Advance Program

Sunday, 10 May 2009

Laguna/Sunset

1:30 PM - 5:30 PM
Session: SHORT COURSE I
Session Chair:

SC1 1:30 PM - 3:00 PM
Scaling of High Frequency III-V Transistors, M. J. W. Rodwell, *University of California - Santa Barbara, Santa Barbara, CA, USA*
ABSTRACT NOT AVAILABLE

3:00 PM - 4:00 PM **BREAK**

SC2 4:00 PM - 5:30 PM
InP Based Solar Cells, H. A. Atwater, *California Institute of Technology, Pasadena, CA, USA*
ABSTRACT NOT AVAILABLE

6:00 PM - 7:30 PM **WELCOME RECEPTION – SEAVIEW TERRACE**

Monday, 11 May 2009

Salon ABC

8:30 AM - 10:45 AM
Session PLE: PLENARY SESSION
Session Chair: Young-Kai Chen, *Alcatel-Lucent, Murray Hill, NJ, USA*

8:30 AM - 8:45 AM **OPENING REMARKS**

PLE1 8:45 AM - 9:25 AM
THz Technologies and Applications, M. Rosker, *Defense Advanced Research Projects Agency, Arlington, VA, USA*

BIO: Dr. Mark J. Rosker joined the Defense Advanced Research Projects Agency in July 2003. He received is B.S. degree in Physics from the California Institute of Technology in 1981, his M.S. (1983) and Ph.D. (1987) degrees in Applied and Engineering Physics from Cornell University. Dr. Rosker came to DARPA from NASA's Jet Propulsion Laboratory (JPL) in Pasadena, CA, where he has been a member of the Submillimeter Wave Advanced Technology Group. From 1986 to 1989, he was a postdoctoral Research Fellow at Caltech, where he performed fundamental studies (cited in the 1999 Nobel Prize in Chemistry) observing the dynamics of unimolecular chemical reactions in real-time.

ABSTRACT: Emerging semiconductor device technologies will allow circuits to operate at frequencies beyond 1THz. The DARPA THz Electronics Program is seeking to develop such high-performance circuits. This talk will discuss the program and its potential impact.

PLE2 9:25 AM - 10:05 AM

Recent Advances in InP PICs, L. A. Coldren, *University of California - Santa Barbara, Santa Barbara, CA, USA*

BIO: Larry A. Coldren is the Fred Kavli Professor of Optoelectronics and Sensors at the University of California, Santa Barbara, CA. He is also Chairman and Chief Technology Officer of Agility Communications, Inc. He received the Ph.D. degree in Electrical Engineering from Stanford University in 1972. After 13 years in the research area at Bell Laboratories, he joined UC-Santa Barbara in 1984 where he now holds appointments in Materials and Electrical & Computer Engineering, and is Director of the Optoelectronics Technology Center. In 1990 he co-founded Optical Concepts, later acquired as Gore Photonics, to develop novel VCSEL technology; and in 1998 he co-founded Agility Communications to develop widely-tunable integrated transmitters.

ABSTRACT: Within the past couple of years InP-based Photonic Integrated Circuits (PICs) have become the subject of aggressive development for commercial applications primarily for the telecommunications industry. Chips with hundreds of photonic components carry live traffic in the field, but questions remain about cost/volume/performance tradeoffs, as well as the need for common integration platforms and/or foundry services. Research efforts have been influenced by these issues.

PLE3 10:05 AM - 10:45 AM

Quantum Cascade Lasers and Applications, K. Patel, *Pranalytica, Inc., Santa Monica, CA, USA*

BIO: Kumar Patel is professor of physics, chemistry, and electrical engineering at University of California, Los Angeles. Simultaneously, he is the founder, CEO and Chairman of the Board of Pranalytica, Inc., a Santa Monica based company that is commercializing highly sensitive and selective trace gas sensors and high power quantum cascade lasers for commercial, homeland security and defense markets.

Dr. Patel received his B.E. in Telecommunications from the College of Engineering in Poona, India in 1958. He received M.S. and Ph.D. in Electrical Engineering from Stanford University in 1959 and 1961, respectively. In 1988, he was awarded an honorary Doctor of Science degree from the New Jersey Institute of Technology.

ABSTRACT: I will describe the developments leading to QCLs producing >2 W of CW/RT power from 4μm-12μm and their applications in high sensitivity CWA and explosives detection, DIRCM, target designators and beacons and human breath analysis.

10:45 AM – 11:15 AM COFFEE BREAK

Salon AB

11:15 AM - 12:30 PM

Session MA1: **HBT DEVICES AND CIRCUITS**
Session Co-Chairs: Dennis W. Scott, *Northrop Grumman Corporation, Redondo Beach, CA, USA*
Zach Griffith, *Teledyne Scientific Company, Thousand Oaks, CA, USA*

MA1.1 11:15 AM - 11:45 AM (Invited)

InP-Based DHBT Technology for High-Speed Mixed Signal and Digital Applications, R. Driad, R. E. Makon, V. Hurm, F. Benkhelifa, R. Loesch, J. Rosenzweig and M. Schlechtweg, *Fraunhofer-Institut, Freiburg, Germany*

We report on 100Gbit/s mixed-signal ICs using InP-DHBTs exhibiting current gains >80 and f_T>300 GHz. A distributed amplifier achieved 20dB gain, 90GHz bandwidth, and 3V output voltage at 100Gbit/s. A CDR/DEMUX-IC has been tested up to 107Gbit/s.

MA1.2 11:45 AM - 12:00 PM

200-nm InGaAs/InP Type I DHBT Employing a Dual-Sidewall Emitter Process Demonstrating f_{max} > 800GHz and f_t = 360GHz, E. Lobisser, *University of California - Santa Barbara, Santa Barbara, CA, USA*, Z. Griffith, *Teledyne Scientific Company, Thousand Oaks, CA, USA*, V. Jain, J. Koo, B. Thibeault, 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*

Salon C

11:15 AM - 12:30 PM

Session MB1: **PHOTONIC CRYSTAL AND LONG WAVELENGTH LASERS**
Session Co-Chairs: Fumio Koyama, *Tokyo Institute of Technology, Yokohama, Kanagawa, Japan*
Meint K. Smit, *Eindhoven University of Technology, Eindhoven, The Netherlands*

MB1.1 11:15 AM - 11:30 AM

Widely Tunable Photonic Crystal Coupled Cavity Laser Diodes Based on Quantum-Dash Active Material, L. Nähle, C. Zimmermann, W. Zeller, K. Brückner, H. Sieber, J. Koeth, *nanoplus Nanosytems and Technologies GmbH, Gerbrunn, Bavaria, Germany*, S. Hein, S. Höfling and A. Forchel, *Universität Würzburg, Würzburg, Germany*

Widely tunable monomode laser diodes emitting in the 1.9 μm wavelength range have been realized on InP based InAs/InGaAs quantum dash-in-a-well active material. 2D photonic crystal structures are used to define coupled cavity devices with two sections.

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

Local Digital Etching and Infiltration for Tuning of a H1-Cavity in Deeply Etched InP/InGaAsP/InP Photonic Crystals, H. Kicken, *Eindhoven University of Technology, Eindhoven, Noord-Brabant, The Netherlands*, P. Alkemade, *Kavli Institute of Nanoscience, Delft,*

Incorporated, Bethlehem, PA, USA

We report mesa InP/InGaAs/InP heterojunction bipolar transistors where power gain cutoff frequency f_{max} is 800+GHz, a record for mesa HBTs, and emitter-base junctions are 200nm wide, the narrowest reported III-V HBTs from our group.

MA1.3 12:00 PM - 12:15 PM

Performance Improvement of Composition-Graded AlGaAsSb/InP Double Heterojunction Bipolar Transistors, B.-R. Wu, M. W. Dvorak, P. A. Colbus, T. S. Low and D. D'Avanzo, *Agilent Technologies, Inc., Santa Rosa, CA, USA*

Compositional graded base $Al_xGa_{1-x}AsSb$/InP DHBT is demonstrated to show DC current gain of ~100 with 300 Å base and base sheet resistance of 1000 ohm/sq. The improvement is more than 50% compared to uniform base GaAsSb/InP DHBT with the same base thickness and sheet resistance.

MA1.4 12:15 PM - 12:30 PM

172 GHz Divide-by-Two Circuit using a 0.25-µm InP HBT Technology, C. Monier, M. D' Amore, D. W. Scott, A. Cavus, E. Kaneshiro, S. Lin, P. C. Chang, L. Dang, K. Sato, M. Truong, P. S. Nam, D. Pascua, D. Li, B. Chan, R. Sandhu, J. Wang, B. Oyama, A. L. Gutierrez and A. K. Oki, *Northrop Grumman Space Technology, Redondo Beach, CA, USA*

Continuous scaling in device layout and epitaxial stack from 0.25µm emitter InP DHBT technology has resulted in simultaneous measured f_T and f_{max} frequencies in the 500GHz range and divide-by-two circuits operating at 172GHz clock input.

The Netherlands, R. van der Heijden, F. Karouta, R. Noetzel, *Eindhoven University of Technology, Eindhoven, The Netherlands*, E. van der Drift and H. W. M. Salemink, *Kavli Institute of Nanoscience, Delft, The Netherlands*

A single hole defect photonic crystal cavity resonance was blueshifted 40 nm using local digital etching and redshifted 40 nm by locally infiltrating the nearest neighbor holes using Focussed Ion Beam selective mask opening.

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

An Electrically Driven Quasi-L2 Photonic Crystal Nano-Cavity with a Small Mode Volume, Y.-C. Tseng, T.-Y. Chi, W.-Y. Chen, P.-C. Chiu, C.-J. Wang, T.-M. Hsu and J.-I. Chyi, *National Central University, Jhongli, Taiwan, R.O.C.*

We propose an oxygen ion implantation process to fabricate electrically driven photonic crystal cavity. A 1.3 µm InAs quantum dot qL2 photonic crystal cavity light-emitting diode with a Q value of 1600 is demonstrated.

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

Low-dispersion InGaAsP/InP Slow Light Waveguide Optical Switch with Coupled Bragg Reflector Waveguide, A. Fuchida and F. Koyama, *Tokyo Institute of Technology, Yokohama, Kanagawa, Japan*

We propose slow light coupled Bragg reflector waveguide for expanding the optical bandwidth of ultra-compact slow light switches. We carried out the modeling of total-internal-reflection optical switch with 40-degrees crossing-angle, exhibiting optical bandwidth of over 10nm.

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

Improvement of 1.55 µm InAs QD Laser using Vicinal (001)InP Substrate, G. Elias, A. Letoublon, R. Piron, I. Algoraibi, K. Tavernier, N. Chevalier, N. Bertru, A. Le Corre and S. Loualiche, *Institut National des Sciences Appliquees de Rennes, Rennes, France*

We present an improvement of threshold current density of InAs QD lasers at 1.55µm thanks to a high QDs density achieved by combining the right off-cut direction of the (001)InP substrate with optimized arsenic flux.

12:30 PM - 1:30 PM LUNCH BREAK

1:30 PM - 3:30 PM

Session MA2: EPITAXY & HETERO-INTEGRATION
Session Chair: Rajesh D. Rajavel, *HRL Laboratories, Malibu, CA, USA*

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

Ultra High Repetition Rate and Very Low Noise Mode Locked Lasers based on InAs/InP Quantum Dash Active Material, A. Akrout, K. Merghem, A. Martinez, J.-P. Tourrenc, G. Aubin, A. Ramdane, *Laboratoire de Photonique et de Nanostructures, Marcoussis, France*, F. Lelarge, O. Le Gouezigou, A. Accard and G.-H. Duan, *Alcatel Thales III-V Lab, Palaiseau, France*

Optimization of novel InAs/InP quantum dash nanostructures has allowed the realization of mode locked lasers that exhibit unprecedent performance, enabling subpicosecond pulse generation at >300 GHz repetition rates and very low timing jitter.

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

Uniform InGaAs Micro-Discs on Si by Micro-Channel Selective-Area MOVPE, M. Deura, T. Hoshii, M. Takenaka, S. Takagi, Y. Nakano and M. Sugiyama, *University of Tokyo, Tokyo, Japan*

1:30 PM - 3:30 PM

Session MB2: QUANTUM DOTS AND NANOSTRUCTURED LASERS
Session Co-Chairs: Kent D. Choquette, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*
Luke J. Mawst, *University of Wisconsin-Madison, Madison, WI, USA*

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

Progress in Photonic Crystal Quantum-Dot and Quantum-Well Lasers, M. Kamp, S. Hoefling and A. Forchel, *Universität Würzburg, Würzburg, Germany*

The integration of photonic crystals with semiconductor lasers allows to integrate additional optical functionality in a very compact manner. Examples for this approach are multi-channel sources or the addition of an on-chip wavelength monitor to tunable lasers.

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

Characteristics of Highly Stacked Quantum Dot Laser Fabricated on InP(311)B Substrate, K. Akahane, N. Yamamoto and T. Kawanishi, *National Institute of Information and Communications Technology, Koganei, Tokyo, Japan*

We fabricated broad-area laser diodes containing highly stacked InAs quantum dots by using the strain-compensation technique. The

We have obtained thin and flat InGaAs micro-discs on Si with the in-plane uniformity of the size by multi-step growth, in which the partial pressures of group-III sources are modulated, using micro-channel selective-area MOVPE.

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

Selective Growth and Characterization of InGaAs Quantum Dots on Patterned InP Substrates Utilizing a Diblock Copolymer Template, J. H. Park, J. Kirch, C.-C. Liu, M. Rathi, L. J. Mawst, P. F. Nealey and T. F. Kuech*, University of Wisconsin-Madison, Madison, WI, USA*

Selective MOCVD growth with diblock copolymer nanopatterning is utilized to produce InGaAs/InGaAsP QDs on InP substrates. Higher growth temperatures are found to lead to improved QD photoluminescence intensity near 1.6 μm at RT.

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

Influence of Growth Rate and Temperature on InP/GaInAs Interface Structure Analyzed by X-ray CTR Scattering Measurement, H. Tameoka*, Nagoya University, Nagoya, Japan*

Compositional grading at hetero-interfaces of InP/GaInAs grown by OMVPE with different growth rate and growth temperature was investigated by X-ray CTR. A potential energy diagram of Ga in the crystal was obtained from the analysis.

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

Heterogeneous Integration of Indium Phosphide on Silicon by Nano Epitaxial Lateral Overgrowth, C. Junesand, F. Olsson, M.-H. Gau, Y. Xiang and S. Lourdudoss*, Royal Institute of Technology, Kista, Stockholm, Sweden*

InP on Si is grown by nano epitaxial lateral overgrowth on patterns of line and net openings. Analysis shows large lateral growth rate and good luminescence when the patterns are of net type.

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

Defect Reduction in Large Lattice Mismatch Epitaxial Growth through Block Copolymer Full Wafer Patterning, T. F. Kuech, S. Jha*, University of Wisconsin-Madison, Madison, WI, USA*, T. S. Kuan*, State University of New York at Albany, Albany, NY, USA*, S. Babcock and L. J. Mawst*, University of Wisconsin-Madison, Madison, WI, USA*

Full wafer nano-lithographic patterning, using co-polymers, was used to reduce the defect density during large lattice mismatch growth without the use of thick metamorphic buffer layers. A large reduction in x-ray line width was achieved during the initial stages of GaSb growth on GaAs.

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

InAs QDs on thin GaPN buffer on GaP by MOCVD, S. Tanabe, R. Suzuki, T. Sengoku, K. Nemoto, and T. Miyamoto*, Tokyo Institute of Technology, Yokohama, Kanagawa, Japan*

GaP based InAs QDs on a thin GaPN buffer layer were investigated using MOCVD. By introducing dilute nitrogen into buffer layer, dots density was significantly increased.

diodes exhibited laser emission at 1529 nm in the pulsed mode with a large characteristic temperature of 113K.

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

Energy Transfer in Patterned InAs Quantum Dot Cluster Grown on GaAs Nano-Pyramid, B.-L. Liang, P.-S. Wong, J. 0. Tatebayashi and D. L. Huffaker*, University of California - Los Angeles, Los Angeles, CA, USA*

We demonstrate controlled nucleation of QD-cluster and QD-pair on patterned GaAs pyramidal buffer. Photoluminescence measurements indicate lateral energy transfer for the QD-cluster but an isolated nature for the QD-pair.

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

Columnar Quantum Dashes for Polarization Insensitive Semiconductor Optical Amplifiers, S. Hein, S. Höfling, A. Forchel*, Universität Würzburg, Würzburg, Germany*, P. Podemski, G. Sek, J. Misiewicz*, Wroclaw University of Technology, Wroclaw, Poland*, P. Ridha, A. Fiore*, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland* and G. Patriarche*, Laboratoire de Photonique et de Nanostructures, Marcoussis, France*

InAs Columnar Quantum Dash structures on (100) InP for polarization insensitive SOAs have been realized. The polarization properties could be changed from predominantly transverse electric to transverse magnetic by adjusting the dash orientation within the cavity.

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

InAs Quantum Dots on AlGaInAs Emitting in the Optical C-Band at 1.55 μm, R. H. Enzmann, M. Kraus, M. Bareiss, C. Seidel, D. Baierl, G. Böhm, J. J. Finley, R. Meyer and M.-C. Amann*, Technical University of Munich, München, Germany*

We present the formation of InAs quantum dots with a low density on AlGaInAs surfaces, lattice matched to InP(001)-substrates using solid source molecular beam epitaxy. An emission wavelength at 1.55 μm was realized.

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

Surface States Passivation for and Regrowth around Nanoposts Formed for the Fabrication of InP-based Intersubband Quantum Box Lasers, M. Rathi, G. Tsvid, J. C. Shin, A. Khandekar, D. Botez and T. F. Kuech*, University of Wisconsin-Madison, Madison, WI, USA*

Passivation of interfaces corresponding to the nanoposts' sidewalls in InP-based intersubband quantum-box (IQB) lasers has resulted in interfacial-state densities < 1011/cm2. High-quality regrowths of semi-insulating InP around dry-etched, passivated, 40nm-diameter nanoposts were realized.

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

Near-field Imaging Spectroscopy of Low Density InAs/InP Quantum Dots, R. Kubota, D. Mizuno, T. Saiki*, Keio University, Yokohama, Japan*, E. Dupuy, P. Regreny and M. Gendry*, Institut des Nanotechnologies de Lyon, Ecully, France*

Low density InAs/InP quantum dots (QDs) were grown by molecular beam epitaxy applying ripening process. Near-field imaging spectroscopy of these diluted QDs reveals the photoluminescence properties of single quantum dots.

3:30 PM – 4:00 PM **COFFEE BREAK**

4:30 PM - 6:00 PM
Session: SHORT COURSE II
Room: Baycliff

SC3 4:30 PM - 6:00 PM

PIC Technology for Advanced Modulation Format, C. R. Doerr, *Alcatel-Lucent, Holmdel, NJ, USA*

We will cover photonic integrated circuits (PICs) for optical communications, with a focus on PICs that generate or receive optical signals with advanced modulation formats. An example of an advance modulation format is polarization-division multiplexed quadrature phase-shift keying.

Benefits and Learning Objectives:
1. Be able to identify the strengths and weaknesses of PICs for optical communications applications.
2. Be able to explain advanced modulation formats.
3. Be able to get started in designing your own PICs.
4. Be able to project with some confidence where PIC technology is headed in the next 5 years.
5. Be able to explain many of the components in PICs.

Intended Audience:
The intended audience is anyone interested in photonic integrated circuits with some basic knowledge of optical communications.

Instructore Biography:
Christopher R. Doerr earned a B.S. in aeronautical engineering and a B.S., M.S., and Ph.D. in electrical engineering from the Massachusetts Institute of Technology (MIT). He attended MIT on an Air Force scholarship and earned pilot wings in 1991. Since coming to Bell Labs in 1995, Doerr's research has focused on integrated devices for optical communication. He was promoted to Distinguished Member of Technical Staff in 2000, received the OSA Engineering Excellence Award in 2002, and became an IEEE Fellow in 2006 and an OSA Fellow in 2009. Doerr was Editor-in-Chief of IEEE Photonics Technology Letters from 2007-2009.

Tuesday, 12 May 2009

Salon AB

8:30 AM - 10:30 AM
Session TuA1: NOVEL SUBSTRATE TECHNOLOGY AND HETERO-INTEGRATION
Session Co-Chair: David F. Bliss, *US Air Force Research Laboratory, Hanscom AFB, MA, USA*
Mark Rosker, *Defense Advanced Research Projects Agency, Arlington, VA, USA*

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

Growth Crystal InP with REEs Elements, R. Yatskiv, K. Zdansky and L. Pekarek, *Academy of Sciences of the Czech Republic, Prague, Czech Republic*

The influence of the rare earth (RE) elements (Pr, Er and Dy) addition during vertical Bridgman low pressure synthesis on the electrical properties has been studies. The effects are attributed to RE atoms acting as efficient gettering agents.

TuA1.2 8:45 AM - 9:15 AM (Invited)

Nano-Electronics of High k Dielectrics on InGaAs for Key Technologies Beyond Si CMOS, T. D. Lin, P. Chang, M. L. Huang, H. C. Chiu, C. A. Lin, W. H. Chang, Y. J. Lee, Y. C. Chang, Y. H. Chang, J. Kwo and M. Hong, *National Tsing Hua University, Hsinchu, Taiwan*

The surface Fermi level unpinning in InGaAs has been realized with high κ dielectric growth using MBE and ALD. Furthermore, world-record device performances in self-aligned inversion-channel InGaAs MOSFET and a CET of $\leq$ 1 nm in $Ga_2O_3(Gd_2O_3)$ and ALD-HfO_2 on InGaAs have been achieved.

TuA1.3 9:15 AM - 9:45 AM (Invited)

Progress and Challenges in the Direct Monolithic Integration of III-V Devices and Si CMOS on Silicon Substrates, T. E. Kazior,

Salon C

8:30 AM - 10:30 AM
Session TuB1: PHOTODETECTORS
Session Co-Chairs: P. Daniel Dapkus, *University of Southern California, Los Angeles, CA, USA*
Sophie Bouchoule, *Laboratoire de Photonique et de Nanostructures, Marcoussis, France*

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

Advances in Single Photon Detectors, J. C. Campbell, *University of Virginia, Charlottesville, VA, USA*

Quantum mechanics can be utilized to develop ultra-secure communication channels. Practical implementation of these systems requires solid-state detectors such as single photon avalanche detectors (SPADs). This paper will review state-of-the-art SPADs and describe recent advances.

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

High Detection Efficiency InGaAs/InP Single Photon Avalanche Photodiodes, Y. Gu, *University of Maryland Baltimore County, Baltimore, MD, USA*, X. Wu, *Adtech Optics, City of Industry, CA, USA* and F.-S. P. Choa, *University of Maryland Baltimore County, Baltimore, MD, USA*

InGaAs/InP avalanche photodiodes with high detection efficiency at 1.55 μm is reported in Geiger mode for single photon detection. In addition, mechanisms to improve device dark count rate versus photon detection efficiency performance are reported.

TuB1.3 9:15 AM - 9:30 AM

Reduced Frequency Dependence of Third Order Nonlinearities in Partially-Depleted-Absorber Photodiodes, H. Pan, A. Beling, H. Chen and J. C. Campbell, *University of Virginia, Charlottesville, VA,*

J. R. LaRoche, *Raytheon Integrated Defense Systsems, Andover, MA, USA*, D. I. Lubyshev, J. M. Fastenau, W. K. Liu, *IQE Incorporated, Bethlehem, PA, USA*, M. Urteaga, W. Ha, J. Bergman, M. J. Choe, *Teledyne Scientific Company, Thousand Oaks, CA, USA*, M. T. Bulsara, E. A. Fitzgerald, *Massachusetts Institute of Technology, Cambridge, MA, USA*, D. Smith, D. Clark, R. Thompson, *Raytheon Systems Limited, Glenrothes, Fife, UK*, C. Drazek, N. Daval, *S.O.I.TEC, Bernin, France*, L. Benaissa and E. Augendre, *Commissariat à l'Énergie Atomique, Grenoble, France*

The future of high performance integrated circuits includes integration of III V devices with Si CMOS. We review progress in the direct integration of InP HBTs and Si CMOS on SOLES (Silicon on Lattice Engineered Substrates).

TuA1.4 9:45 AM - 10:15 AM (Invited)

Technology for Dense Heterogeneous Integration of InP HBTs and CMOS, Y. Royter, P. R. Patterson, J. Li, K. Elliott, T. Hussain, M. F. Boag-O'Brien, J. R. Duvall, M. Montes, D. A. Hitko, M. Sokolich, D. H. Chow and P. Brewer, *HRL Laboratories, Malibu, CA, USA*

Wafer-scale device-level integration of InP HBTs and CMOS was developed. Simple ICs have been fabricated, showing no significant CMOS or HBT degradation and high heterogeneous interconnect yield. Resulting circuits maintain maximum CMOS integration density and HBT performance, while keeping the heterogeneous interconnect length below 5µm.

TuA1.5 10:15 AM - 10:30 AM

Source/Drain Formation by Using Epitaxial Regrowth of n+InP for III-V nMOSFETs, M. Takenaka, K. Takeda, T. Hoshii, T. Tanemura, M. Sugiyama, Y. Nakano and S. Takagi, *University of Tokyo, Tokyo, Japan*

Defect-free n-type InP source/drain for III-V nMOSFETs was successfully formed by epitaxial regrowth at 610° C. The impurity concentration of $1x10^{19}$ cm^{-3} with the S/D junction steepness of around 10 nm/dec. was obtained.

USA

The local third-order intercept point (IP3) of an InGaAs/InP partially-depleted-absorber photodiode is characterized. The IP3 has a flat frequency response: a record IP3 of 39 dBm is achieved at 20 GHz

TuB1.4 9:30 AM - 9:45 AM

Low Dark Current SWIR Photodiode with InGaAs/GaAsSb Type II Quantum Wells grown on InP Substrate, H. Inada, *Sumitomo Electric Industries Ltd., Osaka, Osaka, Japan*

For sensing SWIR (1.0-2.5µm) region, phtodiodes with $In_{0.53}Ga_{0.47}As/GaAs_{0.5}Sb_{0.5}$ type II quantum well structures grown on InP substrates by solid source MBE, were successfully fabricated. Low dark current was obtained by improving GaAsSb crystalline quality.

TuB1.5 9:45 AM - 10:00 AM

InGaP/GaAs Heterojunction Phototransistors for Ultra-low Optical Power Detection, J. Jang, Y. Byun and M. Park, *Gwangju Institute of Science and Technology, Gwangju, Korea*

The fabricated InGaP/GaAs heterojunction bipolar phototransistors (HPTs) without base contact metal and with low base doping concentration showed the superior high optical gain. The devices (Base:4E18) exhibited very high optical gain of 162 at optical power of 1.74 µW under the 640 nm illumination.

TuB1.6 10:00 AM - 10:15 AM

Optically Pre-Amplified Photodetectors for Multi-Guide Vertical Integration in InP, C. Watson, V. I. Tolstikhin, F. Wu, K. Pimenov, R. Moore and Y. Logvin, *OneChip Photonics Inc., Ottawa, ON, Canada*

An integrated optically pre-amplified photodetector, featuring waveguide gain and absorption sections defined on the same active waveguide layers atop a common passive waveguide, is reported. The device demonstrates high responsivity while exhibiting little polarization sensitivity.

TuB1.7 10:15 AM - 10:30 AM

Investigation of Evanescent Coupling Between SOI Waveguides and Heterogeneously-Integrated III-V pin Photodetectors, Z. Sheng, *Ghent University, Ghent, Belgium*

Efficient evanescent coupling between SOI waveguides and heterogeneously-integrated III-V pin photodetectors is proposed. The serious absorption by p-InGaAs and metal contact layers are greatly reduced by introducing a central opening on these layers.

10:30 AM - 11:00 AM COFFEE BREAK

11:00 AM - 12:45 PM

Session TuA2: HEMT Devices
Session Co-Chairs: Edward Y. Chang, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.*
Arnulf Leuther, *Fraunhofer-Institut, Freiburg, Germany*

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

High Performance InP HEMT Technology with Multiple Interconnect Layers for Advanced RF and Mixed Signal Circuits, W. Ha, *Teledyne Scientific Company, Thousand Oaks, CA, USA*

High performance InP HEMTs in a low-loss interconnect environment were successfully developed. The devices demonstrated balanced fT / fmax of 420/417 GHz, excellent uniformity, and yield after interlayer dielectric process. Compact, feedback-linearized, low noise amplifiers were demonstrated.

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

11:00 AM - 12:30 PM

Session TuB2: Photonic Integration Technology
Session Co-Chairs: Christopher R. Doerr, *Alcatel-Lucent, Holmdel, NJ, USA*
Shinji Matsuo, *NTT Corporation, Atsugi, Kanagawa, Japan*

TuB2.1 11:00 AM - 11:15 AM

Programmable Photonic Filters Fabricated with Deeply Etched Waveguides, E. J. Norberg, R. S. Guzzon, S. Nicholes, J. S. Parker and L. A. Coldren, *University of California - Santa Barbara, Santa Barbara, CA, USA*

Novel monolithic programmable optical filters are proposed and demonstrated. Deeply-etched waveguides are used throughout. Single unit cells, incorporating a ring resonator in one arm of a Mach-Zehnder, have given programmable poles and zeros; cascaded unit cells have yielded flat-topped band-pass filtercharacteristics.

Enhancement Mode $In_{0.53}Ga_{0.47}As$ MOSFET with Self-aligned Epitaxial Source/Drain, U. Singisetti, M. A. Wistey, G. J. Burek, A. K. Baraskar, *University of California - Santa Barbara, Santa Barbara, CA, USA*, Y.-J. Lee, *Intel Corporation, Santa Clara, CA, USA*, A. Ballinger, B. Thibeault, M. J. W. Rodwell, A. C. Gossard, *University of California - Santa Barbara, Santa Barbara, CA, USA*, E. Kim, B. Shin and P. C. McIntyre, *Stanford University, Stanford, CA, USA*

We report an enhancement mode InGaAs MOSFET with a self-aligned source/drain defined by MBE regrowth with a peak Id of 0.14 mA/ μm. The InGaAs channel is 5 nm thick with InAlAs back barrier suitable for sub-22nm gate length technologies.

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

Theoretical Study of Performance Limits in Nano-Scale InAs HEMTs Based on Quantum-Corrected Monte Carlo Method, T. Takegishi, R. Yamada, T. Matsumoto, S. Hara and H. I. Fujishiro, *Tokyo University of Science, Noda, Chiba, Japan*

The ultimate limits of the performance that include the electron injection velocity and the cutoff frequency f_T in the nano-scale InAs HEMTs are investigated using the quantum-corrected Monte Carlo method.

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

A 40-nm-Gate InAs/InGaAs Composite-Channel HEMT with 2200 mS/mm and 500-GHz f_T, C.-I. Kuo, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.*, H.-T. Hsu, *Yuan Ze University, Chung Li, Taiwan, R.O.C.*, C.-Y. Wu, E. Y. Chang, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.*, Y. Miyamoto, *Tokyo Institute of Technology, Meguro-ku, Tokyo, Japan*, Y.-L. Chen, *National Chiao Tung University, Hsinchu, Taiwan, R.O.C.* and D. Biswas, *Indian Institute of Technology, Kharagpur, India*

A 40-nm gate high-electron-mobility-transistor with InAs/InGaAs composite-channel has been fabricated. The Device exhibits a transconductance (gm) of 2200 mS/mm and a f_T of 506 GHz. These performances make the device well-suited for millimeter-wave applications.

TuA2.5 12:15 PM - 12:30 PM

Scaling Benefit of InAs PHEMTs, D.-H. Kim, *Massachusetts Institute of Technology, Cambridge, MA, USA*

We have experimentally investigated the scaling benefit of InAs PHEMTs on InP against InGaAs PHEMTs, from the logic point of view. We find that thinning down the channel thickness leads to enormous improvements in the electrotatic integrity of the device.

TuA2.6 12:30 PM - 12:45 PM

Hetero-Epitaxy of III-V Compounds Latticed-Matched to InP on GaAs/Si by MOCVD for Device Applications, K. M. Lau, C. W. Tang, H. Li, Z. Zhong and K. L. Ng, *Hong Kong University of Science and Technology, Kowloon, Hong Kong*

Device quality $Al_{0.50}In_{0.50}As/Ga_{0.47}In_{0.53}As$ mHEMT structures have been grown by MOCVD on GaAs substrates, with 2-DEG mobilities > 8700 $cm^2/V\text{-}s$ and sheet carrier densities >4 x 10^{12} cm^{-2}. An 150nm T-gate transistor demonstrated f_T of 279GHz.

TuB2.2 11:15 AM - 11:30 AM

First Monolithic InP-Based 90°-Hybrid OEIC Comprising Balanced Detectors for 100GE Coherent Frontends, R. Kunkel, H.-G. Bach, D. Hoffmann, C. M. Weinert, *Fraunhofer-Institut, Berlin, Germany*, I. Molina-Fernandez and R. Halir, *Universidad de Málaga, Málaga, Spain*

A monolithically integrated InP 90°hybrid with waveguide balanced photodiodes is presented useable in optical links. Stable performance is achieved over a wavelength range from 1530 nm to 1565 nm.

TuB2.3 11:30 AM - 11:45 AM

Chained Integration of Broadband Electroabsorption Modulators and Semiconductor Optical Amplifier for Noise Reduction, Y.-J. Chiu, *National Sun Yat-sen University, Kaohsiung, Taiwan, R.O.C.*

A new monolithic integration of EAM/SOA, chain-integration, is proposed and demonstrated. As compared with conventional EAM/SOA, chain-integration offer higher speed with lower noise. Speed of >40GHz, optical link gain of 12dB and 2dB sensitivity improvement of 10Gb/s transmission is obtained.

TuB2.4 11:45 AM - 12:00 PM

Low-Threshold and High-Efficiency Operation of Distributed Reflector Laser with Wirelike Active Regions by Reduced Waveguide Loss, S. Lee, T. Shindo, D. Takahashi, N. Tajima, N. Nishiyama and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

By reducing waveguide loss, low-power operations, i.e. low-threshold current as well as high differential quantum efficiency, of distributed reflector lasers with wirelike active regions were achieved. Injection currents for 1-mW output power of 4.2 and 3.6-mA were obtained for uniform and phase-shifted grating structures, respectively.

TuB2.5 12:00 PM - 12:15 PM

Lateral Current Injection Type GaInAsP/InP DFB Lasers on SI-InP Substrate, T. Okumura, M. Kurokawa, D. Kondo, H. Ito, N. Nishiyama and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

Lateral current injection type DFB lasers on a SI-InP substrate were realized toward low power membrane lasers. Threshold current of 27 mA and a side-mode suppression ratio of 35dB were obtained.

TuB2.6 12:15 PM - 12:30 PM

Multiple-Wavelength GaInAs/GaAs VCSELs with Grading a Spacer Layer for Short Reach WDM Applications, P. B. Dayal, A. Imamura, T. Sakaguchi, A. Matsutani and F. Koyama, *Tokyo Institute of Technology, Yokohama, Kanagawa, Japan*

We propose and demonstrate a simple method of making multi-channel VCSEL arrays with grading a SiO_2 spacer layer. Multiple-channel 980 nm VCSELs with wavelength span exceeding 30.0 nm and scalability up to 8 channels are presented.

12:30 PM – 1:30 PM **LUNCH BREAK**

1:30 PM **FREE AFTERNOON**

Wednesday, 13 May 2009

Salon AB

8:30 AM - 10:30 AM

Session WA1: **HEMT CIRCUITS**
Session Co-Chairs: Nils G. Weimann, *Alcatel-Lucent, Murray Hill, NJ, USA*
James Li, *HRL Laboratories, Malibu, CA, USA*

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

Sub-MMW Active Integrated Circuits based on 35 nm InP HEMT Technology, R. Lai, W. Deal, X. Mei, V. Radisic, K. Leong, W. Yoshida, J. Lee, J. Uyeda, A. Fung, L. Samoska and T. Gaier, *Northrop Grumman Corporation, Redondo Beach, CA, USA*

This paper will discuss currrent state-of-the-art results for active Sub-MMW (>300 GHz) integrated circuits (S-MMIC) including recent amplifier results at 340 GHz. These results are based on the continued development and evolution of the 35 nm InP HEMT device and S-MMIC process.

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

Metamorphic HEMT Technology for Low-noise Applications, A. Leuther, A. Tessmann, I. Kallfass, R. Loesch, M. Seelmann-Eggebert, *Fraunhofer-Institut, Freiburg, Germany*, N. Wadefalk, *Chalmers University of Technology, Göteborg, Sweden*, F. Schäfer, *Max Planck Institute for Radio Astronomy, Bonn, Germany*, J. D. Gallego Puyol, *Centro Astronómico de Yebes, Yebes, Spain*, M. Schlechtweg, M. Mikulla and O. Ambacher, *Fraunhofer-Institut, Freiburg, Germany*

Different noise sources in HEMTs are discussed, and low-noise amplifiers using 50 nm and 100 nm metamorphic HEMTs are presented. For the first time metamorphic HEMT based LNAs demonstrate state-of-the-art noise figures at ambient and cryogenic temperatures.

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

Fundamental Oscillation up to 831 GHz in GaInAs/AlAs Resonant Tunneling Diodes, S. Suzuki, A. Teranishi, K. Hinata, M. Asada, *Tokyo Institute of Technology, Meguro-ku, Tokyo, Japan*, H. Sugiyama and H. Yokoyama, *NTT Corporation, Atsugi, Kanagawa, Japan*

Fundamental oscillation up to 831 GHz was observed in GaInAs/AlAs resonant tunneling diodes with ultra high current density (18 mA/square micron), reduced mesa area (0.88 square micron), and optimum spacer thickness (20 nm) at room temperature.

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

A 300 GHz mHEMT Amplifier Module, A. Tessmann, A. Leuther, H. Massler, R. Loesch, M. Zink, M. Riessle, V. Hurm, M. Schlechtweg and O. Ambacher, *Fraunhofer-Institut, Freiburg, Germany*

In this paper, we present the development of a 300 GHz S-MMIC amplifier module demonstrating a maximum small-signal gain of 13 dB at 276 GHz and a linear gain of more than 10 dB between 270 and 300 GHz.

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

Manufacturable Tri-Stack AlSb/InAs HEMT Low Noise Amplifiers Using Wafer-Level-Packaging Technology for Light-Weight and Ultralow-Power Applications, Y.-C. Chou, P. Chang-Chien, J. Yang, M. Nishimoto, K. Hennig, M. D. Lange, X. Zeng, L. S. Lee, P. S. Nam, M. R. Parlee, A. L. Gutierrez, M. Wojtowicz, M. Barsky and A. K. Oki, *Northrop Grumman Corporation, Redondo*

Salon C

8:30 AM - 10:30 AM

Session WB1: **EPITAXY & HETEROJUNCTION**
Session Chair: Thomas F. Kuech, *University of Wisconsin-Madison, Madison, WI, USA*

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

III-V/SOI Heterogeneous Photonic Integrated Devices for Optical Interconnection in LSI, N. Nishiyama, T. Maruyama and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

InP-based photonic devices on SOI substrate using bonding technologies were demonstrated. Direct bonding and BCB bonding enable us to realize high optical confinement DFB lasers and other devices for intra/inter-chip connection in Si LSI circuit.

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

Novel Application of Quantum Well Intermixing Implant Buffer Layer to Enable High-Density Photonic Integrated Circuits in InP, S. Nicholes, *University of California - Santa Barbara, Santa Barbara, CA, USA*, M. Mashanovitch, *Freedom Photonics, LLC, Santa Barbara, CA, USA*, J. S. Barton, E. J. Norberg, E. Lively, B. Jevremovic, L. A. Coldren and D. J. Blumenthal, *University of California - Santa Barbara, Santa Barbara, CA, USA*

We demonstrate an application of a novel technique for free-carrier absorption reduction using an InP buffer layer with quantum well intermixing. This technique enabled fabrication of monolithic tunable optical routers with more than 200 functions.

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

Deep Etching and Rabbit-Ear-Free Regrowths for Quantum Cascade Lasers, L. Cheng, M. Godbole, F.-S. P. Choa, *University of Maryland Baltimore County, Baltimore, MD, USA*, D. Janssen, *Greater Grace Christian Academy, Baltimore, MD, USA*, R. Astri, *Centennial High School, Ellicott City, MD, USA* and J.-Y. Fan, *Adtech Optics, City of Industry, CA, USA*

Extensive deep etchings were presented. The effects of etched mesa profiles along different waveguide orientations with various mask overhang lengths on buried-heterostructure quantum-cascade-laser regrowth were studied. Successful regrowths were reproducibly obtained with a ratio of mesa height to overhang length between 2.5 and 3.0.

WB1.4 9:30 AM - 9:45 AM

Ultra-thin InAlP/InGaAs Heterojunctions Grown by Metal-Organic Vapor-Phase Epitaxy, H. Sugiyama, H. Yokoyama, N. Shigekawa, T. Enoki, *NTT Corporation, Kanagawa, Japan*, A. Teranishi, S. Suzuki and M. Asada, *Tokyo Institute of Technology, Tokyo, Japan*

Ultra-thin InAlP/InGaAs heterojunctions were grown by MOVPE for use as etching stoppers in InP-based HEMTs and barriers in RTDs. Practical etching selectivity in even 2-nm-thick InAlP was demonstrated. High peak current densities of over 5E5 A/cm^2 with PVRs of around 2 were obtained in RTDs.

WB1.5 9:45 AM - 10:00 AM

Uncooled (25-85 °C) 10-Gbps Operation of 1.3-μm-Range Metamorphic InGaAs Laser on GaAs Substrate, M. Arai, T. Tadokoro, W. Kobayashi, T. Fujisawa, K. Nakashima, M. Yuda and Y. Kondo, *NTT Corporation, Atsugi, Kanagawa, Japan*

We have developed a 1.3-μm-range ridge waveguide laser with a high quality InGaAs metamorphic buffer on a GaAs substrate. The

Beach, CA, USA

A wafer-level-packaging (WLP) technology was used to integrate the AlSb/InAs HEMT LNAs with other elements to form a tri-stack transimit/receiver module with light-weight and ultralow-power operation. This demonstration of high manufacturability of tri-stack transimit/receiver modules is essential for phase-array applications requiring light-weight and ultralow-power operation.

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

InGaAs/InAlAs/InP Power HEMT with an Improved Ohimc Contact and an Extremely High Operating Voltage, X. Mei, D. L. Farkas, W. B. Luo, C. H. Lin, L. J. Lee, W. Liu, P. H. Liu, A. Cavus and R. Lai, *Northrop Grumman Corporation, Redondo Beach, CA, USA*

A 0.15μm InP HEMT with improved ohmic contact and a double recess process has demonstrated an output power density of 471mW/mm at 40GHz with a drain bias of 5V.

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

An InGaAs PIN-diode based Broadband Traveling-wave Switch with High-Isolation Characteristics, J. G. Yang, *Korea Advanced Institute of Science and Technology, Daejeon, Korea*

A high-isolation broadband traveling-wave switch using InGaAs PIN diodes is proposed. The circuit design, the fabrication technology and the measurement results of the proposed traveling-wave switch are described.

optimized laser structure enabled us to realize low threshold operation and 10-Gbps direct modulation up to 85 °C.

WB1.6 10:00 AM - 10:15 AM

Semiconductive Properties of Heterointegration of InP/InGaAs on High Doped Silicon Wire Waveguide for Silicon Hybrid Laser, L.-H. Li, R. Takigawa, A. Higo, E. Higurashi, M. Kugota, M. Sugiyama and Y. Nakano, *University of Tokyo, Tokyo, Japan*

The hetero-integration of InP/InGaAs on high doped silicon micro wires for Si hybrid laser using plasma aided direct bonding was done and its semiconductor properties for current injection were measured and analyzed.

WB1.7 10:15 AM - 10:30 AM

Photoluminescence Characteristics of MOCVD Grown-InAs Quantum Dots Covered by GaInP Layer, R. Suzuki, T. Miyamoto, T. Sengoku, K. Nemoto, S. Tanabe and F. Koyama, *Tokyo Institute of Technology, Yokohama, Japan*

PL characteristics of MOCVD-grown InAs QDs using a GaInP cover layer were investigated. It is confirmed that the strain modification effect of the cover layer regardless of growth methods is a cause of wavelength shift of QDs.

10:30 AM - 11:00 AM COFFEE BREAK

11:00 AM - 12:30 PM

Session WA2: QUANTUM CASCADE & NOVEL DEVICES
Session Co-Chairs: Joe C. Campbell, *University of Virginia, Charlottesville, VA, USA*
Claire Gmachl, *Princeton University, Princeton, NJ, USA*

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

High Temperature Operation of Terahertz Quantum Cascade Laser Sources, F. Capasso, *Harvard University, Cambridge, MA, USA*, M. Belkin, *University of Texas at Austin, Austin, TX, USA*, Q. Wang, C. Pfluegl, *Harvard University, Cambridge, MA, USA*, A. A. Belyanin, *Texas A&M University, College Station, TX, USA*, S. P. Khanna, A. Davies and E. H. Linfield, *University of Leeds, Leeds, UK*

Recent progress in quantum design and waveguide design has led to temperatures approaching thermoelectric cooled operation for THz QCLs and to room temperature operation in dual frequency mid-ir QCLs with intracavity difference frequency generation.

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

Temporal Wavelength Multiplexing of a Quantum Cascade Laser, F. Toor, *Princeton University, Princeton, NJ, USA*, D. L. Sivco, *Alcatel-Lucent, Murray Hill, NJ, USA* and C. Gmachl, *Princeton University, Princeton, NJ, USA*

A quantum cascade laser based system is presented that is both temporally and wavelength multiplexed. A multiplexing circuit is used to drive a bi-directional and multi-wavelength QC laser source that emits at 10.8 μm wavelength for positive polarity and 8.6 μm for negative polarity current.

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

Phase-Locking in Quantum Cascade Laser Arrays, L. K. Hoffmann, *Vienna University of Technology, Wien, Austria*, M. Klinkmüller, *Humboldt University, Berlin, Germany*, E. Mujagic, *Vienna University of Technology, Wien, Austria*, M. P. Semtsiv, *Humboldt University, Berlin, Germany*, W. Schrenk, *Technical*

11:00 AM - 12:30 PM

Session WB2: NANOWIRE AND HETEROSTRUCTURES
Session Co-Chairs: Diana L. Huffaker, *University of California - Los Angeles, Los Angeles, CA, USA*
Edward T. Yu, *University of California - San Diego, La Jolla, CA, USA*

WB2.1 11:00 AM - 11:15 AM

MOVPE Growth and Structural Characterization of Extremely Lattice-Mismatched InP-InSb Nanowire Heterostructures, B. M. Borg, M. E. Messing, P. Caroff, K. A. Dick, K. Deppert and L.-E. Wernersson, *Lund University, Lund, Sweden*

We here show growth of InSb nanowire heterostructures with extreme lattice-mismatch, with focus on growth of InP-InSb nanowires. Growth studies and structural characterization of the InP-InSb nanowires using HRTEM, XRD and XEDS are presented, revealing relaxed InSb nanowires with excellent crystal quality.

WB2.2 11:15 AM - 11:45 AM (Invited)

Growth of III-V Nanowire using MOCVD, D. Wang, *University of California - San Diego, La Jolla, CA, USA*

We present the systematic study on the epitaxial growth of III arsenide nanowires via vapor-liquid-solid mechanism using MOCVD, and some key new insights into the optimal control over the nanowire morphology, structure, and properties.

WB2.3 11:45 AM - 12:00 PM

Spontaneous Formation of Ultra-Short-Period Lateral Composition Modulation in TlGaInAsN/TlInP Structures, M. Ishimaru, Y. Tanaka, S. Hasegawa, H. Asahi, *Osaka University, Ibaraki, Osaka, Japan*, K. Sato and T. J. Konno, *Tohoku University, Sendai, Japan*

Lateral composition modulation with a wavelength of ~1 nm was successfully formed in TlGaInAsN layers by spontaneous phase separation. We discuss its formation process using a simple kinetic Ising model for epitaxial growth.

University of Vienna, Wien, Austria, W. Masselink, *Humboldt University, Berlin, Germany* and G. Strasser, *State University of New York at Buffalo, Buffalo, NY, USA*

A monolithic coupling scheme for mid-infrared InP-based quantum cascade laser arrays is presented. The tree-shapedresonator exhibits phase-locking, which leads to in-phaseemission from the coupled branches and a high level of modalcontrol.

WA2.4 12:00 PM - 12:15 PM

SSC-Integrated TM Mode LD for Long-Range Surface-Plasmon-Polariton Waveguide, J.-S. Choe, K. Kim, S. Park, J.-T. Kim, M.-S. Kim, J.-M. Lee, S. K. Park and J. J. Ju, *Electronics & Telecommunications Research Inst., Daejeon, Korea*

We fabricated 1.3μm TM mode LD with integrated SSC. The high polarization ratio of 21dB was obtained between TM and TE mode. SSC supplied good coupling efficiency and alignment tolerance with LR-SPP waveguide. Clear eye opening was observed under 10Gbps NRZ modulation.

WA2.5 12:15 PM - 12:30 PM

Improvement in Electrostatic-Discharge-Tolerance of 1.3μm AlGaInAs/InP Buried Heterostructure Laser Diodes, H. Ichikawa, C. Fukuda, S. Matsukawa, K. Hamada, N. Ikoma and T. Nakabayashi, *Sumitomo Electric Industries Ltd., Yokohama, Japan*

This is the first report on electrostatic discharge (ESD) induced degradation of an AlGaInAs/InP buried heterostructure laser diode. We found that the dominant degradation mechanism was light absorption at an active layer. We successfully improved ESD-tolerance by facet passivation.

WB2.4 12:00 PM - 12:15 PM

Fabrication and Structural Characterization of Nearly Lattice-matched p-$ZnSnAs_2$/n-InP Heterojunctions, J. T. Asubar, *Nagaoka University of Technology, Nagaoka, Japan*, S. I. Nakamura, *Aoyama Gakuin University, Sagamihara, Kanagawa, Japan*, Y. Jinbo and N. Uchitomi, *Nagaoka University of Technology, Nagaoka, Japan*

Rectifying p-$ZnSnAs_2$/n-InP hetero-junctions were fabricated by growing unintentionally p-type $ZnSnAs_2$ epilayers on n-type InP(001) substrates using MBE. RSM studies indicate pseudomorphic growth. HR-XRD, AFM, and TEM investigations suggest high structural qualities of the epitaxial films.

WB2.5 12:15 PM - 12:30 PM

Improvement in Luminescence Properties of TlInGaAsN/TlInP Multi-Layers Grown by Gas Source Molecular Beam Epitaxy, H. Asahi, Y. Tanaka, M. Ishimaru, J.-Q. Liu and S. Hasegawa, *Osaka University, Osaka, Japan*

Introduction of N atoms was found to increase the Tl incorporation in TlInGaAs/TlInP/InP structures. The use of the TlInGaAsN/TlInP/InP multiple layer structures with thin N-containing layers was also found to improve their PL emission properties.

12:30 PM – 1:30 PM LUNCH BREAK

1:30 PM – 1:50 PM **INVITATION TO IPRM 2010 AT TAKAMATSU**

Takatomo Enoki, *NTT Corporation, Japan*

IPRM 2010, the 22nd exciting event, will be held at Takamatsu Symbol Tower in Japan from 31 May to 4 June 2010. Let's submit your exciting achievements and come together at Takamatsu facing the beautiful Seto inland sea.

Room: Salon ABC

1:50 PM - 4:00 PM

Session WP: POSTER SESSION
Room: Sunset/Laguna

WP1 GaAsSb-GaAsN -based Type-II 'W' Structures for Mid-IR Emission, M. Rathi, A. Khandekar, X. Song, S. Babcock, L. J. Mawst and T. F. Kuech, *University of Wisconsin-Madison, Madison, WI, USA*

GaAsSb-GaAsN-based type-II 'W' structures have been studied for mid-IR (1.3-1.6μm) emission. Post growth annealing increases the photoluminescence (PL) intensity of the structures. Temperature dependent PL show a charge localization effect due to presence of nitrogen.

WP2 X-Ray Diffraction Analysis of Quantum Cascade Lasers, L. Cheng, *University of Maryland Baltimore County, Baltimore, MD, USA*, R. Choa, *Ellicott, MD, USA*, J. B. Khurgin, *Johns Hopkins University, Baltimore, MD, USA*, F.-S. P. Choa, X. Chen, *University of Maryland Baltimore County, Baltimore, MD, USA*, X. Wang, J.-Y. Fan, *Adtech Optics, City of Industry, CA, USA*, J. Chen and C. Gmachl, *Princeton University, Princeton, NJ, USA*

Growth quality of quantum-cascade-lasers (QCLs) is difficult to characterize due to the tough requirements on hetero-interface quality and thickness control for all >1000 nano-scale layers. We present methods to effectively evaluate QCL-wafer growths with X-ray.

1:50 PM - 4:00 PM

Session PD: POSTDEADLINE SESSION
Session Chair:

WP3 Evaluation of the Degeneracy of Hole's Quantum Levels in the InGaAsP/InP Quantum Well Structures by using Photoluminescence Spectra, H. Imai and M. Esaki, *Japan Women's University, Tokyo, Tokyo, Japan*

We have evaluated the strain in the InGaAsP/InP quantum well structures by using photoluminescence spectra.Analyzing the behavior between the PL peak shift of TE and TM mode excitation, it is estimated the degeneracy of first quantum levels of light and heavy holes.

WP4 Effect of Sulfur Passivation and Dielectric Capping on the Dark Current of InGaAs/InP PIN Photodetectors, N. DasGupta and S. Devarajamani, *Indian Institute of Technology, Chennai, TN, India*

This work is aimed at optimizing the surface passivation scheme for InGaAs/InP PIN photodetector using [$(NH_4)_2S_x$, x>1] solution and comparing the effect of two different dielectric capping layers on the long term stability of the detector.

WP5 Electrical Derivative Analysis of Leakage Current in Quantum Cascade Lasers, D. Guo, X. Chen, L. Cheng, M. Godbole and F.-S. P. Choa, *University of Maryland Baltimore County, Baltimore, MD, USA*

Leakage current in quantum-cascade-lasers with oxide-blocked-ridge waveguide and buried-heterostructure (with/without n-InP top-cover) are compared using electrical derivative measurements. Oxide-blocking structure provides the least leakage current although the top-covered BH QCLs show the toughest durability.

WP6 Enhancing Oscillator Strength for Second Harmonic Generation in AlGaAs/InGaAs Quantum Cascade Laser Structures, G. E. Triplett, D. Roberts and S. Ikpe, *University of Missouri-Columbia, Columbia, MO, USA*

This paper explores tunable oscillator strength and nonlinear susceptibility in strained quantum cascade (QC) laser that lead to frequency mixing within an AlGaAs/InGaAs matrix. This study involves QCL cavity design with emission near 3.8 micrometers.

WP7 Injection Locked Fabry-Perot Lasers with Integrated Phase Modulators, S. Taebi and S. S. Saini, *University of Waterloo, Waterloo, ON, Canada*

An injection-locked Fabry-Perot laser with an integrated phase modulator is demonstrated. The phase modulator allows for adjusting the wavelength of the internal Fabry-Perot mode to match the input injected signal and counter any drift in FP modes due to change in temperature.

WP8 Realization of a Tunable Near Infra Red InP / InGaAs QWs based Photodetector Integrated in a MOEMS Structure for Micro-Spectrometer Applications, O. Parillaud, O. Huet, J. Decobert, *Alcatel Thales III-V Lab, Palaiseau, France*, M. Garrigues, R. Gil-Sobraques and J. L. Leclercq, *École Centrale de Lyon, Ecully, France*

This paper concerns the realization of a near infrared InGaAs strained QWs based photodiode integrated in a MOEMS structure for wavelength tunability. The technological steps are described and results such as wavelength tunability presented.

WP9 Semiconductor Optical Amplifier Designs for Passive Optical Network Extensions, A. Assadihaghi, H. Teimoori, A. Benhsaien, *University of Ottawa, Ottawa, ON, Canada*, V. I. Tolstikhin, *OneChip Photonics Inc., Ottawa, ON, Canada*, T. J. Hall and K. Hinzer, *University of Ottawa, Ottawa, ON, Canada*

We report a polarization insensitive broadband semiconductor optical amplifier design based on an asymmetric multi-quantum well structure. The device operates with 9 dBm saturation output power, 23 dB gain, and less than 0.8 dB polarization dependency as applied in a CWDM-based PON.

WP10 Temperature Effects on the Modulation Response of an Injection-Locked InAs/InP Quantum-Dash Laser, N. A. Naderi,

M. C. Pochet, F. Grillot, Y. Li and L. F. Lester, *University of New Mexico, Albuquerque, NM, USA*

The impact of device temperature variations on the modulation response of an injection-locked Quantum-Dash laser is analyzed. Lower slave operating temperatures result in a large reduction in the undesirable pre-resonance dip in the modulation response.

WP11 Wavelength-Selective Receiver for Simultaneous λ=1.3μm and λ=1.55μm RF Optical Transmission, A. Poloczek, B. Muenstermann, I. Nannen, I. Regolin and F.-J. Tegude, *University of Duisburg-Essen, Duisburg, Germany*

We report on a dual-wavelength detector consisting of two stacked PIN-diodes with a common center terminal. The aspect of electrical and optical crosstalk in dependence of layer parameters is discussed and the RF-performance is investigated on fabricated devices up to 12GHz.

WP12 Room-Temperature CW Operation of Lateral Current Injection Lasers with Thin Film Lateral Cladding Layers, T. Okumura, M. Kurokawa, H. Ito, D. Kondo, N. Nishiyama and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

RT-CW operation of lateral current injection type lasers on a SI-InP substrate applicable for low power membrane photonic active devices was achieved.

WP13 Experimental Study on Temperature Dependance of RTD-based Low-Power MMIC VCO, S. Choi, Y. Jeong and K. Yang, *Korea Advanced Institute of Science and Technology, Daejon, Korea*

The temperature dependence of low-power InP RTD/HBT VCOs is experimentally investigated. The VCO with an oscillation frequency of 14.85 GHz has demonstrated an oscillation frequency shift of ?fOSC = -0.50 GHz/100K.

WP14 Scaling Behaviors of 25-nm Asymmetrically Recessed Metamorphic High Electron-Mobility Transistors, D. Xu, W. M. T. Kong, X. Yang, P. Seekell, L. Mohnkern, K. Duh, P. M. Smith and P. C. Chao, *BAE Systems, Nashua, NH, USA*

We report the scaling behaviors of 25-nm asymmetrically recessed metamorphic electron-mobility transistors and demonstrated the record combination of transconductance, off-state and on-state breakdown voltages for devices of this gate-length range.

WP15 Temperature Dependent Characteristics of InP RTD based CML-MOBILE D-Flip Flop IC, J. Lee, S. Choi and K. Yang, *Korea Advanced Institute of Science and Technology, Daejeon, Korea*

The temperature dependence of the InP-based RTDs and RTD/HBT CML–MOBILE D-Flip Flops has been investigated from 25°C to 150°C. The MOBILE D-Flip Flop shows the stable operation at high temperatures, up to 100°C.

WP16 Vertical InGaAs MOSFET with Hetero-Launcher and Undoped Channel, H. Saito, Y. Miyamoto and K. Furuya, *Tokyo Institute of Technology, Tokyo, Japan*

Vertical InGaAs MOSFET with hetero-launcher and undoped channel was reported. In this trial, gate metal and gate insulator were deposited successively at the sidewall of the channel. By using a 10 nm-thick SiO_2 layer as an insulator, drain current of 270 mA/mm was obtained.

WP17 InP/InGaAs-channel MOSFET with MOVPE Selective Regrown Source, T. Kanazawa, H. Saito, K. Wakabayashi, T. Tajima, Y. Miyamoto and K. Furuya, *Tokyo Institute of Technology, Tokyo, Japan*

We fabricated an InP/InGaAs-channel MOSFET with an InGaAs S/D region selectively regrown by MOVPE. A maximum drain current of ~360 mA/mm is obtained at room temperature with a Si-doped channel and SiO_2 gate insulator.

WP18 InAlAs/InGaAsSb/InGaAs Double Heterojunction Bipolar Transistors with High Current Gain and Low Base Sheet Resistance, S.-H. Chen, C.-M. Chang, P.-Y. Chiang, S.-Y. Wang and J.-I. Chyi, *National Central University, Jhongli, Taiwan, R.O.C.*

The proposed InAlAs/InGaAsSb/InGaAs DHBTs exhibit low turn-on voltage, low crossover current as well as high current gain with wider current gain flattening range. Current gain over base sheet resistance ratio is improved to 0.066, suggesting that the feasibility of using InGaAsSb base for high-speed DHBTs.

WP19 DC Characteristics of InAs/AlSb HEMTs at Cryogenic Temperatures, G. Moschetti, J. Grahn, and P. A. Nilsson, *Chalmers University of Technology, Göteborg, Sweden*

The DC characteristics of InAs/AlSb HEMTs at cryogenic temperature have been investigated. The DC performance was improved, showing lower R_{ON}, higher g_m, lower output conductance and a distinct knee in the I_{ds} vs V_{ds} characteristics.

WP20 Metal-Oxide-HEMT on 6.1Å Antimonides, D.-W. Fan, Y.-C. Lin, H.-K. Lin, P.-C. Chiu, S.-H. Chen, J.-I. Chyi, *National Central University, Jhongli, Taiwan, R.O.C.*, C.-H. Ko, T.-M. Kuan, M.-K. Hsieh, W.-C. Lee and C. H. H. Wann, *Taiwan Semiconductor Manufacturing Company Ltd., Hsinchu, Taiwan, R.O.C.*

Metal-oxide-HEMTs on 6.1Å antimonides are developed based on our developed InAs/AlSb HEMT epitaxy materials with mobility as high as 25,000 cm^2/V-s. Similar device performance and improved gate and off-state drain leakage behaviors are demonstrated compared to conventional InAs/AlSb HEMTs.

WP21 Low-Leakage InAs/AlSb HEMT with High f_T-L_g Product, Y.-C. Lin, T.-W. Fan, H.-K. Lin, P.-C. Chiu, J.-I. Chyi, *National Central University, Jhongli, Taiwan, R.O.C.*, C.-H. Ko, T.-M. Kuan, M.-K. Hsieh, W.-C. Lee and C. H. H. Wann, *Taiwan Semiconductor Manufacturing Company Ltd., Hsinchu, Taiwan, R.O.C.*

We developed high-quality InAs/AlSb HEMT materials by solid-source MBE, and an improved process flow for device fabrication. Very high $f_T.L_g$ product of 62GHz-um and very low gate leakage of 5×10^{-8} A/μm^2 at pinch-off voltage are demonstrated.

Thursday, 14 May 2009

Salon AB

8:30 AM - 10:30 AM

Session ThA1: **Advanced Processing and Materials Properties**

Session Co-Chairs: Wonill Ha, *Teledyne Scientific Company, Thousand Oaks, CA, USA*
Abbas Torabi, *Raytheon RF Components, Andover, MA, USA*

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

InP-based Photonic Integrated Circuits: Technology and Manufacturing, R. P. Schneider, J. Pleumeekers, S. Hurtt, D. Lambert, A. G. Dentai, S. W. Corzine, S. Murthy, E. M. Strzelecka, P. V. Studenkov, V. Lal, R. Muthiah, M. Kato, M. Missey, M. Ziari, J. Rossi and F. A. Kish, *Infinera, Sunnyvale, CA, USA*

Large-scale InP-based photonic integrated circuits (PICs) were first introduced in 2005, representing an order-of-magnitude increase in integration complexity for commercial InP devices. In this talk we will review recent developments in the technology and manufacturing of these novel components.

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

Optimization of 1550nm InAs/InP Quantum Dash and Quantum

Salon C

8:30 AM - 10:30 AM

Session ThB1: **High Speed Laser Sources**

Session Co-Chairs: Thomas L. Koch, *Lehigh University, Bethlehem, PA, USA*
Radhakrishnan Nagarajan, *Infinera, Sunnyvale, CA, USA*

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

Uncooled EA/DFB Lasers for 40Gb/s and 100GBE Applications, S. Makino, *Hitachi, Ltd., Tokyo, Japan*

ABSTRACT NOT AVAILABLE

ThB1.2 9:00 AM - 9:15 AM

40-Gbit/s, Uncooled (-15 to 80°C) Operation of a 1.55-µm, InGaAlAs, Electroabsorption Modulated Laser for Very Short Reach Applications, W. Kobayashi, T. Yamanaka, M. Arai, N. Fujiwara, T. Fujisawa, K. Tsuzuki, T. Ito, Y. Kondo and F. Kano, *NTT Corporation, Atsugi, Kanagawa, Japan*

A 2-km 40-Gb/s transmission from -15 to 80°C is demonstrated using a 1.55-µm InGaAlAs EML for the first time. A power penalty below 2 dB with over 8.2-dB dynamic extinction ratio is achieved at -15°C.

Dot based Semiconductor Optical Amplifier, F. Lelarge, F. Pommereau, R. Brenot, O. Drisse, *Alcatel Thales III-V Lab, Marcoussis, France* and G. Patriarche, *Laboratoire de Photonique et de Nanostructures, Marcoussis, France*

We demonstrate that the combination of Quantum Dots and Quantum Dashes (QD) structures with buried ridge stripe technology allows to achieve QD SOA with an internal gain of 30dB for an injected current of 500mA.

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

Circular, Narrow Beam Emission of 1.3-µm Surface-Emitting Laser with Monolithically-Integrated InP Lens for Direct Fiber Coupling, K. Shinoda, K. Adachi, T. Shiota, T. Kitatani, T. Fukamachi, T. Sugawara and M. Aoki, *Hitachi, Ltd., Tokyo, Japan*

We present a monolithic integration of an InP lens with a 1.3-µm horizontal-cavity surface-emitting laser. A fabricated lens-integrated laser exhibited a circular, narrow far-field pattern with full-width at half-maximums of 3.9° x 3.5°.

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

Properties of High Index Contrast GaInAsP Wired Waveguides with Benzocyclobutene on Si Substrate, H. Enomoto, K. Inoue, T. Okumura, H. D. Nguyen, N. Nishiyama, Y. Atsumi, S. Kondo and S. Arai, *Tokyo Institute of Technology, Tokyo, Japan*

500×150 nm GaInAsP wired waveguides were fabricated on Si substrate by benzocyclobutene bonding and ICP-RIE with SiO_2 mask deposited by PECVD at 300 °C. The propagation loss and 1.5 µm-radius bending loss were 2.1 dB/mm and <1.0 dB/90°, respectively.

ThA1.5 9:45 AM - 10:00 AM

Optical Absorption Coefficient of Carbon-doped GaAs Epitaxial Layer by Means of Propagation-Loss Measurement of Waveguide for Long Wavelength VCSEL, T. Kageyama, K. Kiyota, H. Shimizu, Y. Kawakita, N. Iwai, K. Takaki, S. Imai, M. Funabashi, N. Tsukiji and A. Kasukawa, *Furukawa Electric Co. Ltd, Ichihara, Chiba, Japan*

The optical absorption coefficient (α) for carbon-doped GaAs epitaxial layer by CBr_4 with doping range from 10^{18} to 10^{20} cm^{-3} was measured for the first time. Obtained $\alpha_{GaAs:C}$ was 2-times larger than $\alpha_{GaAs:Zn}$ at 1300nm.

ThA1.6 10:00 AM - 10:15 AM

High Resolution Imaging of InAs/InP Single Quantum Dots by Low-Voltage Cathodoluminescence, E. Dupuy, *Institut des Nanotechnologies de Lyon, Ecully, France*, N. Pauc, *Commissariat à l'Énergie Atomique, Grenoble, France*, D. Drouin, *University of Sherbrooke, Sherbrooke, QC, Canada*, G. Xu, M. Gendry, *Institut des Nanotechnologies de Lyon, Ecully, France* and D. Morris, *University of Sherbrooke, Sherbrooke, QC, Canada*

We have performed high spatial resolution CL images of single InAs/InP quantum dots. Carrier diffusion lengths in the wetting layer below single dots are evaluated as a function of carrier injection and temperature.

ThA1.7 10:15 AM - 10:30 AM

Effect of Surface Preparations on Contact Resistivity of TiW to Highly Doped n-InGaAs, V. Jain, A. K. Baraskar, M. A. Wistey, U. Singisetti, *University of California - Santa Barbara, Santa Barbara, CA, USA*, Z. Griffith, *Teledyne Scientific Company, Thousand Oaks, CA, USA*, E. Lobisser, B. Thibeault, A. C. Gossard and M. J. W. Rodwell, *University of California - Santa Barbara, Santa Barbara, CA, USA*

We show the effect of different surface preparations on contact resisitivity to highly doped n-InGaAs. We report low resistance, non-alloyed, ex-situ, refractory TiW metal contacts to n-InGaAs exhibiting contact resistivity of (1.82±0.34) Ohm-μm^2.

ThB1.3 9:15 AM - 9:30 AM

26 Gbit/s Direct Modulation of AlGaInAs/InP Lasers with Ridge-Waveguide Structure Buried by Benzocyclobutene Polymer, H. Yagi, K. Koyama, Y. Onishi, H. Yoshinaga, H. Ichikawa, N. Kaida, T. Nomaguchi, K. Hiratsuka and K. Uesaka, *Sumitomo Electric Industries Ltd., Yokohama, Kanagawa, Japan*

The high electrical bandwidth of more than 20 GHz was obtained with the ridge-waveguide structure buried by the benzocyclobutene polymer. Consequently, a clear eye-opening under 26 Gbit/s direct modulation at room temperature was attained in AlGaInAs/InP lasers with this structure.

ThB1.4 9:30 AM - 9:45 AM

1.3-µm InGaAlAs/InP-AlGaAs/GaAs Wafer-Fused VCSELs with 10-Gb/s Modulation Speed up to 100°C, A. Mereuta, A. Sirbu, A. Caliman, *École Polytechnique Fédérale de Lausanne, Marcoussis, France*, V. Iakovlev, G. Suruceanu, *BeamExpress SA, Lausanne, Switzerland* and E. Kapon, *École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*

10-Gb/s modulation speed up to 100°C temperature is achieved with wafer-fused VCSELs incorporating re-grown tunnel junction and emitting more than 1mW single mode power at the 1300-nm waveband.

ThB1.5 9:45 AM - 10:00 AM

High-Speed Optical Modulation based on Frequency-Modulated VCSELs and Optical Filters, K. Hasebe, Y. Mada, K. Sakairi, T. Sakaguchi, A. Matsutani and F. Koyama, *Tokyo Institute of Technology, Yokohama, Kanagawa, Japan*

We proposed frequency-modulated VCSELs for high-speed modulation beyond 100GHz and presented the modeling including the intensity modulation associated with frequency modulation. We also experimentally demonstrated the bandwidth enhancement of directly-frequency-modulated 1060nm VCSELs using optical filters.

ThB1.6 10:00 AM - 10:15 AM

Effect of P-Doping on Temperature and Dynamic Performances of 1550nm InAs/InP Quantum Dash based Lasers, F. Lelarge, R. Brenot, F. Pommereau, A. Accard and F. van-Dijk, *Alcatel Thales III-V Lab, Marcoussis, Ile de france, France*

The effect of p-doping on both temperature and dynamic performances of 1.55µm Quantum Dashes lasers is investigated in detail. A relaxation frequency up to 13.5GHz and a damping factor as low as 0.22ns are demonstrated.

ThB1.7 10:15 AM - 10:30 AM

Device Performance of Light Emitting Transistors with Zn-Doped and C-Doped Base Layers, R. D. Dupuis, Y. Huang, J.-H. Ryou, *Georgia Institute of Technology, Atlanta, GA, USA*, F. Dixon, N. Holonyak and M. Feng, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*

Effect of p-type doping in the base layer of N-InP/p-InAlGaAs/N-InAlAs light emitting transistors (LETs) operating at ~1.55 µm were investigated. Both Zn and C are used as the p-type dopants. Device performances for both devices are compared and conclusions are drawn.

10:30 AM - 11:00 AM COFFEE BREAK

11:00 AM - 12:30 PM

Session ThA2: Micro and Nano-Cavity Emitters
Session Co-Chairs: Toshihiko Baba, *Yokohama National University, Yokohama, Kanagawa, Japan*
Martin Kamp, *University of Würzburg, Würzburg, Germany*

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

High Efficiency 1060nm VCSELs for Low Power Consumption, T. Kageyama, K. Takaki, S. Imai, Y. Kawakita, K. Hiraiwa, N. Iwai, H. Shimizu, N. Tsukiji and A. Kasukawa, *Furukawa Electric Co. Ltd, Ichihara, Chiba, Japan*

High efficiency VCSELs will be reviewed in terms of power conversion efficiency. Other lasing parameters will be discussed in this presentation.

ThA2.2 11:30 AM - 12:00 PM (Invited)

Photonic Crystal Emitters Incorporating Ordered Quantum Wires and Dots, E. Kapon, *École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland*

The technology and optical properties of site-controlled quantum wires and quantum dots integrated with photonic crystal membrane cavities are presented. Applications in lasers and single photon devices and circuits are discussed.

ThA2.3 12:00 PM - 12:15 PM

Photonic Crystal Band Edge Diode Light Emitters, C. Long, A. V. Giannopoulos and K. D. Choquette, *University of Illinois at Urbana-Champaign, Urbana, IL, USA*

We report electrically injected band edge light emitting diodes. The semiconductor membrane emitters utilize a transverse junction that is created using selective ion implantation. Spectral properties showing the influence of the photonic crystal are reported.

ThA2.4 12:15 PM - 12:30 PM

Selectively-Pumped Grating-Mirror Long-Wavelength VCSEL, I.-S. Chung, *Technical University of Denmark, Lyngby, Denmark*, V. Iakovlev, *BeamExpress SA, Lausanne, Switzerland*, A. Mereuta, *École Polytechnique Fédérale de Lausanne, Marcoussis, France*, A. Caliman, A. Sirbu, *BeamExpress SA, Lausanne, Switzerland*, E. Kapon, *École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland* and J. Moerk, *Technical University of Denmark, Lyngby, Denmark*

A novel long wavelength VCSEL structure incorporating a subwavelength grating mirror, an embedded air gap and a tunnel junction is suggested. The laser has very strong single-mode characteristics and strong polarization stability.

End of Program