

ISPEC 2013

The 3rd International Symposium on Photonics and Electronics Convergence
-Advanced Nanophotonics and Silicon Device Systems-

Technical Digest

November 18, 2013

Venue: Ito International Research Center (IIRC), Hongo Campus

November 19-20, 2013

Venue: ENEOS Hall, Komaba Research Campus

Symposium Committee

Symposium Committee

General Chair:	Yasuhiko Arakawa (<i>The University of Tokyo</i>)
Vice Chairs:	Kazumi Wada (<i>The University of Tokyo</i>) Susumu Noda (<i>Kyoto University</i>)
Program Co-chairs:	Takahiro Nakamura (<i>PETRA, NEC</i>) Toshihiko Baba (<i>Yokohama National University</i>)
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Symposium Information

Scope of the Symposium

The purpose of this 3rd international symposium on photonics and electronics convergence (ISPEC 2013) is to provide a forum for discussing recent advances in photonics for future LSI systems and related technologies. The scope of this symposium includes designs, fabrication technologies, and characterizations of photonics-electronics convergence systems and devices. Subjects on Si-photonics, nano-photonics (photonic crystals, plasmonics and so on) and photonic-electronics integration circuits are also covered.

List of Invited Speakers

Gerhard Abstreiter (*Technical University of Munich*)
John E. Bowers (*University of California, Santa Barbara*)
Joris Van Campenhout (*IMEC*)
Peter De Dobbelaere (*Luxtera*)
Susumu Fukatsu (*The University of Tokyo*)
Laurent Fulbert (*CEA-LETI*)
Kazuhiro Hane (*Tohoku University*)
Qinfen Hao (*Huawei Technologies*)
Lionel C. Kimerling (*Massachusetts Institute of Technology*)
Hai-Feng Liu (*Intel*)
Mitsuru Takenaka (*The University of Tokyo*)
Yurii A. Vlasov (*IBM*)
S. J. Ben Yoo (*University of California, Davis*)

Venue

The Symposium will be held in Hongo Campus of the University of Tokyo on November 18, and in Komaba Research Campus of the University of Tokyo on November 19-20. Hongo Campus is the main campus of the University of Tokyo and is situated in the heart of Tokyo. The sessions on November 18 take place at the Ito International Research Center (IIRC), Hongo Campus. The sessions on November 19-20 take place at the ENEOS Hall, Komaba Research Campus. The Komaba Research Campus is close to Shinjuku and Shibuya city in Tokyo.

【Notice】

Food or drink *must not* be brought into the conference halls and rooms at the Ito International Research Center, Hongo Campus.

Internet Access

November 18: Ito International Research Center, Hongo Campus

Wireless LAN is Available.

Network: iirc-hall

Password: %01-2012-guest

November 19-20: ENEOS Hall, Komaba Research Campus

Wireless LAN is Available.

Network: bldg3s-hall

Password: sentanken2012

Language

The conference language is English.

Climate

The climate in late November in Tokyo area is relatively dry and mild. The average temperature during the symposium period is around 10 °C (50 °F).

Sponsors

Sponsored by

The University of Tokyo,

Institute for Photonics-Electronics Convergence System Technology (PECST).

Co-sponsored by

Photonics and Electronics Technology Research Association (PETRA),

The National Institute of Advanced Industrial Science and Technology (AIST).

Supported by

Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program),

Optoelectronics Industry and Technology Development Association (OITDA),

The Japan Society of Applied Physics (JSAP),

IEICE Technical Group on Silicon Photonics,

IEEE Photonics Society Japan Chapter.

Symposium Program

18th November (Monday)

Venue: Ito International Research Center
Hongo Campus, The University of Tokyo

Registration (9:00-9:40)

Welcome Address (9:40-9:50)

Y. Matsumoto (*Vice President, The University of Tokyo*)

Session A: Opening (9:50-12:30)

9:50 **A-1 (Keynote)**

Advances in Photonics and Electronics Convergence System Technology: Overview of the PECST Project

Y. Arakawa (*The University of Tokyo/PECST*)

10:30 **A-2 (Invited)**

System-Level Design-for-Function with Microphotonics

L. C. Kimerling (*Massachusetts Institute of Technology*)

11:10 **A-3 (Invited)**

Hybrid III-V Silicon Photonic Integrated Circuits and Lasers

J. E. Bowers (*University of California, Santa Barbara*)

11:50 **A-4 (Invited)**

Prospects and Challenges for Large-Scale Photonic-Electronic Integrated Circuits

S. J. Ben Yoo (*University of California, Davis*)

12:30-14:00 Lunch break

Session B: Silicon Nanophotonics Devices & Systems I (14:00-17:40)

14:00 **B-1 (Invited)**

Transmission of 25 Gb/s Signals from Integrated Silicon Photonics Transceiver over Multimode Optical Fibers

H. Liu (*Intel*)

14:40 **B-2 (Invited)**

Silicon Photonics: Technology Development and Applications

P. De Dobbelaere (*Luxtera*)

15:20 **B-3**

Strain Tuning of Pure Germanium for Franz-Keldysh Electro-Absorption Modulation

K. Wada (*The University of Tokyo/PECST*)

15:35 **B-4**

Advanced Light Manipulation with Photonic Crystal Nanostructures

S. Noda and T. Asano (*Kyoto University/PECST*)

15:50-16:10 Break

(Session B contd.)

16:10 **B-5**

Demonstration of 30-Tbps/cm² Bandwidth Density by Silicon Optical Interposers Fully Integrated with Optical Components

Y. Urino (*PETRA/PECST*)

16:25 **B-6**

Hybrid Integrated Light Source on a Si Platform Using a Quantum Dot Laser under Wide Temperature Range

M. Ishizaka (*PETRA/PECST*)

16:40 **B-7**

Low-Voltage-Driven 50-Gb/s Ring-Resonator-Based Silicon Modulator

S. Akiyama (*PETRA/PECST*)

16:55 **B-8**

High Performance PIN Ge Photodetector and Si Optical Modulator with MOS Junction

J. Fujikata (*PETRA/PECST*)

17:10 **B-9**

Wide Wavelength and Temperature Tolerance in 10 Gbps Photonic Crystal Modulators

T. Baba (*Yokohama National University/PECST*)

17:25 **B-10**

Multi-Layer On-Chip Interconnection Using Si Waveguide Devices

N. Nishiyama (*Tokyo Institute of Technology/PECST*)

Banquet (18:00-20:00): Foyer of Ito International Research Center

19th November (Tuesday)

Venue: ENEOS Hall (Oral Sessions & Poster Preview) / Convention Hall (Poster Presentation)
Komaba Research Campus, The University of Tokyo

Session C: Silicon Nanophotonics Devices & Systems II (9:30-11:30)

9:30 **C-1 (Invited)**

Near Infrared Optical Properties of III-V Core-Shell Nanowires on Si

G. Abstreiter (*Technical University of Munich*)

10:10 **C-2 (Invited)**

Recent Silicon Photonic Activities in Europe

L. Fulbert (*CEA-LETI*)

10:50 **C-3 (Invited)**

25Gb/s Silicon-Photonics WDM Platform for Low-Power Optical I/O

J. Van Campenhout (*IMEC*)

11:30-13:00 Lunch break

Poster Session (13:00-15:45)

13:00 **Poster preview**

13:55 **Poster presentation (core time for the odd-numbered posters)**

14:50 **Poster presentation (core time for the even-numbered posters)**

Session D: Silicon Nanophotonics Devices & Systems III (16:00-17:25)

16:00 **D-1 (Invited)**

MEMS-Based Integration for Optical Systems

K. Hane (*Tohoku University*)

16:40 **D-2**

Enhancement of Wavelength Characteristic Shift in Si Grating Waveguides with Ferroelectric Liquid Crystals Cladding

K. Nakatsuhara (*Kanagawa Institute of Technology*)

16:55 **D-3**

Electrically-driven Permeability Control of Photonic Metamaterials in Semiconductor Optical Devices

T. Amemiya (*Tokyo Institute of Technology*)

17:10 **D-4**

Introduction of “Photonics Electronics Convergence Technology For Power-Reducing Jisso System” Project

T. Mogami (*PETRA/PECST*)

20th November (Wednesday)

Venue: ENEOS Hall
Komaba Research Campus, The University of Tokyo

Session E: Silicon Nanophotonics Devices & Systems IV (9:30-12:00)

- 9:30 **E-1 (Invited)**
IBM Silicon Nanophotonics Technology for optical interconnects in large-scale datacenters and computer systems
Y. A. Vlasov (*IBM*)
- 10:10 **E-2 (Invited)**
Optical Interconnect Project at Huawei
Q. Hao (*Huawei Technologies*)
- 10:50 **E-3 (Invited)**
Heterogeneous Integration for CMOS Photonics
M. Takenaka (*The University of Tokyo*)
- 11:30 **E-4**
Crossbenchmarking an Optical Network-on-Chip with an Aggressive Electrical Baseline with Physical Layer Awareness
D. Bertozzi (*University of Ferrara*)
- 11:45 **E-5**
Investigating the Robustness of All-Optical NAND Gates Composed by Microring Cavities
A. Fushimi (*Keio University*)

12:00-13:30 Lunch break

Session F: Silicon Nanophotonics Devices & Systems V (13:30-16:20)

- 13:30 **F-1 (Invited)**
Bulk Ge Revisited: Toward Group-IV Interband Laser
S. Fukatsu (*The University of Tokyo*)
- 14:10 **F-2**
High-Performance Silicon Hybrid Lasers for Energy-Efficient WDM Transmitter
S. Tanaka (*PETRA/Fujitsu Labs.*)
- 14:25 **F-3**
Performance of Germanium Waveguide Photodiode under High-Voltage Bias
K. Takeda (*NTT*)
- 14:40 **F-4**
Reduction of Wavelength Dependence of Coupling Characteristics using Si/SiO₂ Optical Waveguide Curved Directional Coupler
T. Maruyama (*Kanazawa University*)

- 14:55 **F-5**
Silicon-based Waveguide Platform for Optical Interconnection
H. Fukuda (*PETRA/PECST*)
- 15:10 **F-6**
Three Dimensional Optical Circuits
M. Mori (*AIST/PECST*)
- 15:25 **F-7**
Development of III-V Quantum Dot Lasers on Silicon
K. Tanabe (*The University of Tokyo/PECST*)
- 15:40 **F-8**
Germanium Waveguide Devices on Silicon
M. Sagawa (*PETRA/Hitachi/PECST*)
- 15:55 **F-9**
Silicon Light Emitting Diodes with Photonic Crystal Nanocavities
S. Iwamoto (*The University of Tokyo/PECST*)

Closing Session (16:10-16:20)

Poster Session (Tuesday)

P-1

Analysis of Energy Cost of Membrane Distributed-Reflector Lasers for On-Chip Optical Interconnection

T. Hiratani¹, K. Doi¹, Y. Atsuji¹, T. Amemiya², N. Nishiyama¹, S. Arai^{1,2}

(1 Tokyo Inst. Tech., 2 QNERC)

P-2

Time-Resolved Photoluminescence of InAs QDs Fabricated by In-Flush Technique

M. Senshu¹, S. Kitamura¹, Y. Wen¹, K. Imai¹, T. Katsuyama¹, Y. Hino², N. Ozaki², Y. Sugimoto³

(1 Univ. Fukui, 2 Univ. Wakayama, 3 NIMS)

P-3

Si Wire Waveguide AWG with Stray Light Reduction

H. Okayama^{1,2,3}, D. Shimura³, Y. Onawa^{1,2,3}, H. Takahashi^{1,2,3}, M. Seki^{2,4}, K. Koshino^{2,4}, N. Yokoyama^{2,4}, M. Ohtsuka^{2,4}, N. Hirayama^{2,4}, T. Tsuchizawa^{1,2,5}, H. Nishi^{1,2,5}, K. Yamada^{1,2,5}, H. Yaegashi^{1,2,3}, T. Horikawa^{2,4}, H. Sasaki³

(1 PETRA, 2 PECST, 3 Oki Electric Industry, 4 AIST, 5 NTT Microsystem Integration Laboratories)

P-4

Humidity Tolerance of Athermal Si-Slot Wavelength Filters Embedded with Polymer

Y. Atsumi¹, J. Kang¹, Y. Hayashi¹, J. Suzuki¹, N. Nishiyama¹, S. Arai^{1,2}

(1 Tokyo Inst. Tech., 2 QNERC)

P-5

On-Chip Optical Correlator using Photonic Crystal Slow-Light Devices

N. Ishikura¹, T. Baba¹

(1 Yokohama Nat'l Univ.)

P-6

Characterization and Size-Reduction of Si Photonic Crystal Slow Light Modulator

Y. Terada¹, H. C. Nguyen¹, N. Yazawa¹, T. Watanabe¹, T. Baba¹

(1 Yokohama Nat'l Univ.)

P-7

High-Speed Delay Tuning in Si Photonic Crystal Slow Light Device with pin Junction

S. Kinugasa¹, N. Ishikura¹, R. Hayakawa¹, T. Baba¹

(1 Yokohama Nat'l Univ.)

P-8

Design of Si Ring-Resonator-Type Reflector for GaInAsP/SOI Hybrid Laser

J. Suzuki¹, Y. Hayashi¹, J. Kang¹, Y. Atsumi¹, N. Nishiyama¹, S. Arai^{1,2}

(1 Department of Electrical and Electronic Engineering, Tokyo Inst. Tech., 2 Quantum Nanoelectronics Research Center, Tokyo Inst. Tech.)

P-9

SiO₂ Mask Thickness Dependence of Bandgap Wavelength Shift in Quantum Well Intermixing for Photonic Integration

J. Lee¹, K. Doi¹, T. Hiratani¹, D. Inoue¹, T. Amemiya², N. Nishiyama¹, S. Arai^{1,2}

(1 Tokyo Inst. Tech., 2 Quantum Nanoelectronics Res. Center)

P-10

Low-Loss Optical Interlayer Coupling for 3D On-Chip Optical Interconnect

R. Takei^{1,2}, E. Omoda^{1,2}, M. Suzuki^{1,2}, S. Manako^{1,2}, T. Kamei^{1,2}, M. Mori^{1,2}, Y. Sakakibara^{1,2}

(1 AIST, 2 PECST)

P-11

Silicon-Photonics Coherent Optical Modulators and Demodulators

N. Yazawa¹, K. Suzuki¹, H. C. Nguyen¹, T. Watanabe¹, T. Baba¹

(1 Yokohama Nat'l Univ.)

P-12

High-speed and Compact Non-blocking 8×8 InAlGaAs/InAlAs Mach-Zehnder-Type Optical Switch Fabric

H. Koketsu¹, S. Kawasaki¹, N. Koyama¹, A. Takei², T. Taniguchi², Y. Matsushima¹, K. Utaka¹

(1 Faculty of Science and Engineering, Waseda University(Waseda Univ.), 2 Hitachi Ltd. Central Research Laboratory(Hitachi CRL))

P-13

Triangular-Shaped Coupled Microrings for Si Photonics WDM (De-)Multiplexers

H. Ito¹, N. Ishikura¹, T. Baba¹

(1 Yokohama Nat'l Univ.)

P-14

Feasibility Study of High-Performance Optical Modulators Using Semiconductor-Metal Transition in Graphene

T. Kayoda¹, J. Han¹, M. Takenaka¹, S. Takagi¹

(1 Univ. Tokyo)

P-15

Effect of SCH/Barrier Regions on K-factor of 1.3- μm InAs/GaAs Quantum Dot Lasers

N. Yasuoka¹, M. Ishida², M. Ekawa², T. Yamamoto², M. Yamaguchi², K. Nishi¹, M. Sugawara³, Y. Arakawa¹
(1 Univ. Tokyo, 2 Fujitsu Labs. Ltd., 3 QD Laser, Inc.)

P-16

Conditions for Polariton Condensation and Photon Lasing in Quantum Dot Systems

K. Kamide¹, S. Kako², S. Iwamoto^{1,2}, Y. Arakawa^{1,2}
(1 NanoQuine, Univ.Tokyo, 2 Inst. Ind. Sci., Univ. Tokyo)

P-17

Investigation on the Q Factor of SiC-Based Photonic Crystal Nanocavity

S. Jeon¹, B. Song^{1,2}, T. Asano¹, Y. Tanaka¹, S. Noda¹
(1 Dept. of Electron. Sci. and Eng., Kyoto Univ., 2 School of Info. and Commun., Sungkyunkwan Univ.)

P-18

Surface Leakage Reduction for Ge Metal-Semiconductor-Metal Photodetector by GeOx Passivation

J. Kang¹, R. Zhang^{1,2}, M. Takenaka¹, S. Takagi¹
(1 Univ. Tokyo, 2 Univ. Nanjing)

P-19

Temperature Dependence of Light Emission from Germanium: A First Principles Study

Y. Suwa^{1,2,3}
(1 PETRA, 2 PECST, 3 Hitachi, Ltd.)

P-20

Enhancement of Dynamic Wavelength Conversion in Photonic Crystal Slow-Light Waveguide

K. Kondo¹, T. Baba¹
(1 Yokohama Nat'l Univ.)

P-21

Properties of Ge Waveguides Fabricated by Low Temperature Seletive Epitaxial Growth and Rapid Thermal Annealing

K. Oda^{1,2,3}, T. Okumura^{1,2,3}, K. Tani^{1,2,3}, T. Ido^{1,2,3}, S. Kako⁴, S. Iwamoto⁴, Y. Arakawa⁴
(1 PETRA, 2 PECST, 3 Hitachi, 4 Univ. Tokyo)

P-22

Low Loss Silicon Wire Waveguide and Multimode Interferometer Coupler for 1.3- μm Band

H. Takahashi^{1,2}, Y. Onawa^{1,2}, D. Shimura^{1,2}, H. Okayama^{1,2}, H. Yaegashi^{1,2}, H. Nishi^{1,2}, H. Fukuda^{1,2}, T. Tsuchizawa^{1,2}, K. Yamada^{1,2}, N. Hirayama^{1,3}, M. Yamagishi^{1,3}, S. Saitou^{1,3}, Y. Noguchi^{1,3}, T. Horikawa^{1,3}

(1 PECST, 2 PETRA, 3 AIST)

P-23

Vertical Light Coupling Between Silicon Waveguide and Single-Mode Fiber Achieved by Vertically Curved Waveguide Using Ion-Induced Bending Technique

T. Yoshida¹, R. Takei¹, T. Nishi¹, S. Tajima², E. Omoda¹, M. Nagao¹, N. Miura², M. Mori¹, Y. Sakakibara^{1,2}

(1 AIST, 2 Meiji Univ.)

P-24

Bit Error Rate Analysis of a Si Optical Interposer Using its Equivalent Circuit

D. Okamoto^{1,2}, T. Akagawa^{1,2}, T. Usuki^{1,2}, J. Fujikata^{1,2}, S. Akiyama^{1,2}, Y. Urino^{1,2}, T. Nakamura^{1,2}

(1 PECST, 2 PETRA)

P-25

Light Emission and Detection in Germanium Waveguides on Lateral Silicon-on-Insulator Diodes

K. Tani^{1,2,3}, K. Oda^{1,2,3}, T. Okumura^{1,2,3}, T. Mine³, T. Ido^{1,2,3}

(1 PETRA, 2 PECST, 3 Hitachi, Ltd.)

P-26

Low Energy Cost Operation of Hybrid Integrated Light Source on A Silicon Optical Interposer for Optical Interconnection

N. Hatori^{1,2}, T. Shimizu^{1,2}, M. Okano^{2,3}, M. Ishizaka^{1,2}, T. Yamamoto^{1,2}, Y. Urino^{1,2}, M. Mori^{2,3}, T. Nakamura^{1,2}, Y. Arakawa^{2,4}

(1 PETRA, 2 PECST, 3 AIST, 4 Univ. Tokyo)

P-27

Reduction in Crosstalk of Carrier-Injection Mach-Zehnder Interferometer Optical Switches by Using III-V CMOS Photonics Platform

Y. Ikku¹, M. Yokoyama¹, M. Noguchi¹, O. Ichikawa², T. Osada², M. Hata², M. Takenaka¹, S. Takagi¹

(1 Univ. Tokyo, 2 Sumitomo Chemical Company Ltd.)

P-28

Observation of Enhanced Spontaneous Raman Scattering in Silicon Grating Waveguides

Y. Hsiao¹, S. Iwamoto¹, Y. Arakawa¹

(1 Univ. Tokyo)

P-29

High Efficiency Si Optical Modulator with MOS Junction for 1.55 μm and 1.3 μm Wavelengths

S. Takahashi^{1,2}, M. Takahashi^{1,3}, J. Fujikata^{1,2}, T. Horikawa^{1,3}, T. Nakamura^{1,2}, Y. Arakawa^{1,4}

(1 PECST, 2 PETRA, 3 AIST, 4 Univ. Tokyo)

P-30

Study of On-Demand Light Transfer Schemes among Distant Photonic Crystal Nanocavities

R. Konoike¹, T. Asano¹, Y. Tanaka¹, S. Noda¹

(1 Kyoto Univ.)

P-31

Novel Spot-Size Converter with SiO_x Thin Film Slab Layer

T. Shimizu^{1,2}, H. Takahashi^{1,2}, N. Hatori^{1,2}, M. Ishizaka^{1,2}, M. Okano^{1,3}, T. Horikawa^{1,3}

(1 PECST, 2 PETRA, 3 AIST)

P-32

Simulations of Silicon Modulator for Optical Data Transmission

T. Akagawa^{1,2}, S. Akiyama^{1,2}, T. Baba^{1,2}, M. Imai^{1,2}, T. Usuki^{1,2}

(1 PECST, 2 PETRA)

P-33

Single Photon Source Based on Quantum Dot Embedded in Nanowire on Silicon

J. Kwoen¹, K. Watanabe², Y. Ota², S. Iwamoto^{1,2}, Y. Arakawa^{1,2}

(1 IIS, Univ. Tokyo, 2 NanoQuine)

P-34

Strong Coupling between a Single Semiconductor Quantum Dot and a High-Q H₀ Photonic Crystal Nanocavity

Y. Ota¹, D. Takamiya², R. Ohta², N. Kumagai¹, S. Ishida², S. Iwamoto^{1,2}, Y. Arakawa^{1,2}

(1 NanoQuine, Univ. Tokyo, 2 IIS, Univ. Tokyo)

P-35

Frequency Shift in Q-factor Control of Photonic Crystal Nanobeam Cavity

R. Ohta¹, Y. Ota¹, S. Iwamoto¹, Y. Arakawa¹

(1 Univ. Tokyo)

P-36

The Effects of Surfaces and Interfaces on the Carrier Lifetime of Highly n-doped Germanium Stripes Grown on Silicon

S. Kako¹, K. Oda^{2,3,4}, K. Tani^{2,3,4}, T. Ido^{2,3,4}, Y. Arakawa¹

(1 Univ. Tokyo, 2 PETRA, 3 PECST, 4 CRL, HITACHI)

P-37

Manipulation of Circular Polarization in a Three-Dimensional Semiconductor Chiral Photonic Crystal

S. Takahashi¹, A. Tандаechanurat¹, R. Igusa¹, Y. Ota¹, J. Tatebayashi¹, S. Iwamoto¹, Y. Arakawa¹

(1 Univ. Tokyo)

P-38

High-Q Nanocavity Design with Vertically Mirror-Symmetric Three-Dimensional Woodpile Photonic Crystal

J. Fu¹, A. Tандаechanurat², S. Iwamoto^{1,2}, Y. Arakawa^{1,2}

(1 Univ. Tokyo, IIS, 2 Univ. Tokyo, NanoQuine)

P-39

Design of a Three-Dimensional Photonic Crystal Nanocavity with a <110>-Layered Diamond Structure

T. Tajiri¹, S. Takahashi², A. Tандаechanurat², S. Iwamoto^{1,2}, Y. Arakawa^{1,2}

(1 Institute of Industrial Science, 2 Institute of Nano Quantum Information Electronics, University of Tokyo)

P-40

EOT Scaling of Plasma Post-Nitrided SiGe Gate Stack for High Performance MOS Optical Modulators

J. -H. Han¹, R. Zhang¹, T. Osada², M. Hata², M. Takenaka¹, S. Takagi¹

(1 University of Tokyo, 2 Sumitomo Chemical)

P-41

Low Temperature Al₂O₃ Surface Passivation for Carrier Injection Type Si/strained SiGe/Si Waveguide Modulator

Y. Kim¹, J. Han¹, M. Takenaka¹, S. Takagi¹

(1 University of Tokyo)

P-42

Novel CVD Process for Ultra-Small Butt-Joint Germanium Photodetector

M. Miura^{1,2}, J. Fujikata^{1,2}, M. Noguchi^{1,2}, T. Horikawa^{1,3}, Y. Arakawa^{1,4}

(1 PECST, 2 PETRA, 3 AIST, 4 Univ. Tokyo)

P-43

High Efficiency Inter-Layer Amorphous Silicon Grating Couplers with Metal Mirrors for On-Chip 3D Interconnects

J. Kang¹, Y. Atsumi¹, Y. Hayashi¹, J. Suzuki¹, Y. Kuno¹, T. Amemiya¹, N. Nishiyama¹, S. Arai¹

(1 Tokyo Institute of Technology)

P-44

MOCVD Growth of High Density InAs-stacked Quantum Dots on Ge/Si Substrate and its Electroluminescence Characteristics for Silicon Photonics Application

M. Rajesh¹, K. Tanabe¹, S. Kako¹, M. Nishioka¹, Y. Arakawa¹

(1 University of Tokyo)

P-45

Study on Selective Epitaxial Growth of Ge on Submicron Scaled Si Trenches

Y. Mizuno¹, N. Kawai¹, K. Wada¹

(1 University of Tokyo)