

PROCEEDINGS OF SPIE

Physics and Simulation of Optoelectronic Devices XX

Bernd Witzigmann
Marek Osinski
Fritz Henneberger
Yasuhiko Arakawa
Editors

23–26 January 2012
San Francisco, California, United States

Sponsored and Published by
SPIE

Volume 8255

Proceedings of SPIE, 0277-786X, v. 8255

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Physics and Simulation of Optoelectronic Devices XX*, edited by Bernd Witzigmann, Marek Osinski, Fritz Henneberger, Yasuhiko Arakawa, Proceedings of SPIE Vol. 8255 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN 0277-786X
ISBN 9780819488985

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)· Fax +1 360 647 1445

SPIE.org

Copyright © 2012, Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/12/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.



SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

- xi *Conference Committee*
- xiii *Spinoptics: spin degeneracy removal in nanostructures (Plenary Paper) [8269-100]*
V. Kleiner, N. Shitrit, E. Hasman, Technion-Israel Institute of Technology (Israel)

SESSION 1 SPONTANEOUS TWO-PHOTON EMISSION FROM SEMICONDUCTORS

- 8255 03 **Applications of quantum photonics for communications and metrology (Invited Paper)** [8255-02]
A. Hayat, A. Feizpour, A. Darabi, L. Rozema, D. Mahler, Y. Soudagar, X. Xing, A. M. Steinberg, Univ. of Toronto (Canada)
- 8255 05 **Generation of a two-photon state from a quantum dot in a microcavity under incoherent and coherent continuous excitation (Invited Paper)** [8255-04]
E. del Valle, Technische Univ. München (Germany); A. Gonzalez-Tudela, Univ. Autónoma de Madrid (Spain); F. P. Laussy, Technische Univ. München (Germany)

SESSION 2 LASER DYNAMICS: OPTICAL INJECTION

- 8255 07 **Frequency chirp stabilization in semiconductor distributed feedback lasers with external control (Invited Paper)** [8255-06]
F. Grillot, Univ. Européenne de Bretagne, INSA, CNRS, Lab. FOTON (France) and LTCl, CNRS, Telecom ParisTech (France); J. G. Provost, III-V Lab. (France); K. Kechaou, B. Thedrez, D. Erasme, LTCl, CNRS, Telecom ParisTech (France)
- 8255 08 **Rate equation analysis of dynamic response in strongly injection-locked cascaded semiconductor microring lasers** [8255-07]
G. A. Smolyakov, The Univ. of New Mexico (United States); Y. Fichou, Institut de Biologie Structurale (France); M. Osinski, The Univ. of New Mexico (United States)
- 8255 09 **Optical spectral analysis of the nonlinear dynamics in long-wavelength single-mode VCSELs subject to orthogonal optical injection** [8255-08]
A. Quirce, P. Pérez, A. Valle, L. Pesquera, Univ. de Cantabria (Spain)
- 8255 0A **Dynamics of polarization switching in 1550nm-VCSELs under single and double optical injection** [8255-09]
A. Hurtado, I. D. Henning, M. J. Adams, Univ. of Essex (United Kingdom)

SESSION 3 QUANTUM DOT DEVICES

- 8255 0B **Negative differential gain in 1.3 μ m quantum dot lasers: comparison of self-heating and free carrier effects** [8255-10]
H. Shahid, D. T. D. Childs, B. J. Stevens, R. A. Hogg, The Univ. of Sheffield (United Kingdom)

- 8255 0C **Temperature effects on the characterization of new quantum dot dual mode lasers for terahertz generation** [8255-11]
B. Gonzalez, H. Lamela, E. Dadrasnia, Univ. Carlos III of Madrid (Spain); V. Sichkovskiy, K. Kozhuharov, J. P. Reithmaier, Univ. Kassel (Germany)
- 8255 0D **Numerical simulation of nonlinear mode interactions in ridge-waveguide semiconductor lasers** [8255-12]
H. Kalagara, P. G. Eliseev, M. Osinski, The Univ. of New Mexico (United States)
- 8255 0E **Hybrid quantum well/quantum dot structures for broad spectral bandwidth devices** [8255-13]
S. Chen, K. Zhou, Z. Zhang, D. T. D. Childs, J. R. Orchard, R. A. Hogg, K. Kennedy, M. Hughes, The Univ. of Sheffield (United Kingdom)

SESSION 4 LIGHT EMITTING DIODES

- 8255 0G **Computational study of multi-color InGaN/GaN nanowire LEDs with continuously varied indium composition** [8255-15]
M. Deppner, M. Bjelica, F. Römer, B. Witzigmann, Univ. Kassel (Germany)
- 8255 0H **Luminescence and efficiency optimization of InGaN/GaN core-shell nanowire LEDs by numerical modelling** [8255-16]
F. Römer, M. Deppner, Z. Andreev, Univ. Kassel (Germany); C. Kölper, Univ. Kassel (Germany) and Osram Opto Semiconductors GmbH (Germany); M. Sabathil, M. Strassburg, Osram Opto Semiconductors GmbH (Germany); J. Ledig, S. Li, A. Waag, Technische Univ. Braunschweig (Germany); B. Witzigmann, Univ. Kassel (Germany)
- 8255 0I **The effect of exciton dimensionality on resonance energy transfer: advances for organic color converters in hybrid inorganic/organic LEDs** [8255-17]
J. J. Rindermann, Univ. of Southampton (United Kingdom); G. Pozina, Linköping Univ. (Sweden); B. Monemar, Linköping Univ. (Sweden) and Lund Univ. (Sweden); L. Hultman, Linköping Univ. (Sweden); H. Amano, Nagoya Univ. (Japan); P. G. Lagoudakis, Univ. of Southampton (United Kingdom)

SESSION 5 ELECTROMAGNETICS I

- 8255 0K **3D finite element simulation of optical modes in VCSELs** [8255-19]
M. Rozova, Zuse Institute Berlin (Germany); J. Pomplun, JCMwave GmbH (Germany); L. Zschiedrich, F. Schmidt, S. Burger, Zuse Institute Berlin (Germany) and JCMwave GmbH (Germany)
- 8255 0L **A meshless based solution to vectorial mode fields in optical microstructured waveguides** [8255-20]
D. R. Burke, T. J. Smy, Carleton Univ. (Canada)
- 8255 0N **Choice of the perfectly matched layer boundary condition for iterative solvers of the frequency-domain Maxwell's equations** [8255-22]
W. Shin, S. Fan, Stanford Univ. (United States)

SESSION 6 PLASMONICS

- 8255 0P **Fundamentals of excitation and resonance of a near-field transducer in the presence of a conductive magnetic recording medium** [8255-24]
J. R. Piper, P. C. Hansen, L. Hesselink, Stanford Univ. (United States)
- 8255 0R **Dispersion analysis of subwavelength square apertures at optical frequencies** [8255-26]
E. Lansey, The City College of New York (United States); J. N. Gollub, Phoebus Optoelectronics, LLC (United States); D. T. Crouse, The City College of New York (United States)
- 8255 0S **Ultra-sensitive long-range surface plasmon modes in asymmetric double-electrode waveguide** [8255-27]
Y. Zhou, A*STAR Singapore Institute of Manufacturing Technology (Singapore) and Nanyang Technological Univ. (Singapore); F. Luan, Nanyang Technological Univ. (Singapore); X. Yu, Y. Zhang, A*STAR Singapore Institute of Manufacturing Technology (Singapore)

SESSION 7 ELECTROMAGNETICS II

- 8255 0U **Design of Bragg gratings having negative group time delay for continuum generation** [8255-29]
G. A. Iordachescu, J. Jacquet, Supélec (France)
- 8255 0W **Efficient 3D FDTD analysis of arbitrary birefringent and dichroic media with obliquely incident sources** [8255-32]
M. N. Miskiewicz, P. T. Bowen, M. J. Escuti, North Carolina State Univ. (United States)
- 8255 0X **Scattered light in reflective and refractive optical systems** [8255-33]
R. Pawluczyk, A. Rohani, P&P Optica Inc. (Canada)

SESSION 8 SEMICONDUCTOR LASERS

- 8255 0Z **Realization of a photonic crystal surface emitting laser through GaAs based regrowth** [8255-35]
D. M. Williams, K. M. Groom, D. T. D. Childs, B. J. Stevens, S. Khamas, T. S. Roberts, R. J. E. Taylor, R. A. Hogg, The Univ. of Sheffield (United Kingdom); N. Ikeda, Y. Sugimoto, National Institute for Materials Science (Japan)
- 8255 10 **Thermo-optical simulation of high-power diode lasers** [8255-36]
J. Pomplun, JCMwave GmbH (Germany); H. Wenzel, Ferdinand-Braun-Institut (Germany); S. Burger, JCMwave GmbH (Germany) and Zuse Institute Berlin (Germany); L. Zschiedrich, JCMwave GmbH (Germany); M. Rozova, Zuse Institute Berlin (Germany); F. Schmidt, JCMwave GmbH (Germany) and Zuse Institute Berlin (Germany); P. Crump, H. Ekhteraei, C. M. Schultz, G. Erbert, Ferdinand-Braun-Institut (Germany)
- 8255 11 **Bending losses and modal properties of serpentine and bent waveguides** [8255-37]
F.-H. Chu, L. Naznin, H. Kalagara, G. A. Smolyakov, M. Osinski, The Univ. of New Mexico (United States)

- 8255 12 **Thermally tunable DFB dual mode laser diode by an external platinum thin-film heater for THz generation** [8255-38]
E. Dadrasnia, B. Gonzalez, H. Lamela, Univ. Carlos III of Madrid (Spain); K. Kozhuharov, V. Sichkovskiy, J. P. Reithmaier, Univ. Kassel (Germany)
- 8255 13 **Comparison of linewidth enhancement factor for compressively strained AlGaInAs and InGaAsP quantum well lasers** [8255-39]
D. P. Sapkota, M. S. Kayastha, K. Wakita, Chubu Univ. (Japan)

SESSION 9 PHOTOVOLTAICS SIMULATION

- 8255 16 **Carrier dynamics and defects in MOVPE-grown bulk InGaAs layers with metamorphic InGaAs and InGaPb buffer layers for solar cells** [8255-42]
Y. Sin, S. D. LaLumondiere, B. J. Foran, W. T. Lotshaw, S. C. Moss, The Aerospace Corp. (United States); T. W. Kim, P. Dudley, J. Kirch, S. Ruder, L. J. Mawst, T. F. Kuech, Univ. of Wisconsin-Madison (United States)
- 8255 17 **Study of silicon solar cell double-triangular nano-gratings** [8255-43]
A. Ellaboudy, M. J. Marshall, G. Chavoor, X. Jin, California Polytechnic State Univ., San Luis Obispo (United States)

SESSION 10 PASSIVE OPTICS

- 8255 1A **Modeling of a 2x2 multimode interference switch for wider optical window operation** [8255-46]
G. Singh, A. Goyal, V. Janyani, R. P. Yadav, Malaviya National Institute of Technology (India)

SESSION 11 MICROCAVITIES AND VECSELS

- 8255 1F **Exciton-polaritons study in ZnO-based hybrid microcavities** [8255-51]
Y.-P. Lan, Y.-Y. Lai, S.-W. Huang, J.-R. Chen, Y.-C. Wu, S.-C. Lin, T.-C. Lu, S.-C. Wang, W.-F. Hsieh, National Chiao Tung Univ. (Taiwan); H. Deng, Univ. of Michigan (United States)
- 8255 1G **Universal signatures of lasing in the strong coupling regime** [8255-52]
F. P. Laussy, E. del Valle, J. J. Finley, Technische Univ. München (Germany)

SESSION 12 LASER DYNAMICS: MODULATION AND FEEDBACK

- 8255 1J **Novel picosecond optical sources based on gain switched diode lasers and nonlinear pulse reshaping (Invited Paper)** [8255-56]
H. Lamela, C. de Dios, Univ. Carlos III de Madrid (Spain)

- 8255 1K **Delay differential equation-based modeling of passively mode-locked quantum dot lasers using measured gain and loss spectra** [8255-57]
R. Raghunathan, M. T. Crowley, The Univ. of New Mexico (United States); F. Grillot, Univ. Européenne de Bretagne, INSA, CNRS, Lab. FOTON (France) and LTCI, CNRS, Telecom ParisTech (France); S. D. Mukherjee, The Univ. of New Mexico (United States); N. G. Usechak, V. Kovanis, Air Force Research Lab. (United States); L. F. Lester, The Univ. of New Mexico (United States)
- 8255 1L **THz wave generation using frequency stabilized laser diodes** [8255-58]
Y. Minamisawa, T. Nimonji, K. Nakano, T. Sato, M. Ohkawa, Niigata Univ. (Japan)
- 8255 1M **Passive cavity surface-emitting and edge-emitting lasers: physics, design, modeling (Invited Paper)** [8255-54]
V. Shchukin, J. Lott, N. Ledentsov, VI Systems GmbH (Germany)

SESSION 13 NONLINEAR FIBERS AND LASER SYSTEMS

- 8255 1N **Potentials and challenges for the optoelectronic oscillator (Invited Paper)** [8255-59]
W. Zhou, O. Okusaga, U.S. Army Research Lab. (United States); E. Levy, Technion Institute of Technology (Israel); J. Cahill, U.S. Army Research Lab. (United States) and Univ. of Maryland, Baltimore County (United States); A. Docherty, C. Menyuk, G. Cater, Univ. of Maryland, Baltimore County (United States); M. Horowitz, Technion Institute of Technology (Israel)
- 8255 1O **System modeling of passive millimeter wave imager based on optical up-conversion (Invited Paper)** [8255-60]
S. Shi, Univ. of Delaware (United States); C. Schuetz, R. Martin, T. Dillon, Phase Sensitive Innovations, Inc. (United States); P. Yao, J. Murakowski, G. Schneider, D. W. Prather, Univ. of Delaware (United States)
- 8255 1P **Speckle noise reduction of a dual-frequency laser Doppler velocimeter based on an optically injected semiconductor laser** [8255-61]
C.-H. Cheng, J.-W. Lee, T.-W. Lin, F.-Y. Lin, National Tsing Hua Univ. (Taiwan)
- 8255 1Q **Simulation on the evolution of spectrum-managed optical pulse propagation in active fibers with programmable gain spectral profile** [8255-62]
T. Yang, Y. Peng, D. Yang, Z. Wang, D. Jia, M. Sang, Tianjin Univ. (China)

POSTER SESSION

- 8255 1R **Application of anti-reflection structures on curved surfaces** [8255-65]
K. Yamamoto, T. Yamamoto, T. Takaoka, M. Seigo, S. Kitagawa, Nalux Co., Ltd. (Japan)
- 8255 1S **A novel single-transistor APS and its comparison with 3T CMOS image sensor** [8255-66]
X.-Y. Liu, X. Lin, C.-W. Cao, Q.-Q. Sun, Fudan Univ. (China); P.-C. Lin, Y.-J. Bian, C. Xing, Semiconductor Manufacturing International Corp. (China); P.-F. Wang, D. W. Zhang, Fudan Univ. (China)

- 8255 1T **Two-dimensional cell parameters measurement of a twisted nematic liquid crystal device by using imaging ellipsometer** [8255-67]
C.-J. Yu, Chang Gung Univ. (Taiwan); Y.-T. Tseng, Chang Gung Univ. (Taiwan) and National Central Univ. (Taiwan); K.-C. Hsu, National Central Univ. (Taiwan) and Unice E-O services Inc. (Taiwan); C. Chou, Chang Gung Univ. (Taiwan)
- 8255 1U **Non-equilibrium QW populations and internal efficiency of polar and nonpolar III-nitride light emitters** [8255-68]
M. V. Kisin, H. S. El-Ghoroury, Ostendo Technologies, Inc. (United States)
- 8255 1Z **Optical 90° hybrids based on silicon-on-insulator multimode interference couplers** [8255-73]
T. Hong, W. Yang, H. Yi, X. Wang, Y. Li, Z. Wang, Z. Zhou, Peking Univ. (China)
- 8255 20 **Biaxial strain effects on the electronic band structure of wurtzite $\text{In}_x\text{Ga}_{1-x}\text{N}$ alloys using first-principles calculations** [8255-74]
B.-T. Liou, Hsiuping Univ. of Science and Technology (Taiwan); B.-Y. Wu, De-Lin Institute of Technology (Taiwan); Y.-K. Kuo, National Changhua Univ. of Education (Taiwan)
- 8255 21 **Fast random-number generation using a diode laser's frequency noise characteristic** [8255-75]
H. Takamori, K. Doi, S. Maehara, K. Kawakami, T. Sato, M. Ohkawa, Y. Ohdaira, Niigata Univ. (Japan)
- 8255 22 **Oscillation wavelength shifts observed in vertical cavity surface emitting lasers exposed to magnetic fields** [8255-76]
Y. Yamagishi, S. Tabira, Y. Matsumoto, K. Doi, T. Sato, M. Okawa, Niigata Univ. (Japan)
- 8255 23 **Self-pulsation in two-section laser with an air gap** [8255-77]
C.-C. Lin, C.-W. Lin, C.-Y. Chien, H.-C. Kuo, National Chiao Tung Univ. (Taiwan)
- 8255 24 **Enhancing the transmission of diffracted light in sub-wavelength apertures** [8255-78]
A. N. Enemu, D. T. Crouse, The City College of New York (United States)
- 8255 25 **A new approach for implementation of associative memory using volume holographic materials** [8255-79]
M. Habibi, R. Pashaie, Univ. of Wisconsin-Milwaukee (United States)
- 8255 26 **Nonlinear pulse reshaping in passive optical fibers towards quasi-parabolic waveforms** [8255-80]
S. O. Iakushev, Kharkov National Univ. of Radio Electronics (Ukraine); I. A. Sukhoivanov, Univ. de Guanajuato (Mexico); O. V. Shulika, Kharkov National Univ. of Radio Electronics (Ukraine); J. A. Andrade-Lucio, I. V. Guryev, A. G. Perez, Univ. de Guanajuato (Mexico)
- 8255 27 **Thermal and optical properties of both ridge and buried structures laser including waveguide layer** [8255-81]
J. Jacquet, A. Ou-Sair, M. Faugeron, E. Mercier, J. Taki, H. Sakala, M. Jeanin, T. Molines, Supélec (France)

- 8255 28 **Analysis of 1D-like photonic crystal microcavity sensor using surface plasmon resonance effect** [8255-82]
H.-S. Kim, T.-K. Lee, G.-Y. Oh, B.-H. Lee, Chung-Ang Univ. (Korea, Republic of); D.-G. Kim, Korea Photonics Technology Institute (Korea, Republic of); Y.-W. Choi, Chung-Ang Univ. (Korea, Republic of)
- 8255 29 **Oscillation frequency stabilization and narrowing of a laser diode by using an external cavity** [8255-83]
M. Iwahori, K. Doi, H. Arai, T. Sato, M. Ohkawa, Niigata Univ. (Japan)
- 8255 2C **Geometric and material modeling environment for the finite-difference time-domain method** [8255-87]
Y.-G. Lee, W. Muhammad, Gwangju Institute of Science and Technology (Korea, Republic of)

Author Index

Conference Committee

Symposium Chair

Klaus P. Streubel, OSRAM GmbH (Germany)

Symposium Cochairs

David L. Andrews, University of East Anglia Norwich (United Kingdom)

Liang-Chy Chien, Kent State University (United States)

Program Track Chair

James G. Grote, Air Force Research Laboratory (United States)

Conference Chairs

Bernd Witzigmann, Universität Kassel (Germany)

Marek Osinski, The University of New Mexico (United States)

Fritz Henneberger, Humboldt-Universität zu Berlin (Germany)

Yasuhiko Arakawa, The University of Tokyo (Japan)

Program Committee

Hiroshi Amano, Nagoya University (Japan)

Toshihiko Baba, Yokohama National University (Japan)

Weng W. Chow, Sandia National Laboratories (United States)

Shun Lien Chuang, University of Illinois at Urbana-Champaign (United States)

Aldo Di Carlo, Università degli Studi di Roma Tor Vergata (Italy)

Silvano Donati, Università degli Studi di Pavia (Italy)

Keiichi Edamatsu, Tohoku University (Japan)

Nicholas J. Ekins-Daukes, Imperial College London (United Kingdom)

Shanhui Fan, Stanford University (United States)

Alexandre Freundlich, University of Houston (United States)

Stephan W. Koch, Philipps-Universität Marburg (Germany)

Vassillios I. Kovanis, Air Force Research Laboratory (United States)

Nikolay N. Ledentsov, VI Systems GmbH (Germany)

Cun-Zheng Ning, Arizona State University (United States)

Joachim Piprek, NUSOD Institute LLC (United States)

Ikuo Suemune, Hokkaido University (Japan)

Session Chairs

- 1 Spontaneous Two-Photon Emission from Semiconductors
Ikuo Suemune, Hokkaido University (Japan)
Bernd Witzigmann, Universität Kassel (Germany)
- 2 Laser Dynamics: Optical Injection
Horacio Lamela, Universidad Carlos III de Madrid (Spain)
- 3 Quantum Dot Devices
Elena del Valle, Technische Universität München (Germany)
- 4 Light Emitting Diodes
James A. Loff, VI Systems GmbH (Germany)
- 5 Electromagnetics I
Stavroula Foteinopoulou, The University of Exeter (United Kingdom)
- 6 Plasmonics
Bernd Witzigmann, Universität Kassel (Germany)
- 7 Electromagnetics II
Friedhard Römer, Universität Kassel (Germany)
- 8 Semiconductor Lasers
Jan Pomplun, JCMwave GmbH (Germany)
- 9 Photovoltaics Simulation
Weng W. Chow, Sandia National Laboratories (United States)
- 10 Passive Optics
Frederic Grillot, Université Européenne de Bretagne (France) and
Telecom ParisTech (France)
- 11 Microcavities and VECSELS
Alex Hayat, University of Toronto (Canada)
- 12 Laser Dynamics: Modulation and Feedback
Marek Osinski, The University of New Mexico (United States)
- 13 Nonlinear Fibers and Laser Systems
Thierry Guillet, Université Montpellier 2 (France)