

PROCEEDINGS OF SPIE

Light-Emitting Devices, Materials, and Applications

Jong Kyu Kim
Michael R. Krames
Martin Strassburg
Editors

4–7 February 2019
San Francisco, California, United States

Sponsored and Published by
SPIE

Volume 10940

Proceedings of SPIE 0277-786X, V. 10940

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

The papers 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. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers 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 these proceedings:

Author(s), "Title of Paper," in *Light-Emitting Devices, Materials, and Applications*, edited by Jong Kyu Kim, Michael R. Krames, Martin Strassburg, Proceedings of SPIE Vol. 10940 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)

ISBN: 9781510625228
ISBN: 9781510625235 (electronic)

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 © 2019, 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/19/\$18.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

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

SPIE. DIGITAL LIBRARY

SPIDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of 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 and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five 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.

Contents

| | |
|-----|-----------------------------|
| vii | <i>Authors</i> |
| ix | <i>Conference Committee</i> |

UV DEVICES I

| | |
|----------|---|
| 10940 02 | Transparent deep ultraviolet light-emitting diodes with a p-type AlN ohmic contact layer (Invited Paper) [10940-1] |
| 10940 05 | Optical stimulated emission in AlGaN/InGaN ultraviolet multi-quantum-well structures (Invited Paper) [10940-4] |

UV DEVICES II

| | |
|----------|--|
| 10940 08 | Advances in UV-A and UV-C LEDs and the applications they enable (Invited Paper) [10940-7] |
| 10940 09 | Discussion on reliability issues for UVB and UVC LEDs [10940-8] |
| 10940 0A | An innovative Si package for high-performance UV LEDs [10940-9] |

MICROLEDs AND NANOLEDs

| | |
|----------|--|
| 10940 0D | Three-dimensional nanorod structure through nano-mold process [10940-12] |
| 10940 0F | Flexible micro light-emitting diodes for wearable applications (Invited Paper) [10940-14] |

VISIBLE SPECTRUM LEDs I

| | |
|----------|---|
| 10940 0I | Challenges for highly reliable GaN-based LEDs (Invited Paper) [10940-22] |
| 10940 0J | Origin of the low-forward leakage current in InGaN-based LEDs [10940-18] |
| 10940 0K | Polarization matched c-plane III-nitride quantum well structure [10940-19] |

AUTOMOTIVE APPLICATIONS

- 10940 0O **What will mainstream adaptive driving beam look like by 2025? (Invited Paper)** [10940-24]
- 10940 0Q **Laser-scanner headlamp systems with high output, contrast, and bandwidth** [10940-26]

SENSING AND COMMUNICATION

- 10940 0U **Modeling and compensating dynamic nonlinearities in LED photon-emission rates to enhance OWC** [10940-30]
- 10940 0V **Near-UV LED-based systems for low-cost and compact oxygen-sensing systems in gas and liquids** [10940-31]

EPITAXY I

- 10940 0Z **Achieving high uniformity and yield for micro LED applications with precise strain-engineered large-diameter epiwafers (Invited Paper)** [10940-35]

DOWN-CONVERSION MATERIALS I

- 10940 10 **Quantum dots: the technology platform for all future displays (Invited Paper)** [10940-36]

DOWN-CONVERSION MATERIALS II

- 10940 15 **High brightness light sources based on LD-pumped luminescent converters and LED-pumped luminescent concentrators** [10940-41]
- 10940 17 **Ceramic phosphor wheels for high luminance SSL-light sources with >500W of laser power for digital projection** [10940-43]

EPITAXY II

- 10940 18 **Remote plasma chemical vapour deposition of group III-nitride tunnel junctions for LED applications (Invited Paper)** [10940-44]

LIGHTING APPLICATIONS I

- 10940 1G **Study on laser-based white light sources** [10940-52]

LIGHTING APPLICATIONS II

- 10940 1J **Analysis of color rendition specification criteria (Invited Paper)** [10940-55]
- 10940 1L **Spectrally tunable LED light engines and the metamer optimization tool (MOTO)** [10940-57]

POSTER SESSION

- 10940 1U **Micro pixel LEDs: design challenge and implementation for high-resolution headlamps**
[10940-66]
- 10940 1V **Enhanced heat dissipation for high-power UV LED devices using sintering** [10940-67]
- 10940 1Y **Evidence for avalanche generation in reverse-biased InGaN LEDs** [10940-70]