

**SPECIAL ISSUE**

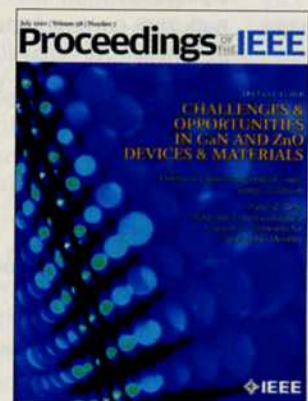
## CHALLENGES & OPPURTUNITIES IN GaN AND ZnO DEVICES & MATERIALS

Edited by H. Morkoç, J.-I. Chyi, A. Krost, Y. Nanishi, and D. J. Silversmith

- 1118 **Ultrafast Removal of LO-Mode Heat From a GaN-Based Two-Dimensional Channel**  
By A. Matulionis, J. Liberis, I. Matulionienė, M. Ramonas, and E. Šermukšnis  
| INVITED PAPER | Efficiency of conversion of electric power into optical millimeter-wave radiation may be improved by controlling temperature and other technological and operating conditions.
- 1127 **Status of Reliability of GaN-Based Heterojunction Field Effect Transistors**  
By J. H. Leach and H. Morkoç  
| CONTRIBUTED PAPER | For high-power, high-frequency transistors used in communications and radar, better predictions of reliability may be obtained by developing new models for failure mechanisms.
- 1140 **Small Signal Equivalent Circuit Modeling for AlGaIn/GaN HFET: Hybrid Extraction Method for Determining Circuit Elements of AlGaIn/GaN HFET**  
By Q. Fan, J. H. Leach, and H. Morkoç  
| CONTRIBUTED PAPER | An algorithm developed for modeling field-effect transistors containing gallium compounds may be improved by taking account of conditions that are more suitable for modeling transistors.
- 1151 **GaN Power Transistors on Si Substrates for Switching Applications**  
By N. Ikeda, Y. Niyama, H. Kambayashi, Y. Sato, T. Nomura, S. Kato, and S. Yoshida  
| CONTRIBUTED PAPER | Hybrid MOS-FET transistor devices with low on-resistance, high hold-voltages and high breakdown voltage promise to provide high-power, low-loss operation for switching applications.
- 1162 **Solid-State Lighting: An Integrated Human Factors, Technology, and Economic Perspective**  
By J. Y. Tsao, M. E. Coltrin, M. H. Crawford, and J. A. Simmons  
| CONTRIBUTED PAPER | Commercially available solid-state lamps, based on high-efficiency low-cost LEDs and capable of superior long-life operation, are believed to be capable of replacing traditional lighting technologies.
- 1180 **GaN-Based Light-Emitting Diodes: Efficiency at High Injection Levels**  
By Ü. Özgür, H. Liu, X. Li, X. Ni, and H. Morkoç  
| CONTRIBUTED PAPER | Highly efficient, high-brightness LEDs operating at high efficiency are taking over automobile lighting and signaling by demonstrating the advantages of their superior capabilities.
- 1197 **High Brightness GaN Vertical Light-Emitting Diodes on Metal Alloy for General Lighting Application**  
By C.-F. Chu, C.-C. Cheng, W.-H. Liu, J.-Y. Chu, F.-H. Fan, H.-C. Cheng, T. Doan, and C. A. Tran  
| CONTRIBUTED PAPER | Flexible chip size, capability for high driving-current and excellent heat dissipation, high-performance device mounting and packaging technology can meet the requirements of this application.
- 1208 **Structural Defects and Degradation Phenomena in High-Power Pure-Blue InGaIn-Based Laser Diodes**  
By S. Tomiya, O. Goto, and M. Ikeda  
| CONTRIBUTED PAPER | Analysis of aged devices using fluorescence microscopy is used to assess the role that point defects play in generating optical damage and additional defects.
- 1214 **Degradation Mechanisms of InGaIn Laser Diodes**  
By P. Perlin, L. Marona, M. Leszczynski, T. Suski, P. Wisniewski, R. Czernecki, and I. Grzegory  
| CONTRIBUTED PAPER | Many experiments have reported that carbon deposition involving photochemical reactions that lead to the decomposition of hydrocarbons, along with increased threshold current, are frequent causes of degradation.
- 1220 **Wide Bandgap Semiconductor-Based Surface-Emitting Lasers: Recent Progress in GaN-Based Vertical Cavity Surface-Emitting Lasers and GaN-/ZnO-Based Polariton Lasers**  
By R. Shimada and H. Morkoç  
| CONTRIBUTED PAPER | Applications of these lasers including lighting, high-speed, high-resolution laser printing and scanning, and new types of coherent optical sources are reviewed in this paper.
- 1234 **Intersubband Transition-Based Processes and Devices in AlN/GaN-Based Heterostructures**  
By D. Hofstetter, E. Baumann, F. R. Giorgetta, R. Théron, H. Wu, W. J. Schaff, J. Dawlaty, P. A. George, L. F. Eastman, F. Rana, P. K. Kandaswamy, F. Guillot, and E. Monroy  
| CONTRIBUTED PAPER | This review covers the physics, epitaxial growth, fabrication, and characterization of optoelectronic devices for use in video players and other consumer electronics as well as in commercial systems.

**DEPARTMENTS**

- 1111 **POINT OF VIEW**  
Vehicular Communications: Ubiquitous Networks for Sustainable Mobility  
By E. Ström, H. Hartenstein, P. Santi, and W. Wiesbeck
- 1113 **SCANNING THE ISSUE**  
Challenges and Opportunities in GaN and ZnO Devices and Materials  
By H. Morkoç, J.-I. Chyi, A. Krost, Y. Nanishi, and D. J. Silversmith
- 1356 **SCANNING OUR PAST**  
Electrical Engineering Hall of Fame: George H. Brown  
By J. E. Brittain
- 1359 **FUTURE SPECIAL ISSUES/SPECIAL SECTIONS**



**On the Cover:** The cover on this issue is designed to suggest the concept of light-emitting diodes (LEDs) which is one of the applications discussed in this Special Issue on GaN and ZnO Devices & Materials.

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## SPECIAL ISSUE: CHALLENGES & OPPURTUNITIES IN GaN AND ZnO DEVICES & MATERIALS

- 1249 Resonant Tunneling in III-Nitrides**  
By V. I. Litvinov  
| CONTRIBUTED PAPER | Rising interest in applications of optoelectronic devices motivates this report on nitride-based lasers that seem to exhibit capabilities like those formerly attributed to gallium-based devices.
- 1255 ZnO Devices and Applications: A Review of Current Status and Future Prospects**  
By Ü. Özgür, D. Hofstetter, and H. Morkoç  
| CONTRIBUTED PAPER | The possible importance of zinc-oxide-based optoelectronic devices is reviewed in this paper, which places special emphasis on the need to achieve p-type ZnO.
- 1269 Doping Asymmetry Problem in ZnO: Current Status and Outlook**  
By V. Avrutin, D. J. Silversmith, and H. Morkoç  
| CONTRIBUTED PAPER | In pursuit of improved optoelectronic devices, current experimental efforts to achieve p-type ZnO are examined along with techniques for testing GaN and ZnO doped with magnetic ions.
- 1281 ZnO-GaN Hybrid Heterostructures as Potential Cost-Efficient LED Technology**  
By A. Bakin, A. Behrends, A. Waag, H.-J. Lugauer, A. Laubsch, and K. Streubel  
| CONTRIBUTED PAPER | Low-temperature and low-cost chemical growth, using a combination of nanorods and conducting material, was used to fabricate efficient ZnO-based light-emitting diodes.
- 1288 Ferromagnetism in ZnO- and GaN-Based Diluted Magnetic Semiconductors: Achievements and Challenges**  
By V. Avrutin, N. Izyumskaya, Ü. Özgür, D. J. Silversmith, and H. Morkoç  
| CONTRIBUTED PAPER | This paper reports on the current status of studies of optoelectronic devices that have been developed by doping with rare-earth and transition elements.
- 1302 Growth of Bulk GaN and AlN: Progress and Challenges**  
By V. Avrutin, D. J. Silversmith, Y. Mori, F. Kawamura, Y. Kitaoka, and H. Morkoç  
| CONTRIBUTED PAPER | The ultimate goal of current investigations of nitride(N)-based materials for producing optoelectronic devices is to find compounds sliced from single crystals that are structurally perfect.
- 1316 The Ammonothermal Crystal Growth of Gallium Nitride—A Technique on the Up Rise**  
By D. Ehrentraut and T. Fukuda  
| CONTRIBUTED PAPER | Progress for over a decade has resulted in fabrication of large, single, gallium nitride crystals with structural properties that make them suitable for production of optoelectronic devices.
- 1324 GaN Substrates for III-Nitride Devices**  
By T. Paskova, D. A. Hanser, and K. R. Evans  
| CONTRIBUTED PAPER | Bulk gallium nitride substrates for optoelectronic devices have been under intense development, and availability of this crystalline material has been increasing in size, doping, and orientation.
- 1339 Bulk ZnO: Current Status, Challenges, and Prospects**  
By V. Avrutin, G. Cantwell, J. Zhang, J. J. Song, D. J. Silversmith, and H. Morkoç  
| CONTRIBUTED PAPER | As mass production of zinc oxide appears to be approaching commercial viability, thick ZnO crystals are being fabricated for use in the production of optoelectronic devices.
- COMMENTS AND REPLIES**
- 1351 Comments on “Negative Index Materials With Gain Media for Fast Optical Modulation”**  
By R. V. Snyder
- 1352 Reply to “Comments on “Negative Index Materials With Gain Media for Fast Optical Modulation””**  
By A. M. Bratkovsky
- 1353 Comments on “Consensus and Cooperation in Networked Multi-Agent Systems”**  
By P. Chebotarev
- 1354 Reply to “Comments on “Consensus and Cooperation in Networked Multi-Agent Systems””**  
By R. Olfati-Saber, J. A. Fax, and R. M. Murray

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