguide photodetectors monolithically integrated in the CMOS process. The integrated receiver achieves a sensitivity of -14.2dBm (10-12 BER) at 10Gbps and 1550nm.

WB3 14.45 - 15.00

1310nm Silicon Evanescent Laser, H.-H. Chang, A. W. Fang, M. N. Sysak, H. Park, J. E. Bowers, *University of California - Santa Barbara, Santa Barbara, CA, USA*, R. Jones, M. Paniccia, *Intel Corporation, Santa Clara, CA, USA*, O. Cohen, and O. Raday, *Intel Corporation, Jerusalem, Israel*

An electrically pumped 1310 nm silicon evanescent laser (SEL) is demonstrated utilizing the hybrid silicon evanescent waveguide platform. The SEL operates continuous wave (C.W.) up to 105 °C with a threshold current of 30 mA and a maximum output power of 5.5 mW.

WB4 15.00 - 15.15

InP-based Membrane Photodetectors for Optical Interconnects to Si, P. R. A. Binetti, X. J. M. Leijtens, M. Nikoufard, T. de Vries, S. Oei, R. Van Veldhoven, R. Notzel, M. K. Smit, *Technical University of Eindhoven, Eindhoven, The Netherlands*, L. Di Cioccio, J.-M. Fedeli, *CEA-LETI, Grenoble, France*, C. Lagahe, *TRACIT, Grenoble, France*, R. Orobtchouk, *INSA/LPM, Villeurbanne, France*, C. Seassal, *École Centrale de Lyon, Ecully, France*, J. Van Campenhout, and D. J. Van Thourhout, *Ghent University, Gent, Belgium*

We present the design, fabrication and characterization of an InP-based photodetector for optical interconnections on an SOI wafer containing a Si-wiring photonic circuit. Si waveguide losses are below 5 dB/cm. Measured detector responsivity is 0.45 A/W.

WB5 15.15 - 15.45 (Invited)

Heterogeneous Integration of III-V Active Devices on a Silicon-on-Insulator Photonic Platform, G. Roelkens, J. Brouckaert, J. Van Campenhout, D. J. Van Thourhout and R. G. Baets, *Ghent University, Gent, Belgium*

We present the heterogeneous integration of III-V active opto-electronic devices on top of a silicon-on-insulator photonic integrated circuit. This is achieved by adhesive die-to-wafer bonding of an unprocessed InP/InGaAsP epitaxial layer structure.

15.45 - 16.00 Special Talk

16.00 - 16.30 **COFFEE BREAK**

16.30 - 18.00
Session WC: MEMS AND 3D STRUCTURES
Session Chair: Koji Yamada, *NTT Corporation, Atsugi-shi, Kanagawa, Japan*

WC1 16.30 - 17.00 (Invited)
Recent Developments in Silicon-based MEMS Photonic Systems, N. F. de Rooij and W. Noell*, University of Neuchatel, Neuchatel, Switzerland*

Silicon-based photonic MEMS modulate light by displacing microoptical elements such as micromirrors and microlenses. Recent development focus on fiber-laser couplers, multi-object spectrometers, and tunable cavities.

WC2 17.00 - 17.30 (Invited)

Silicon Microresonators with MEMS-Actuated Tunable Couplers, M. C. Wu*, University of California - Berkeley, Berkeley, CA, USA*

We review the current state-of-the-art of tunable microdisk/microtoroidal resonators with MEMS-actuated couplers. They are key enabling elements of many wavelength-division-multiplexing switches and tunable filters. The performance of dynamic add-drop and bandwidth-tunable filters will be discussed.

WC3 17.30 - 17.45

Effect of Slab Deflection on a Mechano-Optic Modulator, T. Takahata*, University of Tokyo, Bunkyo-ku, Tokyo, Japan*, K. Matsumoto and I. Shimoyama*, University of Tokyo, Tokyo, Japan*

Mechano-optic modulator with a flexible photonic crystal waveguide and silicon rods fixed on a substrate has been devised. Simulations showed that the wavelength range was 90 nm. We have experimentally demonstrated 15 dB attenuation.

WC4 17.45 - 18.00

Efficient Mode Converter for Coupling between Fiber and Micrometer Size Silicon Waveguides, A. Barkai*, Intel Corporation, Jerusalem, Israel*

A low-loss polarization independent mode converter for coupling standard single mode fiber to a silicon chip is presented. For a micrometer size silicon waveguide, we demonstrate a coupling loss of 1-1.5 dB/facet.

18.15 - 20.30
Session WP: POSTER SESSION & WELCOME RECEPTION
Session Chair: Keishi Ohashi, *NEC Corporation, Tsukuba, Ibaraki, Japan*

WP1 Integration of Tensile-strained Ge p-i-n Photodetector on Advanced CMOS platform, J. Wang, W.-Y. Loh, H. Zang, K. T. Chua, T. H. Loh, J.-D. Ye, R. Yang, S. Wang, M. B. Yu, G.-Q. Loand D. L. Kwong*, Institute of Microelectronics, Singapore,* J. Wang, H. Zang, S. J. Lee, B.-J. Cho*, National University of Singapore, Singapore*

Tensile-strained Ge photodetector is realized on Si-substrate using novel Si/SiGe compliant layer with two-step Ge-process. Monolithic integration of p-i-n detectors with low dark current (0.4nA), responsivity (190mA/W) and high speed (>5GHz) on Ge-CMOS platform is demonstrated, with Ge pMOSFET showing 2X Si hole mobility.

WP2 Spectral Responsivity of Vertical p-i-n Photodiode of Selectively Grown Ge on Silicon-on-Insulator (SOI) Platform, S. Park, Y. Ishikawa, K. Wada*, University of Tokyo, Tokyo, Tokyo, Japan*, T. Tsuchizawa, T. Watanabe, K. Yamada, and S.-I. Itabashi*, NTT Corporation, Atsugi-shi, Kanagawa, Japan*

We demonstrated vertical Ge p-i-n photodiodes on an SOI substrate by selective epitaxial growth. It is strongly suggested from the spectral responsivity that strain in selective Ge mesas would be relieved because of a small and stripe shape of Ge mesas.

WP3 Gas Cluster Ion Beam Processing for Si Photonics, N. Toyoda, I. Yamada*, University of Hyogo, Himeji, Hyogo, Japan*, S. A. Akiyama, L. C. Kimerling*, Massachusetts Institute of Technology, Cambridge, MA, USA*, Y. Ishikawa, and K. Wada*, University of Tokyo, Tokyo, Japan*

Gas Cluster Ion Beam (GCIB) process is applied for surface smoothing of photonic band gap structure. After Ar-GCIB irradiations, hillocks on the Si_3N_4 surface were preferentially removed and smooth surface was realized. Reflectance spectra after Ar-GCIB irradiation came close to that of theoretical value.

WP4 Optical Properties of Silicon Three-Dimensional Photonic Crystal Fabricated by Self-Aligned Two-Directional Electrochemical Etching Method, D. Hippo, Y. Tsuchiya, H. Mizuta, S. Oda*, Tokyo Institute of Technology, Meguro-ku, Tokyo, Japan*, K. Urakawa, and N. Koshida*, Tokyo University of Agriculture and Technology, Koganei, Tokyo, Japan*

We deposited silicon nanocrystals on the three-dimensional photonic crystal structures fabricated by two-directional electrochemical etching method and observed a photoluminescence (PL) enhancement and a reduction in the PL decay time both at around 750nm.

WP5 High-Quality Factor Photonic Crystal Nanocavities Probed with SiGe/Si Self-Assembled Islands, M. El Kurdi, *Laboratoire de Photonique et de Nanostructures, Orsay, France*, X. Checoury, S. David, P. Boucaud, *Institut d'Electronique Fondamentale, Orsay, France*, T. P. Ngo, *Université Paris-Sud, Orsay, France*, O. Kermarrec, Y. Campidelli, and D. Bensahel, *STMicroelectronics, Crolles, France*

High-Q factor silicon photonic crystal nanocavities are probed using SiGe/Si self-assembled islands photoluminescence. Quality factor values of 15, 000 limited by spectrometer resolution, are measured with the internal source method. The measured quality factor values are strongly affected by the optical pumping of the cavity.

WP6 Assessment of the Excited Carrier Absorption Losses in Si-nc Rib-Waveguides, D. Navarro-Urrios, A. Pitanti, L. Ferraioli, N. Daldosso, L. Pavesi, *University of Trento, Trento, Italy*, F. Gourbilleau, and R. Rizk, *École Nationale Supérieure d'Ingénieurs de Caen, Caen, France*

Carrier absorption mechanisms and the additional losses that providee at 1.5 μm have been characterised on silicon-nanocrystal rib-waveguides pumped at 532 nm. We demonstrate that the dynamics of the mechanism is that of the luminescence.

WP7 Charge Transport and Electroluminescence in PECVD Grown Silicon-Nanocrystals-Based LEDs, O. Anopchenko, S. Prezioso, Z. Gaburro, L. Ferraioli, L. Pavesi, *University of Trento, Povo, Trento, Italy*, G. Pucker, *Microtechnologies Laboratory, Trento, Italy*, and P. Bellutti, *Istituto Trentino di Cultura, Trento, Italy*

Electrical carrier injection into PECVD grown silicon-nanocrystals-based LEDs was examined by I-V, C-V, and impedance measurements. Electroluminescence was measured as a function of gate AC frequency. The correlations between conduction mechanism and electroluminescence are discussed.

WP8 Theoretical and Experimental Demonstration of Light Confinement in a Multi-Slot Waveguide, Y. Fu, H. G. Yoo, D. Riley, P. M. Fauchet, *University of Rochester, Rochester, NY, USA*, and J. H. Shin, *Korea Advanced Institute of Science and Technology, Daejeon, Korea*

We describe an easy-to-fabricate multi-slot waveguide that is able to confine light in the low refractive index regions. Its application for future silicon light emission device is also discussed.

WP9 Controlling the Dynamics of Spontaneous Emission from SiN Material by Two-Dimensional Photonic Crystals, X. Xu, *Chinese Academy of Sciences, Beijing, China*, T. Yamada, R. Ueda and A. Otomo, *National Institute of Information and Communications Technology, Nishi-ku, Kobe, Japan*

We investigate the dynamics of spontaneous emission in photonic crystal etched into SiN slab. It was found that the spontaneous emission is enhanced much by photonic crystal and the decay curves are non-single exponentials.

WP10 Enhanced Light-emission from Crystalline Silicon in Microdisk Resonators, J. Xia, *Musashi Institute of Technology, Tokyo, Japan*

Microdisks were fabricated on silicon-on-insulator. Sharp resonant luminescent peaks, corresponding to the whispering-gallery modes, were observed in the disks. Integral photoluminescence intensity from crystalline silicon was significantly enhanced due to the microdisks.

WP11 Suppression of Er Optical De-Activation using Silicon-Rich Silicon Nitride, M.-S. Yang, K. J. Kim and J. H. Shin, *Korea Advanced Institute of Science and Technology, Daejeon, Korea*

The effect of nitride passivation on the Si nanocluster - Er coupling and Er optical activity is investigated. Based on a comparison with Er doped Si-rich Si oxide (SRSO), breaking of nc-Si/Er coupling and Er de-activation in Si-rich Si nitride (SRSN) are strongly reduced.

WP12 Effect of Ion-Irradiation Induced Defect on the Optically Active Er Ions in Er-doped Silicon-Rich Silicon Oxide, H. Jeong, S.-Y. Seo and J. H. Shin, *Korea Advanced Institute of Science and Technology, Daejeon, Korea*

We found that the initial presence of defects induced by ion-irradiation reduces the fraction of Er ions that can be excited via nanocluster silicon (nc-Si) even after their removal via high-temperature annealing.

WP13 Visible Luminescence from Controlled Multi-Layer Stack Comprising of Thin Amorphous Silicon and Silicon Nitride Layers, W. K. Tan, Q. Chen, M. B. Yu , G.-Q. Lo and D. L. Kwong, *Institute of Microelectronics, Singapore, Singapore*

We report photoluminescence (PL) and electroluminescence (EL) from multi-layer α-silicon/Si_3N_4. Peak PL is tunable within the red region by varying α-Si thickness. EL result is also reported. This structure benefits from a low-thermal-budget process (≤700°C).

WP14 Growth Rate Limiting by Er(TMOD)3 Supply in MOMBE Growth of ErSiO Crystalline, H. Choi, K. Tateishi, Y. Nakayama, H. Isshiki and T. Kimura, *University of Electro-Communications, Chofu, Tokyo, Japan*

This paper presents the relation between the partial pressures and growth rate on forming Er-Si-O crystalline thin films used by MOMBE.

WP15 Investigation of Solid Phase Growth Conditions of ErSiO Crystalline Compound Prepared by Sol-Gel Method, M. Ohe, H. Isshiki and T. Kimura, *University of Electro-Communications, Chofu, Tokyo, Japan*

Solid phase growth conditions of ErSiO crystalline compound are investigated. The temperature range between 1100 and 1200^{o}C is suitable to grow ErSiO crystalline compound in the oxygen free condition and then $Er_2Si_1O_5$ crystal can be obtained.

WP16 Optical Characteristics of Erbium-doped Silicon Suboxide Emitting at 1.5μm, Y. Naka, D. Miyawaki, T. Yoshida, T. Minami, K. Ito, Y. Nakamura, *Kumamoto University, Kumamoto, Japan*, M. Kishi, *University of Tokyo, Tokyo, Japan*, N. Yamamoto and M. Tsuchiya, *National Institute of Information and Communications Technology, Koganei, Tokyo, Japan*

We have formed erbium-doped silicon suboxide by vacuum deposition of erbium and silicon monoxide and subsequent annealing. The samples exhibited strong photoluminescence intensity at 1.5μm at room temperature.

WP17 Enhanced Hole Mobility in p-type β-FeSi2 Films Grown by Molecular Beam Epitaxy Using High-Purity Fe Source, M. Suzuno, Y. Ugajin, S. Murase and T. Suemasu, *University of Tsukuba, Tsukuba, Ibaraki, Japan*

The hole mobilities increased and hole densities decreased by one order of magnitude in intentionally undoped p-type β-$FeSi_2$ films formed with high-purity 5N-Fe source. The measured mobilities were reproduced well by considering several scattering mechanisms.

WP18 The Effect of Negative Direct Current Bias on the Crystallization of nc-Si:H Films Prepared by Plasma Enhanced Chemical Vapor Deposition, N.-H. Cho, *Inha University, Incheon, Korea*

Nanocrystalline Si thin films were prepared by PECVD. The effect of negative DC biases on the formation of Si nanocrystallites in the films and relevant optical features was investigated.

WP19 The Role of Excess Si Content on the Number of Si-Nanoclusters/Er Ions Couplings of Er Doped SiOx thin films, S.-Y. Seo, *Korea Advanced Institute of Science and Technology, Yusong-ku, Daejeon, Korea*, O. Jambois, *Laboratoire de Physique des Matériaux, Vandoeuvre-lès-Nancy, France*, P. Pellegrino, B. Garrido, *University of Barcelona, Barcelona, Spain* and R. Rizk, *École Nationale Supérieure d'Ingénieurs de Caen, Caen, France*

Due to short Er/Si-nanoclusters coupling distance, Er^{3+} ions located in close to Si-nanoclusters can be efficiently coupled Si-nanoclusters. More Er^{3+}/Si-nanoclusters were found for higher Si excess SiO_x:Er film wider Si-nanocluster surface area.

WP20 A Spot-Size Converter using a Nonlinear Vertical Up-Taper for Efficient Coupling of a Single-Mode Fiber to a Si-Wire Waveguide, K. Shiraishi, H. Yoda, H. Ikedo, *Utsunomiya University, Utsunomiya, Tochigi, Japan* and C. S. Tsai, *University of California - Irvine, Irvine, CA, USA*

Theoretical and experimental performances of a robust spot-size converter (SSC) for efficient coupling between a single-mode fiber and a silicon wire waveguide are presented. The SSC comprised of cascaded horizontal and nonlinear vertical up-tapers.

WP21 Polarization Insensitive Fiber to SOI Waveguide Experimental Coupling Technique Integrated with a V-Groove Structure, J. V. Galan Conejos, P. Sanchis Kilders, B. Sanchez and J. Martí, *Universidad Politécnica de Valencia, Valencia, Spain*

A coupling technique for highly efficient coupling between SOI waveguides and standard single-mode fibers is experimentally demonstrated. The proposed coupling structure is CMOS compatible, polarization insensitive and aimed for being integrated with V-groove auto-alignment techniques.

WP22 Silicon Concentric-Ring Optical Buffers, K. Wada, L. P. Huei, *University of Tokyo, Tokyo, Toyko, Japan* and C. S. Lim, *Nanyang Technological University, Singapore*

We designed a concentric-ring optical buffer with double the delay-bandwidth product of a conventional single-ring buffer with the same footprint and eliminated the usual maximal 3rd order dispersion at resonance.

WP23 Applications of Low-loss Silicon Photonic Wire Waveguides with Carrier Injection Structures, K. Yamada, T. Tsuchizawa, T. Watanabe, H. Fukuda, M. Shinojima and S.-I. Itabashi, *NTT Corporation, Atsugi-shi, Kanagawa, Japan*

Using low-loss silicon photonic wire waveguides with p-i-n structures, we developed compact variable optical attenuators with low power consumption and fast responses. We also examined ultra-fast carrier extraction for enhancing efficiencies of nonlinear optical devices.

WP24 A Compact Optical Switch Module with Si-Wire Waveguides, H. Yamada, *Tohoku University, Sendai, Miyagi, Japan*, T. Chu, S. Nakamura, M. Tokushima, Y. Urino, *NEC Corporation, Tsukuba, Ibaraki, Japan*, M. Tojo, *Alnair Labs, Tokyo, Tokyo, Japan*, S. Ishida and Y. Arakawa, *University of Tokyo, Meguro-ku, Tokyo, Japan*

A compact 1 x 4 optical switch modules were demonstrated with extremely small thermo-optic switches constructed by high-delta Si-wire waveguides. The characteristics of the device chip and the module will be presented.

WP25 Silicon Photonic Crystal Modulation Device based On Horizontally Activated MOS Capacitor, X. Chen, J. Chen, L. Gu, R. T. Chen, *University of Texas at Austin, Austin, TX, USA* and W. Jiang, *Omega Optics Inc., Austin, TX, USA*

A MOS-capacitor-based silicon photonic crystal modulation device is proposed to achieve active transmission control with ultra-low gate capacitance and simplified fabrication processes. Optical and electrical simulation results confirm the enhanced modulation efficiency.

WP26 Design Considerations for a Silicon-based p-i-n Phase Modulator Integrated on Double Ridge Waveguide with Side Isolating Grooves, S. Chen, X. Xu, X. Tu, J. Yu, *Chinese Academy of Sciences, Beijing, China*, D.-X. Xu, R. McKinnon, P. J. Barrios, P. Cheben, and S. Janz, *National Research Council, Ottawa, ON, Canada*

This paper presents design considerations and simulation results for a silicon-based p-i-n phase modulator integrated on double ridge waveguide with side isolating grooves, obtaining a balance between device response speed and absorption loss.

WP27 Effective Carrier Lifetime under High Injection in a Si P-i-N Diode Modulator, D. Zheng, J. Dong, B. T. Smith and M. Asghari, *Kotura, Monterey Park, CA, USA*

Effective carrier lifetime in a Si diode modulator was measured by two methods: a static optoelectronic method and a dynamic electrical transient method. Both methods demonstrated a declining lifetime with increasing carrier density.

WP28 High-Performance Silicon Phase Modulator based on a Double MOS Capacitor Configuration, A. Mao, D. Gao and Z. Zhou *Wuhan National Laboratory for Optoelectronics, Wuhan, Hubei, China*

A silicon double metal-oxide-semiconductor (MOS) capacitor structure is proposed to form a high efficient, high speed, and compact electrooptic phase modulator. The simulation results show that the modulation efficiency, , reaches 0.16 (V•cm) and the modulation speed exceeds 15GHz.

WP29 Dispersion and Anisotropy of Si's Third-Order Nonlinearity from 1.2 to 2.4 μm, J. Zhang, Q. Lin, G. P. Agrawal, and P. M. Fauchet, *University of Rochester, Rochester, NY, USA*

We present the first detailed characterization, to the best of our knowledge, of wavelength and polarization dependence of two-photon absorption and the Kerr nonlinearity in silicon over a spectral range extending from 1.2 to 2.4 μm.

WP30 Silicon Raman Amplifiers in the Limit of Zero Free-Carrier Lifetime, H. Renner, *Technische Universität Hamburg-Harburg, Hamburg, Germany*

Optimal lengths are given for silicon-waveguide Raman amplifiers assuming the free-carrier lifetime has been reduced to zero. For large pump powers the optimal length approaches an asymptotic upper limit, while the total gain grows unlimitedly.

WP31 Improving Switching Speed of a Nonlinear Mach-Zehnder Interferometric Logic Gate with Ring-Resonators, F. Cuesta-Soto, P. Sanchis Kilders and J. Martí, *Universidad Politécnica de Valencia, Valencia, Spain*

Ring-resonators enhance nonlinear effects but induce bandwidth and speed limitations in the device. By cascading RR an improved device with numerically estimated speed of 60 Gbit/s for a switching power of 5 mW is obtained.

WP32 Fabrication of InP Micro-Lasers on 200 mm Wafers, F. Mandorlo, *École Centrale de Lyon, Ecully, France* and J.-M. Fedeli, *CEA-LETI, Grenoble cedex 9, France*

By die to wafer bonding of InP heterostructure on 200 mm wafer, microelectronics type fabrication of μsource has been achieved using DUV lithography. LED emission was only obtained due to slanted etching of the cavity.

WP33 The ePIXnet Silicon Photonics Platform, P. Dumon, *Ghent University, Gent, Belgium*

The ePIXnet Silicon Photonics Platform provides a facility access programme for research and prototyping of silicon-on-insulator nanophotonic devices and circuits based on CMOS fabrication facilities. Through cost sharing, wafer-scale processing becomes affordable for academic and commercial users.

WP34 Large Group Index under Zero GVD Condition in Photonic Crystal Coupled Waveguides, T. Kawasaki, *Yokohama National University, Yokohama, Kanagawa, Japan*

A low group velocity of c/130 was obtained under zero GVD condition in photonic crystal coupled waveguides, which will be effective for optical buffering.

WP35 Demonstration of Low-Group-Velocity and Low-Dispersion Photonic Crystal Waveguide, S. Kubo, *Yokohama National University, Yokohama, Kanagawa, Japan*

We observed the light propagation characteristics in a photonic crystal waveguide, exhibiting low group velocity and low dispersion in a wide normalized bandwidth of 0.7%.

WP36 High Transmission Photonic Crystal Line-Defect Bend with Double Low-Index Trenches, S. H. Tao, *Institute of Microelectronics, Singapore*

A compact 120º hybrid bend sandwiched by two low-index trenches and embedded in photonic crystal is designed and fabricated. The simulation results show that the hybrid bend is efficient and has large high-transmission bandwidth.

WP37 Silicon Photonic Crystal Microcavities for Optical Quantum Information Processing, B. W. Balmforth, F. S. F. Brossard, S. Schirmer, *University of Cambridge, Cambridge, UK* and D. Williams, *Hitachi Cambridge Laboratory, Cambridge, UK*

We propose a system for scalable on-chip optical QIP using a coupled atom-cavity system in a silicon photonic crystal slab. Devices are optimised through simulation, and fabricated to allow completely non-intrusive experimental characterisation before further processing.

WP38 Low-Crosstalk in Silicon-on-Insulator Waveguide Crossings with Optimized-Angle, J. V. Galan Conejos, P. Sanchis Kilders, A. Brimont, A. Griol, J. Martí, M. A. Piqueras, *Universidad Politécnica de Valencia, Valencia, Spain* and J. M. Perdigues, *European Space Agency, Noordwijk, The Netherlands*

Low crosstalk losses in silicon-on-insulator (SOI) waveguides are demonstrated. The proposed crossing structure has a high compactness, a broad bandwidth with almost flat transmission losses and constant crosstalk losses and is robust against fabrication inaccuracies.

WP39 A High Efficiency Silicon Nitride Grating Coupler, L. Vivien, G. Maire, G. Sattler, D. Marris-Morini, E. Cassan, S. Laval, *Institut d'Electronique Fondamentale, Orsay cedex, France,* A. Kaźmierczak, D. Giannone, *Multitel a.s.b.l., Belgium*, B. Sanchez, A. Griol, D. Hill, *NTC, Valencia, Spain*, K.B. Gylfason, and H. Sohlström, *KTH, Sweden*

The experimental demonstration of a high efficiency silicon nitride grating coupler is reported for wavelengths from 1.25 to 1.45 μm for TE polarization. At the resonant angle, a coupling efficiency higher than 60% has been measured.

WP40 Design of a Temperature-Independent Arrayed Waveguide Grating on SOI Substrates, M. Uenuma, *Kyushu University, Fukuoka, Japan*

We have proposed a new temperature-independent AWG composed of 0.3 micron-thick Si waveguides with the widths of 0.4 and 1 micron on SOI substrates. The temperature dependence is minimized by optimizing these optical path lengths.

WP41 Design, Fabrication and Characterization of High Q-Factor SOI Microring Resonators, S. Maine, D. Marris-Morini, L. Vivien, E. Cassan, S. Laval, *Institut d'Electronique Fondamentale, Orsay cedex, France,* L. El Melhaoui and J-M. Fédéli, *CEA-LETI, Minatec, CEA-Grenoble, France*, B. Han, R. Orobtchouk, T. Benyattou, *INL Lyon, France*

Design, fabrication and characterization of SOI ring resonators using slightly etched rib waveguides are reported. Q-factor of 35300 has been measured for a 100µm ring radius and a 450nm coupling gap.

WP42 CMOS Compatible Intergrated Optical Isolator, D. Thomson, G. T. Reed, W. R. Headley and G. Z. Mashanovich, *University of Surrey, Guildford, Surrey, UK*

Herein we present our efforts to realise a novel integrated optical isolator. Utilising the principles of total internal reflection, the isolator is CMOS compatible and can be realised in a variety of materials.

WP43 Optimization Considerations for 4 µm SOI-Waveguide Technology with Respect to Polarization Dependence, L. Zimmermann, K. Voigt, G. Winzer, J. Bruns and K. Petermann, *Technical University Berlin, Berlin, Germany*

The geometry of 4 µm Silicon rib waveguides was optimized to reduce sensitivity of modal birefringence to process & substrate nonuniformities. Similar birefringence uniformities have been demonstrated experimentally on BESOI and SmartCut material.

WP44 Temperature Dependence of Grating-Assisted Coupling to Small Silicon Waveguides, G. Z. Mashanovich, B. Patel, V. Nsengumuremyi, D. Thomson, S. Howe, W. R. Headley, G. T. Reed, *University of Surrey, Guildford, Surrey, UK*, V. M. N. Passaro, *Bari Politechnic University, Bari, Italy*, and G. J. Ensell, *University of Southampton, Southampton, UK*

Coupling optical fibres with small silicon waveguides can present a challenge due to a large difference in refractive index and dimensions between the two. Here we investigate the temperature influence on a grating-assisted directional coupler.

Thursday, 20 September 2007

09.00 - 09.45

Session PLE2: **PLENARY SESSION II**
Session Chair: Lionel C. Kimerling, *Massachusetts Institute of Technology, Cambridge, MA, USA*

PLE2.1 09.00 - 09.45

Optoelectronic Integration for Computing Systems based on Group IV Photonics, A. V. Krishnamoorthy, *Sun Microsystems, San Diego, CA, USA*

The growth in demand for content and high-performance computing are driving system scaling to extreme levels. This creates a need for low-cost, energy efficient, high-performance interconnect within high-end systems. Can Group IV photonic interconnects help?

09.45 - 10.15 COFFEE BREAK

10.15 - 12.15

Session ThA: **MODULATORS & SWITCHES**
Session Chair: Andrew W. Poon, *Hong Kong University of Science and Technology, Kowloon, Hong Kong*

ThA1 10.15 - 10.45 (Invited)
The Quantum Confined Stark Effect in Ge/SiGe Quantum Wells: An Efficient Electroabsorption Mechanism for Silicon-based Applications, J. E. Roth, O. Fidaner, R. K. Schaevitz, E. H. Edwards, Y.-H. Kuo, J. S. Harris, D. A. B. Miller, *Stanford University, Stanford, CA, USA*, and T. I. Kamins, *HP Laboratories, Palo Alto, CA, USA*

The recent discovery of the quantum confined Stark effect in Ge/SiGe quantum wells with absorption coefficient modulation comparable to III-V materials will permit compact, low-power photonics components densely integrated with silicon electronics.

ThA2 10.45 - 11.00

A 1550 nm, 10 Gbps optical modulator with integrated driver in 130 nm CMOS, T. J. Pinguet, V. Sadagopan, A. Mekis, B. Analui, D. Kucharski and S. Gloeckner, *Luxtera, Inc., Carlsbad, CA, USA*

We present the world's first optical transmitter monolithically integrated in a CMOS process, achieving 10 Gb/s data modulation rate at 1550 nm with an extinction ratio greater than 6 dB.

ThA3 11.00 - 11.15

Circular Grating Resonators as Micro-Cavities for Optical Modulators, N. Moll, S. Schönenberger, T. Stöferle, R. F. Mahrt, B.-J. Offrein, *IBM Research, Rüschlikon, Switzerland*, T. Wahlbrink, J. Bolten, T. Mollenhauer, and C. Moormann, *AMO GmbH, Aachen, Germany*,

Because of their small footprint circular grating resonators could lead to the development of very advanced Silicon-on-insulator based nano-photonic devices clearly beyond state of the art. These photonic micro-cavities which are computationally designed and studied in their functionality and then fabricated and characterized.

ThA4 11.15 - 11.30

Femtosecond Carrier Dynamics in Ge/SiGe Quantum Wells, S. A. Claussen, L. Tang, J. E. Roth, O. Fidaner, S. Latif and D. A. B. Miller, *Stanford University, Stanford, CA, USA*

We resolve photoinduced changes in carrier populations of Ge/SiGe quantum wells using femtosecond pump-probe spectroscopy. Absorption transients < 400fs indicate rapid Γ→L intervalley scattering that may explain exciton linewidth and suggest saturable absorber applications.

ThA5 11.30 - 11.45

Low Loss Optical Modulator in a Silicon Waveguide Based on a Carrier Depletion Horizontal Structure, D. Marris-Morini, L. Vivien, S. Maine, E. Cassan and S. Laval, *Institut d'Electronique Fondamentale, Orsay, France,* P. Lyan and J. M. Fedeli, *Commissariat à l'Énergie Atomique, Grenoble, France*

Experimental results on an all-silicon optical modulator integrated into a SOI micro-waveguide are reported. A boron doped layer is embedded in the intrinsic region of a PIN diode, and carrier depletion is obtained by applying a reverse bias on the diode.

ThA6 11.45 - 12.15 (Invited)

Silicon Optical Modulator for High-speed Applications, A. Liu, L. Liao, J. Basak, H. Nguyen, M. Paniccia, *Intel Corporation, Santa Clara, CA, USA*, D. Rubin, *Intel Corporation, Jerusalem, Israel*, Y. Chetrit, R. Cohen and N. Izhaky, *Intel Corporation, Jerusalem, Israel*

We review silicon photonic technologies enabling low-cost photonic integrated circuits (PIC) for future optical interconnects. In particular, we discuss design, fabrication, and characterization of a high-speed silicon optical modulator capable of transmitting data up to 30 Gbps.

12.15 - 13.45 LUNCH BREAK

13.45 - 15.45

Session ThB: DISRUPTIVE MATERIALS & PROCESS TECHNOLOGIES
Session Chair: Tadamasa Kimura, *University of Electro-Communications, Chofu, Tokyo, Japan*

ThB1 13.45 - 14.15 (Invited)
Advances in Si-Ge-Sn Materials Science and Technology, J. Kouvetakis, *Arizona State University, Tempe, AZ, USA*

SiGeSn-based optical materials are synthesized on silicon and designed to undergo indirect-to-direct bandgap transitions via strain engineering and composition tuning across the IR range. These provide enabling buffer-layer technologies for integration of semiconductors with Si.

ThB2 14.15 - 14.30

Light-Emissive Nonvolatile Memory based on Nanocrystalline Porous Si, B. J. Gelloz, Y. Yoshida and N. Koshida, *Tokyo University of Agriculture and Technology, Koganei, Tokyo, Japan*

The characteristics of light-emissive nonvolatile memory based on nanocrystalline Si are dramatically improved by complete surface passivation with high-quality tunnel oxides. Electrically or optically stored information can be read out as either electrical or optical signal.

ThB3 14.30 - 15.00 (Invited)

Garnet Waveguides and Polarizers for Integrated Optical Isolators on Si Substrates, S.-Y. Sung, X. Qi and B. J. H. Stadler, *University of Minnesota, Minneapolis, MN, USA*

High quality YIG waveguides and photonic crystal polarizers were fabricated on Si with various cladding/buffer layers. The structures were designed for optical isolation at 1.55µm with the waveguide acting as a Faraday rotator with an integrated magnetic biasing film.

ThB4 15.00 - 15.15

PLZT Electro-Optic Modulators on Si Substrates Using Aerosol Deposition for On-Chip Optical Interconnections, T. Shimizu, K. Nishi, K. Ohashi, *NEC Corporation, Ibaraki, Japan*, M. Nakada, *MIRAI-Selete, Tsukuba, Japan*, H. Tsuda, and J. Akedo, *National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan*

We developed PLZT electro-optic modulators on Si substrates using aerosol deposition. The modulator was 250×300-micron with a 7-dB extinction ratio at the peak-to-peak voltage of 3 V. We observed an optical waveguide loss of 4 dB/mm.

ThB5 15.15 - 15.45 (Invited)

Optically Activated Si Nanowires and Nanoribbons as a Platform for Si-based Photonics, H.-J. Choi, *Yonsei University, Seoul, Korea*

Single crystalline Si nanowires were grown and Er coupling was carried out by ex-situ and in-situ method. Optical activation was confirmed by observing luminescence at the wavelength of 1.5 µm. The potential of Si nanowires as a new platform for Si-based photonics will be discussed.

15.45 - 16.15 COFFEE BREAK

16.15 - 18.00
Session ThC: **NONLINEAR OPTICS & ACTIVE FUNCTIONS**
Session Chair: Lorenzo Pavesi, *University of Trento, Povo, TN, Italy*

ThC1 16.15 - 16.45 (Invited)
Helium Implanted Silicon Waveguides and Their Applications to Functional Optical Devices, H. K. Tsang and Y. Liu, *Chinese University of Hong Kong, Shatin, Hong Kong*

Helium ion implantation in Si can modify both the linear absorption of below bandgap energy photons and the free carrier lifetime. Implanted Si waveguides may thus be used as low-loss photodetectors for power monitoring. Their shorter carrier lifetimes also help give longer nonlinear effective lengths.

ThC2 16.45 - 17.15 (Invited)

Photonic Crystal Nanocavities: Slow Light, All-optical Processing, Wavelength Conversion, Optical MEMS, M. Notomi, *NTT Corporation, Atsugi, Kanagawa, Japan*

We discuss several interesting applications of ultrahigh-Q and ultrasmall nanocavities recently realized in silicon photonic-crystal slabs: 1) All-dielectric slow-light media, 2) All-optical bistable switching elements towards all-optical logic chips, 3) Adiabatic wavelength conversion, 4) Super-efficient optomechanical energy converter.

ThC3 17.15 - 17.30

Deep-UV Lithography Fabrication of Slot Waveguides and Sandwiched Waveguides for Nonlinear Applications, J.-M. Fedeli, E. Jordana, P. Lyan, J.-P. Colonna, P. Gautier, *CEA-LETI, Grenoble, France*, N. Daldosso, L. Pavesi, *University of Trento, Povo, TN, Italy*, Y. Lebour, P. Pellegrino, B. Garrido, *University of Barcelona, Barcelona, Spain*, J. Blasco, F. Cuesta-Soto and P. Sanchis Kilders, *Universidad Politécnica de Valencia, Valencia, Spain*

Slot and sandwiched waveguides with silicon nanocrystals were fabricated by means of industrial microelectronic tools, including DUV lithography. Low loss of 4 dB/cm will pave the way to compact all-optical XOR logic gates.

ThC4 17.30 - 17.45

Spectral Narrowing and Optical Soliton Formation in SOI Waveguides, J. Zhang, Q. Lin, G. P. Agrawal, and P. M. Fauchet, *University of Rochester, Rochester, NY, USA*

We observe, for the first time to our knowledge, spectral narrowing due to the formation of optical solitons inside a short 5 mm long silicon waveguide with sub-picojoule pulse energies.

ThC5 17.45 - 18.00

Mid-Infrared Optical Amplifier utilizing Traveling Plasmons in Si-based Photonic Crystal Cavities, S. Lin and K. Wada, *University of Tokyo, Tokyo, Tokyo, Japan*

A novel mid-infrared optical amplifier utilizing direct interaction between traveling plasmons and optical wave is designed. Slow light in a photonic crystal resonator helps designing a maximal gain coefficient of 78dB.

Friday, 21 September 2007

08.45 - 10.15
Session FA: **SLOW LIGHT DEVICES & PASSIVE PHOTONIC CRYSTALS**
Session Chair: Susumu Noda, *Kyoto University, Kyoto, Japan*

FA1 08.45 - 09.15 (Invited)

Controlled Slowlight and Miniature Devices based on Silicon Photonics Waveguides, T. Baba, *Yokohama National University, Yokohama, Kanagawa, Japan*

Recent progress on micro-photonic devices in Si photonics are presented. Slowlight in photonic crystal waveguides optimized for optical buffering and signal processing is discussed. A polarization-insensitive micro-AWG based on photonic wire waveguides is also demonstrated.

FA2 09.15 - 09.30

Two-Dimensional Si Photonic Crystal Microcavity for Single Particle Detection, M. Lee and P. M. Fauchet, *University of Rochester, Rochester, NY, USA*

We theoretically and experimentally present a Si-based photonic crystal sensor for single particle detection. With a sensing area of ~40 μm^2, the device is capable of detecting a sphere of ~ 50 nm in diameter or less.

FA3 09.30 - 09.45

Group Velocity Measurements in 1D Periodic Corrugated SOI Waveguide, J. Garcia, J. Martí and P. Sanchis Kilders, *Universidad Politécnica de Valencia, Valencia, Spain*

The group velocity of a 1D SOI corrugated waveguide has been measured. Extremely low values at wavelengths near the edge of the guided band (around 1550 nm) have been obtained.

FA4 09.45 - 10.15 (Invited)

Slow Light and Low Loss Propagation on SOI Photonic Crystal Waveguides, T. F. Krauss, *University of St. Andrews, St. Andrews, Fife, UK*

Slow light in photonic crystal waveguides offers field and phase enhancement for photonic functionality. We demonstrate broadband operation (2.5 THz) of slow light devices and low loss (4 dB/cm) propagation of e-beam and DUV fabricated structures and discuss their dependence on disorder.

10.15 - 10.30 COFFEE BREAK

10.30 - 12.15
Session FB: LIGHT SOURCE: MATERIALS
Session Chair: TBD

FB1 10.30 - 11.00 (Invited)
Si-Ge Quantum Well and Cascade Structures for Optoelectronics, D. Gruetzmacher and G. Mussler, *Research Center Juelich, Jülich, Germany*

Low dimensional quantum structures may be suitable to overcome limitations given by the indirect bandgap of Si. The paper discusses the physics and technology of Si/SiGe and SiGe/Ge quantum wells for cascade and modulator devices.

FB2 11.00 - 11.15

Towards a Monolithically-Integrated Electrically-Pumped Si Light Emitter Technology using Epitaxial Erbium Oxide, V. A. Sabnis, H. Yuen, A. Jamora, S *ranslucent, Inc., Palo Alto, CA, USA*

WITHDRAWN

We present epitaxial e emitter technology for integration with CMOS electronics. These films offer strong photoluminescence and can be integrated into heterostructures for providing photodetection and electroluminescence.

FB3 11.15 - 11.30

Full Spectrum Emission and Hybrid OLEDs from Silicon Nanoparticles, S. Campbell, X. Pi, R. Liptak, R. Ligman and U. Kortshagen, *University of Minnesota Twin Cities, Minneapolis, MN, USA*

We demonstrate silicon nanoparticles with PL efficiencies >80%. An in-line process passivates the nanoparticles with a C-F coating, producing controlled emission from blue to red. Nanoparticles have been incorporated into polymers and electroluminescent devices have been demonstrated

FB4 11.30 - 11.45

Luminescence Characterization and Room-Temperature 1.6µm Electroluminescence in Si/β-FeSi2/Si Double Heterostructures on Si(001) by Molecular Beam Epitaxy, S. Murase, T. Suemasu, Y. Ugajin and M. Suzuno, *University of Tsukuba, Tsukuba, Ibaraki, Japan*

We have fabricated Si/β-FeSi$_2$/Si double heterostructures light-emitting diodes on Si(001) by molecular beam epitaxy and 1.6µm electroluminescence was realized at room temperature. The origin of luminescence was investigated using time-resolved photoluminescence measurements.

FB5 11.45 - 12.00

Auger Recombination in Luminescent, CMOS-compatible Si Nanowires, A. R. Guichard, R. D. Kekatpure and M. L. Brongersma, *Stanford University, Stanford, CA, USA*

TiSi$_2$-catalyzed Si nanowires are examined with time-resolved photoluminescence (PL). Analysis of PL decay at 1.55 eV (800 nm) reveals Auger recombination is the dominant process at high excitation and Auger rates are less than nanoparticles by over an order of magnitude.

FB6 12.00 - 12.15

Recent Advances in Si Nanocrystal LEDs by Employing Transparent SiCN Electron Injection Layer, C. Huh, J.-H. Shin, K.-H. Kim, J. Hong and G. Y. Sung, *Electronics & Telecommunications Research Inst., Daejeon, Korea*

We present recent progress in Si nanocrystal LEDs by applying a transparent SiCN electron injection layer and demonstration of the 8x8 micro-LED array with a high performance for bio-sensing applications.

12.15 - 13.45 LUNCH BREAK

13.45 - 15.30
Session FC: LIGHT SOURCES: DEVICE STRUCTURES
Session Chair: Siegfried Janz, National Research Council, Ottawa, ON, Canada

FC1 13.45 - 14.15 (Invited)
Light-Emitting Transistor based on Ultra-Thin Silicon, S.-I. Saito, D. Hisamoto, H. Shimizu, H. Hamamura, R. Tsuchiya, Y. Matsui, T. Mine, T. Arai, N. Sugii, K. Torii, S. Kimura and T. Onai*, Hitachi, Ltd., Tokyo, Japan*

We confirmed enhanced electroluminescence by lateral carrier injections to quantum confined ultra-thin silicon. The optical intensity can be controlled by the back gate voltage, and the device operates as a light-emitting transistor.

FC2 14.15 - 14.30

High Q/V Microdisk Resonators for Observation of Purcell Effect in Silicon Nanocrystals, R. D. Kekatpure, A. R. Guichard and M. L. Brongersma*, Stanford University, Stanford, CA, USA*

With an aim to optimize the Q/V figure-of-merit, we report fabrication and optical characterization of pedestal-supported silicon-nitride microdisk resonators containing silicon nanocrystals. Using experimental values of Q/V, range of achievable Purcell factors for this material system is predicted.

FC3 14.30 - 14.45

Resonant Photoluminescence from Crystalline Si with Photonic Crystal Nanocavity Structures, S. Iwamoto, Y. Arakawa*, University of Tokyo, Tokyo, Japan*, and A. Gomyo*, NEC Corporation, Tsukuba, Ibaraki, Japan*

We fabricated silicon photonic crystal nanocavities and observed intense photoluminescence (PL) form crystalline silicon at cavity resonant wavelengths. More than 300-times stronger peak intensity and a 50-fold enhancement of integrated PL intensity were demonstrated.

FC4 14.45 - 15.00

Cavity-Mode Light Emission in Silicon Photonic Nanocavities at Room Temperature, M. Fujita*, Kyoto University, Kyoto, Japan*

We report on the light emission of cavity modes from silicon-slab photonic crystal nanocavities at room temperature. The emission intensity of higher- order cavity mode is increased ~50 times compared with that of unprocessed silicon-on-insulator substrate.

FC5 15.00 - 15.15

Light Confinement in Ridge-Type, Single Mode Multi-Slot Waveguide with Er-doped Silica Layers, S. Lee, J. S. Chang, J. H. Shin*, Korea Advanced Institute of Science and Technology, Daejeon, Korea*, H. G. Yoo, Y. Fu and P. M. Fauchet*, University of Rochester, Rochester, NY, USA*

We have fabricated ridge-type, multi-slot waveguides that consist of nanometer-thin Si and Er-doped silica layers. Er ions in the low-index silica region will be used as atom-sized probes for actual power confined in the slot.

FC6 15.15 - 15.30

Fabrication and Characterization of Er doped Silicon-Rich-Silicon Nitride(SRSN) Microdisks, J. S. Chang, S. Lee, J. H. Shin*, Korea Advanced Institute of Science and Technology, Daejeon, Korea*, J.-H. Shin and G. Y. Sung*, Electronics & Telecommunications Research Inst., Daejeon, Korea*

Two types of Er doped silicon-rich silicon nitride (SRSN) based microdisks with different structures were fabricated. Optical property such as quality factors and emission spectrum were measured by using tapered fiber.

15.30 - 16.00 COFFEE BREAK

16.00 - 18.00
Session FD: DETECTORS
Session Chair: TBD

FD1 16.00 - 16.30 (Invited)
Ge-based Active Devices for Si Photonics, J. Liu, D. Ahn, S. Jongthammanurak, D. Pan, C.-Y. Hong, M. A. Beals, L. C. Kimerling and J. Michel*, Massachusetts Institute of Technology, Cambridge, MA, USA*

We present waveguide-coupled, Ge-based photodetectors and electro-absorption (EA) modulators for active Si integrated photonics. These devices offer high optoelectronic performance and compatibility with Si CMOS process.

FD2 16.30 - 17.00 (Invited)

Integrated Si/Ge Photodetectors for the Visible to the Near Infrared, E. Kasper*, University of Stuttgart, Stuttgart, Germany*

Ge on Si photodetectors increased their speed dramatically. We report about integration concepts of waveguides and modulators/detectors and about Ge/Si detector bandwidths of up to 40 GHz.

FD3 17.00 - 17.15

Germanium Photodetector Integrated in a Silicon-on-Insulator Microwaveguide, L. Vivien, M. Rouvière*, D. Marris-Morini, J. Mangeney, P. Crozat, E. Cassan,X. Le Roux, S. Laval, *Institut d'Electronique Fondamentale, Orsay cedex, France,* L. El Melhaoui, J-F. Damlencourt, and J-M. Fédéli, *CEA-LETI, Minatec, CEA-Grenoble, France*

Design, fabrication and characterization of germanium on silicon photodetector integrated in SOI waveguide are reported. A responsivity of 1 A/W and a -3dB bandwidth of 25 GHz under 6 V bias have been obtained at 1.55 µm.

FD4 17.15 - 17.30

High Speed Selective-Area-Epitaxial Ge-on-SOI PIN Photo-Detector using Thin Low Temperature Si0.8Ge0.2 Buffer by Ultra-High-Vacuum Chemical Vapor Deposition, T. H. Loh, J. Wang, H.-S. Nguyen, R. Murthy, W.-Y. Loh, M. B. Yu, G.-Q. Lo, B. Narayanan, and D. L. Kwong, *Institute of Microelectronics, Singapore, Singapore*

Ge/SiGe/SOI PIN photodiodes with 17~20GHz bandwidth at 1550nm, external quantum efficiency of 20%~36% at 850nm, and bulk dark current density of 1.5~2mA/cm^2, using low temperature $Si_{0.8}Ge_{0.2}$ buffer and without cyclic annealing were demonstrated.

FD5 17.30 - 17.45

Si/Ge Nano-Photodiode with a Surface-Plasmon Antenna, J. Fujikata, D. Okamoto, K. Nishi and K. Ohashi, *NEC Corporation, Tsukuba, Ibaraki, Japan*

We report on a Si nano-photodiode with Ag nano-electrodes embedded in a Si absorption layer and its near-field coupling structure with a surface plasmon antenna. For a Ge nano-photodiode, a good photoresponse with suppressed dark current was obtained for subwavelength electrode spacing.

FD6 17.45 - 18.00

Ge/Si Avalanche Photodiodes for 1.3µm Optical Fiber Links, Y. Kang, M. T. Morse, M. Paniccia, *Intel Corporation, Santa Clara, CA, USA*, S. Litski, G. Sarid, *Intel Corporation, Jerusalem, Israel*, A. Pauchard, *id Quantique, Carouge/Geneva, Switzerland*, K.-G. Gan and J. E. Bowers, *University of California - Santa Barbara, Santa Barbara, CA, USA*

We demonstrate the epitaxially-grown Ge/Si avalanche photodiodes with a responsivity at 1310nm of 0.52A/W, a breakdown thermal coefficient of 0.07%/°C, a 3dB-bandwidth of 7GHz and a dark current density of 2.75mA/cm^2 at unity gain.

END OF PROGRAM