

PROCEEDINGS OF SPIE

Gallium Nitride Materials and Devices VIII

Jen-Inn Chyi
Yasushi Nanishi
Hadis Morkoç
Joachim Piprek
Euijoon Yoon
Hiroshi Fujioka
Editors

**4–7 February 2013
San Francisco, California, United States**

Sponsored and Published by
SPIE

Volume 8625

Proceedings of SPIE 0277-786X, V.8625

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

Gallium Nitride Materials and Devices VIII, edited by Jen-Inn Chyi, Yasushi Nanishi, Hadis Morkoç,
Joachim Piprek, Euijoon Yoon, Hiroshi Fujioka, Proc. of SPIE Vol. 8625, 862501 · © 2013 SPIE
CCC code: 0277-786X/13/\$18 · doi: 10.1117/12.2025079

Proc. of SPIE Vol. 8625 862501-1

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 *Gallium Nitride Materials and Devices VIII*, edited by Jen-Inn Chyi, Yasushi Nanishi, Hadis Morkoç, Joachim Piprek, Euijoon Yoon, Hiroshi Fujioka, Proceedings of SPIE Vol. 8625 (SPIE, Bellingham, WA, 2013) Article CID Number.

ISSN: 0277-786X

ISBN: 9780819493941

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 © 2013, 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/13/\$18.00.

Printed in the United States of America.

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



SPIEDigitalLibrary.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
xv	Introduction
xvii	Group IV photonics for the mid infrared (Plenary Paper) [8629-1] R. Soref, The Univ. of Massachusetts at Boston (United States)
xxxiii	Light in a twist: optical angular momentum (Plenary Paper) [8637-2] M. J. Padgett, Univ. of Glasgow (United Kingdom)

SESSION 1 GROWTH I

8625 02	Application of DERI method to InN/InGa_N MQW, thick InGa_N and InGa_N/InGa_N MQW structure growth (Invited Paper) [8625-1] T. Yamaguchi, Kogakuin Univ. (Japan); K. Wang, T. Araki, Ritsumeikan Univ. (Japan); T. Honda, Kogakuin Univ. (Japan); E. Yoon, Seoul National Univ. (Korea, Republic of); Y. Nanishi, Ritsumeikan Univ. (Japan) and Seoul National Univ. (Korea, Republic of)
8625 03	Semipolar GaN growth on patterned sapphire substrates by hydride vapor phase epitaxy (Invited Paper) [8625-2] K. Yamane, N. Okada, H. Furuya, K. Tadatomo, Yamaguchi Univ. (Japan)

SESSION 2 GROWTH II

8625 07	Effect of internally focused laser processing of sapphire substrate on bowing management for III-nitride epitaxy (Invited Paper) [8625-6] H. Aida, Namiki Precision Jewel Co., Ltd. (Japan); H. Hoshino, DISCO HI-TEC EUROPE GmbH (Germany); H. Takeda, Namiki Precision Jewel Co., Ltd. (Japan); C. Aikawa, DISCO Corp. (Japan); N. Aota, Namiki Precision Jewel Co., Ltd. (Japan); K. Honjo, DISCO Corp. (Japan)
8625 09	Role and influence of impurities on GaN crystal grown from liquid solution under high nitrogen pressure in multi-feed-seed configuration [8625-8] M. Boćkowski, B. Lucznik, T. Sochacki, M. Amilusik, Institute of High Pressure Physics (Poland) and TopGa _N Sp. z o.o. (Poland); E. Litwin-Staszewska, R. Piotrkowski, I. Grzegory, Institute of High Pressure Physics (Poland)
8625 0B	HVPE-GaN growth on ammonothermal GaN crystals [8625-10] T. Sochacki, M. Amilusik, B. Lucznik, M. Boćkowski, Institute of High Pressure Physics (Poland) and TopGa _N Sp. z o.o. (Poland); J. L. Weyher, G. Nowak, B. Sadovyi, G. Kamler, I. Grzegory, Institute of High Pressure Physics (Poland); R. Kucharski, M. Zajac, R. Doradzinski, R. Dwilinski, Ammono S.A. (Poland)

SESSION 3 DOPING

- 8625 0D **The source of holes in p-type $\text{In}_x\text{Ga}_{1-x}\text{N}$ films** [8625-12]
M. E. Zvanut, W. R. Willoughby, Univ. of Alabama at Birmingham (United States);
D. D. Koleske, Sandia National Labs. (United States)

SESSION 4 MATERIAL CHARACTERIZATION

- 8625 0G **Defects in nitrides, positron annihilation spectroscopy (Invited Paper)** [8625-15]
F. Tuomisto, Aalto Univ. (Finland)
- 8625 0J **Short period InN/nGaN superlattices: experiment versus theory** [8625-16]
T. Suski, I. Gorczyca, G. Staszczak, Institute of High Pressure Physics (Poland); X. Q. Wang, Peking Univ. (China); N. E. Christensen, A. Svane, Aarhus Univ. (Denmark); E. Dimakis, Univ. of Crete (Greece); T. D. Moustakas, Boston Univ. (United States)
- 8625 0K **Defects generation and annihilation in GaN grown on patterned silicon substrate** [8625-17]
N. Sawaki, S. Ito, T. Nakagita, H. Iwata, Aichi Institute of Technology (Japan); T. Tanikawa, M. Irie, Y. Honda, M. Yamaguchi, H. Amano, Nagoya Univ. (Japan)
- 8625 0L **Nonlinear absorption in InN under resonant- and non-resonant excitation** [8625-18]
H. Ahn, M.-T. Lee, Y.-M. Chang, National Chiao Tung Univ. (Taiwan); J. L. Peng, Industrial Technology Research Institute (Taiwan); S. Gwo, National Tsing Hua Univ. (Taiwan)

SESSION 5 NANO STRUCTURES AND DEVICES I

- 8625 0P **Raman spectroscopy of GaN and AlGaN nanowires: from ensemble to single nanowire study (Invited Paper)** [8625-22]
J. Wang, C. Bayon, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales, CNRS (France); F. Demangeot, R. Pechou, A. Mlayah, Ctr. d'Elaboration de Matériaux et d'Etudes Structurales, CNRS (France) and Univ. de Toulouse (France); A. Cros, Univ. de Valencia (Spain); B. Daudin, Commissariat à l'Énergie Atomique, CNRS (France)

SESSION 6 NANO STRUCTURES AND DEVICES II

- 8625 0R **Nanolithography for 3-dimensional nanostructures: enhancement of light output power in vertical light emitting diodes (Invited Paper)** [8625-24]
Y. H. Song, J. H. Son, B. J. Kim, J.-L. Lee, Pohang Univ. of Science and Technology (Korea, Republic of)
- 8625 0S **High efficient InGaN blue light emitting diode with embedded nanoporous structure (Invited Paper)** [8625-25]
W.-C. Peng, S.-P. Chang, T.-C. Hsu, Epistar Corp. (Taiwan)

- 8625 OT **Low resistivity electrical contacting of porous n-type GaN layers due to reduced workfunction intermetallic seed layers** [8625-26]
O. V. Bilousov, J. J. Carvajal, Univ. Rovira i Virgili (Spain); C. O'Dwyer, Univ. College Cork (Ireland) and Tyndall National Inst. (Ireland); X. Mateos, F. Díaz, M. Aguiló, Univ. Rovira i Virgili (Spain)

SESSION 7 FETS

- 8625 OV **GaN power devices for automotive applications (Invited Paper)** [8625-28]
T. Uesugi, T. Kachi, Toyota Central R&D Labs., Inc. (Japan) and Japan Science and Technology Agency (Japan)
- 8625 OW **The effects of proton irradiation on the reliability of InAlN/GaN high electron mobility transistors (Invited Paper)** [8625-29]
L. Liu, C. F. Lo, Y. Y. Xi, Y. X. Wang, The Univ. of Florida (United States); H.-Y. Kim, J. Kim, Korea Univ. (Korea, Republic of); S. J. Pearton, O. Laboutin, Y. Cao, J. W. Johnson, The Univ. of Florida (United States); I. I. Kravchenko, Kopin Corp. (United States); F. Ren, The Univ. of Florida (United States)
- 8625 OX **Junction temperature measurements and reliability of GaN FETs (Invited Paper)** [8625-30]
M. Kuball, J. W. Pomeroy, M. Montes Bajo, M. Silvestri, M. J. Uren, N. Killat, The Univ. of Bristol (United Kingdom)
- 8625 OZ **Traps and defects in pre- and post-proton irradiated AlGaIn-GaN high electron mobility transistors and AlGaIn Schottky diodes** [8625-32]
Y. Sin, B. Foran, N. Presser, S. LaLumondiere, W. Lotshaw, S. C. Moss, The Aerospace Corp. (United States)

SESSION 8 LASERS I

- 8625 11 **Nonpolar and semipolar GaN, optical gain and efficiency (Invited Paper)** [8625-34]
S.-H. Park, Catholic Univ. of Daegu (Korea, Republic of); D. Ahn, The Univ. of Seoul (Korea, Republic of)
- 8625 12 **True-blue nitride laser diodes grown by plasma assisted MBE on low dislocation density GaN substrates** [8625-35]
H. Turski, Institute of High Pressure Physics (Poland); M. Siekacz, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland); G. Muzioł, Institute of High Pressure Physics (Poland); M. Sawicka, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland); S. Grzanka, Institute of High Pressure Physics (Poland); P. Perlin, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland); T. Suski, Institute of High Pressure Physics (Poland); Z. R. Wasilewski, The Univ. of Waterloo (Canada); I. Grzegory, S. Porowski, Institute of High Pressure Physics (Poland); C. Skierbiszewski, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland)

- 8625 13 **Thin AlGaIn cladding, blue-violet InGaIn laser diode with plasmonic GaN substrate** [8625-36]
S. Stanczyk, Institute of High Pressure Physics (Poland); T. Czystanowski, Technical Univ. of Lodz (Poland); R. Kucharski, TopGaN Ltd. (Poland); A. Kafar, T. Suski, Ł. Marona, Institute of High Pressure Physics (Poland); G. Targowski, TopGaN Ltd. (Poland); M. Boćkowski, P. Perlin, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland)
- 8625 15 **Picosecond pulse generation in monolithic GaN-based multi-section laser diodes** [8625-38]
K. Holc, T. Weig, W. Pletschen, K. Köhler, J. Wagner, Fraunhofer Institute for Applied Solid State Physics (Germany); U. T. Schwarz, Fraunhofer Institute for Applied Solid State Physics (Germany) and Freiburg Univ. (Germany)

SESSION 9 LASERS II

- 8625 16 **Intersubband spontaneous emission from GaN-based THz quantum cascade laser (Invited Paper)** [8625-39]
W. Terashima, H. Hirayama, RIKEN (Japan)
- 8625 18 **Latest developments in AlGaInN laser diode technology** [8625-41]
S. P. Najda, TopGaN Ltd. (Poland); P. Perlin, TopGaN Ltd. (Poland) and Institute of High Pressure Physics (Poland); T. Suski, Ł. Marona, Institute of High Pressure Physics (Poland); M. Boćkowski, M. Leszczyński, P. Wisniewski, R. Czernecki, TopGaN Ltd. (Poland) and Institute of High Pressure Physics (Poland); R. Kucharski, Ammono S. A. (Poland); G. Targowski, TopGaN Ltd. (Poland)
- 8625 19 **Room-temperature optically pumped AlGaIn-AlN multiple-quantum-well lasers operating at <260nm grown by metalorganic chemical vapor deposition** [8625-42]
Z. Lochner, T.-T. Kao, Y.-S. Liu, X.-H. Li, M. M. Satter, S.-C. Shen, P. D. Yoder, J.-H. Ryou, R. D. Dupuis, Georgia Institute of Technology (United States); Y. Wei, H. Xie, A. Fischer, F. A. Ponce, Arizona State Univ. (United States)
- 8625 1A **Tunable light source with GaN-based violet laser diode** [8625-43]
M. Omori, N. Mori, N. Dejima, Nichia Corp. (Japan)

SESSION 10 LED I

- 8625 1C **Prospect of GaN light-emitting diodes grown on glass substrates (Invited Paper)** [8625-45]
J.-H. Choi, Y. S. Lee, C. W. Baik, H. Y. Ahn, K. S. Cho, S. I. Kim, S. Hwang, Samsung Advanced Institute of Technology (Korea, Republic of)

SESSION 11 LED II

- 8625 1G **Effects of local structure on optical properties in green-yellow InGaIn/GaN quantum wells** [8625-49]
J. Hwang, R. Hashimoto, S. Saito, S. Nunoue, Toshiba Corp. (Japan)

- 8625 1J **InGaN based multi-double heterostructure light-emitting diodes with electron injector layers** [8625-52]
F. Zhang, S. A. Hafiz, X. Li, S. Okur, V. Avrutin, Ü. Özgür, H. Morkoç, Virginia Commonwealth Univ. (United States)

SESSION 12 LED III

- 8625 1M **Investigation of droop-causing mechanisms in GaN-based devices using fully microscopic many-body theory** [8625-55]
J. Hader, J. V. Moloney, Nonlinear Control Strategies Inc. (United States) and The Univ. of Arizona (United States); S. W. Koch, Philipps-Univ. Marburg (Germany)
- 8625 1P **Changes in the Mg profile and in dislocations induced by high temperature annealing of blue LEDs** [8625-58]
M. Meneghini, N. Trivellin, M. Berti, T. Cesca, A. Gasparotto, Univ. degli Studi di Padova (Italy); A. Vinattieri, F. Bogani, Univ. degli Studi di Firenze (Italy); D. Zhu, C. J. Humphreys, The Univ. of Cambridge (United Kingdom); G. Meneghesso, E. Zanoni, Univ. degli Studi di Padova (Italy)

SESSION 13 LED IV

- 8625 1Q **Development of 260 nm band deep-ultraviolet light emitting diodes on Si substrates (Invited Paper)** [8625-59]
T. Mino, RIKEN (Japan) and Panasonic Corp. (Japan); H. Hirayama, RIKEN (Japan); T. Takano, K. Tsubaki, RIKEN (Japan) and Panasonic Corp. (Japan); M. Sugiyama, The Univ. of Tokyo (Japan)
- 8625 1S **High optical power ultraviolet superluminescent InGaN diodes** [8625-61]
A. Kafar, S. Stańczyk, Institute of High Pressure Physics (Poland); G. Targowski, R. Czernecki, TopGaN Ltd. (Poland); P. Wiśniewski, Institute of High Pressure Physics (Poland); M. Leszczyński, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland); T. Suski, Institute of High Pressure Physics (Poland); P. Perlin, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland)

SESSION 14 NOVEL DEVICES

- 8625 1W **X-ray detectors based on GaN (Invited Paper)** [8625-65]
J. Y. Duboz, E. Frayssinet, S. Chenot, Ctr. de Recherche sur l'Hétéro-Epitaxie et ses Applications, CNRS (France); J. L. Reverchon, Thales R&T (France); M. Idir, Synchrotron SOLEIL (France)
- 8625 1X **Electroabsorption and refractive index modulation induced by intersubband transitions in GaN/AlN heterostructure waveguides** [8625-67]
A. Lupu, M. Tchernycheva, S. Sakr, Institut d'Electronique Fondamentale, CNRS, Univ. Paris-Sud (France); Y. Kotsar, Commissariat à l'Énergie Atomique-Grenoble, INAC/SP2M/NPSC (France); N. Isac, Institut d'Electronique Fondamentale, CNRS, Univ. Paris-Sud (France); E. Monroy, Commissariat à l'Énergie Atomique-Grenoble, INAC/SP2M/NPSC (France); F. H. Julien, Institut d'Electronique Fondamentale, CNRS, Univ. Paris-Sud (France)

- 8625 1Z **High voltage bulk GaN-based photoconductive switches for pulsed power applications** [8625-69]
J. H. Leach, R. Metzger, E. A. Preble, K. R. Evans, Kyma Technologies, Inc. (United States)

POSTER SESSION

- 8625 21 **Thermal properties of InGaN laser diodes and arrays** [8625-71]
S. Stańczyk, A. Kafar, Institute of High Pressure Physics (Poland); G. Targowski, TopGaN Ltd. (Poland); P. Wiśniewski, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland); I. Makarowa, TopGaN Ltd. (Poland); T. Suski, Institute of High Pressure Physics (Poland); P. Perlin, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland)
- 8625 22 **Nonradiative recombination due to point defects in GaInN/GaN quantum wells induced by Ar implantation** [8625-72]
T. Langer, H.-G. Pietscher, H. Bremers, U. Rossow, D. Menzel, A. Hangleiter, Technische Univ. Braunschweig (Germany)
- 8625 24 **Design and geometry of hybrid white light-emitted diodes for efficient energy transfer from the quantum well to the nanocrystals** [8625-74]
O. Kopylov, A. Huck, R. Shirazi, K. Yvind, Technical Univ. of Denmark (Denmark); B. Kardynal, Technical Univ. of Denmark (Denmark) and Forschungszentrum Jülich (Germany)
- 8625 25 **Influence of free-standing GaN substrate on ultraviolet light-emitting-diodes by atmospheric-pressure metal-organic chemical vapor deposition** [8625-75]
C. Y. Shieh, National Central Univ. (Taiwan); Z. Y. Li, National Chiao Tung Univ. (Taiwan); C. H. Chiu, P. M. Tu, National Chiao Tung Univ. (Taiwan) and Advanced Optoelectronic Technology Inc. (Taiwan); H. C. Kuo, National Chiao Tung Univ. (Taiwan); G. C. Chi, National Central Univ. (Taiwan) and National Chiao Tung Univ. (Taiwan)
- 8625 26 **Numerical analysis of using superlattice-AlGaIn/InGaIn as electron blocking layer in green InGaIn light-emitting diodes** [8625-76]
F.-M. Chen, National Changhua Univ. of Education (Taiwan); B.-T. Liou, Hsiuping Univ. of Science and Technology (Taiwan); Y.-A. Chang, J.-Y. Chang, Y.-T. Kuo, Y.-K. Kuo, National Changhua Univ. of Education (Taiwan)
- 8625 27 **Role of nonequivalent atomic step edges in the growth of InGaIn by plasma-assisted molecular beam epitaxy** [8625-77]
H. Turski, Institute of High Pressure Physics (Poland); M. Siekacz, M. Sawicka, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland); Z. R. Wasilewski, Univ. of Waterloo (Canada); S. Porowski, Institute of High Pressure Physics (Poland); C. Skierbiszewski, Institute of High Pressure Physics (Poland) and TopGaN Ltd. (Poland)
- 8625 28 **Diffusion-assisted current spreading for III-nitride light-emitting applications** [8625-78]
P. Kivisaari, J. Oksanen, J. Tulkki, Aalto Univ. (Finland)
- 8625 29 **Structural and optical characterizations of GaN-based green light-emitting diodes growth using TiN buffer layer** [8625-79]
C. Y. Shieh, National Central Univ. (Taiwan); Z. Y. Li, H. C. Kuo, National Chiao Tung Univ. (Taiwan); G. C. Chi, National Central Univ. (Taiwan) and National Chiao Tung Univ. (Taiwan)

- 8625 2B **Microwave performance of AlGaN/AlN/GaN-based single and coupled channels HFETs** [8625-81]
R. A. Ferreyra, X. Li, F. Zhang, C. Zhu, N. Izyumskaya, C. Kayis, V. Avrutin, Ü. Özgür, H. Morkoç, Virginia Commonwealth Univ. (United States)
- 8625 2C **Linewidth reduction of site-controlled InGaN quantum dots by surface passivation** [8625-82]
C.-H. Teng, L. Zhang, H. Deng, P.-C. Ku, The Univ. of Michigan (United States)
- 8625 2D **Recombination dynamics in non-polar m-plane GaN investigated by time- and polarization-resolved photoluminescence** [8625-83]
S. Okur, Virginia Commonwealth Univ. (United States); K. Jarašiūnas, Vilnius Univ. (Lithuania); S. Hafiz, Virginia Commonwealth Univ. (United States); J. Leach, T. Paskova, Kyma Technologies, Inc. (United States); V. Avrutin, H. Morkoç, Ü. Özgür, Virginia Commonwealth Univ. (United States)
- 8625 2F **GaN-based vertical cavity lasers with semiconductor/dielectric and all dielectric reflectors** [8625-85]
F. Zhang, S. Okur, S. Hafiz, V. Avrutin, Ü. Özgür, H. Morkoç, Virginia Commonwealth Univ. (United States)
- 8625 2G **Depth distribution of carrier lifetimes in semipolar (11 $\bar{1}$ 0) GaN grown by MOCVD on patterned Si substrates** [8625-86]
N. Izyumskaya, S. Okur, F. Zhang, V. Avrutin, Ü. Özgür, Virginia Commonwealth Univ. (United States); S. Metzner, C. Karbaum, F. Bertram, J. Christen, Otto-von-Guericke-Univ. Magdeburg (Germany); H. Morkoç, Virginia Commonwealth Univ. (United States)
- 8625 2H **Investigation of microwave and noise properties of InAlN/GaN HFETs after electrical stress: role of surface effects** [8625-87]
C. Zhu, F. Zhang, R. A. Ferreyra, X. Li, C. Kayis, V. Avrutin, Ü. Özgür, H. Morkoç, Virginia Commonwealth Univ. (United States)
- 8625 2I **Surface analysis of free-standing GaN substrates with polar, non-polar, and semipolar crystal orientations** [8625-88]
O. Romanyuk, P. Jiríček, P. Mutombo, Institute of Physics of the ASCR, v.v.i. (Czech Republic); T. Paskova, North Carolina State Univ. (United States); I. Bartoš, Institute of Physics of the ASCR, v.v.i. (Czech Republic)

Author Index

Conference Committee

Symposium Chair

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

Symposium Cochairs

Alexei L. Glebov, OptiGrate Corporation (United States)

Klaus P. Streubel, OSRAM GmbH (Germany)

Program Track Chair

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

Conference Chairs

Jen-Inn Chyi, National Central University (Taiwan)

Yasushi Nanishi, Ritsumeikan University (Japan)

Hadis Morkoç, Virginia Commonwealth University (United States)

Conference Cochairs

Joachim Piprek, NUSOD Institute LLC (United States)

Euijoon Yoon, Seoul National University (Korea, Republic of)

Hiroshi Fujioka, The University of Tokyo (Japan)

Conference Program Committee

Hiroshi Amano, Nagoya University (Japan)

Jong Hyeob Baek, Korea Photonics Technology Institute (Korea, Republic of)

Shigefusa F. Chichibu, Tohoku University (Japan)

Bernard Gil, Université Montpellier 2 (France)

Nicolas Grandjean, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

Hideki Hirayama, RIKEN (Japan)

Stacia K. Keller, University of California, Santa Barbara (United States)

Michael Kneissl, Technische Universität Berlin (Germany)

Hao-Chung Kuo, National Chiao Tung University (Taiwan)

Narihiko Maeda, NTT Photonics Laboratories (Japan)

Koh Matsumoto, Taiyo Nippon Sanso EMC Ltd. (Japan)

Hideto Miyake, Mie University (Japan)

Yong-Tae Moon, LG Electronics Inc. (Korea, Republic of)

Ki-Bum Nam, Seoul Semiconductor (Korea, Republic of)
Ümit Özgür, Virginia Commonwealth University (United States)
Ulrich T. Schwarz, Fraunhofer-Institut für Angewandte Festkörperphysik
 (Germany)
Tae-Yeon Seong, Korea University (Korea, Republic of)
Jong-In Shim, Hanyang University (Korea, Republic of)
Chih-Chung Yang, National Taiwan University (Taiwan)

Session Chairs

- 1 Growth I
Jen-Inn Chyi, National Central University (Taiwan)
- 2 Growth II
Hiroshi Fujioka, The University of Tokyo (Japan)
- 3 Doping
Tadek Suski, Institute of High Pressure Physics (Poland)
- 4 Material Characterization
Alois J. Krost, Otto-von-Guericke-Universität Magdeburg (Germany)
- 5 Nano Structures and Devices I
Yasushi Nanishi, Ritsumeikan University (Japan)
- 6 Nano Structures and Devices II
Axel Hoffmann, Technische Universität Berlin (Germany)
- 7 FETs
Fan Ren, University of Florida (United States)
- 8 Lasers I
Joachim Piprek, NUSOD Institute LLC (United States)
- 9 Lasers II
Raphaël Butté, Ecole Polytechnique Fédérale de Lausanne
 (Switzerland)
- 10 LED I
Ray-Hua Horng, National Chung Hsing University (Taiwan)
- 11 LED II
Emmanouil Kioupakis, University of Michigan (United States)
- 12 LED III
Seong-Ju Park, Gwangju Institute of Science and Technology (Korea,
 Republic of)

- 13 LED IV
Hideito Miyake, Mie University (Japan)
- 14 Novel Devices
Ümit Özgür, Virginia Commonwealth University (United States)

Introduction

GaN based electronic and optoelectronic devices continue to develop rapidly as reflected by the advances reported at the meeting. Today, the GaN based light emitters adorn the automobiles, traffic lights, moving signs, outdoor displays, handheld electronics, and back lighting in many consumer electronic devices. LED outdoor lighting applications are already in full swing. Indoor lighting is also gaining tremendous momentum as the price of LED luminaires has become appealing to consumers in large.

The SPIE symposium on GaN Materials and Devices is annually organized to disseminate the latest advances and provide an opportunity for researchers from around the world to engage in far reaching and probing discussions. Many world renowned invited speakers from Asia, Europe and the United States set the stage with wide ranging formal discussions. Not to be underestimated is the fact that the meeting serves the purpose of getting experts and newcomers together for friendship and informal discussions on issues relevant to GaN and related materials and devices, and also to develop collaborations. Such exchanges will undoubtedly play an invaluable role in propelling the field forward in general and addressing pivotal issues such as determination and improvement of quantum efficiency of LEDs as well as realizing the full potential of GaN power devices for energy efficiency products in particular.

Papers contained in this volume cover the areas of material growth and characterization, novel devices, and device physics. Subject areas are focused on the preparation of GaN substrates, including semi-polar and nonpolar orientations; epitaxial growth of InN-rich InGaN alloys; growth of GaN on large area substrates, including sapphire and Si; mechanisms of defect generation and the role of defects in device characteristics, techniques for LED efficiency retention and improvement, including UV emitters down to about 260 nm; fabrication and physics of nano-cavity light emitters; and last but not least progress of GaN-based FETs for power and microwave applications.

**Jen-Inn Chyi
Hiroshi Fujioka
Hadis Morkoç
Yasushi Nanishi
Joachim Piprek
Euijoon Yoon**

