Poster Session 1 (Nanostructures)

P1.01

Photoluminescence property of multiply stacked CdSe/ZnSe quantum dot structure fabricated by an alternate molecular beam supply

Yuto Banden

Okayama University of Science

Multiply stacked CdSe dots structure was fabricated by an alternate molecular beams supply (ALS). PL peak energy is expressed exact linear function of ALS cycle number, PL intensity showed maximum value above 14K, the activation energy of thermal quenching increased with ALS cycle number.

P1.02

Nucleation of GaN nanowires on amorphous SiNx

Kris Bertness, Aric Sanders, Andrew Herrero, Alexana Roshko, Roy Geiss

NIST

We report on the unexpected observation that GaN nanowires nucleated on amorphous SiNx are aligned with the underlying Si (111) substrate and columnar AlN buffer. Possible mechanisms include partial crystallization and strain propagation.

P1.03

Fabrication of Concentric Quantum Double Rings to Quantum Rings with Squarelike Nanoholes on GaAs(001) by Droplet Epitaxy

Poonyasiri Boonpeng, Wipakorn Jevasuwan, Supachok Thainoi, Somchai Ratanathammaphan, Somsak Panyakeow

Chulalongkorn University
Department of Electrical Engineering

The fabrication of self-assembled InxGa1-xAs nanoholes on GaAs(001) substrates grown by droplet epitaxy using molecular beam epitaxy was reported. The effect of In contents for InxGa1-x droplet deposition on their shape, dimension, density, and depth profile was investigated.

P1.04

Decoupling of Growth Temperature and Nanowire Density for Magnesium Doped GaN Nanowires Grown by Plasma Assisted MBE

Matt Brubaker, Kris Bertness

National Institute of Standards and Technology
Optoelectronics Division

Control of coalescence in Mg doped nanowires presents several difficulties including high nanowire densities and strong tapering effects. High temperature nucleation and subsequent low temperature growth limits nanowire densities and provides favorable conditions for Mg incorporation.

P1.05

Site- and shape-controlled growth of isolated and coupled InAs quantum dots using AFM anodic oxidation

K. M. Cha, K. Shibata, T. Ueda, K. Hirakawa

University of Tokyo
Institute of Industrial Science

We have optimized the growth condition for site- and shape-controlled InAs QDs by using atomic force micro-scope (AFM)-assisted anodic oxidation and investigated how the size and the interdot coupling depend on the AFM-oxidation condition.

P1.06

Bi-modal growth and properties of self-assembled InP-whiskers on (001) InP by gas source MBE

Mikaela Chashnikova, Anna Mogilatenko, Oliana Fedosenko, Vadym Bryksa, Stefan Machulik, Alexander Petrov, Mykhaylo P. Semtsiv, Wolfgang Neumann, William Ted Masselink

Humboldt University Berlin
Department of Physics

InP-InGaAs whiskers grown catalyst-free by gas-source molecular-beam epitaxy on InP (001) substrates result in two types of whiskers with: a) mixed zincblende and wurtzite structure and b) purely zincblende structure.

P1.07

Phase transition from prism to dome for Si1-xGex on Si (1 1 10) substrate

Gang Chen, Bolormaa Sandujev, Daniele Scopece, Heiko Groiss, Julian Stangl, Wolfgang Jantsch, Leo Miglio, Gunther Springholz, Friedrich Schäffler

Johannes Kepler University
Institute of Semiconductor and Solid State Physics

Surface phase transition diagram from prism to dome has been obtained via systematic study on heteroepitaxial of Si1-xGex (x ranging from 0.2 to 1) on Si (1 1 10) substrate under equilibrium condition. Ab initio calculation reveals the thermodynamics behind the morphological evolution.

P1.08

Effects of nano-pattern size on the property of InAs site-controlled quantum dots

Norman K. Y. Cheng, Chien-Chia Cheng, Kevin Meneou

University of Illinois at Champaign-Urbana
Electrical and Computer Engineering

Site-controlled InAs quantum dots grown in nanopores on GaAs substrate offers the ability to position QDs precisely with improved uniformity. A smaller nano-pattern size (≤60nm) is more favourable for single-dot occupancy while improving the photoluminescence linewidth and intensity.

P1.09

Growth and structural studies of defect free PbTe nanowires on GaAs(111)B

Piotr Dziawa, Janusz Sadowski, Piotr Dluzewski, Elzbieta Lusakowska, Viktor Domukhovski, Badri Taliashvili, Tomasz Wojciechowski, Wojciech Knoff, Malgorzata Bukala, Marta Galicka, Ryszard Buczko, Perla Kacman, Tomasz Story

Institute of Physics, PAS

We present Au-catalyzed growth of the PbTe nanowires on GaAs(111)B. Structural studies show defect free NWs with [100] orientation along growth axis and uniform planar orientation. Theoretical predictions for small diameters confirm these results.

P1.10

Molecular Beam Epitaxial growth of high quality positioned InAs quantum dots on patterned GaAs (100) substrates

Ian Farrer, Ayesha Jamil, Joanna Skiba-Szymanska, Christine Nicoll, David Ellis, Martin Ward, David Anderson, Geb Jones, Andrew Shields, David Ritchie

University of Cambridge
Cavendish Laboratory

Conventional MBE growth of low density Self Assembled Quantum Dots results in randomly positioned QDs on the wafer surface. Here we report both good site control and exceptionally narrow linewidths (~100μeV) for QDs which are grown only 15nm from a lithographically patterned interface.

P1.11

Arsenic induced shape transition of InAs islands on InAlGaAs/InP (100) surfaces

Christian Gilfert, Emil-Mihai Pavelescu, Johann-Peter Reithmaier

University of Kassel
Institute of Nanostructure Technologies and Analytics

The nucleation behavior of InAs islands on InAlGaAs/InP (100) under different As species was studied. With As2 quantum dots were observed while As4 delivered quantum dashes. With this basic concept low line widths of down to 23 meV were achieved.

P1.12

Quantum dot lasers grown by gas source molecular-beam epitaxy

Qian Gong, ShiGuo Li, YanFeng Lao, ChunFang Cao, ChengFu Xu, YongGang Zhang, SongLin Feng

Shanghai Institute of Microsystem and Information Technology
State Key Laboratory of Functional Materials for Informatics

We report on InAs quantum dot (QD) lasers grown by gas source molecular-beam epitaxy (GSMBE) respectively on GaAs and InP substrates. Device performance of both types of lasers were systematically characterized.

P1.13

Formation of PbTe Nanocrystals in MBE-Grown PbTe/CdTe Heterostructures

Heiko Groiss, Friedrich Schäffler, Günter Hesser, Nikolai Zakharov, Peter Werner, Kazuto Koike, Mitsuaki Yano

Johannes Kepler University Linz
Institute of Semiconductor and Solid State Physics

We report time resolved TEM annealing experiments to reveal the transformation kinetics of 2D PbTe epilayers into quantum dots. Fast interface diffusion and slower bulk diffusion determine the final shape, which minimizes the interface energies.

P1.14

Growth and annealing of InAs quantum dots on pre-structured GaAs substrates

Mathieu Helfrich, Dongzhi Hu, Joshua Hendrickson, Michael Gehl, Daniel Rülke, Roland Gröger, Dimitri Litvinov, Stefan Linden, Martin Wegener, Dagmar Gerthsen, Thomas Schimmel, Michael Hetterich, Galina Khitrova, Hyatt M. Gibbs, Daniel M. Schaadt

Karlsruhe Institute of Technology (KIT)
DFG-Center for Functional Nanostructures (CFN)

Semiconductor quantum dots (QDs) have attracted a lot of attention due to their unique properties. We investigate the effects of in-situ annealing on InAs QDs grown on pre-structured GaAs substrates.

P1.15

Growth of GaN nanorods on Si(111) by rf-plasma-assisted molecular beam epitaxy

Nobuhiro Isomura, Hashizume Tamotsu, Motohisa Junichi

Hokkaido University
Graduate School of Information Science and Technology

We studied the growth of GaN nanorods on Si(111) by rf-plasma-assisted molecular beam epitaxy (rf-MBE). GaN nanorods with average diameter of 170nm were grown at 800oC. Photoluminescence measurement confirmed the formation of GaN nanorods.

P1.16

InP Ring-shaped Quantum-dot Molecules Grown by Droplet Molecular Beam Epitaxy

Wipakorn Jevasuwan, Poonyasiri Boonpeng, Supachock Thainoi, Somchai Ratanathammaphan, Somsak Panyakeow

Chulalongkorn University
Department of Electrical Engineering

We report on the morphological and optical properties of InP ring-shaped QDMs on In0.5Ga0.5P layer. The transition from a 2D growth mode to a 3D growth mode of ring-shaped QDM formation is observed. The tendencies of PL peak and FWHM on the power and temperature are investigated and discussed.

P1.17

Si-SiOx core-shell nanowires induced by metallic Fe on Si wafers

Zuimin Jiang, Tianxiao Nie, Zhigang Chen, Yueqin Wu, Jiale Wang, Jiuzhan Zhang, Yongliang Fan, Xinju Yang, Jin Zou

University of Fudan
Physics department

Hundreds of micrometers long Si-SiOx core-shell nanowires, with a crystalline Si core and an amorphous SiOx shell, were fabricated by heating Fe thin layer covered Si wafer. A Fe-FeOx core-shell catalyzed solid-liquid-solid mechanism is proposed to explain the nanowire growth.

P1.18

Effect of As/In-flux on the growth of InAs nanowire by Molecular Beam Epitaxy

Bubesh Babu Jotheeswaran, Yoh Kanji

Hokkaido University
Research Center for Integrated Quantum Electronics

A systematic analysis on varying In and As flux have shown that under a particular growth condition, the growth rate can be improved to the maximum of 3.8nm/s, which is nearly twice that of the previously reported results.

P1.19

Growth and photoluminescence of lateral InGaAs quantum dot molecules

S Kanjanachuchai, N Thongkamkoon, N Siripitakchai, S Thainoi, S Panyakeow

Chulalongkorn University
Department of Electrical Engineering, Faculty of Engineering

InGaAs QDMs are grown and characterized by temperature- and excitation-dependent photoluminescence. The results indicate material inhomogeneity, with several optically active regions interacting in complicated manner as sample temperature and excitation power vary.

P1.20

Marked reduction in photocarrier lifetime by erbium doping into self-assembled InAs quantum dots embedded in strain-relaxed InGaAs barriers

Takahiro Kitada, Tomoya Takahashi, Ken Morita, Toshiro Isu

University of Tokushima
Center for Frontier Research of Engineering, Institute of Technology and Science

Erbium doping during MBE of self-assembled InAs quantum dots (QDs) is found to be quite effective to reduce photocarrier lifetime, which is useful for ultrafast all-optical switching devices based on QDs with strain-relaxed InGaAs barriers.

P1.21

High-quality ZnTe-based micropillars containing CdTe quantum dots

Carsten Kruse, Wojciech Pacuski, Tomasz Jakubczyk, Matthias Florian, Kristian Frank, Tomasz Kazimierczuk, Andrzej Golnik, Jan Gaj, Frank Jahnke, Andreas Rosenauer, Detlef Hommel

University of Bremen
Semiconductor Epitaxy

We report on the realization of ZnTe-based micropillars containing CdTe quantum dots prepared by focused ion beam etching. Quality factors of up to 4000 have been achieved according to micro-photoluminescence measurements.

P1.22

Group III-element assisted growth of InAs nanowires

Mihail Ion Lepsa, Thomas Grap, Christian Blömers, Thomas Schäpers, Hans Lüth, Detlev Grützmacher

Forschungszentrum Jülich
Institute of Bio- and Nanosystems (IBN-1)

We report on the growth of InAs NWs using a solid source MBE system. Our method is based on In droplets, as seeds and intermediate growth reservoirs. Systematic results obtained for different growth conditions and the influence of dopants on the NW morphology and electrical properties are presented.

P1.23

Investigation of the optical properties of quantum rods grown by molecular beam epitaxy using As2 and As4

lianhe li, S.P. Khanna, E. H. Linfield, A. G. Davies

university of leeds

The effect of As2 and As4 on the optical properties of InGaAs quantum rods (QRs) grown by MBE was investigated. A marked improvement in the photoluminescence intensities from QR samples grown using As4 is achieved. However, an increase of the As overpressure results in a PL intensity degradation.

P1.24

Effect of growth parameters on the surface morphology of InAs quantum dots grown on graded Si1-xGex/Si substrates

Yu Yan Liang, Soon Fatt Yoon, Chun Yong Ngo, Hendrix Tanoto, Kah Pin Chen, Wan Khai Loke, Eugene A. Fitzgerald

Nanyang Technological University
Singapore-MIT Alliance

We investigated the effects of growth parameters (V/III ratio and InAs monolayer coverage) on the surface morphology of InAs QDs grown on graded Si1-xGex/Si substrates using AFM. By tuning the abovementioned growth parameters, high areal density of ~1.1x1011 cm-2 was obtained.

P1.25

High Optical Property Vertically Aligned InAs Quantum Dot Structures with GaAsSb Overgrown Layers

Wei-Sheng Liu, Hong-Ming Wu, Yu-Ann Liao, Jen-Inn Chyi, Wen-Yean Chen, Tzu-MIn Hsu

Yuan Ze University
Department of Photonics Engineering

Increase of dot density with reduced coalescence is obtained in vertically aligned InAs quantum dots capped by GaAsSb layers. Columnar dot structure with enhanced luminescence intensity and narrow linewidth can thus be demonstrated.

P1.26

Intermediate stage analysis of template patterning with metal droplets of varying compound on (001) GaAs surface

Anna Lyamkina, Dmitry Dmitriev, Yury Galitsyn, Sergey Moshchenko, Alexander Toropov

Institute of Semiconductor Physics

Metal droplets on the initial substrate are studied as an intermediate stage of etching. Due to high temperature intermixing happens, so the compound should change. Aspect ratio distribution reveals a shift accordingly to supposed droplet compound varying from pure Ga to InxGa1-x.

P1.27

Wave function coupled InGaAs quantum dot infrared photodetector

Wenquan Ma, Yanhua Zhang, Yongheng Huo, Yang Wei, Lianghui Chen

Institute of Semiconductors, Chinese Academy of Sciences

We report a quantum dot infrared photodetector (QDIP) device utilizing wave function strongly coupled InGaAs dots. Compared to the decoupled QDIP, the coupled QDIP not only should have an improved performance, but also demonstrates a significant detection wavelength shift of about 4 μm.

P1.28

Highly-periodic surface corrugation in the homoepitaxial growth of GaAs (631)A

Esteban Cruz-Hernández, Satoshi Shimomura, Máximo López-López, David Vázquez-Cortes, Victor H Méndez-García

University of San Luis Potosi
Coordinacion para la Innovacion y Aplicacion de la Ciencia y la Tecnologia

The surface corrugation ordering degree in the homoepitaxial growth of GaAs (631)A as a function of the As pressure (PAs) is reported. The correlation function analysis is used to quantitatively describe the highly-periodic surface corrugation with the aim to obtaining quantum wires templates

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P1.29

Photoluminescence analysis of semiconductor InAs quantum wires and quantum dots grown on GaAs(631)

Víctor H Méndez-García, Gerardo García-Liñán, Edgar López-Luna, Esteban Cruz-Hernández, Juan Hernández-Rosas, Máximo López-López

University of San Luis Potosi
Coordinacion para la Innovacion y Aplicacion de la Ciencia y la Tecnologia

We have studied the optical properties by photoluminescence spectroscopy (PL) of self-assembled InAs nanostructures grown by MBE on GaAs (631) substrates. LT-PL polarization and excitation power dependence experiments indicate the self-assemblage of quantum wires and quantum dots

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P1.30

Structural and Optical Properties of High Density InAs Bilayer Quantum Dots Grown at Constant Growth Rate and Temperature

C. Y. Ngo, S. F. Yoon, H. Tanoto, H. K. Hui, D. R. Lim, Vincent Wong, S. J. Chua

Institute of Materials Research and Engineering

We report the effects of GaAs spacer thickness and InGaAs strain-reducing layer on the structural and optical properties of high density InAs bilayer quantum dots (BQDs) grown at constant growth rate and temperature.

P1.31

Bandgap Engineering of 1.3 μm Quantum Dot Structures for Terahertz (THz) Emission

C. Y. Ngo, S. F. Yoon, J. H. Teng

Institute of Materials Research and Engineering

The terahertz (THz) frequency range has attracted considerable interest over the past ten years due to a lot of important applications. By tuning the QD growth parameters, we aim to engineer the bandgap of 1.3μm QD structures for THz emission.

P1.32

Fabrication of InAs ring strcuture on InGaAs/InP by droplet epitaxy

Takeshi Noda, Takaaki Mano, Kazutaka Mitsuishi, Kazuaki Sakoda, Hiroyuki Sakaki

National Institute for Materials Science

We report the fabrication of circular-shaped InAs ring structure on In0.51Ga0.49As/InP by droplet epitaxy. AFM images revealed that the base diameter of the ring was ~ 120 nm and its density was ~2x108 cm-2.

P1.33

Thermal annealing effects of MBE-grown GaN nanocolumns

Vico Triviño Noelia, Dussaigne Amélie, Martin Denis, Butté Raphaël, Ganière Jean-Daniel, Grandjean Nicolas

École Polytechnique Fédéral de Lausanne (EPFL)
Laboratory of Advanced Semiconductors for Photonics and Electronics (LASPE)

Optimization of the growth of GaN nanocolumns combining PAMBE and ammonia MBE is performed. To improve their crystalline quality, the influence of thermal annealing is systematically investigated through structural and optical characterization means.

P1.34

New Method to Isolate and Distribute Photoluminescence Emissions from InAs Quantum Dots over a Wide-Wavelength Range

Shunsuke OHKOUCHI, Naoto KUMAGAI, Masayuki SHIRANE, Yuichi IGARASHI, Masahiro NOMURA, Yasutomo OTA, Shinichi YOROZU, Satoshi IWAMOTO, Yasuhiko ARAKAWA

The University of Tokyo
Institute for Nano Quantum Information Electronics (Nano Quine)

We propose a new method to isolate and distribute the photoluminescence emission wavelengths of the InAs quantum dots over a wide-wavelength range by decreasing the growth temperature of the partial GaAs capping layer in the indium-flush process.

P1.35

Sb-Mediated Self-Formation of Ultra-High Densiy InAs Quantum-Dots on GaAs(001)

Jun Ohta, Koichi Yamaguchi, Katsuyoshi Sakamoto

The University of Electro-Communications
Department of Engineering Science

Ultra-high density InAs QDs with more than 3 ×10^11 cm-2 were grown on GaAsSb/GaAs(001) by MBE. The coalescence of neighboring QDs was suppressed in spite of ultra-high density. Characteristics of in-plane QD superlattices due to ultra-high density were studied from photoluminescence properties.

P1.36

MBE-VLS growth of catalyst-free III-V axial heterostructure nanowires on (111)Si substrates

Jihyun Paek, Masahito Yamaguchi, Hiroshi Amano

Nagoya University
Department of Electrical Engineering and Computer science

For the device application of nanowire (NW), we investigated axial heterostructure of catalyst-free GaAs/InGaAs NWs grown by MBE-VLS. When we introduce In flux during the growth of GaAs NWs, the oversupplied In results in an increased NW diameter unlike the occasion of Ga flux increasing.

P1.37

MBE Growth Process and PL Characterization of Multi-stack QDs

Ong-arj Tangmettajittakul, Supachok Thainoi, Pornchai Changmoang, Songphol Kanjanachuchai, Somchai Rattanathammaphan, Somsak Panyakeow

Chulalongkorn University
Electrical engineering

Multi-stack QDs and multi-stack QDMs with same order of QD number per projected unit area (4 -5x1010 cm-2) are compared in term of MBE growth process and PL characterization both in temperature and excitation power dependent measurements.

P1.38

Self-Assembled Quantum Dots on Anti-Phase Domains of GaAs on Ge Substrates

Wichit Tantiweerasophon, Supachok Thainoi, Pornchai Changmoang, Songphol Kanjanachuchai, Somchai Rattanathammaphan, Somsak Panyakeow

Chulalongkorn University
Electrical engineering

Self-assembled quantum dots are grown on GaAs/Ge and GaAs/AlAs/Ge modified substrates and are characterized by PL measurement. PL results indicate QDs quality as well as APD domain creation related to Ge-Ga and Ge-As bondings.

P1.39

Growth of Germanium Nanowires by Vapour-Liquid-Solid Molecular Beam Epitaxy: importance of kinetics effects

Clement Porret, Thibaut Devillers, Abhinav Jain, Romain Dujardin, André Barski

CEA Grenoble
SP2M / SiNaPS

Ge nanowires (NWs) have been grown by MBE on Ge (111) and Si (001) and (110) substrates. Substrate temperature and Ge deposition rate are key parameters that determine the NWs nucleation phenomena. We show that the growth of Ge NWs is controlled by surface diffusion and kinetics effects.

P1.40

Surface morphology and photoluminescence of InGaAs quantum rings grown by droplet epitaxy with varying In0.5Ga0.5-droplet amount

Naraporn Pankaow, Supachok Thainoi, Somsak Panyakeow, Somchai Ratanathammaphan

Chulalongkorn University
Semiconductor Device Research Laboratory, Department of Electrical Engineering

InGaAs quantum rings were grown by droplet epitaxy with 2-5 ML In0.5Ga0.5 droplet using MBE. Increasing In0.5Ga0.5 caused the ring higher heights, density but smaller diameter. PL was measured at 20 K using 20-80mW laser. PL intensity is increasing without shifting when increase laser power.

P1.41

Preparation of ultra-thin tunneling oxides and Si/SiO2 nanodots for photovoltaic applications

Maurizio Roczen, Enno Malguth, Orman Gref, Andreas Schöpke, Manfred Schmidt

Helmholtz-Zentrum Berlin

For the application as hetero-emitter and passivation layer in high-efficiency solar cells we explore the UHV synthesis of Si/SiO2 nanostructures and ultra-thin tunneling oxides.

P1.42

Studies on Germanium Nanowire Growth

Jan Schmidtbauer, Torsten Boeck, Nils Deßmann, Robert Heimburger, Gerd Schadow, Hans-Peter Schramm, Thomas Teubner, Roberto Fornari

Leibniz Institute for Crystal Growth Berlin

The homoepitaxial growth of germanium nanowires on different substrate orientations is investigated. Parameters such as evaporation rate and substrate temperature are varied to observe the influence on nanowire yield and growth rate.

P1.43

Tunable mid-infrared emission from MBE grown PbTe/CdTe quantum dots with highly symmetric shapes

Thomas Schwarzl, Stefan Kriechbaumer, Astrid Hochreiner, Tomac Wojtowicz, Wolfgang Heiss, Gunther Springholz

University of Linz
Halbleiterphysik

We show the IR emission and its wide range tuning of unique PbTe QDs fabricated by epitaxial precipitation of PbTe in CdTe. In addition, we directly compare the spectra to the QD size distribution using calculations of the ground state transition.

P1.44

Space arrangement of Ge nanoislands during growth of Ge on pit-patterned Si substrates

Zhanna Smagina, Pavel Novikov, Vladislav Zinoviev, Dmitriy Vlasov, Anatoliy Dvurechenskii, Dmitriy Nasimov, Alexsandr Deryabin, Anton Kozhukhov

Institute of Semiconductor Physics SB RAS

Study of Ge nanoislands growth on pit-patterned Si(100) and Si(111) substrates is carried out. Ge islands grown on Si(111) are located inside 50nm-wide pits, those grown on Si(100) are positioned at the pits' edge. Mechanism of islands nucleation is suggested.

P1.45

Successive Ge growth on “V”-stripe patterned Si (001) surfaces at different growth temperatures

Sanduijav Bolormaa, Matei Dan, Gunther Springholz

University of Linz
Institut fuer Halbleiterphysik

Ge island growth on stripe-patterned Si (001) substrates, consisting of stripes with well defined „V“- shaped geometry, is investigated using in situ scanning tunneling microscopy, revealing a strong temperature dependence of the island nuclation process.

P1.46

Evaluation of multi-stacked InAs/GaNAs self-assembled quantum dots on GaAs (001) grown by using different As species

Ayami Takata, Ryuji Oshima, Yasushi Shoji, Kouichi Akahane, Yoshitaka Okada

The University of Tokyo
School of Engineering

We studied the effect of using different As species on the degree of vertical self-alignment of InAs QDs in MBE. The QD pairing ratio for As2 sample of 53 % was lower than that for As4 of 62 %, when the spacer layer thickness was thicker than 20 nm due to a higher step density of GaNAs spacer layer.

P1.47

InAs/GaAs quantum dot density variation across a quarter wafer when grown with substrate rotation

Sedsel Fretheim Thomassen, Bjørn-Ove Fimland, Turid Worren Reenaas

Norwegian University of Science and Technology
Department of Physics

The variation in MBE grown (continuous growth, 460ºC) InAs/GaAs quantum dot sizes, densities, and homogeneity across a ¼-wafer is studied by SEM. The quantum dot density varies from 8.0 to 17.9×1010 cm-2 and the diameter from 11 to 20 nm.

P1.48

Nanoimprint lithography patterned GaAs templates for site-controlled InAs quantum dots

Juha Tommila, Jukka Viheriälä, Antti Tukiainen, Arto Aho, Andreas Schramm, Tapio Niemi, Mihail Dumitrescu, Mircea Guina

Tampere University of Technology
Optoelectronics Research Centre

We report the development of high throughput UV-nanoimprint lithography process for patterning of GaAs templates used to fabricate site-controlled InAs QDs by MBE. Surface preparation process is discussed in detail.

P1.49

in situ STM observation of quantum dots formation in nano holes at 300oC

Takashi Toujyou, Shiro Tsukamoto

Anan National College of Technology
Center for Collaborative Research

in situ STM observation of quantum dots grown in nano holes was performed under As4 and In irradiation at 300oC. By applying voltage, the holes were artificially created. These holes were congregated In atoms on a wetting layer and it went beyond the critical thickness, forming the dot structures.

P1.50

Nanohole formation of Ga nanostructure on GaAs (001) by droplet epitaxy

T. Teraoka, C. Somaschini, T. Toujyou, T. Noda, S. Sanguinetti, N. Koguchi, T. Konishi, S. Tsukamoto

Anan National College of Technology

The formation process of nanoholes was investigated by Ga droplets on GaAs (001). The nanoholes at ring-shaped structures were confirmed by STMBE: in situ scanning tunneling microscopy during molecular beam epitaxy. The nanohole depth gradually increased and saturated at about 2 nm.

P1.51

Selective growth of GaAs nanostructures and subsequent guided self-assembly of InAs quantum dots on nanoimprint lithography patterned SiO2/GaAs substrates

Antti Tukiainen, Juha Tommila, Arto Aho, Andreas Schramm, Jukka Viheriälä, Risto Ahorinta, Mihail Dumitrescu, Markus Pessa, Mircea Guina

Tampere University of Technology
Optoelectronics Research Centre

Various GaAs nanostructures with different shapes were selectively grown on NIL-patterned SiO2/GaAs substrates and used for guided epitaxy of InAs quantum dots. Adequate parameters and pattern shapes allowed growth of single dots per

P1.52

Control of alignment of InP/InGaP QDs using self-organized growth mechanism

Asli Ugur, Fariba Hatami, Nick Vamivakas, Laurent Lombez, Mete Atatüre, W. Ted Masselink

Humboldt University
Physics

Super-low density (1/µm2) self-organized InP QDs grown by GSMBE in a InGaP matrix investigated with AFM and PL. QD chains align themselves on InGaP surface undulations, resulting in ordered arrays of dots.

P1.53

Hybrid metal nanocrystal-semiconductor quantum dot structures prepared by molecular beam epitaxy

Adam Urbańczyk, Rian Hamhuis, Richard Nötzel

Technical University of Eindhoven
Departament of Applied Physics

We report alignment of In nanocrystals on InGaAs near surface quantum dot arrays grown by molecular beam epitaxy. Photoluminescence measurements of such structures reveal clear surface plasmon resonance-quantum dot coupling which results in observation of additional emission band.

P1.54

Nanotrenches induced by mobile catalytic particles on MBE-grown II-VI thin films

Gan WANG, S.K. Lok, G.K.L. Wong, I.K. Sou

The Hong Kong University of Science and Technology
Nano Science and Technology Program, Department of Physics

Au nanostructures were fabricated on a ZnSe nanotrench template induced by mobile catalytic nanodroplets. We have succeeded in lengthening the ZnSe nanotrenches using a masked growth approach. Attempts on formation of aligned nanotrenches on other II-VI thin films will also be reported.

P1.55

Power and temperature dependent magneto-photoluminescence of the asymmetric double layers of quantum dots

Hakjoon Lee, Taehee Yoo, Sanghoon Lee, D. Dobrowolsak, J.K. Furdyna

Korea University
physics department

We have studied an asymmetric double layer of quantum dots using magneto-photoluminescence. The behavior of the polarization was discussed in terms of thermal effect and spin interaction between the carriers in the pairs of QDs in the system.

P1.56

Quantum dot growth over nanoholes: the effect of growth conditions and nanohole shape

Eugenio Zallo, Paola Atkinson, Armando Rastelli, Oliver Schmidt

IFW Dresden
Institute for Integrative Nanosciences

We investigate how the shape of a nanohole, and the growth conditions, affect the quantum dot distribution inside and around the hole.

P1.57

A feasible routine to fabricate GeSi quantum dots crystal on patterned Si (001) substrates

Zhenyang Zhong, Bingying Pan, Yanwu Chen, Tianxiao Nie, Yongliang Fan, Zuimin Jiang, Fang Lu

Fudan University
State Key Laboratory of Surface Physics and Department of Physics

Multilayer ordered GeSi quantum dots (QDs) were achieved in combination of self-assembly and nanosphere lithography. The nucleation of GeSi QDs in pits and the vertical alignment QDs in the subsequent layers led to 3D ordered and uniform QDs, which demonstrated the formation of GeSi QD crystal.

P1.58

Molecular beam regrowth of GaInAs-GaAs quantum wells on GaAs substrates

Chantal Fontaine, Olivier Desplats, Guy Lacoste, Alexandre Arnoult

CNRS-LAAS

The effect of the surface preparation prior to MBE regrowth, thermal deoxidation and H-plasma treatment will be compared using as a probe the photoluminescence emission of a GaInAs quantum wells grown at the vicinity of the regrowth interface.

Mon A1.1

2~2.5µm mid infrared light sources using InGaAs/GaAsSb "W" type quantum wells on InP substrates

Chien Hung Pan, Sheng Di Lin, Chien Ping Lee

National Chiao Tung University
Electronics engineering

To develop mid-infrared (mid-IR) light sources, we have investigated the InGaAs/ GaAsSb/ InAlGaAs/InAlAs "W" type quantum wells (QWs) grown on InP substrates by molecular beam epitaxy. We demonstrated for the first time emission wavelength up to 2.5µm on InP substrates.

Mon A1.2

MBE growth of highly tensile strained Ga(In)As/GaSb quantum wells

Alban Gassenq, Esperanza Luna, Thierry Taliercio, Achim Trampert, Eric Tournie

Universite Montpellier 2
IES - CC067

We have investigated Ga1 xInxAs/GaSb ($0 \le x \le 0.50$, -8% < < -4%) heterostructures grown on (001)-GaSb substrates. While in situ RHEED suggests quantum dot formation, ex situ TEM reveals perfect quantum wells and the formation of an GaInSb interfacial layer. Mid-IR PL is obtained up to 3 µm.

Mon A1.3

Strain Relaxation by misfit dislocation array at the GaSb/GaP interface

Salim El Kazzi, Ludovic Desplanque, Christophe Coinon, Xavier Wallart, Yu Wang, Pierre Ruterana

1Institut d'Electronique de Microélectronique et de Nanotechnologie
EPIPHY group

Relaxation of GaSb islands on GaP was studied to achieve a 2D periodic array of 90° misfit dislocations at the interface between GaSb and GaP. We investigate the growth conditions by GSMBE leading to a low defect density GaSb layer on GaP

Mon A1.4

AlGaAsSb superlattice buffer layer for p-channel GaSb quantum well on GaAs substrate

Vadim Tokranov, Michael Yakimov, Padmaja Nagaiah, Thenappan Chidambaram, Serge Oktyabrsky

University at Albany - SUNY
College of Nanoscale Science and Engineering

Metamorphic AlGaAsSb buffers on GaAs substrates to lower defect density for strained GaSb QW p-channels were developed. Maximum hole mobility of 1070 cm2/Vs was obtained in sample with As-, Sb- valves toggled. Correlation between the mobility and the RT PL intensity was noticed.

Mon A1.5

Electron Scattering by Structural Defects in InSb Quantum Wells

Ted Mishima, Michael Santos

University of Oklahoma
Dept. of Physics and Astronomy

Electron scattering by micro-twins (MTs) and threading dislocations (TDs) in InSb quantum wells has been studied. Regression analysis shows that the energy barrier and reflection coefficient of MTs are 0.09eV and 0.33, respectively. The electric charge density along a TD is 1.34×10^-10C/m.

Mon B1.1

Growth and characterization of C60/GaAs interfaces and C60 doped GaAs (Invited)

Jiro Nishinaga, Yoshiji Horikoshi

Waseda University
Waseda Institute for Advanced Study

C60 delta-doped GaAs layers are grown by MEE methods. C60 doped GaAs layers show resistive characteristics and C60 molecules in GaAs lattices are confirmed to produce electron traps which can be charged or discharged by applied electric fields.

Mon B1.2

Growth modification of Ge/Si quantum dots by Antimony

Alexander Tonkikh, Nikolay Zakharov, Vadim Talalaev, Peter Werner

Max Planck Institute of Microstructure Physics
Exp. dept. II

The modification of Ge/Si(100) quantum dots by a submonolayer Sb film during MBE is reported. Increase in array density and decrease in dot sizes are documented. The luminescence properties of modified Ge dots are discussed.

Mon B1.3

Strain engineering in Si by deposition of ordered SiGe islands on patterned Si(001) substrates

Jianjun Zhang, Nina Hrauda, Heiko Grioss, Armando Rastelli, Julian Stangl, Friedrich Schäffler, Oliver G Schmidt, Günther Bauer

Leibniz-Institut für Festkörper- und Werkstoffforschung (IFW)
Institute for Integrative Nanosciences

We present a route to obtain uniform arrays of SiGe/Si(001) islands which have both large lateral size and high Ge fraction. Strain calculations based on the experimentally structure show the tensile strain in a Si cap is significantly enhanced.

Mon B1.4

High quality, high Sn-concentration GeSn alloys using low-temperature MBE growth

Robert Chen, Yijie Huo, Hai Lin, Theodore I. Kamins, James S. Harris

Stanford University
Electrical Engineering

Low-temperature MBE growth of up to 9.2% GeSn alloys on lattice-matched InGaAs resulted in high-quality material as determined by AFM, TEM, and XRD. No Sn segregation or precipitation was seen, suggesting that higher Sn incorporation is possible.

Tue A1.1

Nucleation and growth of collector-induced and self-induced GaN nanowires - a comparison (Invited)

Lutz Geelhaar

Paul-Drude-Institut für Festkörperelektronik

On sapphire, the formation of GaN nanowires (NWs) is induced by Ni islands, but on Si GaN NWs grow in a self-induced way. The nucleation phenomena are very different. Growth is governed in both cases by Ga diffusion on the NW sidewalls.

Tue A1.2

Correlation of structural, chemical and optical characterization of luminescent CdSe quantum dots inserted in ZnSe nanowires

Martien den Hertog, Miryam Elouneg-Jamroz, Edith Bellet-Amalric, Samir Bounouar, Catherine Bougerol, Regis André, Yann Genuist, Jean-Philippe Poizat, Kuntheak Kheng, Serge Tatarenko

CNRS-Institut Néel
NPSC - CNRS / CEA / UJF

ZnSe nanowires containing a luminescent CdSe quantum dot (QD) insertion were grown epitaxially on (100) and (111)B ZnSe. Optical characterization was correlated with transmission electron microscopy based techniques to probe the chemical and crystallographic structure of the QDs.

Tue A1.3

Molecular Beam Epitaxy of Catalyst-free InGaN/GaN Nanowires and Nanowire White Light Emitting Diodes on (001) Silicon

Pallab Bhattacharya

University of Michigan
Electrical & Computer Engineering

Catalyst-free (In)GaN nanowires have been grown on (001) silicon by plasma-assisted MBE and characterized. Electroluminescence spectra of "white" LEDs made with the nanowires have been measured.

Tue A1.4

Light-emitting diode based on catalyst- and mask-free grown GaN nanorods

Gerd Kunert, Waldemar Freund, Timo Aschenbrenner, Carsten Kruse, Stefan Figge, Detlef Hommel, Joachim Kalden, Katrin Sebald, Jürgen Gutowski, Martin Feneberg, Ingo Tischer, Kim Fujan, Klaus Thonke

University of Bremen

We report on the realization of a blue light emitting diode based on GaN nanorods. Incorporation of p-n-junctions and InGaN quantum wells into nanorods will be discussed as well as processing details

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Tue A1.5

Mn Accumulation at the lateral Sidewalls of (Ga,Mn)N Nanowires grown on Si(111) by Molecular Beam Epitaxy

Arne Urban, Michael Carsten, Jörg Malindretos, Michael Seibt, Angela Rizzi

Georg August Universität Göttingen
IV Physikalisches Institut

(Ga,Mn)N nanowires were grown by MBE on p-Si(111). A Mn accumulation at the nanowire sidewalls is observed. The number of planar defects in Mn-doped nanowires is significantly increased as compared to undoped GaN nanowires.

Tue B1.1

Comparison of InP- and GaSb-based VCSELs emitting at 2.3 µm suitable for CO detection

Boehm Gerhard, Bachmann Alexander, Meyer Ralf, Amann Markus-Christian, Rosskopf Jürgen, Ortsiefer Markus, Chen Jia, Hangauer Andreas, Strzoda Rainer

Technische Universität München
Walter Schottky Institut

For the fabrication of a CO detector using VCSELs emitting at 2.3 µm in cw-mode with single-mode emission, the reliable performing lasers based on InP are compared with devices on GaSb. With these new unique devices the achievable wavelength range is expected to be extendable up to 3 µm.

Tue B1.2

MBE growth of low threshold GaSb-based lasers with emission wavelengths in the range of 2.5 to 2.7 µm

Kristijonas Vizbaras, Alexander Bachmann, Shamsul Arafin, Kai Saller, Stefan Sprengel, Gerhard Boehm, Ralf Meyer, Markus-Christian Amann

Technische Universität München
Walter Schottky Institut

An approach towards the growth of active regions and cladding layers for GaSb based record low-threshold lasers, emitting in the range of 2.5 µm – 2.7 µm, is presented. Growth conditions, choice of materials, device results and future outlook are presented.

Tue B1.3

Systematic Growth Investigation of Antimonide-Based Interband Cascade Light Emittting Diodes Targeted at Lambda = 3.2 microns at 300K

Chadwick Canedy, William Bewley, Chul-Soo Kim, Mijin Kim, Ryan Lindle, Josh Abell, Igor Vurgaftman, Jerry Meyer

Naval Research Laboratory
Code 5613

We explored how variations of several MBE growth-related parameters influence evolution of the electroluminescence spectral linewidth and intensity in a series of mid-infrared IC-Light Emitting Diodes with a target lambda = 3.2 microns at 300 K.

Tue B1.4

VCSELs with monolithically integrated photodiodes for single-fiber bidirectional data transmission in the Gbit/s range

Dietmar Wahl, Alexander Kern, Martin Stach, Fernando Rinaldi, Rudolf Roesch, Rainer Michalzik

University of Ulm
Institute of Optoelectronics

We present the epitaxial growth, processing and characteristics of AlGaAs-based transceiver chips for high-speed bidirectional optical data transmission. The devices consist of 850nm VCSELs and monolithically integrated photodetectors.

Tue B1.5

MBE growth of VCSELs for high volume applications (Invited)

Roland Jäger

Philips Technologie GmbH ULM Photonics
EG

Mass market applications like laser computer mouse or optical data transmission based on VCSEL chips needs a high over all yield including epitaxy, processing, dicing, mounting and testing. This is demonstrated on MBE grown VCSEL structures.

Tue A2.1

III-V nanowires fabricated with modulated fluxes: a method to investigate the chronology of their growth (Invited)

Fauzia Jabeen, Jean-Christophe Harmand, Frank Glas, Gilles Patriarche

LPN-CNRS

III-V nanowires (NWs) are grown by molecular beam epitaxy with small and short group V flux modulations. This results in composition oscillations along the NW axis which are exploited to extract the instantaneous growth rate and the NW length at any time of the growth.

Tue A2.2

Au-assisted Vapor-Liquid-Solid nucleation of GaAs on Si(111) - Growth evolution from traces to nanowires

Steffen Breuer, Maria Hilse, Achim Trampert, Lutz Geelhaar, Henning Riechert

Paul-Drude-Institut Berlin
Epitaxy

The nucleation of GaAs nanowires (NWs) on Si(111) assisted by Au droplets shows an evolution from horizontal traces to vertical NWs which is caused by a smaller interface energy of the droplets on Si than on GaAs.

Tue A2.3

Controlling crystal phases in GaAs nanowires grown by Au-assisted molecular beam epitaxy

Dheeraj Dasa, Abdul Mazid Munshi, A.T.J. van Helvoort, Bjørn-Ove Fimland, Helge Weman

NTNU
Department of Electronics and Telecommunications

We demonstrate the growth of pure WZ, pure ZB, and WZ/ZB heterostructure GaAs NWs by Au-assisted MBE. We show that the control on the crystal phase of III-V nanowires (NWs) allows us to engineer the band gap in a NW without changing the composition.

Tue A2.4

Catalyst consumption and structural changes during the growth of self catalysed GaAs nanowires.

Stefano Ambrosini, Mattia Fanetti, Vincenzo Grillo, Silvia Rubini

IOM-CNR

We grew self catalysed GaAs NWs on GaAs substrates covered by a thin Si-oxide layer. We observe a transition from high quality zincblend structure to highly defective mixed zincblend-wurtzite as far as the Ga droplet on the NW tip is consumed.

Tue A2.5

X-ray characterization of Au-free grown GaAs nanowires on Si

Andreas Biermanns, Anton Davydok, Steffen Breuer, Lutz Geelhaar, Ullrich Pietsch

Universität Siegen
Festkörperphysik

The early stage of Au-free GaAs nanowire growth on Si(111) was inspected by x-ray diffraction using a nm-sized beam to inspect single NWs. We show that growth starts with predominantly wurtzite phases which have a different vertical lattice parameter compared to the zinc-blende phases.

Tue B2.1

Resonant Tunneling in a GaMnAs Surface Quantum Well and Its Valence-Band Picture

Shinobu Ohya, Kenta Takata, Masaaki Tanaka

The University of Tokyo
Department of Electrical Engineering and Information Systems

We investigated the valence band structure of GaMnAs surface quantum wells with a wide range of Curie temperatures by resonant tunneling spectroscopy, and found that the spin splitting is only several meV and the Fermi level exists in the bandgap.

Tue B2.2

Anisotropic Structure and Ferromagnetic Properties of Epitaxial GeMnTe

Mahmood Hassan, Springholz Gunther, Kirchschlager Raimund, Bauer Guenther

University of Linz
Institut fuer Halbleiterphysik

The structure-magnetism relationship of GeMnTe is studied systematically as a function of Mn content, demonstrating a switching of the magnetic easy axes from out-of-plane to in-plane at a certain Mn content. This is explained by the structural phase transitions.

Tue B2.3

MBE growth of self-catalysed GaMnAs/GaAs and MnAs/GaAs nanowires on silicon

Janusz Sadowski, Aloyzas Siusys, Piotr Dluzewski, Tomasz Wojciechowski, Anna Reszka, Bogdan J. Kowalski

Lund University
MAX-Lab

The ferromagnetic GaMnAs and MnAs shells were grown at the side facets of GaAs nanowire cores grown at silicon substrates without an external nanowire growth catalyst. The GaAs cores are grown at high substrate temperatures (about 600 C), have diameters of about 150 nm and lengths of up to 15 µm

Tue B2.4

Spin dynamics of Mn in nanostructures (Invited)

Joel Cibert, J. Bernos, L. Besombes, H. Boukari

CNRS
Institut Neel

Some of the parameters which govern the spin dynamics of a Mn^{2+} impurity (hyperfine interaction; strain and Zeman effect; interaction with neighboring spins and carriers) can be controlled by designing appropriate CdTe QWs and QDs grown by MBE.

P2.01

Arsenic environment in MBE-grown HgCdTe:As layers

Philippe BALLET, Bernard POLGE, Ivan-Christophe ROBIN, Xavier BIQUARD, Isabelle ALLIOT

CEA
Leti

This paper focuses on the MBE-growth of arsenic-doped HgCdTe layers using an original plasma arsenic cell, and on the complete characterization of the chemical environment of arsenic using EXAFS and PL. The effect of the activation annealing on the arsenic environment is clearly evidenced.

P2.02

CdSe Quantum Dots grown on a Zn0.2Mg0.8S0.64Se0.36 barrier: MBE growth and µ-PL characterization

Ian Davidson, Richard Moug, Paul Dalgarno, Christine Bradford, Richard Warburton, Kevin Prior

Heriot-Watt University

CdSe quantum dots grown on ZnMgSSe were characterized by PL and µ-PL. A dot density of ~ 1010 cm-2 was obtained. Dot emissions showed intensity and energy high frequency random jittering and intensity correlations over much longer times (~200s).

P2.03

Impact of interfacial germanium on the properties of molecular beam epitaxial grown Gd2O3 on Si

Apurba Laha, Andreas Fissel, H.-Jörg Osten

Leibniz University Hannover
Information Technology Laboratory

Incorporation of few monolayers Ge at the interface between Gd2O3 and Si was found to have significant impact on the electrical properties crystalline Gd2O3 grown by MBE technique on Si substrates however, the same does not show any influence on the epitaxial quality of Gd2O3 layers.

P2.04

Light switching driven by light of ZnSe-ZnTe dual sub-band superlattices

Kazuya Takahashi, Kazuomi Honma, Taisuke Yamamoto, Makoto Abe, Naohito Kimura, Nobuyuki Kimura, Takayuki Sawada, Kazuhiko Suzuki, Kazuaki Imai

Hokkaido Institute of Technology
Dept. of Electric and Electronic Engineerling

Specially designed ZnSe-ZnTe superlattices have a light switching effect. The He-Ne laser light (633 nm, 0.5 mW) passes through the sample the substrate of which is removed partly. The intensity of the transmitted light increases when the sample is exposed to the other He-Ne laser line (605, 5).

P2.05

Influence of In and As flux on growth of self-assembled InAs quantum dots on GaAs(001)

Itaru Kamiya, Takeo Shirasaka, Kenichi Shimomura, David Tex

Toyota Technological Institute
Quantum Interface Laboratory

The growth of self-assembled InAs quantum dots (QDs) on GaAs(001) by MBE is studied as a function of In and As flux. Under growth rates below 0.1 ML/s, the QD density increases not only with increasing In flux but also with As flux. The growth mechanisms monitored by RHEED is discussed.

P2.06

Dynamics and kinetics in homoepitaxy on GaAs (001)-β(2x4) surface under ultra low coverage

Anna Lyamkina, Yury Galitsyn, Dmitry Dmitriev, Sergey Moshchenko, Alexander Toropov

Institute of Semiconductor Physics

Homoepitaxy on GaAs (001)-β(2x4) surface was investigated by RHEED in the range of ultra low coverages as well as temperature dependence of kinetic parameters. The value $\theta c=0.12$ ML was found to be critical coverage of phase transition and the model of GaAs homoepitaxy initial stage is proposed.

P2.07

2.5 μm GaSb based semiconductor disk laser

Jonna Paajaste

Tampere University of Technology
ORC

We report on a first high-power semiconductor disk laser operating at 2.5 μm. Output power of 600 mW with M2

P2.08

Optical and structural properties of Pb1-xEuxTe/CdTe//GaAs (001) heterostructures grown by MBE

Ewa Smajek, Michał Szot, Leszek Kowalczyk, Viktor Domukhovski, Badri Taliashvili, Piotr Dziawa, Wojciech Knoff, Elżbieta Łusakowska, Anna Reszka, Bogdan Kowalski, Maciej Wiater, Tomasz Wojtowicz, Tomasz Story

Polish Academy of Sciences
Institute of Physics

MBE growth, structural and optical properties of Pb1-xEuxTe/CdTe//GaAs(001) heterostructures is reported. Observed interband photoluminescence from Pb1-xEuxTe quantum wells shows expected blue shift in energy from 341meV for x=0 to 533meV for x~0.05.

P2.09

Growth mechanism of GaAs nanostructures by Droplet Epitaxy

Claudio Somaschini, Sergio Bietti, Nobuyuki Koguchi, Stefano Sanguinetti

LNESS and Milano-Bicocca University
Material Science

We will focus on the GaAs/AlGaAs system and present a model for the growth mechanism of GaAs nanostructures by Droplet Epitaxy, which accounts for the fabrication of a great variety of nanostructure shapes accessible through the use of this method.

P2.10

Influence of Reflection High-Energy Electron Diffraction on Anti-Stokes Photoluminescence

David Tex, Itaru Kamiya

Toyota Technological Institute
Quantum Interface Laboratory

We investigate the influence of unfocused electron beam in front of sample during molecular beam epitaxy (MBE) growth on the anti-Stokes efficiency and find a strong influence on the efficiency on certain classes of intermediate states.

P2.11

Growth of III-V quantum dots on silicon substrates: Formation and characterization

Tariq Alzoubi, Reithmaeir Johann Peter

Institute of Nanostructure Technologies and Analytics -university of kassel
Technological Physics

Self assembled InAs and InGaAs quantum dots (QDs) were grown by solid source molecular beam epitaxy(MBE) on different Si substrate orientations (100) and(111) using Stranski-Krastanov growth mode. The quality of the surface preparation and the dots formation process were in-situ monitored by RHEED.

P2.12

Kinetics of (In,Ga)As QD formation on GaAs (110) vicinal substrates via step meandering

Paloma Tejedor, L. Díez-Merino, I. Beinik, C. Teichert

Instituto de Ciencia de Materiales de Madrid, CSIC
Nanostructures and Surfaces

The combination of the surfactant action of atomic hydrogen with the use of nanostructured buffer templates results in a kinetically-driven enhancement of upward mass transport and a reduction of surface free energy, which alters the (In,Ga)As growth mode and enables the formation of 3D dot-like nanostructures on the GaAs(110) vicinal surface.

P2.13

In-situ and Ex-situ Ohmic Contacts To Heavily Doped p-InGaAs

Ashish Baraskar, Vibhor Jain, Mark Wistey, Brian Thibeault, Arthur Gossard, Mark Rodwell

University of California, Santa Barbara
Department of Electrical and Computer Engineering

We report ultra-low specific contact resistivity of (1.0±0.6)×10−8 Ω-cm2 and (1.5±0.9)×10−8 Ω-cm2 for refractory iridium contacts to p-In0.53Ga0.48As prepared by in-situ and ex-situ electron beam deposition, respectively.

P2.14

High Performance Type II Superlattice Photo Diodes for Long Wavelength Infrared Applications

Yiqiao Chen, Aaron Moy, Kan Mi, Peter Chow

SVT Associates, Inc.

A new strain-compensated type II InAs/GaSb superlattice structure is grown by adding controlled interface layers. The fabricated photo diode with 14 um cutoff wavelength shows a Johnson noise limited peak detectivity of 1E11 Jones under zero bias at 83 K.

P2.15

InGaAs self-assembly quantum dot for high-speed 1300nm electroabsorption modulator

Yi-jen Chiu, Chuan-Han Lin, Tsong-Sheng Lay

National Sun Yat-sen University
Department of Photonics

Using InGaAs quantum dot (Q.D.), a high-speed electroabsorption modulator with -3dB bandwidth of 3GHz has been demonstrated. A quadratic relation transition energy shift against voltage is observed, confirming the quantum-confined-Stark-effect .

P2.16

Thermodynamic evolution of Anti-Phase Boundaries (APB) during MBE heterogeneous growth of GaP/Si.

Weiming GUO, Alexandre BONDI, Charles CORNET, Antoine LETOUBLON, Olivier DURAND, Tony ROHEL, Olivier DEHAESE, Nicolas CHEVALIER, Nicolas BERTRU, Alain LE CORRE

INSA Rennes - France
FOTON-INSA Laboratory, CNRS

20 nm thick GaP layers on Si substrate grown by various MBE growth modes are studied. A complete analysis is performed using atomic force microscopy and advanced X-ray analysis, which gives crucial information on defect structural properties. Thermodynamic evolution of APB is then discussed.

P2.17

Al0.56In0.44Sb/Ga0.5In0.5Sb heterostructures for high speed and low power consumption electronic devices

Ludovic Desplanque, Dominique Vignaud, Sylvie Godey, Sébastien Plissard, Erwann Cadio, Xavier Wallart, Peng Liu, Hermann Sellier

IEMN/ CNRS and University of Lille
DHS

Electronic properties of the Al0.56In0.44Sb/Ga0.5In0.5Sb heterostructure are investigated for high speed and low power electronic devices. In particular, we measure its band parameters and study the influence of a large sheet carrier density on the electron mobility.

P2.18

A comparison of the Low Frequency Noise in InSb grown on GaAs and Si by MBE

Julia Dobbert, Lien Tran, Fariba Hatami, W. Ted Masselink, Vasyl P. Kunets, Gregory J. Salamo

Humboldt-Universität zu Berlin
AG FET

The low frequency noise features of InSb channels grown on GaAs and Si substrates using MBE are investigated in the temperature range 80-300 K. In all samples the flicker noise dominates the spectra, with Hooge factors as low as 2*10-5 and 7*10-5 for InSb on GaAs and Si.

P2.19

Enhanced emission efficiency due to an excited subband resonance in a GaAs-based quantum-well system

Kenzo FUJIWARA, Uwe JAHN, Esperanza LUNA, Holger T. GRAHN

Kyushu Institute of Technology
Dept of Electrical Engineering and Electronics

The emission energies and their intensity distributions across a 2-inch wafer are investigated by cathodoluminescence. An intense high-energy emission is observed due to the presence of an interface layer in resonance with the excited subband transition of a neighboring well.

P2.20

Rare Earth Oxide Buffer Engineering for the Integration of Germanium and Silicon Thin Film Substrates onto the Si platform

Alessandro Giussani, Olaf Seifarth, Peter Zaumseil, Markus Andreas Schubert, Dorin Geiger, Peter Storck, Thomas Schroeder

IHP
Materials Research

The heteroepitaxial integration of Si and Ge thin film substrates on Si(111) wafers via single crystalline rare earth oxide buffers is presented. Sample characterization was carried out by means of multiple techniques, among which laboratory and synchrotron-based XRD, Raman and TEM.

P2.21

GaN growth on pseudo Al substrates by molecular beam epitaxy at low temperatures

Taiga Goto, Masato Hayashi, Tatsuhiro Igaki, Satoru Taguchi, Tohru Honda

University of Kogakuin
Department of Electrical Engineering and Electronics

Pseudo Al substrates are proposed for the growth of III-N materials. It was experimentally shown the pseudo Al substrates grown on sapphire by MBE and the formation of (0001)AlN layers on pseudo (111)Al substrates at the temperature below the Al melting point. GaN layers were also grown on them.

P2.22

Strain control of InGaAs/AlAs/AlAsSb quantum wells by interface termination between AlAs and AlAsSb

Shin-ichiro Gozu, Teruo Mozume, Hiroshi Ishikawa

AIST

We studied the strain control of InGaAs/AlAs/AlAsSb material systems by means of an interface termination method. By changing the interface termination from As to Sb, the residual strain was changed by 0.3% without a degradation in the crystal quality.

P2.23

Material characteristics of high indium content InGaAs photodetector structures with InGaAs or InAlAs graded buffer layers

Yi Gu, Yonggang Zhang, Kai Wang, Aizhen Li, Xiang Fang, Cheng Li

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
State Key Laboratory of Functional Materials for Informatics

The structural and optical characteristics of high indium content InxGa1-xAs photodetector structures with InGaAs or InAlAs continuously graded buffers on InP substrate have been investigated and compared by the measurements of AFM, XRD, TEM and PL.

P2.24

Gas source MBE grown Al0.52In0.48P photovoltaic detectors

Cheng Li, Yonggang Zhang, Yi Gu, Kai Wang, Aizhen Li, Hsby Li, Xiumei Shao, Jiaxiong Fang

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences
State Key Laboratory of Functional Materials for Informatics

The Al0.52In0.48P photovoltaic detector is grown by gas source molecule beam epitaxy. Their characteristics have been investigated in detail.

P2.25

Influence of AlAs monolayer on InAs quantum dots stacks embedded in an InGaAs/GaAs matrix

Dongzhi Hu, Daniel Schaadt

Karlsruhe Institute of Technology
Institut für Angewandte Physik/DFG-Center for Functional Nanostructures

An annealing procedure for each QD layer is used to tune the density of QDs, which is embedded in InGaAs/GaAs matrices. We found that annealing procedure deteriorates the device surface. A thin AlAs capping layer was introduced and its influence on the structure surface is investigated.

P2.26

Selective Growth of InSb on Localized Area of Si(100) by Molecular Beam Epitaxy

Tomoaki Iida, Yuichi Nishino, Akinori Uchida, Hiroyuki Horii, Shinsuke Hara, Hiroki I. Fujishiro

Tokyo University of Science
Department of Applied Electronics

Selective growth of InSb on patterned Si dioxide on Si substrates by molecular beam epitaxy has been studied. InSb crystal nuclei grow selectively on the bare Si window areas above 500 °C. Indium agglomeration formed in InSb nucleus can decrease slightly as increasing V/III flux ratio.

P2.27

Direct band engineering with sub-monolayer nitride into III-V quantum system

Fumitaro Ishikawa, Masato Morifuji, Kenichi Nagahara, Masayuki Uchiyama, Kotaro Higashi, Masahiko Kondow

Osaka University
Graduate School of Engineering

The band structure of dilute nitrides has been studied, where N is randomly distributed in III-V matrix. We study the effect of N arranged at a single atomic layer, like δ-doping. That can provide a predictive approach of band gap engineering.

P2.28

Annealing effect of low temperature grown Si capping layers on SiGe quantum dots

Zuimin Jiang, jian Cui, Jianhui Lin, Yueqin Wu, Yongliang Fan, Xinju Yang, jin Zou

University of Fudan
Physics department

The annealing effect of low temperature grown Si capping layer on SiGe quantum dots is investigated. Square pits with a depth of about 8 nm, are formed in the Si capping layer. The dots and pits have one to one correspondence observed by TEM.

P2.29

Growth and characterization of InGaN by RF-MBE

Andreas Kraus, Samir Hammadi, Jörg Hisek, Holger Jönen, Lars Hoffmann, Heiko Bremers, Uwe Rossow, and Andreas Hangleiter

TU Braunschweig
Institute of Applied Physics

Coherently strained InGaN layers with In contents up to 26% were pseudomorphically grown by RF-MBE on MOVPE grown GaN templates. The samples exhibit good crystalline quality with smooth surfaces and promising electrical properties.

P2.30

Rapid thermal annealing of InAs/(In)GaAs quantum dots grown with different areal densities

Lianhe Li, N. N. Yusoff, S. P. Khanna, E. H. Linfield, A. G. Davies

university of leeds

Rapid thermal annealing of InAs/(In)GaAs quantum dots (QDs) results in QD PL peak energy blue-shifting. The blue-shift strongly depends on both the QD areal density and the capping layer materials. Larger energy blue-shifts were observed from low-density QDs and InGaAs-capped QDs.

P2.31

X-ray Diffraction analysis of step-graded InxGa1-xAs buffer layers grown by MBE

Hai Lin, Yijie Huo, yiwen Rong, Robert Chen, Theodore Kamins, James Harris

Stanford University
Materials Science and Engineering

X-ray diffraction Reciprocal Space Mapping is used to study crystal quality of step-graded InGaAs buffer layers grown on GaAs substrate by MBE. High quality InGaAs buffer layers with up to 40% In content of 700nm can be grown with low temperature growth and in-situ annealing method.

P2.32

Sequential growth of semiconductor disc lasers

Christian Manz, Klaus Köhler

Fraunhofer IAF
Epitaxy

MBE growth and lasing operation of VECSEL are reported. A comparison of nominally identical VECSEL structures reveals an increase of the maximum output power of nearly 100% for a 2.0 µm emitting VECSEL structure grown with the sequential growth scheme compared to conventional growth.

P2.33

Molecular beam epitaxy and characterization of InGaAs/AlAs/AlAsSb coupled double quantum wells with extremely thin AlGaAs coupling barriers between InGaAs wells

TERUO MOZUME, SHIN-ICHIRO GOZU

AIST

We grew InGaAs/AlAs/AlAsSb CDQWs with extremely thin AlGaAs coupling barrier between two InGaAs wells by MBE in order to shift the interband absorption edge energy of the CDQWs toward the communication energy and characterized CDQWs using HRTEM and photoreflectance.

P2.34

Thermal dependence of the lattice constant and the Poisson ratio of AlSb grown on GaSb by molecular beam epitaxy

Tron Arne Nilsen, Saroj Kumar Patra, Magnus Breivik, Bjørn-Ove Fimland

Norwegian University of Science and Technology
Electronics and Telecommunications

AlSb is a binary often used as part of compound semiconductors grown on GaSb substrates. There has been little work done on the thermal expansion (TE) of AlSb. We have determined the TE and Poisson ratio from 32 to 546°C by XRD and found it to be very different from previous results.

P2.35

MBE growth of Ge based high quality InGaAs/GaAs quantum wells

Zhichuan Niu, Haiqiao Ni, Haili Wang, Jifang He, Mifeng Li, Yan Zhu, Xiangjun Shang

Insititute of Semiconductors, Chin. Acad. of Sci.

MBE growth of high quality InGaAs/GaAs QWs on offcut (100) Ge substrate have been investigated.

P2.36

GaSb/InAs combined Quantum Rings grown by Metal Organic Molecular Beam Epitaxy

Satoru Odashima, Seiya Sakurai, Masaki Wada, Ikuo Suemune

Hokkaido University
Research Institute for Electronic Science

GaSb QRs have been grown on the GaAs substrates by MOMBE. Partially capped InAs QDs were flattened by In-flushing, then GaSb QRs were regrown. Such QRs have a diameter 240 nm (outer) and 30 nm (inner), and a height 10 nm. The number density is around 1.2e+8 /cm2.

P2.37

Influence of the AlSb and InSb quantum dots interlayer of GaSb grown on Si(111)

Byung-Guon Park, Jin-A You, Young-Kyun Noh, Moon-Deock Kim, Jae-Eung Oh, Woo-Chul Yang, Young-Heon Kim

Chungnam National University
Department of physics

We demonstrate that the high-quality GaSb material system with low defect density can be realized by a relatively QD buffer layer with low defect density. The properties of the GaSb films were investigated using RHEED, AFM, XRD, and PL measurements.

P2.38

Molecular beam epitaxy of InSb involving hydrogen plasma substrate cleaning

Jean-Philippe Perez, J.B. Rodriguez, R. Chaghi, F. Fagnou, P. Christol, H. Sik

Université Montpellier 2 - CNRS
Institut d'Electronique du Sud

In this communication, we present structural characterization of MBE grown InSb samples using hydrogen plasma cleaning of the substrates.

P2.39

Self-Assembled GaAs Local Artificial Substrates on Si by Droplet Epitaxy

Sergio Bietti, Claudio Somaschini, Noboyuki Koguchi, Stefano Sanguinetti, Cesare Frigeri

University of Milano-Bicocca
Department of Materials Science

The fabrication of local artificial substrates on Si via the self-assembly of submicrometer GaAs islands is here presented. The islands show a narrow size distribution (below 10% relative dispersion) and the independent control of density and size.

P2.40

Electrical and Optical properties of GaAs:Be/Al0.1Ga0.4In0.5P:Be heterostructures subjected to thermal treatments

Carlos Soubervielle-Montalvo, Omar Vital-Ochoa, Víctor Hugo Méndez García

Universidad Autónoma de San Luis Potosí
Nanotechnology Department

The samples were grown by SSMBE varying the Be-Cell temperature. After they were annealed at 350°C and 450°C, I-V curves revealed that the electrical resistance of samples was decreased due to Be activation. Also the PL-spectra were affected showing O,DL bands and quenching of A,X transitions.

P2.41

A study of electronic state of GaAs/AlAs super lattice by XPS depth profile

Naoshi Takahashi, Kanaya Hiroe, Ebisu Mari, Osaka Mikako, Sugiyama Noriaki, Miyagawa Hayato, Koshiba Syun

Kagawa University
Department of Physics, Faculty of Education

From the XPS depth profile, we found the periodic profile of As3d area synchronized with that that of Al2p, which should be expected always constant. And we observed another periodic peak shift of Ga3d, and other peaks showed no such the shift.

P2.42

High Carrier Mobility MBE-grown Low Temperature GaAs as Continuous-Wave Terahertz Photomixer

Hendrix Tanoto, Q. Y. Wu, M. Sun, J. H. Teng, Z. N. Chen, T Htoo, S. J. Chua, A. Gokarna, J. F. Lampin, E. Dogheche

Institute of Materials Research and Engineering

Low temperature GaAs grown by MBE system exhibiting Hall carrier mobility of 5000 $cm^2/v.s.$ was fabricated into continuous-wave (CW) Terahertz (THz) photomixers utilizing dual dipole antenna with interdigitated structures. The CW THz photomixer characteristics are presented.

P2.43

GaAs-on-Si heteroepitaxy via selective area growth on self-assembled and nanopatterned buffer templates

Paloma Tejedor, Beatriz Galiana, Marcos Benedicto, Jon Molina-Aldereguia

Instituto de Ciencia de Materiales de Madrid, CSIC
Nanostructures and Surfaces

Selective epitaxy by MBE and H-MBE of GaAs on nanostructured SiO2/Si and STO/Si substrates is investigated, with specific emphasis on the impact of mask aspect ratio and atomic H on defect elimination

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P2.44

InP/InGaAs/InP DHBT Structures with Graded Composition Base Grown by Gas Source Molecular Beam Epitaxy

Teng Teng, Ai Likun, Xu Anhuai, Sun Hao, Zhu Fuying, Qi Ming

Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

The material structure of DHBT with a graded Gallium composition base was grown by GSMBE. The Ga composition increased gradually from 47% on collector side to 55% on emitter side. The material we grown is suitable for DHBT device fabrication.

P2.45

InGaAs quantum dots embedded in DBR-coupled double cavity

T. E. Tzeng, K. Y. Chuang, Y. C. Liu, B. T. Tsuei, E. Y. Lin, T. S. Lay

National Su Yat-Sen University
Department of Photonics

InGaAs quantum dots (QDs) embedded in coupled double cavity with 13.5 periods of AlAs/GaAs as the intermediate DBR is grown on (001) GaAs substrate. Two optical emission peaks corresponding to the coupled cavity modes (=1176, and 1189 nm) are observed.

P2.46

Lasing in Compact Microdisks with InAs Quantum Dots in a Well Structure

J. Y. Hsing, Te En Tzeng, K. Y. Chuang, T. S. Lay

National Su Yat-Sen University
Department of Photonics

Abstract --- We obtained optical coupling between optical mode of compact GaAs microdisk cavities and emission from embedded self-assembled InAs quantum dots at room temperature. A lasing peak was observed at 1269 nm wavelength in a 0.85 m radius microdisk, and the pump threshold power is 0.6 mW.

P2.47

Photovoltaic response of coupled InGaAs quantum dots

K.Y. Chuang, T. E. Tzeng, Y. C. Liu, K. D. Tzeng, T. S. Lay

National Su Yat-Sen University
Department of Photonics

In order to enhance absorption at infrared range for GaAs based solar cell, we insert the vertically coupled quantum dots (QDs) into the active layer. The short-circuit current density (Jsc) is 10.5 mA/cm2 for nine-layer InGaAs QDs of 5-nm GaAs spacer.

P2.48

Photovoltaic response in InGaAs quantum dots-in-a-well structure

T. E. Tzeng, K. Y. Chuang, T. S. Lay, David.J.Y. Feng

National Su Yat-Sen University
Department of Photonics

Photovoltaic results of multi-stack quantum dots-in-a-well (DWELL) of different InGaAs composition are presented. The solar cell of p-doped DWELLs has a filling factor of 67.3%, Jsc = 10.6mA/cm2, and VOC = 0.61V under AM1.5 global illuminations.

P2.49

Uncooled InSb Mid- Infrared LED Used Dislocation Filtering of AlInSb Layer

Koichiro Ueno, Edson Camargo, Tomohiro Morishita, Yoshitaka Moriyasu, Hiromasa Goto, Naohiro Kuze

R&D Center / Asahi Kasei Microdevices Corporation
Compound Semiconductor Development Depatment

Until now we have already developed the InSb photovoltaic mid-infrared sensor operating at room temperature. In this presentation, we refer to uncooled InSb mid- infrared LED used dislocation filtering of AlInSb layer, for the gas sensor using mid-infrared (3-7 um) sensor technology.

P2.50

Characterization of Low Temperature Grown GaAs1-xSbx with x ~ 0.15

Xavier WALLART, Christophe COINON, Sébastien PLISSARD, Sylvie GODEY, Olivier OFFRANC, Vincent MAGNIN, Jean-François LAMPIN

Institute of Electronics, Microelectronics and Nanotechnology (IEMN), University of Lille

We present structural, electrical and lifetime characterizations of GaAs1-xSbx layers with x ~ 0.15 grown at low temperatures on GaAs substrates. We show that short lifetimes of a few picoseconds can be achieved with resistivity around 100 cm.

P2.51

Strain Relaxation Engineering in Epitaxy of Ge on Si(001): The Impact of Sb-Coverage on Interdiffusion

Tobias F. Wietler, Eddy P. Rugeramigabo, Eberhard Bugiel, Karl R. Hofmann

Leibniz Universität Hannover
Institute of Electronic Materials and Devices

We report on composition profiling of Ge films on Si(001) showing reduced intermixing with increasing Sb-coverage during growth. The elimination of strain or defect enhanced diffusion at high Sb-coverage enables ideally sharp Ge/Si-heterojunctions.

P2.52

Morphological Investigation of S-doped GaPN grown by Molecular Beam Epitaxy

Keisuke Yamane, Tomohito Kobayashi, Yuzo Furukawa, Hiroshi Okada, Akihiro Wakahara

Toyohashi University of Technology
Department of Elecrtrical and Electronic Information Engineering

The surface morphology of S-doped GaPN layer was investigated. We found out the pit-formation was caused by S and N related defects while no pits formed on undoped-GaPN and S-doped GaP. In conclusion, the defects can be effectively suppressed at lower growth temperatures.

P2.53

Area-selective epitaxy of InAs by migration enhanced epitaxy (MEE)

Marlene Zander, Jiro Nishinaga, Yoshiji Horikoshi

Waseda University

In the present work, we found that growth and etching processes are competing during InAs area selective epitaxy using MEE. By optimizing the MEE deposition sequence, the precise control of micro- and nanostructure shape formation can be achieved.

P2.54

Molecular beam epitaxy of InAs quantum dots on (100) GaAs substrate formed by droplet epitaxy at high substrate temperatures

Verena Zuerbig, Aleksandar Gushterov, Johann Peter Reithmaier

Universität Kassel
Technische Physik, INA

Self-assembled InAs quantum dots were formed by droplet epitaxy on GaAs (100) oriented substrates at high growth temperatures in the range of 450 °C and 500 °C. The structural and optical parameters were determined by atomic force microscopy and photoluminescence spectroscopy.

P2.55

Effect of excitons on the absorption in solar-cell with AlGaAs/GaAs superlattice grown by molecular beam epitaxy

Kawaharazuka Atsushi, Onomitsu Koji, Nishinaga Jiro, Horikoshi Yoshiji

Waseda University
Waseda Institute for Advanced Study

We present effect of excitons on the photo-absorption in the AlGaAs/GaAs superlattice solar-cell. Absorption spectrum measured at room temperature is well explained by the numerical analysis taking the excitonic effect into account.

P2.56

Dual frequency emission from a heterogenous terahertz quantum cascade laser

Harvey Beere, Joshua Freeman, Anthony Brewer, Owen Marshall, David Ritchie

University of Cambridge
Semiconductor Physics Group

We demonstrate a heterogenous THz QCL showing simultaneous dual frequency laser emission. The order of the two QCL designs did not affect significantly the performance, however, the higher frequency did show degraded performance in both devices.

P2.57

High Hole Mobility Strained InGaSb Quantum Wells Grown on GaAs by Molecular Beam Epitaxy

Pei-Chin Chiu, Han-Chieh Hao, Heng-Kuang Lin, Jen-Inn Chyi

National Central University
Department of Electrical Engineering

The effects of the AlSb spacer thickness on the hole concentration and mobility of Be -doped strained InGaSb quantum wells are investigated. Dominant carrier scattering mechanism in the samples is also clarified.

P2.58

Etch-less fabrication of InP-based mid-infrared quantum-cascade laser

Oliana Fedosenko, Mikaela Chashnikova, Stefan Machulik, Jan Kischkat, Matthias Klinkmüller, Anna Aleksandrova, Monastyrskiy Grygorii, Mykhaylo P. Semtsiv, Ted William Masselink

Humboldt University Berlin
Department of Physics

In this paper we present the way of fabrication of a QCL without etching of semiconductor. The fabrication is basically reduced to the growth on a prepatterned substrate. Test QCL device has shown threshold current density of 3kA/cm2 at 80K.

P2.59

Scaling the output power of quantum cascade lasers with a number of cascades: impact of effusion cell depletion

Oliana Fedosenko, Mikaela Chashnikova, Stefan Machulik, Jan Kischkat, Matthias Klinkmüller, Anna Alexandrova, Grygorii Monastyrskiy, Mykhaylo P. Semtsiv, William Ted Masselink

Humboldt University Berlin
Department of Physics

Scaling of the major QCL parameters with the number of emitting cascades is analyzed. 10W of the peak power is reached at +20°C with a QCL emitting at 11.6µm having 200 cascades. This research addresses also the long-term stability of an MBE system.

P2.60

Evaluation of injectorless quantum cascade lasers by combined XRD and laser characterization

Grasse Christian, Katz Simeon, Boehm Gerhard, Vizbaras Augustinas, Meyer Ralf, Amann Markus-Christian

Technische Universität München
Walter Schottky Institut

Injectorless QCLs are promising as high power mid-infrared sources, but very sensitive to growth deviations. To achieve a wavelength prediction after growth, XRD- and wavelength measurements of several devices, identical in design, have been correlated with bandstructure calculations.

P2.61

Laterally biased double quantum well IR detector fabricated by MBE regrowth

Álvaro Guzmán, Rocío San-Román, Adrián Hierro

Universidad Politécnica de Madrid
Instituto de Sistemas Optoelectrónicos y Microtecnología

We propose for the first time a three step procedure to develop a MBE regrown laterally biased QW IR detector which can be in theory used to detect IR radiation at temperatures higher than 77K. The device is tested showing good preliminary I-V characteristics.

P2.62

Broadband superluminescent diodes with height-engineered InAs quantum dots

Sofiane Haffouz, Pedro J. Barrios, Jean Lapointe, Sylvain Raymond, Zhenguo Lu, Daniel Poitras

National Research Council Canada
IMS

Broadband superluminescent diodes incorporating multiple layers of InAs quantum dots where the dots height was deliberately varied from one layer to another have been grown, fabricated and characterized. 3 dB emission bandwidth as wide as 140 nm centered at 1100 nm was demonstrated.

P2.63

A 1µm-gate-length self-aligned inversion-channel MBE-grown $Al_2O_3/Ga_2O_3(Gd_2O_3)/In_{0.75}Ga_{0.25}As$ MOSFET exhibiting maximum drain current of 1.23 mA/µm

T. D. Lin, P. Chang, H. C. Chiu, Y. D. Wu, Y. J. Lee, J. Kwo, M. Hong

National Tsing Hua University
Department of Materials Science and Engineering

A 1µm-gate-length inversion-channel MBE-grown $Al_2O_3/Ga_2O_3(Gd_2O_3)/In_{0.75}Ga_{0.25}As$ MOSFET has demonstrated a maximum drain current of 1.23 mA/µm, a peak transconductance of 464 µS/µm, and a peak field-effect mobility of 1600 $cm^2/V\cdot s$, setting a new record for III-V MOSFETs.

P2.64

MgS solar blind ultraviolet detectors

Ying Hoi LAI, Shu Kin LOK, Kam Weng TAM, Sut Kam HO, Iam Keong SOU

The Hong Kong University of Science and Technology
Nano Science and Technology Program, Department of Physics

MgS thin films in rocksalt phase were fabricated on n+ GaAs(001) substrates. The photoresponse of a MgS Schottky-barrier device with Au Schottky metal was found to peak at 240nm with high long wavelength rejection, well suited for the usage as a solar-blind UV sensor for fire detection.

P2.65

The Operation Mechanisms of Type-II GaSb/GaAs Quantum-Dot Light-Emitting Diodes

Chi-Che Tseng, Wei-Hsun Lin, Shu-Cheng Mai, Shung-Yi Wu, Shu-Han Chen, Shih-Yen Lin, Meng-Chyi Wu

Academia Sinica
Research Center for Applied Sciences

A type-II GaSb QD LED is investigated. The EL intensity saturation at high injection currents suggests an upper limit to the optical recombination efficiency. Also observed is the enhanced luminescence of the smaller QDs with increasing temperatures at temperature < 100 K.

P2.66

Broadband Quantum-dot Infrared Photodetectors

Wei-Hsun Lin, Chi-Che Tseng, Kuang-Ping Chao, Shu-Yen Kung, Shih-Yen Lin, Meng-Chyi Wu

Academia Sinica
Research Center for Applied Sciences

A 5-period QDIP with bi-stacked QD structures is investigated. The device exhibited a wide detection window 4 to 11 um with high responsivities and flat response curves. The results have demonstrated the possibility of broad detections covering MW- and LW-IR ranges by QDIPs.

P2.67

MBE-grown strain-compensated disk lasers for 460nm second-harmonic generation laser emission in the watt range

Fernando Rinaldi, Susanne Menzel, Frank Demaria, Alexander Hein, Rudolf Roesch, Peter Unger

University of Ulm
Institute of Optoelectronics

The fabrication of MBE-grown strain-compensated disk lasers, designed for an emission wavelength of 920nm and a relative second harmonic at 460nm, is presented.

P2.68

Wavelength Tuning of GaAs/AlGaAs Terahertz Quantum Cascade Lasers By Controlling Aluminum Content In Barriers

Nigam Samal, Yuri Sadofyev, Senthil Annamalai, Li Chen, Ashmeet Samal, Shane Johnson

Trion Technology
Photonics

We present an approach for tuning the emission wavelength of GaAs/AlGaAs THz quantum cascade lasers by uniformly varying the barrier height. By changing aluminum content of all the barriers from 15.5 to 13.5 % emission wavelengths from ~ 70 to 67.5 micron are realized.

P2.69

Optical signatures of different dopants in HgCdTe epilayers.

Frédérique Gemain, Ivan-Christophe Robin, Marie De Vita, Philippe Ballet, Alain Lusson

CEA-LETI-Minatec France

Photoluminescence spectra of As-doped and mercury vacancies-doped Hg1-xCdxTe epilayers were studied. The optical signatures of the different dopants are determined using comparisons with other characterization techniques such as Hall measurements and EXAFS measurements.

P2.70

Gate Operation of InAs/AlGaSb Heterostructures with an ALD Insulating Layer

Kyoichi Suzuki, Yuichi Harada, Fumihiko Maeda, Koji Onomitsu, Toru Yamaguchi, Koji Muraki

NTT Corporatioon
NTT Basic Research Laboratories

Gate operation in InAs/AlGaSb is successful with atomic layer deposited Al2O3 as gate dielectric. A surface treatment before the deposition is strongly effective to remove electron trap states.

Tue A3.1

Self-catalyzed free-standing InAs nanowires on Si (111) by molecular beam epitaxy

Gregor Koblmueller, Simon Hertenberger, Kristijonas Vizbaras, Max Bichler, Jinping Zhang, Timothy Veal, Ian Maskery, Gavin Bell, Gerhard Abstreiter

Technische Univ. Muenchen
Walter Schottky Institut

Self-catalyzed free-standing InAs nanowires on Si (111) were grown by MBE by use of an ultrathin SiOx mask. Microstructural analysis using SEM, XRD and TEM were performed. Results on optical properties by PL and surface electronic states by valence spectral analysis using XPS are also reported.

Tue A3.2

Surface morphology of InAs-InSb heterostructured nanowires

Lorenzo Lugani, Daniele Ercolani, Francesca Rossi, Giancarlo Salviati, Fabio Beltram, Lucia Sorba

Scuola Normale Superiore
NEST

We report on the morphology of InAs-InSb heterostructured nanowires grown by CBE. We show that the hexagonal cross section of the nanowire rotates when passing from the InAs to the InSb segment and the resulting geometry is discussed in detail.

Tue A3.3

Position-controlled growth of InAs nanowires on Si (111) by molecular beam epitaxy

Simon Hertenberger, Daniel Rudolph, Max Bichler, Jonathan Finley, Gerhard Abstreiter, Gregor Koblmueller

Technische Univ. Muenchen
Walter Schottky Institut

We report self-catalyzed selective area growth of free-standing InAs nanowires on Si (111) substrates by solid-source MBE, providing a sophisticated route to grow III–V semiconductor nanowires in a position-controlled fashion with optimum diameters and well selected aspect ratio.

Tue A3.4

Pd-assisted Growth of InAs Nanowires

L. Sorba, S. Heun, B. Radha, D. Ercolani, G.U. Kulkarni, F. Rossi, V. Grillo, G. Salviati, F. Beltram

Istituto Nanoscienze-CNR
NEST

We have grown Pd-assisted InAs nanowires by CBE. Their structural properties were investigated by scanning and transmission electron microscopy. We find the coexistence of two types of nanowire sidewalls: smooth and zig-zag, which grow from solid and liquid catalyst particles, respectively.

Tue A3.5

Au-, Mn- and self-catalysed growth of InAs nanowires: a common picture.

Faustino Martelli, Silvia Rubini, Fauzia Jabeen, Laura Felisari, Vincenzo Grillo

IOM-CNR

Au-, Mn- and self-catalysed growth of InAs nanowires is obtained by MBE in the same narrow temperature range. Wurtzite phase is observed in all cases. We suggest that the nanoparticle state is not relevant to determine growth and lattice structure.

Tue B3.1

Mechanical to electrical energy transduction using a micromechanical 2DES cantilever (Invited)

Hiroshi Yamaguchi, Hajime Okamoto, Yuki Maruta, Sunao Ishihara, Yoshiro Hirayama

NTT Basic Research Laboratories

We studied the strain-induced voltage in GaAs/AlGaAs 2DES at low temperature. The order of magnitude of the maximum generated electrical power is similar to that of the energy dissipation in mechanical vibration, indicating high-efficiency mechanical to electrical energy transduction.

Tue B3.2

MBE of mid-infrared microdisk lasers operating continuous wave above 0° C

Martin Eibelhuber, Thomas Schwarzl, Stefan Pichler, Wolfgang Heiss, Gunther Springholz

Johannes Kepler University
Institute of Semiconductor and Solid State Physics

MBE of PbSe/PbSrSe QWs for mid-infrared lasers is optimized, by systematically varying the well number, well thickness and barrier height over a wide range. As a result cw laser emission up to 0° C at a wavelength of 4.3 μm is demonstrated.

Tue B3.3

Growth and structural properties of ZnTe on GaAs, InP, InAs and GaSb substrates for electronic and optoelectronic device applications

Jin Fan, Lu Ouyang, Xinyu Liu, Ding Ding, Jacek Furdyna, David Smith, Yong-Hang Zhang

Arizona State University
School of Electrical, Computer and Energy Engineering

The paper reports a detailed study of the growth and structural properties of a set of MBE grown ZnTe layers on GaAs, InP, InAs, and GaSb using high-resolution X-ray diffraction and high-resolution transmission electron microscopy.

Tue B3.4

Molecular Beam Epitaxy and Structure Analysis of Phase Change Materials

Ferhat Katmis, Roman Shayduk, Perumal Karthick, Achim Trampert, Wolfgang Braun

Paul-Drude-Institute
Epitaxy

Phase change materials such as Ge-Sb-Te alloys (GST) have found new applications in fast non-volatile memory. We study the epitaxy and analyze the structure of GST on III-V substrates by synchrotron x-ray diffraction to explore its scaling limits.

Tue B3.5

Effects of AlGaAsSb electron supply layer for InGaAs/InAlAs metamorphic HEMTs on GaAs substrates

Hirotaka Geka, Satoshi Yamada, Masato Toita, Kazuhiro Nagase, Naohiro Kuze

ASAHI KASEI MICRODEVICES CORPORATION
Compound Semiconductor Development Dept. , R&D Center

Effects of AlGaAsSb electron supply layer for InGaAs/InAlAs metamorphic HEMTs on GaAs substrate was studied. By implementing an AlGaAsSb electron supply layer, we drastically improved the electron mobility of InGaAs/InAlAs heterostrucure for mHEMTs.

Wed A1.1

Formation and Application of Patterned III-V Nanopillar Arrays (Invited)

Diana Huffaker

UCLA
Electrical Engineering

We describe a growth method for III-V nanopillars (NPs) on nanopatterned surfaces. This catalyst-free growth mode enables lithographic design of pillar diameter, pitch and most important, device registration. Control of growth conditions enables the in-situ formation of either axial or core-shell p-n junctions and heterojunction nanopillars on SiO_2-masked (111)B substrates. The photonic and electrical properties of axial and core-shell p-n junctions are characterized from both single NPs and NP arrays. Device applications such as photoconductors and solar cells are discussed.

Wed A1.2

Direct Integration of gold-free GaAs / GaAsSb nanowires on Si by MBE

Sébastien Plissard, K.A Dick, Xavier Wallart, Philippe Caroff

CNRS - IEMN

Growth of GaAs/GaAsSb heterostructure nanowires on silicon without the need for gold seed particles is presented. A high vertical yield of GaAs nanowires is first obtained, and then $GaAs_xSb_{1-x}$ segments are successfully grown axially in these nanowires.

Wed A1.3

p-Doping mechanism for catalyst-free MBE grown GaAs nanowires

Carlo Colombo, Joseph Dufouleur, Bernt Ketterer, Tonko Garma, Emanuele Uccelli, Anna Fontcuberta i Morral

Ecole Polytechnique Fédérale de Lausanne
Laboratoire des Matériaux Semiconducteurs, Institut des Matériaux

Doped catalyst-free GaAs nanowires have been grown by MBE with the Ga-assisted method. The spatial dependence of the dopant concentration and resistivity reveals two competing doping mechanisms from the side facets and from the gallium droplet.

Wed A1.4

Strains in GaAs-MnAs core-shell nanowires grown by molecular beam epitaxy

Maria Hilse, Takagaki Yukihiko, Herfort Jens, Ramsteiner Manfred, Herrmann Claudia, Breuer Steffen, Geelhaar Lutz, Riechert Henning

Paul-Drude-Institut für Festkörperelektronik
Epitaxie

The MnAs shell growth takes place by direct adsorption on the GaAs nanowire sidewalls. In contrast to planar epitaxy, the core acting as a substrate is strained in the core-shell structure as the sizes of core and shell are comparable.

Wed A1.5

Zeeman Spin Splitting In Hole Quantum Wires De fined From GaAs/AlGaAs(100) Heterostructures

Kirill Trunov, Dirk Reuter, Arne Ludwig, Andreas Wieck, Jason Chen, Oleh Klochan, Adam Micolich, Alex Hamilton

Ruhr-Universität Bochum

We have studied Zeeman spin-splitting dependence on in-plane magnetic field orientation in hole quantum wires fabricated on MBE-grown high mobility undoped GaAs/AlGaAs(100) heterostructures, where a two-dimensional hole gas was induced by a heavily carbon doped GaAs field effect gate

Wed B1.1

Molecular-beam epitaxial growth of Ge/Si nanostructures under low-energy ion irradiation

Zhanna Smagina, Pavel Novikov, Vladislav Armbrister, Vladimir Zinoviev, Alexsey Nenashev, Sergey Teys, Anatoliy Dvurechenskii

Institute of Semiconductor Physics SB RAS

Pulse low-energy ion irradiation during Ge/Si heteroepitaxy leads to increase in the density of islands and decrease in their average size and size dispersion. The observed phenomena were studied by molecular dynamics and Monte-Carlo simulation.

Wed B1.2

Epitaxial graphene on Si(111) substrates using solid source molecular beam epitaxy technique

Apurba Laha, Andreas Fissel, H.-Jörg Osten

Leibniz University Hannover
Information Technology Laboratory

We report on graphitic C growth on Si(111) using solid-source MBE. We found that deposition of sub-monolayer C on Si(111)-(7x7) only in the range 590-625°C results in formation of the Si(111)(√3x√3)R30° superstructure which is key step for subsequent growth of a two-dimensional graphitic-like layer.

Wed B1.3

Growth of exciton-polariton microcavties controlled by in-situ spectral reflectivity measurements

Klaus Biermann, Edgar Cerda-Méndez, Paulo Santos, Rudolf Hey

Paul-Drude-Institut für Festkörperelektronik

We present an in-situ measurement method, which was developed especially for the growth of microcavities. It is based on continuous spectral reflection measurements and offers the required precision to monitor and control the growth of exactly tuned exciton polariton structures.

Wed B1.4

Embedding GaN Quantum Dots in Free-Standing AlN Photonic Crystals Grown by Conformal MBE

Sylvain Sergent, Delphine Néel, Sylvain David, Xavier Chécoury, Philippe Boucaud, Meletis Mexis, Christelle Brimont, Thierry Guillet, Mathieu Leroux, Fabrice Semond

CNRS
CRHEA

We propose an original approach to fabricate nitride-based 2D photonic crystal cavities by combining both top-down and bottom-up techniques. We finally report the successful insertion of GaN QDs in cavities exhibiting confined modes in the near-UV range.

Wed B1.5

Crystallization of amorphous InxGa1-xAs films for wire-like quantum well formation on patterned GaAs(113)A substrates

Rudolf Hey, Paulo V. Santos, Esperanza Luna, Timur Flissikowski, Uwe Jahn

Paul-Drude-Institute

A new route for the fabrication of (In,Ga)As quantum wires by molecular-beam epitaxy via thermally induced crystallization from an amorphous phase during growth interruption is proposed which allows for controlling the compositional profile of wire-like structures on patterned templates.

Wed C1.1

Electrical Spin injection in InAs Quantum Dots from a Ferromagnetic Contact in Remanence at Room Temperature and Adjustment of the Emission Wavelength for Spintronic Applications

Arne Ludwig, Razvan Roescu, Ashish Kumar Rai, Kirill Trunov, Mingyuan Li, Henning Soldat, Frank Stromberg, Astrid Ebbing, Nils C. Gerhard, Martin Hofmann, Heiko Wende, Dirk Reuter, Andreas Dirk Wieck

Ruhr-Universität Bochum
Lehrstuhl für Angewandte Festkörperphysik

We present room temperature spin injection in InAs-quantum dots in remanence, i.e. without applied external magnetic field. We demonstrate and compare in situ and ex situ methods to adjust the emission wavelength for spintronic applications.

Wed C1.2

Ultrafast optical switching using MBE grown InAs quantum dots

Hopkinson Mark

University of Sheffield
Department of Electronic and Electrical Engineering

We report the development of an ultrafast all-optical photonic switch device which uses InGaAs Quantum dots placed within a GaAs/AlGaAs vertical microcavity structure grown by MBE. The device exhibits switching speeds down to ~20ps and we explore various approaches to reduce this speed further.

Wed C1.3

Two-photon Interference from Separate InAs Quantum Dots

Glenn S Solomon, Edward Flagg, Andreas Muller, Sergey Polyakov, Alex Ling, Alan Migdall

Joint Quantum Institute
NIST and University of Maryland

We demonstrate for the first time the interference of single photons from two semiconductor nanostructures, here located in different samples. The interference is below the classical limit. This interference property is needed in several quantum computation and quantum networking schemes.

Wed C1.4

Short wavelength photoluminescence of (Al)GaInP quantum dots grown on GaP substrate by gas-source molecular beam epitaxy

Sven Gerhard, Vasilij Baumann, Sven Höfling, Lukas Worschech, Alfred Forchel

University of Würzburg
Technical Physics

The growth of AlGaInP quantum dots (QDs) on GaP with areal densities up to 1 x 10^(11) cm^(-2) and short emission wavelength (570 nm) using gas-source MBE is presented. The emission behavior of GaInP QDs is explained by detailed analysis of the morphology.

Wed C1.5

MBE grown mid-infrared devices based on PbTe quantum dots in a CdTe matrix

Astrid Hochreiner, Martin Eibelhuber, Thomas Schwarzl, Heiko Groiss, Valery Kolkovsky, Grzegorz Karczewski, Tomasz Wojtowicz, Wolfgang Heiss, Gunther Springholz

University of Linz
Institute of Semiconductor Physics

In this work, MBE grown mid-infrared continuous-wave (cw) light emitting diodes operating up to 300 K and cw optically pumped microdisk lasers up to 200 K based on PbTe quantum dots in CdTe are demonstrated for the first time.

Wed A2.1

Wide-band emissions from highly stacked quantum dot structure grown using strain-compensation technique (Invited)

Kouichi Akahane, Naokatsu Yamamoto

National Institute of Information and Communications Technology
New Generation Network Research Center

We developed a modulated stacking structure consisting of various size QDs using strain compensation technique. This promotes wide-band PL emission (the full-width at half maximum was 201 nm.) because each QD-distributed wide range can emit a different wavelength.

Wed A2.2

Composition uniformity of site-controlled InAs/GaAs quantum dots

Giorgio Biasiol, Vikas Baranwal, Stefan Heun, Mauro Prasciolu, Massimo Tormen, Andrea Locatelli, Tevfik Onur Mentes, Miguel Niño, Lucia Sorba

CNR
Istituto Officina dei Materiali, Laboratorio TASC

We have measured the composition and morphology of site-controlled, self-assembled InAs/GaAs quantum dots grown on lithographic hole arrays. We find that both composition and height are more uniform than in dots grown on planar surfaces.

Wed A2.3

Self-assembled nanohole templates for the growth of large area low density quantum dots and quantum dot molecules

Paola Atkinson, Eugenio Zallo, Oliver Schmidt

IFW Dresden
Institute for Integrative Nanosciences

We present the use of self-assembled nanoholes to grow low density InAs and GaAs quantum dots and quantum dot molecules across a wafer – thereby reducing the influence of the temperature gradient across the substrate on the dot distribution.

Wed A2.4

Atomic Mapping of InAs Quantum Dots: Whither the Wetting Layer?

Roy Clarke, Divine Kumah, Yizhak Yacoby, Rachel Goldman, Vaishno Dasika, Christian Schlepuetz, Yossi Paltiel

University of Michigan
Applied Physics

A revolutionary new atomic mapping technique, using x-ray direct phase retrieval, is described and applied to InAs quantum dots. Several extraordinary findings are reported, including the absence of a wetting layer and epitaxial layer bending.

Wed A2.5

Mechanism and applications of local droplet etching

Christian Heyn, Andrea Stemmann, Matthias Klingbeil, Christian Strelow, Stefan Mendach, Wolfgang Hansen

University of Hamburg
Institute of Applied Physics

We report on the formation mechanism and structural properties of self-assembled nanoholes generated in semiconductor surfaces by local droplet etching. The optical properties of GaAs quantum dots fabricated by filling on the nanoholes are studied.

Wed B2.1

Long-range order and thermal stability of thin Co2FeSi films on GaAs(111)B

Bernd Jenichen, Jens Herfort, Kazuhide Kumakura, Achim Trampert

PDI
microstructure

Co2FeSi/GaAs(111)B grown by MBE is characterized by XRD, TEM, and SIMS. The samples have a stable interface up to T(S) = 275°C. Despite the small misfit between the Co2FeSi and GaAs, the grainy structure of the film indicates Volmer-Weber growth.

Wed B2.2

Cu-doped nitrides: promising candidates for a nitride based spinaligner

Philipp R. Ganz, Christoph Sürgers, Gerda Fischer, Daniel M. Schaadt

Karlsruhe Institute of Technology (KIT)
DFG-Center for Funtional Nanostructures (CFN)

Cu-doped nitrides are promising candidates for nitride based diluted magnetic semiconductors. We investigated the growth of Cu-doped nitrides by plasma assisted MBE on C-plane sapphire. The structural and magnetic properties were analyzed with regard to important growth parameters.

Wed B2.3

Quantitative analysis of the scattering mechanisms in MBE-grown undoped GaAs/AlGaAs heterostructures

Christine Nicoll

University of Cambridge
Semiconductor Physics Group, Cavendish Laboratory

We show a characterisation method capable of determining the magnitude of scattering mechanisms in MBE-grown material; impurities, interface roughness and surface states. It has measured the reduction of background impurities during MBE 'clean-up'.

Wed B2.4

Spin Hall effects in HgTe Quantum Well Structures (Invited)

Christoph Brüne

University of Wuerzburg
Experimentelle Physik 3

Spin-orbit interaction in semiconductors causes many interesting and potentially useful transport effects, such as e.g. the presently very topical spin-Hall effect. So far no direct evidence for a ballistic, intrinsic SHE (i.e. resulting from the band structure) has been obtained by transport experiments. Here, we demonstrate that in specially designed nanostructures, which are based on narrow gap HgTe type-III (a.k.a. inverted) quantum wells, a detection of the spin signal is possible via non-local voltage measurements.

Wed C2.1

InGaAs/GaAsSb Quantum Cascade Lasers grown by MBE

Hermann Detz, Christoph Deutsch, Pavel Klang, Michele Nobile, Alexander Benz, Aaron Maxwell Andrews, Günter Hesser, Werner Schrenk, Karl Unterrainer, Gottfried Strasser

Vienna University of Technology
Center for Micro- and Nanostructures

The InGaAs/GaAsSb material system has the potential to improve intersubband devices. Complex active regions up to 10 µm thick were accomplished by MBE to produce QCLs emitting around 10 µm and even 80 µm (3.75 THz) devices, operating up to 105K.

Wed C2.2

Band-to-band luminescence of as-grown THz QCL structures

Yury Sadofyev, Nigam Samal, Vladimir Kozlovsky

Trion Technology

We report the results of band-to-band luminescence of as-grown GaAs/Al0.15Ga0.85As THz QCL structures. We also discuss how this technique could be used as a tool for calibration of epitaxial growth of QCLs by comparing measured and simulated energy level positions of QCL

Wed C2.3

Short injector interband cascade lasers

Adam Bauer, Matthias Dallner, Thomas Lehnhardt, Andreas Herrmann, Martin Kamp, Sven Höfling, Lukas Worschech, Alfred Forchel

University of Würzburg
Technische Physik

ICL structures and devices based on a newly developed shortened injector design and the special challenges of growing high quality type II superlattice structures in the antimony material system are presented.

Short wavelength high power Quantum Cascade Lasers

Xavier Marcadet, Mathieu Carras, Bouzid Simozrag, Michel Garcia, Guy-Mael De Naurois, Gregory Maisons, olivier Parillaud, olivier Patard, Frédéric Pommereau, olivier Drisse, François Alexandre, Jean Massies

Alcatel-Thales III-V Lab
Opto-electronic sources

This paper deals with the small scale production of reliable high power QCLs. Growth by MBE of strain-balanced GaInAs/AlInAs QCL is described. TM00 sources above 500mW at 4.6µm are obtained. Drawbacks of standard and buried technologies are analyzed.

Wed A3.1

Shape design of complex GaAs nanostructures by Droplet Epitaxy

Claudio Somaschini, Sergio Bietti, Nobuyuki Koguchi, Stefano Sanguinetti

LNESS and Milano-Bicocca University
Material Science

We present the fabrication of new classes of GaAs quantum nanostructures grown by Droplet Epitaxy, characterized by the close spatial coupling of systems with different dimensionality: 0D (quantum dots), 1D (quantum rings) and 2D (quantum disks).

Wed A3.2

The Unique Growth Properties of Ge on High-Indexed Si (11 10) Substrates: Reversible Nanofacetting and Ripple Formation

Gunther Springholz, Bolormaa Sanduijav, Matei Dan, Chen Gang

University of Linz
Institut fuer Halbleiterphysik

Ge growth on high-indexed (11 10) Si substrates is studied using in situ scanning tunneling microscopy, demonstrating that a quasiperiodic equilibrium ripple structure with {105} nanofacets is formed at a critical coverage of 4 ML.

Wed A3.3

Magneto-Optical Studies of GaAs Quantum Dots in GaSb

Ta-Chun Lin, Sheng-Di Lin, Chien-Ping Lee

National Chiao-Tung University

Type-II tensily strained GaAs/GaSb QDs with mid-IR emission up to 2.2 µm were grown by MBE and studied by magneto-PL. The unusual magneto-optic responses are attributed to the tiny tensily-strained QDs and is in good agreement with the simulation results.

Wed A3.4

Multi-color quantum dots grown in selective-areas for broadband light source

Nobuhiko Ozaki, Koichi Takeuchi, Shunsuke Ohkouchi, Naoki Ikeda, Yoshimasa Sugimoto, Richard Hogg

Wakayama University
Faculty of Systems Engineering

We applied a selective-area (SA) growth of QDs to realize a broadband light source. Our results indicate that a broadband light source based on the SA grown multi-color QDs has the potential to achieve ~300-nm band-width emission with shape-controlled spectrum.

Wed B3.1

Role of buried cracks/voids in mitigating strain in crack free GaN grown on Si (111) employing AlN interlayer schemes

Haipeng Tang, J.-M Baribeau, G.C. Aers, J. Fraser, S. Rolfe, J.A. Bardwell

National Reseach Council Canada

This paper investigates the effect of buried cracks/voids in the AlN interlayer buffer on mitigating the thermal mismatch strain in the GaN/Si system by temperature-dependent, high-resolution x-ray diffraction measurements carried out from room temperature up to the growth temperature.

Wed B3.2

Strain relaxation via misfit dislocation formation in semipolar GaN heterostructures

Erin Young, Feng Wu, Alexey Romanov, Anurag Tyagi, Chad Gallinat, James Speck

University of California
Materials Department

Strain relaxation via misfit dislocations is observed for heteroepitaxy of GaN alloys on semipolar substrate orientations (11-22) and (20-21). MBE grown films are investigated with x-ray diffraction and transmission electron microscopy.

Wed B3.3

Study of strain relaxation in GaN/AlGaN superlattices for mid-infrared intersubband absorption

Yulia Kotsar, Prem Kumar Kandaswamy, Aparna Das, Laetitia Rapenne, Eirini Sarigiannidou, Eva Monroy

CEA
DSM/INAC/SP2M/NPSC

In this work we present a study of the strain relaxation in GaN/AlGaN SLs synthesized by plasma-assisted MBE designed for ISB absorption at 10 µm wavelength. Results are compared with SLs for ISB absorption at 1.5 µm.

Wed B3.4

Effect of high-temperature PA-MBE growth conditions on point defect concentrations and dislocation mediated reverse-bias leakage in (0001) GaN

Gregor Koblmueller, Law Jeremy, Wu Feng, Reurings Floris, Tuomisto Filip, Yu Ed, Speck Jim

Technische Univ. Muenchen
Walter Schottky Institut

The role of high-T PAMBE growth conditions on the point defect concentrations (Ga vacancies) and dislocation-mediated reverse bias leakage in (0001) GaN homoepitaxial films was elucidated. Surprisingly, ultra-low reverse bias leakage was found for a narrow band of Ga/N flux ratios near 1.

Wed C3.1

Universal behavior of interface composition profiles in MBE-grown III-V heterostructures (Invited)

Esperanza Luna

Paul-Drude-Institute
Microstructure

Independent of the III-V system considered, experimental concentration profiles reveal that the smooth change in composition across a heterointerface follows a sigmoidal law. This universal behavior is determined by a strong cooperative sequential adsorption during MBE growth.

Wed C3.2

Atomic Structure of the InAs Wetting Layer Grown on GaAs(001)-c(4x4)

Christopher Prohl, Jan Grabowski, Britta Höpfner, Mario Dähne, Holger Eisele

Technische Universität Berlin
Institut für Festkörperphysik

We studied the InAs wetting layer evolution on GaAs(001)-c(4×4) by STM. Three phases were identified before QD occurrence: signatures of InAs on GaAs-c(4×4) for low coverages, an In2/3Ga1/3As-(4×3) reconstructed monolayer at about 0.67 ML, and InAs-(2×4) reconstructions on top of the latter.

Wed C3.3

MBE - Growth processes on MgF2 (111) and (100) surfaces studied by UHV - Atomic Force Microscopy

Patrick Meisner, Enrico Barletta, Klaus Wandelt

University of Bonn
Institute for physical Chemistry

During MBE-Growth processes of BaF2 and MgF2 on the MgF2 (111) and (100) surfaces morphological and structural effects were studied by Atomic Force Microscopy. Especially the thermal influence during and after the deposition was investigated.

Wed C3.4

Reflection high-energy electron diffraction φ scans for the in situ monitoring of the heteroepitaxial growth of Fe on GaN(0001) by molecular beam epitaxy

Cunxu Gao, Oliver Brandt, Hans-Peter Schönherr

Paul-Drude Institute

We monitor the MBE growth of Fe on GaN in situ by RHEED φ scans. The orientation-relationship between Fe and GaN is visualized by these φ scans already at an Fe coverage of two monolayers. The in-plane orientation distribution can be measured quantitatively during growth.

Thu A1.1

New insights into the chemistry and kinetics of interfaces and surface processing during the MBE growth of III-Nitrides exploiting real-time ellipsometry (Invited)

MARIA LOSURDO, Giovanni Bruno, April S. Brown

CNR-IMIP, Bari
Plasmachemistry

The latest achievements in the PA-MBE of GaN, InN, AlN and their alloys grown on a large variety of substrates both polar and non-polar is reviewed. The focus is on the use of the non-invasive in-situ real-time control byspectroscopic ellipsometry to monitor chemistry and kinetics of all the steps of the nitrides growth from the substrate preparation to the buffer, epilayer and multiquantum well growth

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Thu A1.2

Analysis of the atomic hydrogen effect on the terrace width distribution during GaAs (110) homoepitaxial growth using the “Wigner surmise”

Beatriz Galiana, Marcos Benedicto, Paloma Tejedor

Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC)
nanostructures and surfaces

The TWD for homoepitaxial growth on GaAs (110) is analyzed by means of the Wigner surmise for conventional and for H assisted MBE. The resultant fitting parameters show that H inhibits step bunching causing a significant entropic repulsion between steps

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Thu A1.3

Growth temperature dependence of strain relaxation during InGaAs/GaAs(001) heteroepitaxy

Takuo Sasaki, Hidetoshi Suzuki, Akihisa Sai, Masamitu Takahasi, Seiji Fujikawa, Itaru Kamiya, Yoshio Ohshita, Masafumi Yamaguchi

Toyota Technological Institute

In situ X-ray reciprocal space mapping during $In_{0.12}Ga_{0.88}As/GaAs(001)$ MBE growth is performed at SPring-8 (BL11XU), using a MBE-XRD system to investigate effects of growth temperature on dislocation mediated strain relaxation.

Thu A1.4

Threading Dislocation Blocking by Dilute Nitride in Metamorphic Structures on GaAs Grown by MBE

Yuxin Song, Shumin Wang, Zonghe Lai, Mahdad Sadeghi

Chalmers University of Technology
Microtechnology and Nanoscience

Threading dislocation blocking by incorporating nitrogen in metamorphic InGaAs buffers on GaAs grown by MBE is demonstrated. This results in large enhancement of photoluminescence intensity from the metamorphic quantum wells.

Thu A1.5

Growth optimization of InAs/GaSb/InSb short-period super-lattices as active regions of mid-IR lasers

Alban GASSENQ, Laurent CERUTTI, Eric TOURNIE

University Montpellier 2
IES

We have investigated the impact of structural design and growth parameters on the properties of InAs/GaSb/InSb short period super-lattice as laser active region. Laser effect is demonstrated at room temperature with a threshold ~2kA/cm^2 for 3.1< l < 3.3µm

Thu B1.1

Growth and characterization of polar (0001) and semipolar (11-22) InGaN/GaN quantum dots

Aparna Das, Priyasmitha Sinha, Yulia Kotsar, Premkumar Kandaswamy, Sergio Magalhães, Katharina Lorenz, Eduardo Alves, Eva Monroy

CEA-Grenoble
INAC/SP2M/NPSC

We report a comparison of the plasma-assisted MBE growth of (0001) and (11-22)-oriented InGaN/GaN QDs emitting in the visible spectrum. With this purpose, we have analyzed the In kinetics and incorporation during growth of polar and semipolar InGaN.

Thu B1.2

InGaN Growth Using Droplet Elimination by Radical-beam Irradiation Method

Tomohiro Yamaguchi, Ke Wang, Tsutomu Araki, Euijoon Yoon, Yasushi Nanishi

Ritsumeikan University

Using DERI (droplet elimination by radical-beam irradiation) method, the self-formation of InN/InGaN periodic structure was demonstrated and the in-plane InN mole fraction fluctuation in InGaN on structured GaN template was also investigated.

Thu B1.3

Epitaxial Lateral Overgrowth of InN on sapphire substrates with Mo striped patterns by rf-MBE

Jumpei Kamimura, Katsumi Kishino, Akihiko Kikuchi

Sophia University
Engineering and Applied Sciences

Epitaxial lateral overgrowth of InN on (0001) sapphire substrates was demonstrated by rf-MBE using molybdenum mask-selective area growth. For the laterally grown region, photoluminescence spectrum with linewidth of 57 meV and peak energy of 0.63 eV was observed at room temperature.

Thu B1.4

High Performance Tunnel Injection InGaN/GaN Quantum Dot Light Emitting Diodes Emitting in the Green (λ=495 nm)

Pallab Bhattacharya, Meng Zhang, Animesh Banerjee

University of Michigan
Electrical & Computer Engineering

The characteristics of tunnel injection InGaN/GaN quantum dot light emitting diodes (λ=495 nm) are presented for the first time. The current density at maximum efficiency is 201.2A/cm2, the best obtained so far for a green LED.

Thu A2.1

Heterogeneous semiconductor/oxide heterointerfaces (Invited)

Guillaume Saint-Girons

Universite de Lyon
Institut des Nanotechnologies de Lyon

Short-Abstract not available

Thu A2.2

Controlling the surface morphology of $In_2O_3(001)$ epitaxial films on Y-stabilized $ZrO_2(001)$ by plasma-assisted molecular beam epitaxy - smooth films, facets, and large islands

Oliver Bierwagen, Mark E. White, Min-Ying Tsai, James S. Speck

University of California, Santa Barbara
Materials Department

$In_2O_3(001)$ forms rough surfaces with thermodynamically preferred {111} facets, and large square shaped islands by incomplete substrate wetting. In-rich growth conditions prevent faceting and low growth temperatures or high O-flux promote wetting.

Thu A2.3

MBE Growth and Characterization of Wide Band Gap Novel Oxide Semiconductor Films

Shizuo Fujita, Takayoshi Oshima

Kyoto University
Photonics and Electronics Science and Engineering Center

Step-flow growth of Ga_2O_3 and $(Al_xGa_{1-x})_2O_3$, followed their heterointerface is promising to new high-power devices and wavelength-tunable deep UV detectors. A SnO_2 semiconductor leads application to UV-B photodetectors .with the external quantum efficiency of 10% at 290 nm.

Thu A2.4

EPITAXY OF Si NANOCRYSTALS BY MOLECULAR BEAM EPITAXY ON A CRYSTALLINE INSULATOR $LaAlO_3$ (001)

Didier DENTEL

UHA
IS2M

Pure and relaxed Si islands were epitaxied by MBE on a bulk $LaAlO_3$(001) substrate following a Volmer-Weber mode. A unique relationship was observed where the Si(001) planes are parallel to the $LaAlO_3$ ones, but rotated by 45° in the [001] direction

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Thu A2.5

Nd-doped alpha-$Ga_XAl_{2-x}O_3$ epitaxial films: New planar waveguide laser materials with compositional tuning between 1090 - 1096 nm

Raveen Kumaran, Thomas Tiedje, Scott Webster, Shawn Penson, Wei Li

University of British Columbia
Physics and Astronomy

Nd-doped $Ga_xAl_{2-x2}O_3$ alloys, suitable for waveguide lasers, have been grown epitaxially on sapphire substrates in the corundum structure. The films show sharp, composition-dependent emission lines, with peak emission in the 1090-1096 nm range.

Thu B2.1

Growth by Molecular Beam Epitaxy of amorphous and crystalline GaNAs alloys with band gaps from 3.4eV to 0.8eV for solar energy conversion devices

Sergei Novikov, C Staddon, CT Foxon, K Yu, R Broesler, M Hawkridge, Z Liliental-Weber, J Denlinger, I Demchenko, F Luckert, P Edwards, R Martin, W Walukiewicz

University of Nottingham
School of Physics & Astronomy

We have succeeded in growing GaN1-xAsx alloys over a large composition range (0-0.8) by MBE. Although GaN1-xAsx become amorphous as x above 0.17, absorption studies show a shift of the optical band gap with increasing As content from 3.4 to 0.8eV.

Thu B2.2

Towards controlled molecular beam epitaxial growth of artificially layered Si structures

Andreas Fissel, Jan Kruegener, H.-Jörg Osten

Leibniz University Hannover
Information Technology Laboratory

MBE growth of Si on highly boron-doped Si(111) offers the opportunity to create artificially layered Si structures. That, however, demands a perfect surface structure. We report on UPS and RHEED studies to optimized the formation of defect-free Si(111)(√3x√3)R30°-B surface structures.

Thu B2.3

Selective area growth of GaN nanocolumns by rf-plasma-assisted MBE

Ana Bengoechea-Encabo, Javier Grandal, Sergio Fernandez-Garrido, Miguel Angel Sanchez-Garcia, Francesca Barbagini, Pierre Lefebvre, J. Ristic, Enrique Calleja, Esperanza Luna, Achim Trampert, E Gallardo, J. M. Calleja

ISOM-Universidad Politecnica de Madrid

This work focuses on the influence that different factors have on the successful selective area growth of GaN nanocolumns by PA-MBE using Ti masks, with special emphasis on the design and nitridation of the Ti mask, as well as the growth temperature and the impinging Ga/N flux ratio.

Thu B2.4

Metastable II-VI sulphides: growth, characterization and stability

Kevin Prior, Christine Bradford, Ian Davidson, Richard Moug

Heriot-Watt University
School of Engineering and Physical Sciences

We review the growth of II-VI sulphides where the stable structure is rocksalt, but thin epilayers can be grown zinc blende, including recent applications and developments in our understanding of the growth and stability of these compounds.

P3.01

Reproducible and uniform growth of GaN based single and double heterointerface HEMTs on 4“ SiC by plasma assisted molecular beam epitaxy

Rolf Aidam, Patrick Waltereit, Lutz Kirste, Michael Dammann, Rüdiger Quay

Fraunhofer IAF
EP

We report on the progress of PA-MBE of AlGaN-HEMTs towards a process suitable for production on 4” SiC. Identical performance of all transistors on the entire wafers with PAE of 63%,power density of 6 W/mm,linear gain of 25 dB and gate leakage currents below 10 µA/mm at 2 GHz and 50 V were achieved.

P3.02

MBE growth and characterization of InN/InGaN thin films and nanostructures on GaN templates and Si(111) substrates

Steven Albert, Javier Grandal Quintana, Miguel Angel Sanchez-Garcia, Pierre Lefebvre, J. Ristic, Enrique Calleja Pardo, Arantxa Vilalta-Clemente, Bertrand Lacroix, Pierre Ruterana

Universidad Politécnica de Madrid
ISOM and Departamento de Ingeniería Electrónica, ETSIT

This work reports on the MBE growth and characterization, both optical and structural, of InN/In1-xGaxN single quantum wells using GaN templates as substrate. Structures with different well and barrier thicknesses as well as different compositions in the InGaN barrier have been explored.

P3.03

Low-temperature molecular beam epitaxy growth and properties of GaGdN nanorods

H. Tambo, H. Kameoka, Y.K. Zhou, S. Emura, S. Hasegawa, Hajime Asahi

Osaka University
ISIR

Diluted magnetic semiconductor GaGdN nanorods were grown at low substrate temperature of 550˚C by RF-MBE. It was found that the nanorod diameter increases as the growth proceeds for the higher Gd flux during growth. XAFS analyses revealed that Gd atoms substitute Ga sites.

P3.04

RHEED controlled growth of GaN/AlGaN and GaN/InGaN high electron mobility heterostructures

Daniel Broxtermann, Murat Sivis, Jörg Malindretos, Angela Rizzi

Georg-August-Universitöat Göttingen
IV. Physikalisches Institut

We grow GaN/AlGaN and GaN/InGaN structures with Ga>80%. Different aspects of growth are controlled by RHEED and analyzed by magneto transport measurements. A maximum 2DEG mobility of 21.500 cm^2/Vs at 5K is achieved for GaN/AlGaN structures.

P3.05

Phase transformation of MBE-grown nm thick Y2O3 on GaN

Wen Hsin Chang, Pen Chang, Te Yang Lai, Yi Jun Lee, J. Raynien Kwo, Chia Hung Hsu, Chiung Chi Tsai, J. Minghuang Hong, Minghwei Hong

National Tsing Hua University
Department of Material Science and Engineering

For MBE-deposited Y2O3 thin film on GaN, the phase transition from hexagonal phase to monoclinic phase was discovered for the first time. The critical thickness is approximately 2-3 nm according to high resolution synchrotron radiation XRD analysis.

P3.06

Homoepitaxial growth and properties of nitrogen doped ZnO nonpolar thin films

Dimitri Tainoff, Jean-Michel Chauveau, Christiane Deparis, Borge Vinter, Monique Teisseire, Christian Morhain

CRHEA-CNRS

We report the correlation between growth parameters, structural and optical properties of nitrogen doped ZnO thin films grown by MBE on non polar (010-1) oriented (m plane) ZnO substrates. A comparison with film growth on other polar and non polar orientation will also be discussed.

P3.07

Plasma-assisted molecular beam epitaxy of InN films on ZnO{0001}

YongJin Cho, Oliver Brandt, Martin Wienold, Manfred Ramsteiner, Henning Riechert

Paul-Drude-Institut

We study the properties of InN films grown on ZnO(0001) and ZnO(000-1) substrates at different substrate temperature (T_s). With increasing T_s, the morphology improves but the formation of an interfacial In_2O_3 layer results in a deterioration of the crystallinity of the InN film.

P3.08

Growth of bulk m-plane GaN and m-plane AlN/GaN multiple quantum wells on LiAlO2 (100)

Rashid Farivar, Tommy Ive, Thorvald G. Andersson

Chalmers University of Technology
Microtechnology and Nanoscience - MC2

It is possible to avoid polarization effects in III-nitrides by growth along non-polar (1-100) direction. In this work, we demonstrated growth of high quality m-plane bulk GaN and m-plane AlN/GaN heterostructures on LiAlO2 (100) substrates via MBE.

P3.09

Doping of MBE-grown AlxGa1-xN with silicon, a comparison between theory and experiment

Rashid Farivar, Kristian Berland, Thorvald G. Andersson

Chalmers University of Technology
Microtechnology and Nanoscience - MC2

Doping of AlGaN by silicon, especially at high concentrations, is important for the realisation of several electronic and optoelectronic devices. In this work we have made an experimental and theoretical investigation of highly silicon doped AlGaN.

P3.10

Growth of a low defect AlN buffer layer on Si(111) using Al intermediate layer

Seo-Hee Han, Sang-Tae Lee, Moon-Deock Kim, Jae-eung Oh, Song-Gang Kim, Tae Geun Kim

Chung-nam national university
Department of physics

In this study, we investigated effects of Al intermediate layer during initial growth of AlN nucleation layer on Si(111) using SEM and TEM. We have also investigated the dependence of surface morphology and leakage current according the variation of nitridation time by SEM and I-V characteristic.

P3.11

Oxygen Engineered Hafnium Oxide Thin Films by Reactive Molecular Beam Epitaxy

Erwin Hildebrandt, Jose Kurian, Lambert Alff

Technische Universität Darmstadt
Advanced Thin Film Technology Group, Department of Materials- and Geosciences

Stoichiometric and oxygen deficient HfO(2-x) thin films have been grown on c-cut sapphire substrates using Reactive Molecular Beam Epitaxy (R-MBE). R-MBE is an ideal tool to tailor oxygen content dependent materials properties such as structure, band gap and conductivity.

P3.12

RF-MBE Growth of Si doped cubic GaN and AlGaN films on MgO(001)

Masahiro Kakuda, Shigeyuki Kuboya, Kentaro Onabe

The University of Tokyo
Department of Advanced Materials Science

Si-doped cubic GaN and AlGaN films are grown on MgO substrates by RF-MBE. A moderate Si doping keeps the GaN cubic phase purity as high as 98%, but an excess doping and increased Al content degrades the phase purity giving lower electron mobilities.

P3.13

Growth of BeZnCdSe quantum-well green laser diodes with short-period superlattice cladding layer

Jun-ichi Kasai, Ryoichi Akimoto, Haruhiko Kuwatsuka, Toshifumi Hasama, Hiroshi Ishikawa, Sumiko Fujisaki, Takashi Kikawa, Shigehisa Tanaka, Shinji Tsuji, Hiroshi Nakajima, Kunihiko Tasai, Yoshiro Takiguchi, Tsunenori Asatsuma, Kohshi Tamamura

National Institute of Advanced Industrial Science and Technologies (AIST)

We report the growth of BeZnCdSe quantum-well laser-diode structures with a short-period superlattice cladding layer and demonstrate continuous-wave lasing in the pure-green spectral region (540 nm) at room temperature.

P3.14

Piezoelectric and Kelvin force microscopic studies on microstructure of periodic polarity-inverted GaN structures on N-polar GaN template

Ryuji Katayama, Naoto Fujii, Yujiro Fukuhara, Kentaro Onabe, Yuhuai Liu, Takashi Matsuoka

Institute for Materials Research, Tohoku University

Novel fabrication method of polarity-inverted GaN heterostructure based on N-polar templates was demonstrated. Kelvin and piezoelectric force microscopies detected a clear surface potential contrast between two domains, and a reversal of its piezoelectric tensor across their boundary.

P3.15

Photoluminescence study of asymmetry InGaN/GaN quantum well about variation of barrier thickness

moon deock kim, jin a You, young kyun Noh, jae eung Oh, song gang Kim

chung nam university
department of physices

In this work, we report the detailed PL studies on asymmetry InGaN/GaN QW with the various barrier thickness over a wide temperature range from 20 K to room temperature and compared with stimulated results using Cross-light.

P3.16

II-VI-based microcavities for the blue-violet spectral range

Sebastian Klembt, Carsten Kruse, Detlef Hommel, Kathrin Sebald, Aurelien Trichet, Maxime Richard, Le Si Dang

University of Bremen
Institute of Solid State Physics / Semiconductor Epitaxy

The aim is to realize high-quality microcavities that contain ZnSe QWs as the active region. The main objectives are the observation of polariton condensation effects at elevated temperatures and the realization of blue VCSELs.

P3.17

RF-MBE growth of InN on HOPG substrate

Hiromichi Kotake, Yasuhiro Shimotsuji, Akio Yamamoto, Akihiro Hashimoto

University of Fukui
Department of Electrical and Electronics Engineering

RF-MBE InN on highly oriented pyrolytic graphite with large single crystalline domains is demonstrated. Our results strongly indicate a possibility of new concept due to the symmetry of the periodic potential between the epi-layer and the substrate without any covalent bonds at the interface.

P3.18

Growth of ZnMgTe/ZnTe waveguide structures on ZnTe (100) substrates by molecular beam epitaxy

Yuki Kumagai, Shota Imada, Takuya Ohta, Toshiaki Baba, Daishin Kihara, Masakazu Kobayashi

Waseda University
Faculty of Science and Engineering

The ZnMgTe/ZnTe waveguide were grown on (100) ZnTe substrates. The crystal quality was investigated by RSM around (422), cross sectional TEM. Laser beam was irradiated in waveguide and the transmitted light was monitored. The peaks were observed with the multimode.

P3.19

Role of strain in growth kinetics of AlGaN layers during plasma-assisted molecular beam epitaxy

Andrey Mizerov, Valentin Jmerik, Mariya Yagovkina, Sergey Troshkov, Peter Kop`ev, Sergey Ivanov

Ioffe Physical-Technical Institute of RAS

The paper reports on influence of strain on the surface morphology and Ga-incorporation efficiency in the AlxGa1-xN(x=0-1) layers during their growth atop of the relaxed AlN buffer layer by plasma-assisted molecular beam epitaxy. The ways to reduce the strain in AlGaN/AlN layers are proposed.

P3.20

Deeply Degenerate p-GaN with Hole Concentrations Exceeding 7×10^19 cm^-3 Grown by Metal-Modulated Epitaxy

Michael Moseley, Elaissa Trybus, Walter Henderson, Daniel Billingsley, Jonathan Lowder, W. Alan Doolittle

Georgia Institute of Technology
Electrical and Computer Engineering

Metal-Modulated Epitaxy is the shuttered growth of III-nitrides in metal-rich conditions. Transient RHEED intensities during MME are investigated. Mg-doped GaN samples are grown via MME, and hole concentrations of >7×10^19 cm^-3 are obtained.

P3.21

Control of Adlayer Kinetics for the Growth of High Quality InGaN

Michael Moseley, Daniel Billingsley, W. Alan Doolittle

Georgia Institute of Technology
Electrical and Computer Engineering

Surface kinetics of InGaN alloys grown via metal-modulated epitaxy are investigated via RHEED. A method of minimizing indium segregation is demonstrated, and single-phase, high-quality InGaN films with indium content from 22% to 72% are presented.

P3.22

Cleaning of Si(111) surface using Ar cluster ion beam and subsequent molecular beam epitaxial growth of GaN/Si(111) using NH3 cluster ion beam

Shunichiro nakagawa

Okayama University of science

We demonstrate gas cluster ion beam (GCIB), such as Ar-CIB and NH3-CIB, is very useful tool for molecular beam epitaxal growth of III-V nitide films. In this paper we present experimental results on cleaning of Si(111) surface using Ar-CIB and subsequent MBE growth of GaN using NH3-CIB.

P3.23

Molecular Beam Epitaxy as a method for the growth of free-standing bulk zinc-blende GaN and AlGaN crystals

Sergei Novikov, N Zainal, A Akimov, C Staddon, CT Foxon, F Luckert, P Edwards, R Martin, A Kent

University of Nottingham
School of Physics & Astronomy

We have developed a process for growth, by MBE, of free-standing zinc-blende GaN layers with potential application as substrates. We have used the MBE technique for bulk crystal growth and have produced GaN layers up to 100μm in thickness.

P3.24

Growth of GaN thin films on Si(111) substrates by Plasma-Assisted Molecular Beam Epitaxy

MANOLO RAMIREZ LOPEZ, ISAAC MARTINEZ VELIS, JUAN SALVADOR ROJAS RAMIREZ, ROCIO CONTRERAS GUERRERO

CENTRO DE INVESTIGACION Y ESTUDIOS AVANZADOS DEL IPN
PHYSICS DEPARMENT

We grew GaN films on silicon substrates using a thin layer of Al and AlN buffer layer at PAMBE. We observed the columnar growth of GaN, coalescence of the columns and we get smooth surface depending of the substrate temperature and Gallium fluxes.

P3.25

Growth of non-polar GaN on LiGaO2 by plasma-assisted MBE

Ralf Schuber, Yen-Liang Chen, Cheng-Hung Shih, Teng-Hsing Huang, Paul Vincze, Ikai Lo, Liuwen Chang, Thomas Schimmel, Mitch Ming-Chi Chou, Daniel M. Schaadt

Karlsruhe Institute of Technology (KIT)
DFG-Center for Functional Nanostructures (CFN) / Institute for Applied Physics

LiGaO2 offers the possibility to grow closely lattice matched C-, M- and A-plane GaN epitaxially. Here, we present non-polar M- and A-plane GaN growth on LiGaO2 using plasma-assisted molecular beam epitaxy. Structural and morphological analysis show high phase purity of the epitaxial films.

P3.26

Zinc-blende GaN quantum dots grown by vapor-liquid-solid condensation

Thorsten Schupp, Meisch Tobias, Feneberg Martin, Thonke Klaus, Lischka Klaus, As Donat

Universität Paderborn
Physik

Zinc-blende GaN quantum dots were grown on 3C-AlN(001) by a vapor-liquid-solid process (droplet epitaxy) in a molecular beam epitaxy system. We were able to control the density of the quantum dots in a range of 10^9 cm-2 to 10^12 cm-2.

P3.27

ZnSe-based laser heterostructures with ZnMgSSe/ZnSe graded-index superlattice waveguide: structural and optical properties

Irina Sedova, Evgenii Lutsenko, Sergey Gronin, Sergey Sorokin, Alexander Vainilovich, Alla Sitnikova, Marina Baidakova, Gennadii Yablonskii, Sergey Ivanov

Ioffe Physical-Technical Institute of RAS

Structural and optical properties of green optically-pumped laser heterostructures with 400-nm-thick Zn(Mg)SSe/ZnSe graded index waveguide have been investigated in detail. The minimum laser threshold is as low as 1.5 kW/cm2, and maximum external quantum efficiency is of ~44%.

P3.28

A role of low-temperature MEE buffer layer in m-plane GaN growth on m-plane ZnO substrate

Yasuhiro Shimotsuji, Akio Yamamoto, Akihiro Hashimoto

University of Fukui / Japan
Department of Electrical and Electronics Engineering, Graduate School of Engineering

We have investigated a role of low-temperature (LT) MEE buffer layer for the high quality m-plane GaN on m-plane ZnO substrate. We have revealed that the LT MEE buffer layer is effective to suppress the interfacial reaction and to improve the crystal quality for the GaN epitaxial layer.

P3.29

Growth of GaN/AlGaN HEMT on Si (110) for integration with silicon electronics

Haipeng Tang, S. Rolfe, J.-M. Baribeau, J.A. Bardwell, P. Chyurlia, G. Tarr

National Reseach Council Canada

This paper investigates the growth of crack free GaN/AlGaN HEMT on Si (110) by ammonia MBE and optimization of the AlN nucleation conditions yielding excellent reproducibility and properties. Selective windowed epitaxy for integration of Si MOS and GaN HEMT devices is demonstrated on Si(110).

P3.30

Carbon as an acceptor in cubic GaN/3C-SiC

Elena Tschumak, Alexander Zado, Jürgen Gerlach, Klausef Lischka, Donat Josef As

University of Paderborn
Department of Physics

Cubic GaN was doped with carbon using CBr4. The incorporation and the electrical and optical properties of carbon dopants in cubic GaN were studied. An acceptor surplus is demonstrated in highly doped c-GaN:C by capacitance-voltage measurements.

P3.31

GaN nanocolumns grown on sapphire by ammonia MBE: from self -assembled to position controlled growth

STEPHANE VEZIAN, BLANDINE ALLOING, JESUS ZUNIGA PEREZ

CNRS
CRHEA

Catalyst free GaN nanocolumns have been grown by MBE directly onto the (0001) sapphire sub-strate. Two types of samples have been studied: self-organized growth and controlled growth by us-ing prior to the growth an array of apertures in a SiN mask.

P3.32

Growth of ZnO optical microcavities on nitride-based DBRs: strong coupling at room temperature

Jesus Zuniga-Perez, Fabrice Semond, Eric Frayssinet, Sylvain Sergent, Jean-Christophe Moreno, Philippe Vennéguès, Mathieu Leroux, François Médard, Joel Leymarie, Pierre Disseix, Delphine Lagarde, Martine Mihailovic, Stéphane Faure, Christelle Brimont, Thi

CNRS
CRHEA

ZnO films were grown on top of GaN-based DBRS, themselves grown on Si substrates. Two-dimensional growth of high optical quality ZnO has been achieved. These optical cavities show the strong coupling regime up to room temperature, with Rabi energies in the order of 100 meV.

P3.33

Magnetic ordering induced by In adatoms on InAs(111)A surfaces

Toru Akiyama, Kohji Nakamura, Tomonori Ito, Kiyoshi Kanisawa

Mie University
Department of Physics Engineering

We investigate the electronic structure of In adatoms on InAs(111)A surfaces using first-principles calculations. When the number of In adatoms increases, a high spin state can be energetically favored. Our results imply a possibility of magnetic ordering on semiconductor platform.

P3.34

Studies on the InGaGdN/GaN magnetic semiconductor heterostructures grown by plasma-assisted molecular-beam epitaxy

S.N.M. Tawil, D. Krishnamurthy, R. Kakimi, S. Emura, S. Hasegawa, Hajime Asahi

Osaka University
ISIR

InGaGdN/GaN magnetic semiconductor heterostructures were grown by MBE. EXAFS studies confirmed that Gd atoms substitute group III sites. PL emission was observed and its peak energy was changed with In content. SQUID measurements showed room temperature ferromagnetism.

P3.35

Suppression of interfacial intermixing of MBE grown Heusler Alloy Ni2MnIn on (001)InAs and InAs-HEMT structures

Sascha Bohse, Andriy Zolotaryov, Wolfgang Kreuzpaintner, Dieter Lott, Andrea Stemmann, Christian Heyn, Wolfgang Hansen

University of Hamburg
Institute of Applied Physics

We present the application of a thin MgO interlayer as an effective diffusion barrier embedded between MBE grown Heusler Alloy Ni2MnIn films and (001)InAs-substrates and InAs-HEMT structures, respectively.

P3.36

Epitaxial growth and strong ferrimagnetic properties of Mn film

Sunglae Cho, Younghoon Hwang, Wuwei Feng, Dang Duc Dung, Yooleemi Shin

University of Ulsan
Physics

We report on the epitaxial stabilization and magnetic properties of Mn films on GaAs, GaSb, and Si using MBE. A Mn film on GaAs showed ferrimagnetic ordering instead of antiferromagnetic below 95 K and paramagnetic orderings in bulk.

P3.37

Ferromagnetic Heusler alloy Co2FeSi films on GaAs(110)

Thomas Hentschel, Claudia Herrmann, Hans-Peter Schönherr, Bernd Jenichen, Achim Trampert, Jens Herfort

Paul-Drude-Institute

The structural and magnetic properties of Heusler alloy Co2FeSi films on GaAs(110) substrates have been investigated for various growth temperatures. We found films with a high structural and interface perfection up to a growth temperature of 200 °C.

P3.38

Strong crystal anisotropy of magneto-transport property in Fe3Si epitaxial films

H. Y. Hung, S. Y. Huang, P. Chang, W. C. Lin, Y. C. Liu, S. F. Lee, M. Hong, J. Kwo

National Tsing Hua University
Department of Physics

High quality epitaxial Fe3Si/GaAs heterostuctures by MBE was studied for spin injection from half metals into a semiconductor. We found a strongly anisotropic dependence of the magnetoresistance in the film plane, along with the anisotropic behavior from the MOKE measurement.

P3.39

Magnetization and x-ray magnetic circular dichroism studies of GaN/Ga1−xMnxN digital ferromagnetic heterostructure

Hee Chang Jeon, T. W. Kang, J. I. Hwang, A. Fujimori

Dongguk University

We have investigated the electronic structure and magnetic property of GaN/Ga1−xMnxN digital ferromagnetic heterostructure by using MBE. SQUID, XAS and XMCD data are suggested that the ferromagnetic arise from the Ga1−xMnxN layer and cannot be attributed to any ferromagnetic precipitates.

P3.40

Photoreflectance study of GaMnAs layers grown by MBE

Isaac Martínez-Velis, Rocio Contreras-Guerrero, Juan S. Rojas-Ramírez, Manolo Ramírez-López, Salvador Gallardo-Hernández, Yuriy Kudriatsev, Carlos Vázquez-López, Máximo López-López

CINVESTAV-IPN
Physics Department

GaMnAs layers were grown by MBE on GaAs(001), and characterized by SIMS, AFM and Photoreflectance spectroscopy. From Franz-Keldish oscillations in the PR spectra the built-in electric field and the band-gap variation with Mn concentration was obtained.

P3.41

Strain effect on the spin-orbit interaction in InAs-based heterostructures

Takashi Matsuda, Kanji Yoh

Hokkaido University
Research Center for Integrated Quantum Electronics

Highly distorted Shubnikov-de Haas oscillations, indicating large Dresselhaus effect was modulated by small external strain in InAs-based heterostructures. Strong interaction with Zeeman effect was also confirmed by the enhancement of Rashba effect through gate bias modulation.

P3.42

Preparation and Characterization of MnSb-GaAs Spin LED

Taku Hanna, Daisuke Yoshida, Hiro Munekata

Tokyo Institute of Technology
Imaging Science and Engineering Laboratory

Epitaxial MnSb layers having in-plane magnetization have been prepared on GaAs-based LED structures using a two-chamber MBE system. Circular polarization of 1.3% at 30 K has been observed in side-wall electroluminescence at the MnSb remnant state.

P3.43

Molecular Beam Epitaxy of LiMnAs

Vit Novak, Miroslav Cukr, Tomas Jungwirth, Zbynek Soban, Xavier Marti, Vaclav Holy, Petra Horodyska, Petr Nemec

Institute of Physics AS CR
Dept. of Spintronics and Nanoelectronics

We have demostrated the first epitaxial growth of LiMnAs, proving feasibility of the MBE technology to prepare materials of the I-II-V type.

P3.44

Distribution of Mn in ferromagnetic (In,Mn)Sb films grown on (100) GaAs using MBE

Lien Tran, Fariba Hatami, W.Ted Masselink, Jens Herfort, Achim Trampert

Humboldt University Berlin
Physics Department

Distribution of Mn in ferromagnetic (In,Mn)Sb films grown on (100) GaAs substrate using MBE investigated with RHEED, AFM, TEM. The results show the presence of two magnetic phases of (In,Mn)Sb due to alloy (In,Mn)Sb and clusters of MnSb

P3.45

Angular dependence of the planar Hall effect in ferromagnetic GaMnAs film

Jungtaek Kim, Taehee Yoo, Hakjoon Lee, Sanghoon Lee, X. Liu, J.K. Furdyna

Korea University
physics department

We have observed asymmetric behavior with four plateaus in the angle dependence of the planar Hall resistance (PHR), which can be understood in terms of multi-domain structure together with pinning field distribution in the GaMnAs film.

P3.46

Growth of MnGe Nanostructures for Spintronics Applications

Faxian Xiu, Kang L. Wang

UCLA

we present an overview of the state-of-the-art work on MnxGe1-x. We discuss our nanoscale deposition and nano-epi approach in preparing single-crystalline dilute magnetic Mn0.05Ge0.95 QDs and metallic nanostructures when Mn reaches 15%.

P3.47

MBE Growth of ZnO Based Thin Layers and Quantum Wells

Andrey Bakin, Vladimir Petukhov, Mohamed Aid Mansur Al-Suleiman, Sergey Ivanov, Alexey Toropov, Johannis Stoimenos, Andreas Waag

Braunschweig University of Technology
Institute of Semiconductor Technology

MBE fabrication of thin ZnO layers as well as complicated heterostructures like ZnO/ZnMgO single and multiple quantum wells, both as epitaxial layers or embedded into nanopillars is presented.

P3.48

Carrier dynamics in ZnSeO grown on GaAs by molecular beam epitaxy

Cheng-Yu Chen, Chyi Jen-Inn, Chen Wen-Yen, Hsu Tzu-Min

National Central University
Electrical Engineering

Carrier dynamics of ZnSeO alloys have been investigated by temperature-dependent and time-resolved photoluminescence (PL) measurements. Different recombination paths induced by localized states in this material have been discussed and clarified.

P3.49

Carrier dynamics of isoelectronic ZnSe1-xOx

Y. C. Lin, H. L. Chung, Wu Ching Chou, C. Y. Chen, J. I. Chyi

National Chiao Tung University
Department of Electrophysics

The influence of oxygen concentration on the carrier dynamics of ZnSe1-xOx is studied using photoluminescence (PL) and time-resolved PL spectroscopy. Kohlrausch's stretched exponential law and hopping-transport model are highly consistent with the complex decay traces.

P3.50

Study of interdiffusion reaction at the CdS/CdTe interface

Wang Deliang, Hou Zerong, Bai Zhizhong, Wan Lei

University of Science and Technology of China
Hefei National Laboratory for Physical Sciences at Microscale

The strong Raman and high-resolution XRD scattering spectra were used to quantitatively study the interdiffusion and its related reactions at the CdS/CdTe interface.

P3.51

In-Situ XPS study of the initial growth of Ga2O3/GdxGa1-xO3 gate dielectric on GaAs during Molecular Beam Epitaxy

R Droopad, W Priyantha, G Radhakrishnan

Texas State University
Physics

The deposition of Ga2O3 on a clean (2x4) reconstructed GaAs surface results in unpinned Fermi levels due to the insertion of Ga2O molecules into pairs of As dimers. Evolution of oxide/GaAs interface during molecular beam epitaxy growth is studied in-situ using photoemission experiments.

P3.52

Magneto-optical properties of ZnMnTe/ZnSe quantum dots

Wen Chung Fan, K.F. Chien, J.T. Ku, W.C. Chou, C.S. Yang, C.H. Chia

National Chiao Tung University
Department of Electrophysics

The time integrated and time resolved photoluminescence measurements were analyzed by σ+ and σ- circular polarization to investigate the carrier spin dynamics of ZnMnTe/ZnSe quantum dots. The measured spin relaxation time is about 23 ns.

P3.53

Single crystalline Tm2O3 film grown on Si (001) by atomic oxygen assisted molecular beam epitaxy

Zuimin Jiang, Ting Ji, Jian Cui, Yongliang Fan, Zebo Fang, Qing He, Xiaolong Li, Yueliang Gu

University of Fudan
Physics department

Single crystalline Tm2O3 film has been grown on Si (001) by molecular bean epitaxy using metallic Tm and atomic oxygen by means of multi-step growth method. A good Tm2O3 template at the initial growth is critical for the successive epitaxial growth.

P3.54

Growth and studies of ultra thin Gd2O3 layers and Gd2O3/Si/Gd2O3 stacking on p-Si(111) wafers by molecular beam epitaxy for resonant tunnel diode applications

Ramadurai Ranjith, Apurba Laha, Eberhard Bugiel, Hans J Osten

Leibniz University of Hannover

Resonant tunnel diodes (RTD) possess reliable characteristics for high speed devices. Gd2O3 epitaxial layers (~2nm) and a Gd2O3/Si/Gd2O3 stacking were fabricated by encapsulated solid phase epitaxy technique using molecular beam epitaxy for RTD applications.

P3.55

Low-temperature MBE of ZnO-based heterostructures

Sergey Sadofev, Sascha Kalusniak, Peter Schäfer, Sylke Blumstengel, Fritz Henneberger

Humboldt University
Department of Physics

Wurtzite Zn(Cd,Mg)O heterostructures with abrupt interfaces and the band gap modulation from 2.2 to 4.4 eV are realized by low-temperature MBE. The structures exhibit band-gap related emission, low-threshold lasing and crystalline perfection limited only by the wafer material.

P3.56

Structural control of lead phthalocyanine-based solar cells using organic buffer layers

Takeaki Sakurai, Tatsuya Ohashi, Hikaru Kitazume, Masato Kubota, Takashi Suemasu, Katsuhiro Akimoto

University of Tsukuba
Institute of Applied Physics

We have investigated the effect of organic buffer layers on structural and electrical properties of lead phthalocyanine (PbPc)-based solar cells using XRD, AFM, conductivity, and spectrum sensitivity measurements.

P3.57

In-situ Monitoring by Auger and Energy Loss Spectroscopy using a new Energy Analyzer: first results on Oxygen behavior during deposition

Philippe Staib

Staib Instruments Inc.

Auger and Energy Loss Spectroscopy are used to monitor in-situ, during growth, the surface composition with a special emphasis to the behavior of Oxygen.

P3.58

ALL-EPITAXIAL INORGANIC/ORGANIC SEMICONDUCTOR HYBRID HETEROSTRUCTURES

Blumstengel Sylke, Sadofev Sergey, Henneberger Fritz

Humboldt University Berlin
Institute of Physics

The talk summarizes efforts to fabricate heterostructures of ZnO and conjugated organic materials in an all-epitaxial regime. Key is the exceptionally low growth temperature of (Zn,Cd,Mg)O compatible with organics. Inorganic/organic heteroepitaxy and optoelectronic properties are discussed.

P3.59

Tin oxide conductivity control by gallium doping grown by plasma-assisted molecular beam epitaxy (PAMBE)

Min-Ying Tsai, Oliver Bierwagen, Mark White, James Speck

University of California, Santa Barbara
Electrical and Computer Engineering

A series of Ga-doped SnO2 samples were grown by PAMBE. The electron concentration decreased as increasing Ga concentration which indicated that Ga acted as a compensating acceptor. A semi-insulating SnO2 was achieved. Further increasing Ga incorporation, the concentration increased again.

P3.60

The controllable growth, characterization and properties of self-assembly Ni(Co)-BaTiO3 and Ni-BaTiO3/ SrTiO3 nanocomposite epitaxial film by laser molecular beam epitaxy

Weidong Wu, Fangfang Ge, Jia Li, Minjie Zhou, Xueming Wang, Yongjian Tang

Research Center of Laser Fusion, CAEP
Material Science and Technology Department

In this report, the Ni(Co) nanocrystals (NCs) embedded in epitaxial BaTiO3 films (Ni(Co)-BaTiO3) and BaTiO3/ SrTiO3 superlattice films (Ni-BaTiO3/ SrTiO3) were successfully deposited using laser molecular beam epitaxy (LMBE) method.

P3.61

Characterization of GaSe thin films grown on GaAs(100) by molecular beam epitaxy

Chu-Shou Yang, T. T. Tsai, L.K. Hang, C.Y. Pung, C.S. Wu, C.W. Luo, W.C. Chou

University of Tatung
Graduate Institute of Electro-optical Engineering

The γ-type GaSe epillayers were grown on GaAs using MBE. Growth condition at the Se/Ga flux ratio is less than ten, otherwise the Ga2Se3 epilayers will appear. The GaSe epilayers exhibit the similar phonon mode to GaSe bulk. The hardness of GaSe epilayer is around three times for bulk sample.

P3.62

Nano-clustered Pd catalysts formed on GaN surface for green chemistry

Motoi Hirayama, Yukiko Ueta, Tomoya Konishi, Shiro Tsukamoto

Anan National College of Technology

We have succeeded in observing Pd nano-clusters, catalytic prime elements, on a S-terminated GaN(0001) surface by a scanning tunneling microscope (STM) for the first times.

Thu A3.1

Low optical degradation in InGaAsN/GaAs Quantum Dot p-i-n structures emitting from 1.1 to 1.55 µm

Álvaro Guzmán, Raquel Gargallo-Caballero, María-José Milla, José-María Ulloa, Adrián Hierro

Universidad Politécnica de Madrid
Instituto de Sistemas Optoelectrónicos y Microtecnología

We report optical emission from InGaAsN/GaAs quantum dot (QD) p-i-n structures up to 1.55 µm showing a low degradation with the increment of the N content. We explain this behaviour in terms of the different growth parameters and the structure and composition of the quantum dots.

Thu A3.2

InAs/AlInAs quantum dash cascade structures with electroluminescence in the mid-infrared

Valeria Liverini, Alfredo Bismuto, Laurent Nevou, Mattias Beck, Jerome Faist

ETH Zurich
Institute of Quantum Electronics

Mid-IR electroluminescence (EL) from InAs/AlInAs quantum dash (QDash) cascade structures is demonstrated and compared to EL from InGaAs QWs. The emission is around 150 meV and tunes with bias. This study is relevant for the feasibility of InAs QDashes as 3D-confined active elements in QCLs.

Thu A3.3

ZnTe based microcavities containing CdTe QDs with a single Mn ion

Wojciech Pacuski, Tomasz Jakubczyk, Jakub Kobak, Andrzej Golnik, Tomasz Kazimierczuk, Mateusz Goryca, Piotr Kossacki, Jan A Gaj, Grzegorz Karczewski, Maciej Wiater, Tomasz Wojtowicz, Carsten Kruse, Detlef Hommel

University of Warsaw
Institute of Experimental Physics

This work presents photonic structures (microcavities and micropillars) based on II-VI compounds and lattice matched to ZnTe. We demonstrate an application of such structures for enhancement of emission from CdTe QDs, and in particular CdTe QDs containing single magnetic ion.

Site-Controlled In(Ga)As/GaAs Quantum Dots for Integration into Optically and Electrically Operated Devices

Alexander Huggenberger, Christian Schneider, Micha Strauß, Carmen Drescher, Stefan Heckelmann, Thomas Sünner, Tobias Heindel, Pia Weinmann, Sven Höfling, Stephan Reitzenstein, Martin Kamp, Lukas Worschech, Alfred Forchel

University of Wuerzburg
Technische Physik

A scalable technology to integrate site-controlled quantum dots (SCQD) into devices is presented. The optical quality of SCQDs could be improved by an advanced growth scheme. SCQDs coupled to PhC and micropillar cavities show an enhanced emission in resonance.

Thu B3.1

Polarization-Engineered Nitride Heterostructure Devices: Tunneling & Doping (Invited)

Debdeep Jena

University of Notre Dame
Electrical Engineering

By using Molecular Beam Epitaxial growth, we have recently a) Used polarization to enable Zener tunneling in p-n junctions, and b) Used polarization-induced p-type doping in N-Face graded heterostructures and demonstrated UV LEDs. The presentation will cover these new findings.

Thu B3.2

AlGaN/GaN high electron mobility transistor grown on (111) single crystal diamond substrate

Amélie Dussaigne, Marcus Gonschorek, Mohammed Alomari, Denis Martin, Marcel A. Py, Anas Mouti, Pierre Stadelmann, Erhard Kohn, Nicolas Grandjean

EPFL
LASPE

Heteroepitaxial growth of GaN on (111) single crystal diamond is demonstrated. AlGaN/GaN 2D electron gas is then realized. Electron mobility and sheet carrier density are 750 cm2/Vs and 1.4 1013 cm-2 at 300K, respectively. Finally, these layers are used to make a successful transistor.

Thu B3.3

MBE Grown Ultra-thin Barrier (AlGa)N/AlN/GaN HEMTs

Huili (Grace) Xing, Guowang Li, Tom Zimmermann, Yu Cao, Chuanxin Lian, Ronghua Wang, Gregory Snider, Patrick Fay, Debdeep Jena

University of Notre Dame
Electrical Engineering

Alx>0.5GaN or AlN barriers offer high 2DEG density with ultrathin barriers, thus better electrostatics and lower sheet resistance than Alx

Thu B3.4

Very high DC and RF performance of ultra-thin AlN/GaN HEMT structures grown by plasma-assisted MBE (Invited)

A.M. Dabiran, B. Cui, A.M. Wowchak, P.P Chow, C.Y. Chang, C.F. Lo, F. Ren, S.J. Pearton, A. Banerjee, E. Wasige, K. Chabak, A. Crespo, G.H. Jessen, J.K. Gillespie

SVT Associates, Inc.
MBE Laboratory

High quality, ultra-thin AlN/GaN HEMT structures were grown by PA-MBE, with sheet resistivity values <140 Ω/sq @ RT. The optimization of MBE growth and device processing, and the results of device characterization for both depletion-mode and enhancement-mode AlN/GaN HEMTs will be presented.

Fri A1.1

Routes towards III-V based devices on 200 mm silicon wafers (Invited)

Mirja Richter, David J. Webb, Christophe Rossel, Christian Gerl, Mikael T. Björk, Heinz Schmid, Marilyne Sousa, Chiara Marchiori, Caroline Andersson, Daniele Caimi, Heinz Siegwart, Teya Topuria, Leslie E. Krupp, Philip M. Rice, Jean Fompeyrine

IBM Zurich Research Lab

We discuss heterogeneous integration of III-V materials on Si for future CMOS. A complete in-situ MBE process starting from a strain compensating buffer on Si followed by III-V and oxide gate stack deposition is performed in a 200mm MBE cluster tool.

Fri A1.2

Low Thermal Budget III-V Nanostructured Active Layers on Si

Sergio Bietti, Claudio Somaschini, Noboyuki Koguchi, Giovanni Isella, Daniel Chrastina, Stefano Sanguinetti

University of Milano-Bicocca
Department of Materials Science

We present low thermal budget fabrication (CMOS compatible) of high quality GaAs/AlGaAs quantum nanostructures via droplet epitaxy on Ge/Si substrates.

Fri A1.3

Defect reduction in III-Sb semiconductors grown on Si(111)

Andre Proessdorf, Grosse Frank, Romanyuk Oleksandr, Braun Wolfgang, Jenichen Bernd, Trampert Achim, Riechert Henning

Paul Drude Institut für Festkörperelektronik

The integration of III-Sb semiconductors in CMOS technology, based on silicon substrates has for many years been a challenging growth problem. Therefore, we have studied the growth properties and the defect structure of III-Sb on Si(111).

Fri A1.4

Novel buffer approach for GaN integration on Si(111) platform through Sc_2O_3 / Y_2O_3 buffer layers

Lidia Tarnawska, Alessandro Giussani, Peter Zaumseil, Andreas Schubert, Peter Storck, Thomas Schroeder

IHP

In this paper, a novel oxide buffer engineering approach for the integration of GaN on Si is proposed, employing Sc_2O_3 / Y_2O_3 bi-layer templates to gradually reduce the huge lattice mismatch of ~ 17 % between GaN and Si

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Fri A1.5

Nano-crystalline Sb-based compound semiconductor formed on silicon

Naokatsu Yamamoto, Kouichi Akahane, Tetsuya Kawanishi, Hideyuki Sotobayashi

National Institute of Information and Communications Technology
Advanced device technology group

Nano-crystalline InGaSb with high density over $10^{10}/cm^2$ is successfully fabricated on an Si wafer using molecular beam epitaxy self-assembly growth technique. Crystalline lattice images are clearly observed in the nano-structured InGaSb and an interface of the InGaSb and Si surface.

Fri B1.1

Carrier-concentration dependent photoluminescence of InAsN films grown by RF-MBE

Shigeyuki Kuboya, Masayuki Kuroda, Susumu Nishio, Ryuji Katayama, Kentaro Onabe

The University of Tokyo
Department of Advanced Material Science

InAsN films were grown on GaAs(001) substrates by RF-MBE. With increasing the N content up to 1.84%, the PL peak energy clearly decreases due to the bandgap bowing, whereas it increases for the N contents above 2.39% due to the band-filling effect.

Fri B1.2

Monolithic blue-green and white light emitting diodes using a (Ga, In)N/GaN multiple quantum well light converter

Benjamin Damilano, Pierre Demolon, Julien Brault, Thomas Huault, Franck Natali, Jean Massies

CNRS
CRHEA

The electroluminescence characteristics of a blue LED optically pumping a green-yellow emitting (Ga, In)N/GaN multiple quantum well are studied. The observed color (mix of blue and green, white) of the LEDs can be modified depending on the wavelength of the pump and the light converter.

Fri B1.3

Plasma-assisted MBE of AlGaN multi-quantum well structures for LEDs and optically pumped lasers of the UV spectral range 300-340 nm

Valentin Jmerik, Andrei Mizerov, Tatiana Shubina, Maria Yagovkina, Alla Sitnikova, Pyotr Kop'ev, Evgenii Lutsenko, Nikolai Tarasuk, Nikolai Rzheutskii, Gennadii Yablonskii, Sergei Ivanov

IOFFE Physical-Technical Insitute
Center of Nanoheterostructure Physics

The paper reports on plasma-assisted MBE of AlGaN-based multi-quantum well structures, grown directly on c-Al2O3, demonstrating ultra-violet electroluminescence within the wavelength range 300-340 nm and optically pumped lasing at 303 nm with the threshold power density of ~0.8 MW•cm-2.

Fri B1.4

Homoepitaxy and characterization of (Zn,Mg)O/ZnO quantum well heterostructures grown on a-plane ZnO substrates

Jean-Michel Chauveau, Monique Teisseire, Christian Morhain, Hyonju Chauveau, Christiane Deparis, Borge Vinter

CRHEA-CNRS

We show the drastic improvement of the structural and optical properties of nonpolar ZnMgO/ZnO quantum well heterostructures when they are grown on nonpolar ZnO substrates. This demonstrates the interest of homoepitaxial ZnMgO/ZnO structures for bright UV emitters.

Fri B1.5

ZnSe-based lasers and laser diode converters (Invited)

Sergey Ivanov

Ioffe Physical-Technical Institute
Center of Nanoheterostructure Physics

The paper presents the original results on MBE growth, design optimization, and studies of structural, optical and laser properties of efficient ZnCdSe/ZnMgSSe QW and QD laser heterostructures emitting in the green spectral range (500-550nm) under the optical and electron beam pumping.

Fri A2.1

MBE - enabling technology beyond Si CMOS (Invited)

M. Hong, J. Kwo, C.H. Hsu, P. Chang, W.C. Lee, T.D. Lin

National Tsing Hua University
Department of Materials Science and Engineering

Fundamental research and developments using MBE have shown tremendous progresses on solving the key issues for science and technology beyond the 15 nm node ICs; critically important to build a viable platform to be matured in next five years before manufacture implementation in year 2017-2020.

Fri A2.2

Low Interfacial Trap Density in Absence of Peak Features Near Mid-gap of Ga2O3(Gd2O3)/In0.2Ga0.8As Gate Stacks

C.A. Lin, H.C. Chiu, W. H. Chang, T. H. Chiang, Y. C. Chang, L. H. Lai, T. D. Lin, J. Kwo, W. E. Wang, J. Dekoster, M. Caymax, M. Meuris, M. Heyns, M. Hong

National Tsing-Hua University
Department of Physics

Low interfacial trap density in an absence of peak-like features, derived from QS-CV and conductance method, has been reached with MBE-Al2O3/GGO/In0.2Ga0.8As gate stack. Similar to SiO2/Si, the feature is crucial for technologies beyond the 15 nm node CMOS.

Fri A2.3

Surface Passivation Effects in III-V MOSFET Devices

Christian Gerl, Chiara Marchiori, Mirja Richter, David J. Webb, Marilyne Sousa, Daniele Caime, Christiphe Rossel, Heinz Siegwart, Jean Fompeyrine, Kiewra Edward, Yanning Sun

IBM Research GmbH, Zurich Research Laboratory
Advanced Functional Materials

We will present data of MBE grown III-V based MOSCAP and MOSFET structures and will show how device characteristics improve after including an a-Si interface control layer between oxide and III-V surface due to surface passivation effects.

Fri A2.4

Epitaxial Strain Design in Rare-Earth Oxide Layers on Si(111)

Frank Grosse, Bokoch Sergiy, Behnke Steffen, Proessdorf Andre, Niehle Michael, Trampert Achim, Braun Wolfgang, Riechert Henning

Paul-Drude-Institut für Festkörperelektronik
Epitaxie

Coherent La2O3-Lu2O3 superlattices and alloys are prepared on Si(111) by MBE in a kinetically limited growth mode. This allows the variation of the physical properties by designing the internal strain as predicted by DFT calculations.

Fri A2.5

High-quality SrTiO3 films grown by hybrid MBE

Bharat Jalan, Susanne Stemmer

University of California Santa Barbara
Materials

We will present the structural and transport properties of SrTiO3 thin films grown by hybrid MBE. This approach allows the growth of stoichiometric films with excellent structural quality and low temperature electron mobilities as high as 33300 cm2/Vs, exceeding that of single crystals.

Fri B2.1

Growth of cubic InN and InGaN films on YSZ(001) substrates by RF-MBE

Keito Nakamura, Takashi Ishida, Masahiro Kakuda, Shigeyuki Kuboya, Kentaro Onabe

The University of Tokyo
Department of Advanced Materials Science

Cubic InN and InGaN films are grown on yttria-stabilized zirconia (YSZ) substrates by RF-MBE. The cubic phase purity as high as 95% is attained for InN, but it rapidly decreases with the Ga content as evaluated by the X-ray diffraction analysis.

Fri B2.2

Growth of cubic GaN on patterned 3C-SiC (001) substrates

Ricarda Maria Kemper, Michael Weinl, Christian Mietze, Alexander Zado, Maik Häberlen, Elena Tschumak, Jörg K. N. Lindner, Klaus Lischka, Donat Josef As

University of Paderborn
Department Physik

Metastable non-polar cubic GaN layers were grown by plasma assisted MBE on pre-structured 3C-SiC/Si (001) substrates. Nano-pattering of 3C-SiC substrate was realized by nanosphere lithography (NSL) for the first time.

Fri B2.3

Influence of nitrogen precursor and its flow rate on the quality of GaN based structures grown by molecular beam epitaxy

Yvon Cordier, Franck Natali, Jean Massies, Benjamin Damilano, Stéphane Vezian, Nicolas Baron, Magdalena Chmielowska, Mathieu Leroux, Catherine Chaix, Pierre Bouchaib

CRHEA-CNRS

In this study, we compare the structural, electrical and optical properties of GaN-based structures grown using N2 radio frequency plasma source or thermal decomposition of NH3 on the wafer surface. We evaluate the sensitivity to parameters like the nitrogen precursor flow rate.

Pendeoepitaxial overgrowth and coalescence of GaN nanowires on Si(111) by molecular beam epitaxy

Pinar Dogan, Oliver Brandt, Carsten Pfüller, Claudia Roder, Jonas Lähnemann, Anne-Kathrin Bluhm, Achim Trampert, Lutz Geelhaar, Henning Riechert

Paul-Drude-Institut für Festkörperelektronik
Epitaxy

GaN nanowires (NWs) are pendeoepitaxially overgrown and coalesced to fabricate a GaN film on Si(111) by molecular beam epitaxy (MBE). The overgrown GaN NW ensemble exhibits an intense donor-bound-exciton transition at 3.472 eV with a width of 1 meV reflecting high optical quality GaN.