Advance Program

Monday, 08 May 2006

Friend Center

8:15 AM - 10:30 AM

Session PLE: PLENARY SESSION
Session Co-Chairs: Stephen R. Forrest, *Princeton University, Princeton, NJ, USA*
Alwyn J. Seeds, *University College London, London, UK*

8:15 AM – 8:30 AM **Conference Welcome**

PLE1 8:30 AM - 9:10 AM
Improved Functionality and Performance in Photonic Integrated Circuits, L. A. Coldren, J. W. Raring, J. S. Barton, M. N. Sysak and L. A. Johansson, *University of California - Santa Barbara, Santa Barbara, CA, USA*

With the continued maturation of InP-based photonic ICs, improvements in their functionality, performance, and reliability are evolving. High-performance single-chip transmitters, receivers, sensors, transceivers, and wavelength converters that integrate numerous components have been demonstrated. Recent efforts will be reviewed.

PLE2 9:10 AM - 9:50 AM

The Evolution of InP as a Key Semiconductor Technology, G. A. Antypas, *CrystaComm, Mountain View, CA, USA*

Over the past 35 years InP emerged as one of the key technologies in support of the telecommunications revolution that is still underway. This review will address the evolution of the InP crystal growth technology from its origins to the present as driven by real and hyped market demands.

PLE3 9:50 AM - 10:30 AM

III-V Photonic Integration Outside Telecommunications - Does InP Have Any Role? J. H. Marsh, *Intense Photonics Ltd., High Blantyre, Scotland, UK*

Photonic products are now appearing that make extensive use of monolithic integration in III-V semiconductors. Many products use GaAs-based alloys either because the operation wavelength is important or because the physical properties of such alloys result in improved performance. Integration activity will be reviewed and the role for InP analysed.

10:30 AM – 11:00 AM COFFEE BREAK

Friend Center

11:00 AM - 12:30 PM

Session MA1: PHOTONICS AND QUANTUM CASCADE LASERS
Session Chair: Gareth Parry, *Imperial College of Science, Technology & Medicine, London, UK*

MA1.1 11:00 AM - 11:30 AM (Invited)

High Speed Integrated InP Photonic Digital-to-Analog Converter, A. Leven, Y. Yang, *Lucent Technologies, Murray Hill, NJ, USA*, J. Lin, *Bucknell University, Lewisburg, PA, USA*, P. K. Kondratko, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*, A. Tate, T.-C. Hu, N. G. Weimann and Y.-K. Chen, *Lucent Technologies, Murray Hill, NJ, USA*

We demonstrate an InP-based photonic integrated circuit for high-speed digital-to-analog (DAC) conversion. We obtained a single-tone spurious-free dynamic range (SFDR) of 32 dB with 4 control bits at 12.5 GSample/s.

MA1.2 11:30 AM - 11:45 AM

High-Performance of InAlGaAs/InAlAs/InP Multi-Mode Interference Photonic Switch with Partial Index-Modulation Region (MIPS-P), T. Ishikawa, S. Kumai, K. Utaka, *Waseda University, Shinjuku, Tokyo, Japan*, H. Amanai, K. Kurihara and K. Shimoyama, *Mitsubishi Chemical Corp., Ushiku City, Ibaraki, Japan*

Computer Science

11:00 AM - 12:30 PM

Session MB1: HEMT AND NOVEL CIRCUITS
Session Chair: Jesus A. del Alamo, *Massachusetts Institute of Technology, Cambridge, MA, USA*

MB1.1 11:00 AM - 11:30 AM (Invited)

Nanometer Scale InGaAs HEMT Technology for Ultra High Speed IC, K.-S. Seo and D.-H. Kim, *Seoul National University, Seoul, Korea*

Based on novel nano-patterning techniques including sidewall-gate and e-beam resist flowing process, high performance nanometer-scale InGaAs HEMTs were demonstrated and several high speed ICs such as new RTD/100nm HEMT NDR ICs have been successfully fabricated.

MB1.2 11:30 AM - 11:45 AM

High Frequency Drain Noise in InAlAs/InGaAs/InP High Electron Mobility Transistors in Impact Ionization Regime, H. Wang and Y. Liu, *Nanyang Technological University, Singapore*

An experimental characterization and analysis of drain (channel) noise in InP-based HEMTs in impact ionization regime has been performed in the frequency range of 2 to 20 GHz. The results further extend the understanding on high frequency noise originating from the impact ionization and I-V kink mechanism.

Advanced photonic networks in the next generation require high-speed switching with nano-second order switching time as well as low power consumption and low crosstalk, etc. Here higher performances of InAlGaAs/InAlAs MIPS-P has been demonstrated under precise control of the fabrication to obtain lower crosstalk than -20dB and sub-ns switching time.

MA1.3 11:45 AM - 12:00 PM

Low-Threshold Quantum-Cascade Lasers without Injector Regions, Emitting at λ ~ 6.7 μm, A. Friedrich, G. Boehm, and M.-C. Amann, *Technical University of Munich, Munich, Germany*

We report on an unusual quantum-cascade laser design without injector miniband with relatively small threshold current densities and voltages (0.2 kA/cm², 9.7 V at 77 K) and a maximum operating temperature of 380 K.

MA1.4 12:00 PM - 12:15 PM

Controllable Switching between Single Modes in Two-Segment Distributed Feedback Quantum-Cascade Lasers, S. Hoefling, *Universität Würzburg, Würzburg, Germany*, J. Seufert, B. Rösener, *nanoplus Nanosytems & Technologies GmbH, Gerbrunn, Germany*, J. P. Reithmaier, *University of Kassel, Kassel, Germany* and A. Forchel, *Universität Würzburg, Würzburg, Germany*

Reproducible switching between single-modes spectrally separated by ~1.5 cm^{-1} with two-segment quantum-cascade lasers is reported. Using this concept quasi-continuous tuning over 9 cm^{-1} with side mode suppression ratios up to 23 dB is demonstrated.

MA1.5 12:15 PM - 12:30 PM

A Dual-Wavelength Quantum Cascade Laser with Two Optical Transitions in Each Active Region, K. J. Franz, K.-T. Shiu, S. R. Forrest and C. Gmachl, *Princeton University, Princeton, NJ, USA*

We report on a novel quantum cascade laser design based on the second- and first-excited states of the constituent active region quantum wells. The laser produces simultaneous dual-wavelength emission at 8.2 μm and 9.3 μm.

MB1.3 11:45 AM - 12:00 PM

0.07 μm InP HEMT MMIC Technology for G-band Power Amplifiers, R. Lai, *Northrop Grumman Corporation, Redondo Beach, CA, USA*

We present a state-of-the art 0.07 μm T-gate InP HEMT MMIC amplifier with greater than 20 mW output power from 175-191 GHz. This is believed to be the first published power MMIC results at 190 GHz.

MB1.4 12:00 PM - 12:15 PM

Performance Improvement of InP-based Differential HBT VCO using the Resonant Tunneling Diode, Y. Jeong, S. Choi and K. Yang, *Korea Advanced Institute of Science and Technology, Daejon, Korea*

A new InP-based RTD/HBT VCO has been proposed for the first time. The enhancements of phase noise and RF output power for the conventional differential cross-coupled HBT VCO are 3.3 dBm and 8.7 dBc/Hz, respectively.

MB1.5 12:15 PM - 12:30 PM

100 GHz Operation of a Resonant Tunneling Logic Gate MOBILE Having a Symmetric Configuration, K. Maezawa, H. Sugiyama, S. Kishimoto and T. Mizutani, *Nagoya University, Nagoya, Aichi, Japan*

This paper proposes a novel resonant tunneling logic gate, SMOBILE, which can operate at double-clock rate. 100 GHz operation is demonstrated with complementary 50 GHz clocks for circuits fabricated on InP substrates.

12:30 PM – 1:30 PM LUNCH BREAK

1:30 PM - 3:30 PM

Session MA2: LASERS II
Session Co-Chairs: Shigehisa Arai, *Tokyo Institute of Technology, Tokyo, Japan* and Frederic Van Dijk, *Alcatel Thales III-V Lab, Marcoussis, France*

MA2.1 1:30 PM - 2:00 PM (Invited)

High Power Full-Band External Cavity Wavelength Tunable Laser, K. Sato and K. Kudo, *NEC Corporation, Otsu, Shiga, Japan*

We present a high performance external cavity wavelength tunable laser without an intracavity etalon. Fiber coupled output power of more than 50 mW and SMSR of 45 dB over the full C-band are experimentally demonstrated.

MA2.2 2:00 PM - 2:15 PM

Fabrication of InP/InGaAsP Multi-Mode Interference Distributed Bragg Reflector Laser All-Optical Flip-Flops, M. Raburn, Infinera, Sunnyvale, CA, USA, M. Takenaka, K. Takeda, X. Song, *University of Tokyo, Meguro, Japan*, J. S. Barton, *University of California - Santa Barbara, Santa Barbara, CA, USA* and Y. Nakano, *University of Tokyo, Meguro, Tokyo, Japan*

Integrable InP single-MOVPE-regrowth active/passive DBR multi-mode interference bistable laser all-optical flip-flops are demonstrated. They are SET /RESET with –3dBm /–5dBm external light injection. 1D versions have extinction ratios over 32dB and suggest amplification-free cascadability.

1:30 PM - 3:30 PM

Session MB2: HIGH SPEED HBTS
Session Chair: Tahir Hussain, *HRL Laboratories, Malibu, CA, USA*

MB2.1 1:30 PM - 2:00 PM (Invited)

Design and Test of InP DHBT ICs for a 100 Gb/s Demonstrator System, T. Swahn, J. Hallin and T. Kjellberg, *Chalmers University of Technology, Goteborg, Sweden*

We report on design and test of state-of-the-art building blocks for a 100 Gb/s demonstrator system: a 165 Gb/s 4:1 multiplexer IC and a 110 Gb/s PRBS generator IC in InP DHBT technology.

MB2.2 2:00 PM - 2:15 PM

State of the Art Low Power (42mW per flip-flop) 150GHz+ CML Static Divider Implemented in Scaled 0.2μm Emitter-Width InP DHBTs, D. A. Hitko, T. Hussain, D. S. Matthews, R. D. Rajavel, I. Milosavljevic and M. Sokolich, *HRL Laboratories, Malibu, CA, USA*

We report the results of an ultra low power frequency divider implemented in optimally scaled 0.2μm emitter width InP DHBT technology. The power consumption of 21mW per latch is the lowest reported with state of the art high frequency operation above 120GHz.

MA2.3 2:15 PM - 2:30 PM

InP on Silicon Electrically Driven Microdisk Lasers for Photonic ICs, P. Rojo-Romeo, *École Centrale de Lyon, Ecully, France*

An electrically driven microlaser based on a thin InP based microdisk transferred onto silicon is proposed. The technological procedure is described and first experimental results, showing a laser threshold current of 1.5 mA are exposed.

MA2.4 2:30 PM - 2:45 PM

Design and Fabrication of a Tunable InP-based VCSEL using a Electro-Optic Index Modulator, C. Levallois, S. Richard, A. Le Corre, S. Loualiche, O. Dehaese, *Centre National de la Recherche Scientifique, Rennes, France*, B. Caillaud, J.-L. de Bougrenet de la Tocnaye and L. Dupont, *Centre National de la Recherche Scientifique, Brest, France*

We demonstrated the first tunable 1.55-µm VCSEL using a liquid crystal based refractive index modulator. This optically pumped device shown a laser emission at room-temperature and can be tuned on 10-nm wavelength range.

MA2.5 2:45 PM - 3:00 PM

Novel Tunable DFB Laser with Separated High Coupling Coefficient Gratings, N. Nunoya, Y. Shibata, H. Ishii, H. Okamoto, Y. Kawaguchi, Y. Kondo, H. Oohashi, and K. Kato, *NTT Corporation, Atsugi, Kanagawa, Japan*

A novel continuously tunable DFB laser with simple current tuning is proposed. A wide stop-band width achieved by using a grating with a high 200 cm^{-1} coupling coefficient provides a continuous 2.1 nm tuning wavelength range.

MA2.6 3:00 PM - 3:15 PM

Monolithically Integrated QCSE-tuned InGaAsP MQW Ridge Waveguide DBR Laser, M. I. Pantouvaki, C.-P. Liu, C. C. Renaud, *University College London, London, UK*, S. Cole, M. J. Robertson, *Centre for Integrated Photonics, Ipswich, Suffolk, UK*, R. M. Gwilliam, *University of Surrey, Guildford, Surrey, UK* and A. J. Seeds, *University College London, London, UK*

The first QCSE-tuned ridge waveguide InGaAsP MQW DBR laser monolithically integrated with QW-intermixed tuning sections is demonstrated. QCSE is used for tuning with minimal thermal effects over ~7nm for <-2.5V applied voltage.

MA2.7 3:15 PM - 3:30 PM

10-Gb/s - 120-˚C Operation of 1.3-µm AlGaInAs-MQW-FP-LD with Ru-doped InP Buried Heterostructure, K. Tsuruoka, R. Kobayashi, K. Naniwae, K. Tokutome, Y. Ohsawa and T. Kato, *NEC Corporation, Otsu, Shiga, Japan*

We have developed the first 1.3-µm AlGaInAs-MQW-FP-LD with Ru-doped InP buried heterostructure by narrow-stripe selective MOVPE. 10-Gb/s operation up to 120 °C and more than 3,500-hour reliability under 85-°C APC test has been successfully achieved.

MB2.3 2:15 PM - 2:30 PM

Ultra-High Speed Composition Graded InGaAsSb/GaAsSb DHBTs with f_T=500GHz Grown by Gas-Source Molecular Beam Epitaxy, B.-R. Wu, W. Snodgrass, W. Hafez, M. Feng and K. Y. Cheng, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*

Graded InGaAsSb:C base double heterojunction bipolar transistors (DHBT) were grown on InP to enhance the electron transit time through the base region. A record high unity current gain frequency f_T of 500 GHz is achieved in the DHBT with a 250Å thick InGaAsSb:C linear graded base.

MB2.4 2:30 PM - 2:45 PM

High-Current-Gain InAlP/AlGaAsSb/InP HBTs with a Compositionally-Graded AlGaAsSb Base Grown by MOCVD, Y. Oda, K. Kurishima, N. Watanabe, M. Uchida, and T. Kobayashi, *NTT Corporation, Atsugi, Kanagawa, Japan*

To improve current gain of InP/GaAsSb-based HBTs, we propose InAlP/AlGaAsSb/InP HBTs with compositionally-graded Al content in the base. The proposed HBT shows more than 1.5 times the current gain of the conventional GaAsSb-base HBT.

MB2.5 2:45 PM - 3:00 PM

InGaAs/InP DHBTs with a 75nm Collector, 20nm Base Demonstrating 544GHz f_T, BV_{CEO} = 3.2V, and BV_{CBO} = 3.4V, Z. Griffith, M. J. W. Rodwell, *University of California - Santa Barbara, Santa Barbara, CA, USA*, X.-M. Fang, D. Loubychev, Y. Wu, J. M. Fastenau and A. W. K. Liu, *IQE Incorporated, Bethlehem, PA, USA*

InP DHBTs employing a 20nm InGaAs base and 75nm InP collector are presented, exhibiting a maximum f_T=544GHz with a 347GHz f_{max}--the highest f_T for an InP DHBT, and highest f_T at a 75nm collector thickness for any HBT. The current gain β=50, BV_{CEO}=3.1V, BV_{CBO}=3.4V and P,max=24mW/µm^2 at V_{ce}=2.0V.

MB2.6 3:00 PM - 3:15 PM

Sub-Micrometer InP/InGaAs Heterojunction Bipolar Transistors with f_T = 400 GHz and f_{max} > 500 GHz, D. W. Scott, *Northrop Grumman Corporation, Redondo Beach, CA, USA*

We present InP-based HBTs with 0.25µm emitters having f_T = 400GHz and f_{max} > 500GHz. These devices and up to four levels of interconnect have been used to demonstrate static divide-by-2 and small DDS circuits.

MB2.7 3:15 PM - 3:30 PM

Selectively Implanted Subcollector DHBTs, N. Parthasarathy, Z. Griffith, *University of California - Santa Barbara, Santa Barbara, CA, USA*, C. Kadow, *Infineon Technologies, Munich, Germany*, U. Singisetti, *University of California - Santa Barbara, Santa Barbara, CA, USA*, M. Urteaga, K. Shinohara, B. Brar, *Rockwell Scientific Company, Thousand Oaks, CA, USA* and M. J. W. Rodwell, *University of California - Santa Barbara, Santa Barbara, CA, USA*

$In_{0.53}Ga_{0.47}As$/InP double heterojunction bipolar transistors with implanted subcollectors have been designed and fabricated to eliminate the base access pad capacitance. A blanket Fe implant eliminates the interface charge and a patterned Si implant creates an isolated N^{++} subcollector. The extrinsic base-collector capacitance C_{cb} associated with the base interconnect pad (~25% of the total C_{cb}) is thus eliminated. These implanted subcollector DHBTs have 363GHz f_t and 410GHz f_{max}. The DC current gain β ~ 40, BV_{ceo} = 5.6V, BV_{cbo} = 6.9V (I_C = 1 mA).

3:30 PM – 4:00 PM COFFEE BREAK

4:00 PM - 5:00 PM

Session TuPD: POSTDEADLINE PAPERS
Session Chair: Gregory H. Olsen, *GHO Ventures, LLC, Princeton, NJ, USA*

Tuesday, 09 May 2006

Friend Center

8:30 AM - 10:30 AM

Session TuA1: Lasers II
Session Co-Chairs: John H. Marsh, *Intense Photonics Ltd., High Blantyre, Scotland, UK* and Young-Kai Chen, *Lucent Technologies, Murray Hill, NJ, USA*

TuA1.1 8:30 AM - 8:45 AM

Low Threshold Current Operation of Stacked InAs/GaAs Quantum Dot Lasers with GaP Strain-Compensation Layers, J. Tatebayashi, N. Nuntawong, Y. Xin, P. Wong, S. Huang, C. P. Hains, L. F. Lester and D. L. Huffaker, *University of New Mexico, Albuquerque, NM, USA*

We report the device characteristics of stacked InAs/GaAs quantum dots with GaP strain compensation layers grown by MOCVD. We achieve ground-state lasing at 1.265 micron with low threshold current density of 108 A/cm^2.

TuA1.2 8:45 AM - 9:00 AM

High Performance P-doped InAs Tunnel Injection Quantum Dash Lasers on InP, Z. Mi, J. Yang and P. Bhattacharya, *University of Michigan, Ann Arbor, MI, USA*

P-doped tunnel injection InAs quantum dash lasers are reported for the first time. It exhibits very large T_0 (204K), large modulation bandwidth (f-3dB = 12 GHz), and near-zero α-parameter and low chirp (~ 0.3 Å).

TuA1.3 9:00 AM - 9:15 AM

Low Linewidth Enhancement Factor (αH ~ 0.5) of 9- Layer InAs/InP Quantum Dash Lasers Emitting at 1.55 µm, G. Moreau, K. Merghem, A. Ramdane, *CNRS-LPN, Marcoussis, France* and F. Lelarge, *Alcatel, Marcoussis, France*

A record low linewidth enhancement factor (αH ~ 0.5) is demonstrated for high modal gain 9-layer InAs/InP (100) Quantum Dash in-a-well (DWELL) ridge waveguide lasers emitting at 1.55 µm.

TuA1.4 9:15 AM - 9:30 AM

Experimental and Theoretical Investigations on Spectral Gain Bandwidth of Broadband (>300 nm) InP-based Quantum Dash Material, A. Somers, W. Kaiser, *University of Würzburg, Würzburg, Germany*, J. P. Reithmaier, *University of Kassel, Kassel, Germany*, A. Forchel, *University of Würzburg, Würzburg, Germany*, M. Gioannini, and I. Montrosset, *Politecnico di Torino, Torino, Italy*

A spectral gain bandwidth >300 nm is experimentally and theoretically confirmed on an InP based QDash material. Processed DFB lasers show single mode emission (SMSR > 39 dB) over 100 nm on a single chip bar.

TuA1.5 9:30 AM - 9:45 AM

High T_0 Operation of 1590 nm GaInAsP/InP Quantum-Wire DFB Lasers by Bragg Wavelength Detuning, Y. Nishimoto, H. Yagi, K. Miura, D. Plumwongrot, K. Ohira, T. Maruyama, and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

By adopting the Bragg wavelength detuning from the gain peak wavelength, temperature dependences of GaInAsP/InP Quantum-Wire DFB lasers were improved. The characteristic temperature for threshold current of 95 K and that for the differential quantum efficiency of 243 K were obtained for 20 to 80 °C temperature range.

TuA1.6 9:45 AM - 10:00 AM

Buried Ridge Stripe Lasers using InAs/InP (100) Quantum Dashes based Active Layer: A Step Towards Low Noise Sources

Computer Science

8:30 AM - 10:30 AM

Session TuB1: Bulk Materials & Characterization
Session Co-Chairs: David F. Bliss, *US Air Force Research Laboratory, Hanscom AFB, MA, USA* and Eric Monberg, *OFS Laboratories, Murray Hill, NJ, USA*

TuB1.1 8:30 AM - 9:00 AM (Invited)

Recent Research Results on Deep Level Defects in Semi-Insulating InP - Application to Improve Material Quality, Y. Zhao, Z. Dong, *Chinese Academy of Sciences, Beijing, China*, N. Sun and T. Sun, *Hebei Semiconductor Research Institute, Hebei, China*

An apparent defect suppression effect has been observed in InP through an investigation of deep level defects in different semi-insulating (SI) InP materials. Quality improvement of SI-InP based on the defect suppression mechanism is presented.

TuB1.2 9:00 AM - 9:15 AM

A New Approach for Feedback Control of Radius and Growth Rate in Czochralski (Cz) Processes Exemplarily Studied on LEC-InP, M. Neubert, *Institute for Crystal Growth, Berlin, Germany*, J. Winkler and J. Rudolph, *Technical University of Dresden, Dresden, Germany*

System variables 'radius' and 'growth angle' are reconstructed using observers. Tey are less noisy and more releable than those obtained by numerical differentiation. A controler ist presented being capable to control the whole crystal with only one set of parameters, even for different geometries. Growth rate can also be controlled.

TuB1.3 9:15 AM - 9:45 AM (Invited)

Technologies and Applications of Two-Dimensional InP-based Photonic Crystals, F. Pommereau, M. Attali, R. Brenot, C. Cuisin, E. Derouin, O. Drisse, G.-H. Duan,J. Landreau, L. Le Gouezigou, F. Lelarge, F. Poingt and B. Rousseau, *Alcatel, Marcoussis, France*

We present an overview of the fabrication technologies of two-dimensional PhCs on InP based materials, and some results on PhC based high power lasers, filters, and tunable lasers.

TuB1.4 9:45 AM - 10:00 AM

Characterization of HVPE-Grown Thick GaAs Structures for IR and THz Generation, C. Lynch, D. F. Bliss, T. Zens, D. Weyburne, *US Air Force Research Laboratory, Hanscom AFB, MA, USA*, J. Jimenez, M. Avella, *University of Valladolid, Valladolid, Spain*, P. Kuo and X. Yu, *Stanford University, Stanford, CA, USA*

Hydride vapor phase epitaxy (HVPE) growth of quasi-phase-matched GaAs has been characterized by optical microscopy, Hall measurement, and cathodoluminescence imaging. We demonstrate growth of high resistivity, mm-thick orientation-patterned GaAs for efficient nonlinear optical conversion.

TuB1.5 10:00 AM - 10:15 AM

A Band-to-Band Coulomb Interaction Model for Refractive Indices of $Al_xGa_{1-x}As$ and InGaAs Ternary Materials at Photon Energies Near and Above the Band-Gap, E. Y. Lin, T.-S. Lay and T. Y. Chang, *National Sun Yat-sen University, Kaohsiung, Taiwan, R.O.C.*

Refractive indices of ternary materials at photon energies somewhat above the bandgap have been modeled from Kramers-Kronig transform through an absorption model with Coulomb interaction and a double-Lorentzian broadening in employing Vegard's law.

for High-Speed Direct Modulation, F. Lelarge, B. Rousseau, F. Martin, F. Poingt, L. Le Gouezigou, F. Pommereau, A. Accard, D. Make, O. Le Gouezigou, J. Landreau, J. G. Provost, J. Renaudier, G.-H. Duan and B. Dagens, *Alcatel, Marcoussis, France*

We investigate the devices performances of quantum dash based buried lasers. We report high gain, 10Gb/s direct modulation and mode-locking operation and we discuss the potential of such material for high-speed directly-modulated source with low-noise figure.

TuA1.7 10:00 AM - 10:15 AM

Narrow Stripe Membrane BH-DFB Lasers with Surface Corrugation for Stable Single-Mode Operation, S. Sakamoto, H. Kawashima, H. Naitoh, S. Tamura, T. Maruyama, and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

A stable single-mode operation of membrane BH-DFB lasers was demonstrated under RT-CW operation by adopting a surface corrugation structure. Lowest threshold pump power of 0.69 mW was obtained for the stripe width of 1.0 µm and the cavity length of 120 µm.

TuA1.8 10:15 AM - 10:30 AM

Etched Gap Mirror Based Integration of Variable Optical Attenuator with Full C-Band External Cavity Wavelength Tunable Laser, K. Mizutani, S. Sudo, T. Okamoto, K. Turuoka, M. L. Nielson, K. Sato and K. Kudo, *NEC Corporation, Otsu, Shiga, Japan*

We developed etched mirror based integration technology for adding functional devices monolithically on a gain chip for external cavity wavelength tunable laser (ECTL). We demonstrated high output power, sufficient extinction ratio and stable lasing of a novel ECTL with integrated VOA.

TuB1.6 10:15 AM - 10:30 AM

Cathodoluminescence Characterization of InP based Photonic Structures made by Dry Etching, M. Avella, *University of Valladolid, Valladolid, Spain*, F. Pommereau, *Alcatel, Palaiseau, France*, J. Jimenez, *University of Valladolid, Valladolid, Spain*, J.-P. Landesman, B. Liu and A. Rhallabi, *University of Nantes, Nantes, France*

Cathodoluminescence characterization of InP based photonic crystals is presented. RIE and ICP structures were studied. The influence of the etching process in the surface recombination and the generation of defects are discussed for different structures.

10:30 AM – 11:00 AM COFFEE BREAK

11:00 AM - 12:15 PM

Session TuA2: Detectors, Receivers, Modulators
Session Co-Chairs: Shigehisa Arai, *Tokyo Institute of Technology, Tokyo, Japan* and Young-Kai Chen, *Lucent Technologies, Murray Hill, NJ, USA*

TuA2.1 11:00 AM - 11:30 AM (Invited)

A Novel Avalanche-Free Single Photon Detector, H. Mohseni, O. G. Memis and S. Kong, *Northwestern University, Evanston, IL, USA*

A novel single photon infrared detector is presented that is capable of operating at room temperature in principle. Unlike avalanche, this method produces no excess noise, and can potentially cover wavelengths from UV to mid-infrared.

TuA2.2 11:30 AM - 11:45 AM

A Simple, Monolithically Integrated Optical Receiver, K.-T. Shiu, S. S. Agashe and S. R. Forrest, *Princeton University, Princeton, NJ, USA*

We demonstrate an integrated optical receiver based on asymmetric twin-waveguide (ATG) technology. The device has a peak responsivity of 8.2±0.4 A/W, and a 3dB optical bandwidth of 11±1 GHz, equivalent to a 265 GHz gain-bandwidth product.

TuA2.3 11:45 AM - 12:00 PM

10Gbit/s Amplified Reflective Electroabsorption Modulator for Colorless Access Networks, A. Garreau, J. Decobert, C. Kasmierski and C. Cuisin, *Alcatel, Marcoussis, France*

For high speed remote colourless modulation in FTTH technology, a new 10Gbit/s monolithically integrated amplified reflective electroabsorption modulator (R-EAM-SOA) is demonstrated over 60nm spectral range and over 20°C-60°C, with excellent eye diagrams.

11:00 AM - 12:30 PM

Session TuB2: HEMTs for Logic
Session Chair: Edward Y. Chang, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.*

TuB2.1 11:00 AM - 11:30 AM (Invited)

Antimonide based Quantum Well Transistors for High Speed, Low Power Logic Applications, S. Datta, *Intel Corporation, Hillsboro, OR, USA*

Indium antimonide based quantum well field effect transistors have recently been demonstrated with 85nm physical gate length. Enhancement mode n-channel InSb quantum well transistors (QWFETs) exhibit unity gain cutoff frequency, f_T, exceeding 300 GHz at an operating voltage of only 0.5V VDS. The InSb quantum well transistors demonstrate 50% higher intrinsic speed, f_T, than silicon NMOS transistors while consuming 10 times less active DC power.

TuB2.2 11:30 AM - 11:45 AM

The Impact of Side-Recess Spacing on the Logic Performance of 50 nm InGaAs HEMTs, D.-H. Kim, *Massachusetts Institute of Technology, Cambridge, MA, USA*

In this paper, we have studied the impact of Lside on the logic performance of 50 nm InGaAs HEMTs. We demonstrate that insufficient Lside seriously degrades the electrostatic integrity of the device and the logic figures of merit.

TuB2.3 11:45 AM - 12:00 PM

50nm GaAs mHEMTs and MMICs for Ultra-Low Power Distributed Sensor Network Applications, I. G. Thayne, K. Elgaid, M. C. Holland, H. McLelland, D. Moran, S. Thoms and C. R. Stanley, *University of Glasgow, Glasgow, Scotland, UK*

We report well-scaled 50nm GaAs metamorphic HEMTs with DC

TuA2.4 12:00 PM - 12:15 PM

1.55µm Mach-Zehnder Modulators on InP for Optical 40/80 Gbit/s Transmission Networks, H. Klein, H. Chen, D. Hoffmann, S. Staroske, *Fraunhofer-Institut, Berlin, Germany*, A. Steffan, *u2t photonics AG, Berlin, Germany* and K.-O. Velthaus, *Fraunhofer-Institut, Berlin, Germany*

We demonstrate excellent 40 Gbit/s operation of a packaged InP Mach-Zehnder-Modulator with a low rms jitter of 730 fs. A modulator with 63 GHz on-chip bandwidth is shown as a step towards 80 Gbit/s transmission.

power consumption in the range 1-150µW/mm demonstrating f_T of 30-400GHz. These metrics enable the realisation of compact (<5mmx5mm) ultra-low power (<500µW) radio transceivers with integated antennas for autonomous distributed sensor networks.

TuB2.4 12:00 PM - 12:15 PM

A True E-Mode MHEMT with High Static and Dynamic Performances, H. Maher, *OMMIC, Limeil-Brevannes, France*

A production ready, high DC and RF performance, fully passivated, true Enhancement-mode 100nm MHEMT is demonstrated. This transistor is a good candidate for high performance low noise and low power consumption applications.

TuB2.5 12:15 PM - 12:30 PM

Gate Sinking Effect of 0.1 µm InP HEMT MMICs Using Pt/Ti/Pt/Au, Y.-C. Chou, R. Lai, D. Leung, M. Wojtowicz, D. Eng, Q. Kan, P. Chin, T. R. Block and A. K. Oki*, Northrop Grumman Corporation, Redondo Beach, CA, USA*

Pt sinking into the InAlAs Schottky barrier layer was identified as the primary degradation mechanism of 0.1 µm InP HEMTs (with Pt/Ti/Pt/Au gate metals) under elevated temperature lifetests.

12:30 PM – 1:30 PM LUNCH BREAK

FREE AFTERNOON

Wednesday, 10 May 2006

Friend Center

8:30 AM - 10:30 AM

Session WA1: QUANTUM DOTS
Session Co-Chairs: Simon P. Watkins, *Simon Fraser University, Burnaby, BC, Canada* and Francois Lelarge, *Alcatel, Marcoussis, France*

WA1.1 8:30 AM - 9:00 AM (Invited)

Highly-Ordered and Highly-Stacked (150-Layers) Quantum Dots, K. Akahane, N. Yamamoto, S.-I. Gozu, A. Ueta, *National Institute of Information & Communications Technology, Koganei, Tokyo, Japan*, N. Ohtani, *Doshisha University, Kyotanabe, Kyoto, Japan* and M. Tsuchiya, *National Institute of Information & Communications Technology, Koganei, Tokyo, Japan*

The growth procedure for increasing the stacked layer of InAs QDs was developed by strain compensation technique. A Highly stacked (150-layer) QDs were obtained which showed highly-ordered structure and 1.5 µm emission in photoluminescence measurement.

WA1.2 9:00 AM - 9:15 AM

Comparison of Buffer Material for InAs Quantum Dots on GaAs Substrate, H. Shimizu, *Furukawa Electric Co. Ltd, Yokohama, Japan* and S. Saravanan, *ATR Adaptive Communications, Kyoto, Japan*

This paper describes the buffer-material dependence of 1.3-µm-range quantum dots, a subject that is useful for increasing the dot density while maintaining the photoluminescence intensity.

WA1.3 9:15 AM - 9:30 AM

Emission-Wavelength Extension of InAs/GaAs Quantum Dots by Controlling Lattice-Mismatch Strain, T. Inoue, K. Matsushita, M. Kikuno, T. Kita, O. Wada, *Kobe University, Kobe, Japan*, H. Mori,

Computer Science

8:30 AM - 10:30 AM

Session WB1: NOVEL MATERIALS INTEGRATION
Session Co-Chairs: Franz-Josef Tegude, *Duisberg University, Duisberg, Germany* and Rose F. Kopf, *Lucent Technologies, Murray Hill, NJ, USA*

WB1.1 8:30 AM - 9:00 AM (Invited)

A Technology for Integrating Active Photonic Devices on SOI Wafers, J. E. Bowers, H. Park, A. W. Fang, *University of California - Santa Barbara, Santa Barbara, CA, USA*, R. Jones, *Intel Corporation, Santa Clara, CA, USA*, O. Cohen, *Intel Corporation, Jerusalem, Israel* and M. Paniccia, *Intel Corporation, Santa Clara, CA, USA*

We present an integration technology for building active photonic devices on a Silicon-On-Insulator (SOI) based silicon photonics platform through plasma assisted wafer bonding of III-V quantum wells to passive devices fabricated on SOI.

WB1.2 9:00 AM - 9:15 AM

Polymer Microrings Integrated with Thin Film InGaAs MSM Photodetectors for Sensor-on-a-Chip Applications, S.-Y. Cho and N. M. Jokerst, *Duke University, Durham, NC, USA*

A polymer microring has been integrated with an InGaAs photodetector on a Si substrate for chip scale sensing applications. The photocurrent as a function of wavelength agrees well with the spectral response of the microring.

WB1.3 9:15 AM - 9:30 AM

Layer Transfer of FDSOI CMOS to 150mm InP Substrates for Mixed-Material Integration, K. Warner, D. C. Oakley, J. P. Donnelly, C. Keast and D. C. Shaver, *MIT Lincoln Laboratory, Lexington, MA,* *Osaka University, Osaka, Japan* and H. Yasuda*, Kobe University, Kobe, Japan*

Nitrided InAs quantum dots (QDs) have been shown to suppress In-segregation in QDs and achieve emission at 1.3 µm. Effects of strain on structural and optical properties of QDs have been demonstrated through transmission electron microscope and photoluminescence analyses.

WA1.4 9:30 AM - 9:45 AM

Stacking of InAs/GaAs QDs with Less Strain by using Growth Interruption, S. Saravanan and H. Shimizu*, ATR Adaptive Communications, Kyoto, Japan*

InAs quantum dots with less size fluctuations were obtained on GaAs (100) substrate by using the growth interruption. The six layer stacked QDs grown with interruptions showed nearly 7 times stronger PL at RT than the continuously grown structure.

WA1.5 9:45 AM - 10:00 AM

The Wideband Light Emission around 800 nm from Ternary InAsP Quantum Dots with an Intentionally Broadened Size and Composition Distribution, S. Miyake, W.S. Lee, T. Ujihara, and Y. Takeda*, Nagoya University, Nagoya, Aichi, Japan*

The wideband light source is used to OCT which is a new type of optical imaging technique. In other to obtain high spatial resolution images, a broad wavelength emission is very important. In this work, we observed broader spectrum from In(As)P quantum dots than that has been reported.

WA1.6 10:00 AM - 10:15 AM

λ = 1.3 µm High Density InGaAs/GaAs Quantum Dots Grown by Molecular Beam Epitaxy, J. Feng and T.-S. Lay*, National Sun Yat-sen University, Kaohsiung, Taiwan, R.O.C.*

$In_xGa_{1-x}As$ (x=0.5~0.75) QD's of high density of 1.3 x 10^{11} cm^{-2} and uniform size (diameter ~ 23-nm and height ~ 4-nm) were obtained by MBE. λ = 1.3 µm emission was observed for $In_{0.65}Ga_{0.35}As$ QD's capped with $In_{0.1}Ga_{0.9}As$.

WA1.7 10:15 AM - 10:30 AM

Localized Growth of InAs Quantum Dots (QDs) on Nanopatterned InP(001) Surfaces, A. Turala, M. Gendry, P. Regreny, P. Rojo-Romeo*, École Centrale de Lyon, Ecully, France* and C. Priester*, IEMN-CNRS, Villeneuve d'Ascq, France*

This work is devoted to the localization of InAs quantum dots grown by SSMBE on nanostructured InP(001) surfaces: mesas or holes are the sites of privileged nucleation of the quantum dots.

USA

A wafer bonding process that utilizes PECVD SiO_2 has been developed to integrate devices fabricated in dissimilar materials. A functional SOI CMOS wafer was bonded to a 150mm diameter InP wafer as a pathway to building an integrated near-IR imager.

WB1.4 9:30 AM - 10:00 AM (Invited)

Materials Design and Integration for High-Power Quantum Cascade Lasers, O. Malis, D. L. Sivco, J. Chen*, Lucent Technologies, Murray Hill, NJ, USA*, L. Zhang*, Lucent Technologies, Holmdel, NJ, USA*,A. M. Sergent*, Lucent Technologies, Murray Hill, NJ, USA*, Z. Liu and C. Gmachl*, Princeton University, Princeton, NJ, USA*

Maximum output power and operating temperature of QCLs in continuous-wave mode depends strongly on device processing and packaging. Using a combination of semiconductor overgrowth, epi-side down mounting, and metal electroplating, room-temperature, cw operation was achieved.

WB1.5 10:00 AM - 10:30 AM (Invited)

Ultrafast All-Optical Switches using Intersubband Transition in Quantum Wells, H. Ishikawa, T. Simoyama, M. Nagase, T. Mozume, R. Akimoto, B. Li, K. Akita and T. Hasama*, National Institute of Advanced Industrial Science & Technology, Tsukuba, Ibaraki, Japan*

Ultrfast all-optical switches based on intersubband transition in quantum well are developed using two different material systems of InGaAs/AlAs/AlAsSb and CdS/ZnSe/BeTe. Fabricated fiber modules exhibited 8-10dB extinction for 10-15pJ gate pulse.

10:30 AM – 11:00 AM COFFEE BREAK

11:00 AM - 12:30 PM

Session WA2: INTEGRATED DEVICES
Session Chair: Gareth Parry, *Imperial College of Science, Technology & Medicine, London, UK*

WA2.1 11:00 AM - 11:30 AM (Invited)

Large Scale InP Photonic Integrated Circuits for High Speed Optical Transport, R. Nagarajan, M. Kato, V. G. Dominic, J. Pleumeekers, A. G. Dentai, P. Evans, S. Hurtt, J. Baeck, D. Lambert, M. Missey, A. Mathur, S. Murthy, R. A. Salvatore, C. Joyner, R. P. Schneider, M. Ziari, J. Bostak, M. Kauffman, H.-S. Tsai, M. Van Leeuwen, A. Nilsson, R. Taylor*, Infinera, Sunnyvale, CA, USA*, S. G. Grubb*, Infinera, Ellicott City, MD, USA*, D. Mehuys, F. A. Kish and D. F. Welch*, Infinera, Sunnyvale, CA, USA*

Dense wavelength division multiplexed InP transmitter and receiver photonic integrated circuits (PICs) operating at aggregate speeds up

11:00 AM - 12:30 PM

Session WB2: PROCESSING FOR HIGH PERFORMANCE DEVICES
Session Co-Chairs: Nan Marie Jokerst, *Duke University, Durham, NC, USA* and Claire Gmachl, *Princeton University, Princeton, NJ, USA*

WB2.1 11:00 AM - 11:30 AM (Invited)

InP-based Resonant Tunnelnig Diode/HEMT Integrated Circuits for Ultrahigh-Speed Operation, K. Maezawa and T. Mizutani*, Nagoya University, Nagoya, Aichi, Japan*

Resonant tunneling diodes (RTDs) are attracting much attention because of their potential for high-speed operation. In this paper we will discuss the InP-based RTD/HEMT integrated circuits for ultrahigh-speed applications.

to 400Gbit/s are reviewed. The PICs are capable of transmitting and receiving 10 or more wavelengths at data rates between 10Gb/s and 40Gb/s on a ITU grid across a long-haul link.

WA2.2 11:30 AM - 11:45 AM

Monolithically Integrated Differential Mach-Zehnder Filter for 40 Gb/s Wavelength Conversion in High-Confinement Butt-Joint SOAs, P. Bernasconi, L. Zhang, W. Yang, L. Buhl, N. Sauer, A. Bhardwaj, J. Gripp, J. Simsarian and D. T. Neilson, *Lucent Technologies, Holmdel, NJ, USA*

An InP-InPGaAs material platform relying upon active material regrowth is used to fabricate a monolithic wavelength converter. Error-free conversion is demonstrated for RZ signals at 40 Gb/s in a Mach-Zehnder filter with differential signal input.

WA2.3 11:45 AM - 12:00 PM

InGaAlAs/InP Electro Absorption Transceiver with Modulation and Photodetection Bandwidth Exceeding 40GHz, F. Van Dijk, A. Enard, A. Marceaux, D. Carpentier and C. Kasmierski, *Alcatel, Marcoussis, France*

A bandwidth of more than 40GHz both in modulation and in photodetection mode at the same bias voltage has been obtained using an InGaAlAs/InP MQW electro-absorption transceiver. The impact of bias voltage and wavelength on both characteristics has been studied. The optimum operating conditions have then been deduced.

WA2.4 12:00 PM - 12:30 PM (Invited)

High Gain-Bandwidth InP Waveguide Phototransistor, V. Houtsma, A. Leven, J. Chen, J. Frackoviak, A. Tate, N. G. Weimann and Y.-K. Chen, *Lucent Technologies, Murray Hill, NJ, USA*

We present a high speed phototransistor with integrated waveguide based on our InP double hetrojunction bipolar transistor (DHBT) process technology. We measured an optical-gain cutoff frequency $F_{t,opt}$ of 447 GHz at a base current of I_b=650 μA using devices with emitter dimensions of A=0.7 x 4 μm^2.

WB2.2 11:30 AM - 12:00 PM (Invited)

InP DHBT Technology Development for High Bitrate Mixed-Signal IC Fabrication, J. Godin, M. Riet, P. Berdaguer, V. Nodjiadjim, A. Konczykowska and A. Scavennec, *Alcatel, Marcoussis, France*

The development and optimization of an InP DHBT process suiting high bitrate mixed-signal IC fabrication is described. Its relevance is validated by the fabrication of 50 GHz clocked ICs and their use in optical system experiments. Undergoing submicronic scaling allows higher performance and/or lower consumption.

WB2.3 12:00 PM - 12:15 PM

ICP Etching Process Development based on Cl_2/H_2 Chemistry and Adapted to Non-Thermalized InP Wafers for the Realization of High Aspect Ratio and Vertical Sidewall Deep Ridge Waveguides and Buried Heterostructures, S. Guilet, S. Bouchoule, *CNRS-LPN, Marcoussis, France*, C. Jany, *Alcatel, Marcoussis, France*, C. Corr and P. Chabert, *Laboratoire de Physique et Technologie des Plasmas, Palaiseau, France*

ICP etching using Cl_2/H_2 chemistry is studied to realize deep ridges with smooth and vertical sidewall. The influence of Cl_2/H_2 ratio on the etching mechanism is investigated for both InP bulk layers and InGa(Al)As/InP heterostructures. The process is optimised for non-thermalized InP wafers to avoid the use of thermal grease.

WB2.4 12:15 PM - 12:30 PM

Quantum-Dot Intermixing Enhancement using UV Laser Irradiation, H. S. Djie, D.-N. Wang, B. S. Ooi and J. C. M. Hwang, *Lehigh University, Bethlehem, PA, USA*

We report the development of a novel bandgap engineering technique in InGaAs/GaAs quantum-dots using the combination methods of pulsed UV laser irradiation and dielectric induced layer intermixing. Differential bandgap shift of over 180meV has been observed.

12:30 PM – 1:30 PM LUNCH BREAK

Friend Center

1:30 PM - 3:30 PM

Session WP: POSTER SESSION

WP1 Nitrogen Implantation Induced Intermixing in InAs/InAlGaAs/InP Dots-in-Well Laser, H. S. Djie, Y. Wang and B. S. Ooi, *Lehigh University, Bethlehem, PA, USA*

Nitrogen implantation has been performed to promote efficient group-III intermixing in InAs quantum-dots embedded in InAlGaAs quatum-well laser. This novel intermixing method produces high bandgap selectivity at low activation temperature for InAs/InAlGaAs/InP dots-in-well intermixing.

WP2 Direct Bonding of GaInAsP/InP Membrane Structure on SOI Wafer, T. Maruyama, T. Okumura, S. Sakamoto, K. Miura, Y. Nishimoto, and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

A single-quantum-well (SQW) GaInAsP/InP membrane structure bonded onto an SOI wafer was successfully obtained by a direct bonding method with a thermal annealing at 300-450 ˚C under H_2 atmosphere. The PL intensity of the SQW membrane structure did not degrade after this process and its spectral shape did not changed.

WP3 InP Surface Properties under ICP Plasma Etching using Mixtures of Chlorides and Hydrides, J.-P. Landesman, B. Liu, *University of Nantes, Nantes, France*, J. L. Leclercq, *École Centrale de Lyon, Lyon, France*, A. Rhallabi, C. Cardinaud, *University of Nantes, Nantes, France*, S. Guilet, *CNRS-LPN, Marcoussis, France*, F. Pommereau, *Alcatel, Marcoussis, France*, M. Avella, M.-A. Gonzalez and J. Jimenez, *University of Valladolid, Valladolid, Spain*

In the context of the development of an ICP etch process with chlorine based mixtures (application: photonic crystals), InP surfaces have been characterised, with special emphasis on the In/P stoichiometry and the introduction of defects.

WP4 InP Etching by Chlorine ICP Plasma for Photonic Crystal Applications: Experiments and Simulations, A. Rhallabi, B. Liu, J.-P. Landesman, *University of Nantes, Nantes, France* and J. L. Leclercq, *École Centrale de Lyon, Lyon, France*

InP etching process in chlorine ICP plasma is studied using both experimental and simulation approaches. The chlorine plasma discharge is analyzed in order to show the impact of the plasma parameters on the etched InP profiles for the photonic crystal applications.

WP5 High Compositional Uniformity of Epitaxial InGaAlAs on InP Grown by MOVPE for Uncooled Laser Diode, E. Shimizu, M. Nakamura, H. Momoi, E. Ikeda, S. Sugawara, and H. Nakata, *Nikko Materials Co., Ltd., Toda, Saitama, Japan*

High compositional uniformity of InGaAlAs alloy on InP was demonstrated in a high-speed rotating disk MOVPE. The factors that influenced the compositional uniformity were investigated. PL wavelength of less than 6nm across 80% area spread of 2-inch wafers was achieved at 1310 nm MQW structure with multiple wafers.

WP6 Investigation of Hetero-Interfaces formed in InP/GaInAs/InP Structures with Different Growth Rates, Y. Ohtake, T. Eguchi, S. Miyake, W.S. Lee, M. Tabuchi, and Y. Takeda, *Nagoya University, Nagoya, Aichi, Japan*

The compositional grading at interfaces of InP/GaInAs/InP heterostructures was investigated by utilizing the X-ray CTR scattering measurement. The results suggested the most important origin of the compositional grading is exchange of atoms.

WP7 Surface Morphology and Photoluminescence for InAs Quantum Dots of Different Growth Temperature and Capping Layer, T.-S. Lay and T. E. Tzeng, *National Sun Yat-sen University, Kaohsiung, Taiwan, R.O.C.*

InAs QDs of eight different grown temperatures are measured by AFM and Photoluminescence measurement. PL emission peak at 1.306μm was obtained for InAs QDs with $In_{0.1}Ga_{0.9}As$ capping layer grown at 510 °C.

WP8 Optical and Structural Properties of Metamorphic InGaAs/AlAsSb Quantum Wells Grown on GaAs Substrates, S.-I. Gozu, *National Institute of Information & Communications Technology, Koganei, Tokyo, Japan*

Metamorphic InGaAs/AlAsSb multiple quantum wells (M-MQWs) were grown on GaAs. Polarity dependent optical absorption of the M-MQWs revealed clear intersubband absorptions. Therefore, the M-MQWs can be applied to all optical devices.

WP9 MBE Growth and Characterization of Highly Tensile-Strained InGaAs/InGaAlAs Multi-Quantum Well for 1.3 μm Laser Diodes, J. M. Kim, C. Y. Park, S. Y. Nam and Y. T. Lee, *Kwang-Ju Institute of Science and Technology, Kwangju, Korea*

Highly tensile-strained InGaAs/InGaAlAs MQW was grown by MBE using the digital-alloy technique. Two peaks corresponding to electron-light hole transition (E1-LH1) and electron-heavy hole transition (E1-HH1) were clearly observed in the PL spectrum of MQW structure.

WP10 MBE Growth and Characteristics of Self-Assembled InAs/InGaAs/GaAs Quantum Dots, C. Y. Park, J. M. Kim, and Y. T. Lee, *Kwang-Ju Institute of Science and Technology, Kwangju, Korea*

Self-assembled InAs QDs was grown on (001) GaAs substrate by MBE. The dot density was $5.2x10^{10}/cm^2$, the height was 14nm and the width was 30nm. The peak-wavelength and the FWHM were 1266nm and 41.23meV respectively.

WP11 Investigations on Oxide-Free InGaAlAs Waveguides Grown by Narrow Stripe Selective MOVPE, W. Feng, J. Pan, L. Hou, L. Zhao, H. Zhu and W. Wang, *Chinese Academy of Sciences, Beijing, China*

We investigated the growth and characteristics of the oxide-free InGaAlAs waveguides as narrow as 1.2 μm on InP substrates patterned with dielectric mask stripes by narrow stripe selective MOVPE at optimized growth conditions.

WP12 Sub-Threshold Characteristics of the 0.2 μm Capless $InP/In_{0.52}Al_{0.48}As/In_{0.53}Ga_{0.47}As$ p-HEMTs having a Self-Aligned Gate, T.-W. Kim, *Kwang-Ju Institute of Science and Technology, Kwangju, Korea*

Sub-threshold characteristics of a 0.2 μm self-aligned gate (SAG) capless p-HEMT having a highly strained InAs sub-channel were investigated. The extracted I_{ON}/I_{OFF} ratio and sub-threshold slope of the SAG capless HEMT ($1.27x10^4$ and 80mV/dec) was better than those of the conventional recessed p-HEMT (5.1 10^3 and 120mV/dec), respectively.

WP13 Ultra Fast Gunn Effect at THz Frequencies in HEMTs, J. Mateos, S. Perez, D. Pardo and T. González, *University of Salamanca, Salamanca, Spain*

By means of Monte Carlo simulations we explain how, as a consequence of ballistic transport in the channel of a 80nm gate InAlAs/InGaAs HEMT, Gunn oscillations at THz frequencies can be generated. This mechanism could explain recent experiments in HEMTs where emission of radiation in the THz range is observed.

WP14 Non-Abrupt Junctions InP DHBT Power Amplifier in Class-AB CDMA Operation, K. Sawada, M. Uemura, E. Koizumi, I. Hase and S. Wada, *Sony Corporation, Atsugi, Kanagawa, Japan*

We demonstrated a non-abrupt junctions InP DHBT power amplifier and obtained high efficiency of 54% PAE, at -41dBc ACPR, at a supply voltage of 3.5V in 900MHz WCDMA class-AB operation.

WP15 Voltage Controlled Harmonic Oscillation around 1THz in Resonant Tunneling Diodes Integrated with Slot Antennas, M. Asada, N. Orihashi, and S. Suzuki, *Tokyo Institute of Technology, Meguro, Tokyo, Japan*

We observed the third harmonic oscillation around 1THz at room temperature and its frequency change with bias voltage in GaInAs/AlAs resonant tunneling diodes integrated with slot antennas. The frequency changed from about 0.96 to 1.02THz.

WP16 Minimum Emitter Charging Time for Heterojunction Bipolar Transistors, N. Machida, Y. Miyamoto and K. Furuya, *Tokyo Institute of Technology, Meguro, Tokyo, Japan*

The minimum emitter charging time for heterojunction bipolar transistors was derived under simple approximation. Obtained minimum charging time is almost equal to that by quasi-static simulation.

WP17 Effect of Schottky Layer Thickness on DC, RF and Noise of 70-nm Gate Length InP HEMTs, M. Malmkvist, M. Borg, S. Wang, and J. Grahn, *Chalmers University of Technology, Goteborg, Sweden*

The Schottky barrier of 70-nm InP HEMTs has been studied. Biased for low noise, a 2x50 μm device showed a transconductance, f_{max} and noise temperature of 1.1 mS/mm, 200 GHz and 140 K, respectively.

WP18 Electrical Models for Detrimental Effects in Metamorphic HEMTs, O. Pajona, C. Aupetit-Berthelemot and J.-M. Dumas, *University of Limoges, Limoges, France*

This paper presents models of Metamorphic HEMT detrimental effects we have developed in order to be implemented in a distributed double-cascode amplifier circuit simulated with ADS. All models have been optimized regarding experimental measurements results, first made on prototype structure.

WP19 Reduced Features Two-Dimensional Photonic Crystals on InP-based Materials Etched using Cl_2/Ar Inductive Coupled Plasma, K.-H. Lee, S. Guilet, I. Sagnes, and A. Talneau, *CNRS/LPN, Marcoussis, France*

We fabricated two-dimensional InP-based photonic crystal structures with Cl_2/Ar inductive coupled plasma etching. Features as small as 110nm hole diameter are etched down to 1.9µm. Preliminary optical characterization show the feasibility of this approach.

WP20 Feature Size Effects in Ar/Cl_2 Chemically Assisted Ion Beam Etching of InP-based Photonic Crystals, A. Berrier, S. Anand, M. Mulot, *Royal Institute of Technology, Kista, Sweden* and A. Talneau, *CNRS/LPN, Marcoussis, France*

This work addresses feature size effects (the lag-effect and roughness development) in the etching of InP-based photonic crystals. The experimental results are explained using the underlying physical mechanisms and are supported by a physico-chemical model.

WP21 Polarization Characteristics of Sb-Introduced Ga(In)As Covered InAs Quantum Dots, T. Matsuura, *Tokyo Institute of Technology, Yokohama, Kanagawa, Japan*

Polarization characteristics of MBE grown InAs QD using a Ga(In)AsSb cover layer was investigated using room temperature photoluminescence (PL) for in-plane direction. Reduction of polarization was observed due to dot-shape transition by Sb introduction into the cover layer.

WP22 A 45 mW RTD/HBT MOBILE D-Flip Flop IC Operating up to 32 Gb/s, T.-H. Kim, Y. Jeong and K. Yang, *Korea Advanced Institute of Science and Technology, Daejon, Korea*

A new RTD/HBT MOBILE D-flip flop has been proposed and the operation of the fabricated circuit has been for the first time confirmed up to 32 Gb/s at a low DC power dissipation of 45 mW.

WP23 An Integrated Waveguide Detector for Power Control in an InP Mach-Zehnder Modulator Based 10 Gb/s Transmitter, M. G. Boudreau, I. Betty, M. Scheer, *Bookham Technologies, Ottawa, ON, Canada*, L. N. Langley, *Bookham Technologies, Northants, Northamptonshire, UK* and R. Longone, *Bookham Technologies, Paignton, Devon, UK*

An integrated waveguide detector for power control in an InP Mach-Zehnder modulator based optical transmitter is described. Improvements in wavelength, power and voltage sensitivity are achieved by incorporating a graded hetero-junction InGaAs layer.

WP24 Investigation of Fast Monolithic Saturable Absorber Microcavities on GaAs Substrate, M. Le Dû, J.-C. Harmand, and J.-L. Oudar, *CNRS-LPN, Marcoussis, France*

We have developed saturable absorber microcavities grown monolithically on GaAs-substrate with controlled recombination rate based on tunnelling. Quinary alloy GaInNAsSb was used as an absorber and combined to high reflectivity GaAs/AlAs and GaAs/Alox Bragg reflectors.

WP25 Improved Performance of Distributed-Reflector Laser with Antireflection Coating, S. M. Ullah, S. Lee, R. Suemitsu, K. Ohira, and S. Arai, *Tokyo Institute of Technology, Meguro, Tokyo, Japan*

To improve the efficiency and single-mode operation of the DR laser consisting of active DFB section and passive DBR section, Al_2O_3 antirflection (AR) coating was deposited on the front facet of the DFB section. As a result, anomalous property such as an increase of differential quantum efficiency (from 19% to 27%) as well as a reduction of threshold current (from 4 mA to 1.4 mA at RT-CW conditions) was observed reproducibly.

WP26 Intersubband Transitions in Novel Strained Coupled Quantum Wells based on $In_{0.53}Ga_{0.47}As$ Grown by Molecular Beam Epitaxy, M. Nagase, T. Mozume, *National Institute of Advanced Industrial Science & Technology, Tsukuba, Ibaraki, Japan*, T. Simoyama, *Fujitsu Laboratories Ltd., Atsugi, Kanagawa, Japan*, T. Hasama and H. Ishikawa, *National Institute of Advanced Industrial Science & Technology, Tsukuba, Ibaraki, Japan*

Improvments have been done on the InGaAs/AlAs/AlAsSb coupled double quantum wells for intersubband transition switches. Indium content of the well layers was reduced to investigate two-photon absorption in our switches, without affecting the crystal quality.

WP27 Broad and Flat Emission Spectrum from InGaAs/InGaAlAs Asymmetric Multiple Quantum Wells: Effect of Well-Width and Modulation-Doping Profiles, C.-Y. Chen and T.-S. Lay, *National Sun Yat-sen University, Kaohsiung, Taiwan, R.O.C.*

Asymmetric InGaAs/InGaAlAs multi-quantum wells exhibit a λ =1.55µm broad and flat emission spectrum with 3-dB bandwidth upto 2500Å. Emission spectra and laser diodes by the effects of well-width and modulation-doping profiles are presented.

WP28 Polarization Sensitivity of Injection-Locked VCSELs, A. Homayounfar and M. J. Adams, *University of Essex, Colchester, Essex, UK*

Using a model of VCSELs subject to polarized injection that includes the effects of electron spin, it is found that increased birefringence causes the stable locking region to begin at higher injected power and detuning.

WP29 Precision Micro-Cleaving of 1.55 µm Laser Diode Platelets for Integration with Dielectric Waveguides on Silicon Integrated Circuit Wafers, J. Rumpler, E. Barkley and C. G. Fonstad, *Massachusetts Institute of Technology, Cambridge, MA, USA*

A precision micro-cleaving technique has been developed to produce accurately dimensioned (300 ± 2 µm) 5 µm thick cleaved-facet 1.55 µm edge-emitting ridge laser diode platelets for integration with dielectric waveguides on silicon IC wafers.

WP30 Multilayered InAs Quantum Dot Lasers with Different Dot Density, H. Shimizu, *Furukawa Electric Co. Ltd, Yokohama, Japan*, S. Saravanan, J. Yoshida, *ATR Adaptive Communications, Kyoto, Japan*, S. Ibe and N. Yokouchi, *Furukawa Electric Co. Ltd, Yokohama, Kanagawa, Japan*

The dependence of dot density per layer on the laser performance for 1.3-µm range InAs quantum dot lasers having 12-QD layer in order to increase the maximum modal gain of the ground states is described.

5:00 PM – 8:00 PM BANQUET at RATS

Thursday, 11 May 2006

Friend Center

8:30 AM - 10:15 AM

Session ThA1: Electronic Devices
Session Co-Chairs: Amy W. Liu, *IQE Incorporated, Bethlehem, PA, USA* and Rajesh D. Rajavel, *HRL Laboratories, Malibu, CA, USA*

ThA1.1 8:30 AM - 9:00 AM (Invited)

Metamorphic 6.0 Å Narrow Band Gap HBT Technology on InP Substrates, A. Cavus, R. Sandhu, C. Monier, D. Pascua, C. Cox, A. Gutierrez-Aitken, B. Poust, R. Hsing, *Northrop Grumman Space Technology, Redondo Beach, CA, USA*, A. Noori, S. L. Hayashi and M. S. Goorsky, *University of California - Los Angeles, Los Angeles, CA, USA*

$InxAl_{1-x}As/In_xGa_{1-x}As$ heterojunction bipolar transistors with narrow band gap base layers toward InAs ($0.86<X_{In}<1$) is desired for the development of high density complex digital and mixed signal circuits with low power consumption.

ThA1.2 9:00 AM - 9:15 AM

Re-Growth of Transistors on Implanted InP, R. D. Rajavel, M. Chen, Y. Royter, J. Li, S. Bui, M. Sokolich, D. H. Chow, D. A. Hitko and T. Hussain, *HRL Laboratories, Malibu, CA, USA*

The influence of ion-implantation related process steps on the morphology of InP-DHBTs re-grown by MBE on selectively doped substrates will be presented. Under optimum conditions, re-grown DHBTs exhibit smooth morphologies. Through this re-growth approach a significant reduction in Cbc was observed and F_t/F_{max} = 300/300 GHz was measured.

ThA1.3 9:15 AM - 9:30 AM

Metal-Organic Vapor-Phase Epitaxy Growth of InP using Triethylphosphine with Phosphine as Phosphorus Source, H. Sugiyama, R. Sakai, and G. Araki, *NTT Advanced Technology Corporation, Atsugi, Kanagawa, Japan*

A novel MOVPE growth of InP using both triethylphosphine (TEP) and phosphine was examined. The simultaneous supply of TEP and phosphine enhanced the decomposition of phosphorus source and improved crystal quality.

ThA1.4 9:30 AM - 9:45 AM

The Epitaxial Growth of High Electron Mobility InGaAs by Metalorganic Chemical Vapor Deposition with Triethylindium for InP-based HEMTs, M. Uchida and G. Araki, *NTT Corporation, Atsugi, Kanagawa, Japan*

Non-doped InGaAs and brief HEMT structure samples were grown by a new MOCVD system with new material combination (TEI, TEG and AsH_3). The electron mobility of those samples was enhanced than the samples grown by genral MOCVD systems with material combinations generally used.

Computer Science

8:30 AM - 10:30 AM

Session ThB1: Nanophotonics
Session Chair: Alfred Forchel, *Universität Würzburg, Würzburg, Germany*

ThB1.1 8:30 AM - 9:00 AM (Invited)

Ultra-High-Q Photonic Nanocavity, T. Asano and S. Noda, *Kyoto University, Kyoto, Japan*

A photonic nanocavity with ultra-high Q factor on the order of 1 million has been achieved. The underlying concept to achieve such high Q factor will be explained.

ThB1.2 9:00 AM - 9:30 AM (Invited)

Photon Collection from Wavelength-Scale Photonic Crystal Light Emitters, Y. H. Lee, *Korea Advanced Institute of Science and Technology, Taejon, Korea*

Optical and electrical characteristics of electrically-driven, single-cell, nondegenerate-mode, photonic crystal lasers are discussed. These ultra-small, room-temperature, semiconductor lasers generate photons near communication wavelength of 1550 nm. Several schemes to control the direction of photon-coupling out of the wavelength-scale photonic crystal resonators will also be presented. The vertical beaming scheme and the all-fiber coupling scheme are discussed in detail, showing the possibility of high optical coupling efficiency in excess of 80%.

ThB1.3 9:30 AM - 9:45 AM

Lasing Actions of Octagonal Quasi-Periodic Photonic Crystal Micro-Cavities, P.-T. Lee, T.-W. Lu, F.-M. Tsai and T.-C. Lu, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.*

For the first time lasing actions of octagonal quasi-periodic photonic crystal (OQPC) micro-cavities are obtained. The characteristics of two different lasing modes in OQPC micro-cavities are investigated and compared with the calculation results.

ThB1.4 9:45 AM - 10:00 AM

High Modal Gain 9- and 12- Layer InAs/InP Quantum Dash Lasers Emitting at 1.55 µm., G. Moreau, K. Merghem, D.-Y. Cong, A. Ramdane, *CNRS-LPN, Marcoussis, France* and F. Lelarge, *Alcatel, Marcoussis, France*

This paper reports on successful growth of 9 and 12 layer- stacks of Dash- in- a- Well laser structures, for the first time to our knowledge. Optimal modal gain of 48 cm^{-1} is achieved for a 9- layer stack, compatible with high performance laser applications.

ThA1.5 9:45 AM - 10:15 AM (Invited)

The Indium Phosphide Bare Substrate: Its Influence on the Epitaxial Layer Quality, G. Jacob, *Inpact, Moutiers, France*

This paper reviews the relationships between the substrate specifications and the quality of the epi-layer (morphology, photoluminescence, electrical properties) and we will determine the list of needed specification (in opposite to unneeded) in order to get good epi-growth.

ThB1.5 10:00 AM - 10:30 AM (Invited)

Tailoring the Emission from a Single Quantum Dot for Quantum Information Processing, S. Laurent, R. Braive, S. Varoutsis, L. Le gratiet, A. Lemaitre, I. Sagnes, I. Robert-Philip and I. Abram, *CNRS/LPN, Marcoussis, France*

The fundamental concepts of quantum mechanics, while still the focus of experimental verification, provide the resources for an emerging new field that combines quantum physics and information science: Quantum information.

10:30 AM – 11:00 AM COFFEE BREAK

11:00 AM - 12:15 PM

Session ThA2: OPTOELECTRONICS
Session Chair: Hajime Asahi, *Osaka University, Ibaraki, Osaka, Japan*

ThA2.1 11:00 AM - 11:30 AM (Invited)

Metalorganic Chemical Vapor Deposition Growth of High-Quality InAs/GaSb Type II Superlattices for Mid-IR Applications, R. D. Dupuis, X. B. Zhang, *Georgia Institute of Technology, Atlanta, GA, USA*, A. Petschke, S. Mou, C. Xu, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*,J.-H. Ryou, *Georgia Institute of Technology, Atlanta, GA, USA*, S.-L. Chuang and K.-C. Hsieh, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*

We report on the growth of InAs/GaSb Type II superlattices (SLs) on (001) GaAs and GaSb substrates by MOCVD. Through optimizing the growth parameters, morphology and structural properties of the grown structures are significantly improved.

ThA2.2 11:30 AM - 11:45 AM

MBE Growth of Thick InGaAsN Layers with Absorption Edge at 1.95µm on InP Substrates, K. Miura, Y. Nagai, Y. Iguchi, H. Okada, *Sumitomo Electric Industries, Osaka, Japan* and Y. Kawamura, *Osaka Prefecture University, Sakai, Osaka, Japan*

We obtained thick InGaAsN layers with the absorption edge at 1.95µm by MBE growth on InP substrates. Postgrowth RTA and using arsenic dimer as source improve crystalline quality of thick InGaAsN epitaial layers.

ThA2.3 11:45 AM - 12:00 PM

DBR Laser Fabricated by Wide-Stripe Selective Area MOVPE and Mass Transport for Monolithic Integration, J. Darja, M. Sugiyama, and Y. Nakano, *University of Tokyo, Tokyo, Japan*

We demonstrated the potential application of selective area MOVPE in conjunction with mass transport to fabricate DBR MQW lasers in a single growth step. The approach is promising for low-cost monolithic integration of DFB/DBR lasers with other components.

ThA2.4 12:00 PM - 12:15 PM

MBE Growth of TlInGaAs/TlInP/InP SCH LDs and Their Laser Operation, A. Fujiwara, T. Matsumoto, D. Krishnamurthy, S. Hasegawa and H. Asahi, *Osaka University, Ibaraki, Osaka, Japan*

We will report on the MBE growth of TlInP layers and their refractive index as well as the fabrication of the TlInGaAs/TlInP/InP separate confinement heterostructure (SCH) LDs and their temperature variation of the longitudinal-mode peak wavelength.

11:00 AM - 12:30 PM

Session ThB2: NANOELECTRONICS AND PHOTONICS
Session Chair: Franz-Josef Tegude, *Duisberg University, Duisberg, Germany*

ThB2.1 11:00 AM - 11:15 AM

Compact Wavelength Multiplexers/Demultiplexers using Photonic Wires on Silicon-on-Insulator (SOI) Substrate, F. Xia, *IBM Research, Yorktown Heights, NY, USA*

Compact wavelength multiplexers/demultiplexers using photonic wires in add/drop filter and multi-mode interferometer (MMI) configurations were demonstrated on SOI substrate. Device footprint, channel spacing scaling characteristic, crosstalk, operational bandwidth, and manufacturing complexity are compared.

ThB2.2 11:15 AM - 11:45 AM (Invited)

Self-Gating in Nanoelectronic Junctions, L. Worschech, D. Hartmann, and A. Forchel, *Universität Würzburg, Würzburg, Germany*

Self-gating induced switching in low dimensional branched channels is reported. The self-gating is utilized for the realization of compact switches, adders and logic gates based on monolithic junctions.

ThB2.3 11:45 AM - 12:00 PM

Fabrication and Electrical Characterisation of n-InAs Single Nanowhisker Field-Effect Transistors, Q. T. Do, *University Duisburg-Essen, Duisburg, Germany*

The conductivity measurements of n-InAs nanowhiskers were studies by utilizing field-effect transistors with single nanowhisker channel. Using the data obtained from the I-Vg the conduction electron density and the mobility were estimated.

ThB2.4 12:00 PM - 12:15 PM

14 GHz InP-based RTD MMIC VCOs with Ultra Low DC Power Consumption, S. Choi, Y. Jeong and K. Yang, *Korea Advanced Institute of Science and Technology, Daejon, Korea*

Ku-band VCOs with the RTD size of 1 X 1 μm^2 and the 1.5 X 1 μm^2 have been fabricated and characterized using an InP-based RTD/HBT MMIC technology. Both the fabricated MMIC VCOs showedextremely low DC power consumption compared to the conventional VCOs.

ThB2.5 12:15 PM - 12:30 PM

Performance of Electrodeposited Pt/InP Schottky Diode as a Hydrogen Sensing Head for InP-Based Wireless Sensor Chips, T. Kimura, H. Hasegawa, T. Sato and T. Hashizume, *Hokkaido University, Sapporo, Hokkaido, Japan*

Performance of an electro-deposited Pt/InP Schottky diode is evaluated as a hydrogen sensing head of the wireless sensor chip. Sensitivity, response speeds, sensing mechanism and nanometer scale sensing bridges for on-chip integration are investigated.

END OF PROGRAM