

**MATERIALS RESEARCH SOCIETY**  
**SYMPOSIUM PROCEEDINGS VOLUME 482**

# **Nitride Semiconductors**

Symposium held December 1-5, 1997, Boston, Massachusetts, U.S.A.

**EDITORS:**

**F.A. Ponce**

*Xerox, PARC  
Palo Alto, California, U.S.A.*

**S.P. DenBaars**

*University of California  
Santa Barbara, California, U.S.A.*

**B.K Meyer**

*Justus Liebig University  
Gießen, Germany*

**S. Nakamura**

*Nichia Chemical Industries  
Anan, Tokushima, Japan*

**S. Strite**

*IBM Research Laboratory  
Zurich, Switzerland*



**Materials Research Society**  
Warrendale, Pennsylvania

# CONTENTS

Preface .....	xxi
Acknowledgments .....	xxiii
Dedication .....	xxv
Materials Research Society Symposium Proceedings .....	xxxv

## PART I: CRYSTAL GROWTH - BULK GROWTH, EARLY STAGES OF EPITAXY

<b>*The Evolution of Nitride Semiconductors</b> .....	3
<i>I. Akasaki</i>	
<b>*GaN Crystals: Growth and Doping Under Pressure</b> .....	15
<i>I. Grzegory, M. Bockowski, B. Lucznik, M. Wroblewski, S. Krukowski, J. Weyher, G. Nowak, T. Suski, M. Leszczynski, H. Teisseyre, T. Suski, E. Litwin-Staszewska, and S. Porowski</i>	
<b>Sublimation Sandwich Growth of Freestanding GaN Crystals</b> .....	27
<i>Yu.A. Vodakov, E.N. Mokhov, M.G. Ramm, M.S. Ramm, A.D. Roenkov, A.G. Ostroumov, A.A. Wolfson, S.Yu. Karpov, Yu.N. Makarov, and H. Jürgensen</i>	
<b>Deposition Sequences for Atomic Layer Growth of AlN Thin Films on Si(100) Using Dimethylethylamine Alane and Ammonia</b> .....	33
<i>Jason S. Kuo and J.W. Rogers, Jr.</i>	
<b>Organometallic Chemical Vapor Deposition of Group-III Nitride Thin Films Using Single-Source Precursors</b> .....	39
<i>Roland A. Fischer and Wolfram Rogge</i>	
<b>Chemical and Structural Analysis of Nitridated Sapphire</b> .....	45
<i>Y. Cho, S. Rouvimov, Y. Kim, Z. Liliental-Weber, and E.R. Weber</i>	
<b>Effect of Nitridation and Buffer in GaN Films Grown on A-Plane (11-20) Sapphire</b> .....	51
<i>D. Doppalapudi, E. Iliopoulos, S.N. Basu, and T.D. Moustakas</i>	
<b>Substrate Surface Treatments and "Controlled Contamination" in GaN/Sapphire MOCVD</b> .....	57
<i>Yuval Golan, Paul Fini, Steven P. DenBaars, and James S. Speck</i>	
<b>Surface Characterization of GaN Formation on GaAs(100) Using Ammonia</b> .....	63
<i>Chul Huh, Sook Ahn, Jeong Yeul Han, Keun Jae Cho, Jae Myung Seo, and Seong-Ju Park</i>	

\*Invited Paper

<b>The Effect of Low-Temperature GaAs Nucleation on the Growth of GaN on Silicon (001) During MOVPE Process</b> .....	<b>69</b>
<i>L.X. Zheng, J.W. Liang, H. Yang, J.B. Li, Y.T. Wang, D.P. Xu, X.F. Li, L.H. Duan, and X.W. Hu</i>	
<b>The Effect of the Nucleation Layer on the Low-Temperature Growth of GaN Using a Remote Plasma-Enhanced-Ultrahigh Vacuum Chemical Vapor Deposition (RPE-UHV-CVD)</b> .....	<b>75</b>
<i>Kyoung-Kook Kim, Dong-Jun Kim, Jong-Sik Paek, Je-Hee Jo, Hyo-Gun Kim, Tae-Yeon Seong, and Seong-Ju Park</i>	
<b>Nitridation of Sapphire Substrate Using Remote Plasma-Enhanced Ultrahigh Vacuum Chemical Vapor Deposition at Low Temperature</b> .....	<b>81</b>
<i>Jong-Sik Paek, Kyoung-Kook Kim, Ji-Myon Lee, Dong-Jun Kim, Hyo-Gun Kim, and Seong-Ju Park</i>	
<b>A TEM Study of the Microstructural Evolution of MBE-Grown GaN</b> .....	<b>87</b>
<i>David M. Tricker, Paul D. Brown, Graeme Martin, J. Lu, D.I. Westwood, P. Hill, L. Haworth, J.E. MacDonald, T.S. Cheng, C.T. Foxon, and Colin J. Humphreys</i>	
<b>Investigation of Nucleation and Initial Stage of GaN Growth by Atomic Force Microscopy and X-ray Diffraction</b> .....	<b>93</b>
<i>P.W. Yip, S-Q. Wang, A.J. Drehman, L.D. Zhu, and P.E. Norris</i>	
<b>In Situ Observation of AlN Formation During Nitridation of Sapphire by Ultrahigh Vacuum Transmission Electron Microscopy</b> .....	<b>99</b>
<i>M. Yeadon, M.T. Marshall, F. Hamdani, S. Pekin, H. Morkoç, and J.M. Gibson</i>	
<b><u>PART II: CRYSTAL GROWTH-MOCVD</u></b>	
<b>*High Indium Content InGaN Films and Quantum Wells</b> .....	<b>107</b>
<i>W. Van der Stricht, K. Jacobs, I. Moerman, P. Demeester, L. Considine, E.J. Thrush, J.A. Crawley, and P. Ruterana</i>	
<b>Epitaxial Growth and Properties of Mg-Doped GaN Film Produced by Atmospheric MOCVD System With Three-Layered Laminar Flow Gas Injection</b> .....	<b>113</b>
<i>N. Akutsu, H. Tokunaga, I. Waki, A. Yamaguchi, and K. Matsumoto</i>	
<b>Wide GaN Stripes by Lateral Growth in Metalorganic Vapor-Phase Epitaxy</b> .....	<b>119</b>
<i>A. Kimura, C. Sasaoka, A. Sakai, and A. Usui</i>	
<b>Detection and Analysis of Phase Separation in Metalorganic-Chemical-Vapor-Deposition InGaN</b> .....	<b>125</b>
<i>E.L. Piner, N.A. El-Masry, S.X. Liu, and S.M. Bedair</i>	

\*Invited Paper

<b>Microstructural Evaluation of ZnO Thin Films Deposited by MOCVD</b> .....	131
<i>C.R. Gorla, S. Liang, N. Emanetoglu, W.E. Mayo, and Y. Lu</i>	
<b>Growth Mechanism and Structure of AlN Films Grown on Sapphire by MOCVD 137</b>	
<i>Yun-Xin Li, L. Salamanca-Riba, K. Wongchotigui, P. Zhou, M.G. Spencer, and V.K. Jones</i>	
<b>The Effect of Hydrogen Carrier Gas on the Morphological Evolution and Material Properties of GaN on Sapphire</b> .....	143
<i>T.B. Ng, J. Han, R.M. Biefeld, J.C. Zolper, M.H. Crawford, and D.M. Follstaedt</i>	
<b>Diluent Gas Effects on Properties of AlN and GaN Thin Films Grown by Metalorganic Vapor-Phase Epitaxy on <math>\alpha</math>(6H)-SiC Substrates</b> .....	149
<i>Andrew Hanser, Colin Wolden, William Perry, Tsvetanka Zheleva, Eric Carlson, Philip Hartlieb, and Robert F. Davis</i>	
<b>Multiwafer MOVPE of III-Nitride Films for LED and Laser Applications</b> .....	155
<i>R. Beccard, O. Schoen, B. Schineller, D. Schmitz, M. Heuken, and H. Jürgensen</i>	
<b>Low-Temperature GaN Growth of Nitridated Sapphire Using Remote Plasma-Enhanced Ultrahigh Vacuum Chemical Vapor Deposition</b> .....	161
<i>Dong-Jun Kim, Kyoung-Kook Kim, Jong-Sik Paek, Min-Su Yi, Do-Young Noh, Hyo-Gun Kim, and Seong-Ju Park</i>	
<b>A Kinetic Model for GaN Growth</b> .....	167
<i>D.D. Koleske, A.E. Wickenden, R.L. Henry, W.J. DeSisto, and R.J. Gorman</i>	
<b>MOVPE Growth of GaPAsN Quaternary Alloys Lattice-Matched to GaP</b> .....	173
<i>Goshi Biwa, Hiroyuki Yaguchi, Kentaro Onabe, and Yasuhiro Shiraki</i>	
<b>Vacuum Pressure MOCVD Growth and Characterization of AlN Films on MgO(100), Sapphire, and Si</b> .....	179
<i>A.D. Serra, N.P. Magtoto, D.C. Ingram, and H.H. Richardson</i>	
<b>The Effect of Growth Temperature on the Microstructure of MOVPE AlN/Si(111)</b> .....	185
<i>Mei Zhou, N.R. Perkins, E. Rehder, T.F. Kuech, and S.E. Babcock</i>	

### PART III: GROWTH TECHNIQUES-MBE AND HVPE

<b>*Phase Separation and Atomic Ordering in AlGaInN Alloys</b> .....	193
<i>T.D. Moustakas, R. Singh, D. Korakakis, D. Doppalapudi, H.M. Ng, A. Sampath, E. Iliopoulos, and M. Misra</i>	

\*Invited Paper

<b>Controlling 2D/3D Growth of GaN by Molecular-Beam Epitaxy: From Superlattices to Quantum Dots</b> .....	<b>205</b>
<i>B. Daudin, G. Feuillet, F. Widmann, Y. Samson, J.L. Rouviere, N. Pelekanos, and G. Fishman</i>	
<b>Si- and Mg-Doped GaN Layers Grown by Gas Source Molecular-Beam Epitaxy Using Ammonia</b> .....	<b>211</b>
<i>N. Grandjean, M. Massies, and M. Leroux</i>	
<b>Stress-Controlled MBE Growth of GaN:Mg and GaN:Si</b> .....	<b>217</b>
<i>Y. Kim, R. Klockenbrink, C. Kieselowski, J. Krüger, D. Corlatan, G.S. Sudhir, Y. Peyrot, Y. Cho, M. Rubin, and E.R. Weber</i>	
<b>Drastic Change in the GaN Film Quality by <i>In Situ</i> Controlling Surface Reconstructions in GSMBE</b> .....	<b>223</b>
<i>X.Q. Shen, S. Tanaka, S. Iwai, and Y. Aoyagi</i>	
<b>Effect of Atomic-Hydrogen Treatment of (001)GaAs Substrate at "High Temperatures" on rf Plasma-Assisted Molecular-Beam Epitaxy of Cubic GaN</b> .....	<b>227</b>
<i>A. Yoshikawa, H. Nagano, Z.X. Qin, Y. Sugure, A.W. Jia, M. Kobayashi, M. Shimotomai, Y. Kato, and K. Takahashi</i>	
<b>*Bulk GaN Crystal With Low Defect Density Grown by Hydride Vapor-Phase Epitaxy</b> .....	<b>233</b>
<i>A. Usui</i>	
<b>AlN/GaN and AlGaN/GaN Heterostructures Grown by HVPE on SiC Substrates</b> .....	<b>245</b>
<i>Yu.V. Melnik, A.E. Nikolaev, S.I. Stepanov, A.S. Zubrilov, I.P. Nikitina, K.V. Vassilevski, D.V. Tsvetkov, A.I. Babanin, Yu.G. Musikhin, V.V. Tretyakov, and V.A. Dmitriev</i>	
<b>GaN <i>p-n</i> Structures Grown by Hydride Vapor-Phase Epitaxy</b> .....	<b>251</b>
<i>A.E. Nikolaev, Yu.V. Melnik, N.I. Kuznetsov, A.M. Strelchuk, A.P. Kovarsky, K.V. Vassilevski, and V.A. Dmitriev</i>	
<b>*Selective-Area Growth of GaN by MOVPE and HVPE</b> .....	<b>257</b>
<i>K. Hiramatsu, H. Matsushima, T. Shibata, N. Sawaki, K. Tadatomo, H. Okagawa, Y. Ohuchi, Y. Honda, and T. Matsue</i>	
<b>Properties of Freestanding GaN Bulk Crystals Grown by HVPE</b> .....	<b>269</b>
<i>Yu. Melnik, A. Nikolaev, I. Nikitina, K. Vassilevski, and V. Dmitriev</i>	

#### **PART IV: NOVEL SUBSTRATES AND GROWTH TECHNIQUES**

<b>MOCVD Growth of GaN on Bulk AlN Substrates</b> .....	<b>277</b>
<i>Hongqiang Lu, Ishwara Bhat, Byung-Chan Lee, Glen Slack, and Leo J. Schowalter</i>	
<b>Growth of GaN on Lithium Gallate Substrates for Development of a GaN Thin Compliant Substrate</b> .....	<b>283</b>
<i>W.A. Doolittle, T. Kropewnicki, C. Carter-Coman, S. Stock, P. Kohl, N.M. Jokerst, R.A. Metzger, S. Kang, K. Lee, G. May, and A.S. Brown</i>	

\*Invited Paper

<b>Ultrasmooth ZnO Buffer Layers on (001) Sapphire</b> .....	<b>289</b>
<i>A.J. Drehman, S-Q. Wang, and P.W. Yip</i>	
<b>MBE Growth of GaN on NdGaO<sub>3</sub>(101)</b> .....	<b>295</b>
<i>C. Fechtmann, V. Kirchner, S. Einfeldt, H. Heinke, D. Hommel, T. Lukasiewicz, Z. Luczynski, and J. Baranowski</i>	
<b>Organometallic Vapor-Phase Lateral Epitaxy of Low Defect Density GaN Layers</b> .....	<b>301</b>
<i>O.H. Nam, T.S. Zheleva, M.D. Bremser, D.B. Thomson, and R.F. Davis</i>	
<b>Photoluminescence Characteristics of GaN Layers Grown on SOI Substrates and Relation to Material Properties</b> .....	<b>307</b>
<i>A. Philippe, C. Bru-Chevallier, G. Guillot, J. Cao, D. Pavlidis, and A. Eisenbach</i>	
<b>Single-Crystal Gallium Nitride on Silicon Using SiC as an Intermediate Layer</b> .....	<b>313</b>
<i>S.A. Ustin and W. Ho</i>	
<b>Energy Dependent Growth Rates of AlN Using Pulsed Supersonic Jets</b> .....	<b>319</b>
<i>V.W. Ballarotto and M.E. Kordesch</i>	
<b>Design and Characterization of a UHV Arcjet Nitrogen Source</b> .....	<b>325</b>
<i>R.N. Bicknell-Tassius, P.W. Deelman, P.J. Grunthaler, F.J. Grunthaler, C.E. Bryson, E. Snyder, J.L. Giuliani, J.P. Apruzes, and P. Kepple</i>	
<b>Homoepitaxial Growth of GaN Using Seeded Supersonic Molecular Beams</b> .....	<b>331</b>
<i>E. Chen, S. Zhang, A. Michel, R.F. Davis, and H.H. Lamb</i>	
<b>Structure and Properties of III-N Semiconductor Thin Films Grown at Low Temperatures by N-Radical-Assisted Pulsed Laser Deposition</b> .....	<b>337</b>
<i>F.E. Fernandez, M. Pumarol, A. Martinez, V. Pantojas, and M. Garcia</i>	
<b>Pulsed Laser Deposition of Highly Crystalline GaN Films on Sapphire</b> .....	<b>343</b>
<i>R.D. Vispute, V. Talyansky, S. Choopun, R. Enck, T. Dahmas, S.B. Ogale, R.P. Sharma, T. Venkatesan, Y.X. Li, L.G. Salamanca-Riba, A.A. Iliadis, M. He, X. Tang, J.B. Halpern, M.G. Spencer, M.A. Khan, K.A. Jones, V. Bel'kov, V. Botnaryuk, I. Diakonou, L. Fedorov, and Y. Zhilyaev</i>	

## **PART V: STRUCTURAL PROPERTIES**

<b>*Structural and Optical Properties of Group-III Nitride Quantum Wells Studied by (S)TEM and CL</b> .....	<b>351</b>
<i>H. Lakner, Q. Liu, G. Brockel, A. Radefeld, F. Schulze-Kraasch, and F. Scholz</i>	

<b>Scanning-Tunneling-Microscopy Observation of Surface Reconstruction of GaN on Sapphire and 6H-SiC</b> .....	<b>363</b>
<i>A.R. Smith, V. Ramachandran, R.M. Feenstra, D.W. Greve, J. Neugebauer, J.E. Northrup, M. Shin, and M. Skowronski</i>	
<b>Atomic Scale Aluminum and Strain Distribution in a GaN/Al<sub>1-x</sub>Ga<sub>x</sub>N Heterostructure</b> .....	<b>369</b>
<i>Christian Kisielowski, Olaf Schmidt, and Jinwei Yang</i>	
<b>Role of Dopants and Impurities on Pinhole Formation; Defects Formed at InGaN/GaN and AlGaN/GaN Quantum Wells</b> .....	<b>375</b>
<i>Z. Liliental-Weber, S. Ruvimov, W. Swider, Y. Kim, J. Washburn, S. Nakamura, R.S. Kern, Y. Chen, and J.W. Yang</i>	
<b>The Effect of Si and Mg Doping in the Microstructure of Epitaxially Grown GaN</b> .....	<b>381</b>
<i>M. Katsikini, E.C. Paloura, M. Fieber-Erdmann, E. Holub-Krappe, and T.D. Moustakas</i>	
<b>Atomic Structure of Grain Boundaries and Interfaces in III-Nitrides Epitaxial Systems</b> .....	<b>387</b>
<i>S. Ruvimov, Z. Liliental-Weber, J. Washburn, H. Amano, I. Akasaki, and M. Koike</i>	
<b>Lateral Epitaxy Formation Mechanism and Microstructure of Selectively Grown GaN Structures</b> .....	<b>393</b>
<i>Tsvetanka Zheleva, Ok-Hyun Nam, Jason D. Griffin, Michael D. Bremser, and Robert F. Davis</i>	
<b>A Combined TEM/RHEED, SEM/CL Study of Epitaxial GaN</b> .....	<b>399</b>
<i>P.D. Brown, D.M. Tricker, Y. Xin, T.S. Cheng, C.T. Foxon, D. Evans, S.A. Galloway, J. Brock, and C.J. Humphreys</i>	
<b>Crystal Defects in GaN on (0001) Sapphire</b> .....	<b>405</b>
<i>Matthew T. Johnson, Zhigang Mao, and C. Barry Carter</i>	
<b>Comparative Study of Typical Defects in III-Nitride Thin Films and Their Alloys</b> .....	<b>411</b>
<i>K. Dovidenko, S. Oktyabrsky, J. Narayan, V. Joshkin, and M. Razeghi</i>	
<b>Dislocation Distribution and Subgrain Structure of GaN Films Deposited on Sapphire by HVPE and MOVPE</b> .....	<b>417</b>
<i>K.A. Dunn, S.E. Babcock, R. Vaudo, V. Phanse, and J. Redwing</i>	
<b>Transmission-Electron-Microscopy Study of Room-Temperature Lasing Epitaxial ZnO Films on Sapphire</b> .....	<b>423</b>
<i>N. Wang, K.K. Fung, P. Yu, Z.K. Tang, G.K.L. Wong, M. Kawasaki, A. Ohtomo, H. Koinuma, and Y. Segawa</i>	
<b>Amorphous Domains in GaN Layers Grown on 6H-SiC by MBE</b> .....	<b>429</b>
<i>P. Vermaut, V. Potin, P. Ruterana, A. Hairie, G. Nouet, A. Salvador, and H. Morkoç</i>	

<b>Low-Angle and High-Angle Grain Boundaries in AlN/GaN Layers Grown on (0001) Sapphire by MBE</b> .....	<b>435</b>
<i>V. Potin, P. Ruterana, A. Hairie, and G. Nouet</i>	
<b>In Situ RHEED-TRAXS Monitoring Alloy Composition of the Surface During RF-MBE Growth of GaInN and AlGaIn</b> .....	<b>441</b>
<i>A. Ito, H. Sakai, M. Inagaki, G. Nomura, Y. Nakamura, T. Yasuda, H. Amano, and I. Akasaki</i>	
<b>Comparative Analysis of Strain and Stress in MBE- and MOCVD-Grown GaN Thin Films on Sapphire</b> .....	<b>447</b>
<i>Joachim Krüger, G.S. Sudhir, Dorina Corlatan, Yonah Cho, Yihwan Kim, Ralf Klockenbrink, Sergei Rouvimov, Zuzanna Liliental-Weber, Christian Kisielowski, Michael Rubin, Eicke R. Weber, Brian McDermott, R. Pittman, and Edward R. Gertner</i>	
<b>Microstructure of InGaIn Quantum Wells</b> .....	<b>453</b>
<i>F.A. Ponce, D. Cherns, W. Goetz, and R.S. Kern</i>	
<b>The Core Structure of Pure Edge Threading Dislocations in GaN Layers Grown on (0001)SiC or Sapphire by MBE</b> .....	<b>459</b>
<i>P. Ruterana, V. Potin, and G. Nouet</i>	
<b>High-Resolution X-ray-Diffraction Analysis of "Device-Quality" Cubic GaN Grown on (001)GaAs Substrate Prepared by Atomic-Hydrogen Treatment at "High Temperatures"</b> .....	<b>465</b>
<i>A. Yoshikawa, Z.X. Qin, H. Nagano, Y. Sugure, A.W. Jia, M. Kobayashi, M. Shimotomai, Y. Kato, and K. Takahashi</i>	
<b>TEM Study of Interfaces and Defects in MOCVD-Grown GaN on SiC on SIMOX</b> .....	<b>471</b>
<i>W.L. Zhou, P. Pirouz, F. Namavar, P.C. Colter, M. Yoganathan, M.W. Leksono, and J.I. Pankove</i>	

## PART VI: ELECTRONIC PROPERTIES

<b>*Structural Properties of Nitrides Grown by OMVPE on Sapphire Substrate</b> .....	<b>479</b>
<i>H. Amano, T. Takeuchi, S. Yamaguchi, S. Nitta, M. Kariya, M. Iwaya, C. Wetzel, and I. Akasaki</i>	
<b>*Localized Donors in GaN: Spectroscopy Using Large Pressures</b> .....	<b>489</b>
<i>C. Wetzel, H. Amano, I. Akasaki, T. Suski, J.W. Ager, E.R. Weber, E.E. Haller, and B.K. Meyer</i>	
<b>Interactions of LO Phonons With Bound Excitons in Homoepitaxial GaN</b> .....	<b>501</b>
<i>K.P. Korona, A. Wyszomolek, J.M. Baranowski, K. Pakula, J.P. Bergman, B. Monemar, I. Grzegory, and S. Porowski</i>	

\*Invited Paper



<b>Electron Mobility of <i>n</i>-Type GaN Films</b> .....	<b>507</b>
<i>H.M. Ng, D. Doppalapudi, R. Singh, and T.D. Moustakas</i>	
<b>Effects of Piezoelectric Fields in GaInN/GaN and GaN/ AlGaIn Heterostructures and Quantum Wells</b> .....	<b>513</b>
<i>Jin Seo Im, H. Kollmer, J. Off, A. Sohmer, F. Scholz, and A. Hangleiter</i>	
<b>Photocurrent Response in Mg-Doped GaN</b> .....	<b>519</b>
<i>C.H. Qiu, J.I. Pankove, I. Akasaki, and H. Amano</i>	
<b>Effect of Mg, Zn, Si, and O on the Lattice Constant of Gallium Nitride Thin Films</b> .....	<b>525</b>
<i>G.S. Sudhir, Y. Peyrot, J. Krüger, Y. Kim, R. Klockenbrink, C. Kisielowski, M.D. Rubin, E.R. Weber, W. Kriegseis, and B.K. Meyer</i>	
<b>Photoquenching of Persistent Photoconductivity in <i>n</i>-Type GaN</b> .....	<b>531</b>
<i>Michèle T. Hirsch, O. Seifert, O. Kirfel, J. Parisi, J.A. Wolk, W. Walukiewicz, E.E. Haller, O. Ambacher, and M. Stutzmann</i>	
<b>Magnetoluminescence and Resonant Electronic Raman Scattering Investigation of Donors and Excitons in Hydride VPE and MOCVD GaN</b> .....	<b>537</b>
<i>B.J. Skromme, J. Jayapalan, D. Wang, and O.F. Sankey</i>	
<b>Raman Analysis of Al<sub>x</sub>Ga<sub>1-x</sub>N Films</b> .....	<b>543</b>
<i>Leah Bergman, Mitra Dutta, Michael D. Bremser, Ok-Hyun Nam, William G. Perry, Dimitri Alexon, Robert F. Davis, Cengiz M. Balkas, and Robert J. Nemanich</i>	
<b>Characterization of Bulk, Polycrystalline Indium Nitride Grown at Subatmospheric Pressures</b> .....	<b>549</b>
<i>Jeffrey S. Dyck, Kathleen Kash, Kwiseon Kim, Walter R.L. Lambrecht, Cliff C. Hayman, Alberto Argoitia, Michael T. Grossner, Wellie L. Zhou, and John C. Angus</i>	
<b>Fine Structure and Magneto-optics of Excitonic Levels in Wurtzite GaN</b> .....	<b>555</b>
<i>L. Eckey, A. Hoffmann, P. Thurian, I. Broser, B.K. Meyer, and K. Hiramatsu</i>	
<b>Location of Residual Donors in GaN Epitaxial Layers</b> .....	<b>561</b>
<i>E.R. Glaser, T.A. Kennedy, A.E. Wickenden, D.D. Koleske, W.G. Perry, and R.F. Davis</i>	
<b>Characterization of Si-Doped GaN on (00.1) Sapphire Grown by MOCVD</b> .....	<b>567</b>
<i>Chang Soo Kim, Dong-Kun Lee, Cheul-Ro Lee, Sam Kyu Noh, In-Hwan Lee, and In-Ho Bae</i>	
<b>Nondestructive, Room-Temperature Determination of the Nature of the Band-Bending (Carrier Type) in Group-III Nitrides Using Contactless Electroreflectance and Surface Photovoltage Spectroscopy</b> .....	<b>573</b>
<i>Wojciech Krystek, Fred H. Pollak, Z.C. Feng, M. Schurman, and R.A. Stall</i>	

**The Doping and Characterization of Erbium-Implanted GaN** ..... 579  
*J.T. Torvik, R.J. Feuerstein, C.H. Qiu, J.I. Pankove, and F. Namavar*

**Evidence of Potential Fluctuations in Modulation-Doped GaN/AlGaN Heterostructures** ..... 585  
*A.V. Buyanov, J. Sandberg, J.P. Bergman, B.E. Sernelius, P.O. Holtz, B. Monemar, H. Amano, and I. Akasaki*

**GaN Room-Temperature Exciton Spectra by Photovoltaic Measurement** ..... 593  
*W. Liu, M.F. Li, S.J. Chua, Y.H. Zhang, and K. Uchida*

**Electron-Phonon Scattering in GaN/AlN and GaAs/AIAs Quantum Wells** ..... 599  
*T.F. Forbang and C.R. McIntyre*

**PART VII: LUMINESCENCE AND RECOMBINATION**

**\*Time-Resolved Photoluminescence of GaN/Ga<sub>0.93</sub>Al<sub>0.07</sub>N Quantum Wells** ..... 607  
*P. Lefebvre, J. Allègre, B. Gil, A. Kavokine, H. Mathieu, W. Kim, A. Salvador, A. Botchkarev, and H. Morkoç*

**\*Localized Excitons in InGaN** ..... 613  
*S. Chichibu, T. Deguchi, T. Sota, K. Wada, and S. Nakamura*

**Cathodoluminescence Studies of InGaN Quantum Wells** ..... 625  
*F.A. Ponce, S.A. Galloway, W. Goetz, and R.S. Kern*

**Optical Properties of InGaN/GaN Multiquantum-Well Structures** ..... 631  
*J.P. Bergman, N. Saksulv, J. Dalfors, P.O. Holtz, B. Monemar, H. Amano, and I. Akasaki*

**Radiative and Nonradiative Relaxation of Excitons in GaN** ..... 637  
*A. Göldner, L. Eckey, A. Hoffmann, I. Broser, A. Alemu, B. Gil, S. Ruffenach-Clur, R.L. Aulombard, and O. Briot*

**Well Thickness and Doping Effects, and Room-Temperature Emission Mechanisms in InGaN/GaN and GaN/AlGaN Multiple-Quantum-Wells** ..... 643  
*K.C. Zeng, M. Smith, J.Y. Lin, H.X. Jiang, H. Tang, A. Salvador, W. Kim, H. Morkoç, and M. Asif Khan*

**Photoluminescence Properties of GaN/AlGaN Multiple-Quantum-Well Microdisks** ..... 649  
*R.A. Mair, K.C. Zeng, J.Y. Lin, H.X. Jiang, B. Zhang, L. Dai, H. Tang, A. Botchkarev, W. Kim, and H. Morkoç*

\*Invited Paper

<b>Near Bandgap Photoluminescence Broadening in n-GaN Films</b> .....	<b>655</b>
<i>E. Iliopoulos, D. Doppalapudi, H.M. Ng, and T.D. Moustakas</i>	
<b>Depth-Resolved and Excitation Power Dependent Cathodoluminescence of MBE-Grown Cubic GaN Epilayers</b> .....	<b>661</b>
<i>D.J. As, C. Wang, B. Schöttker, D. Schikora, and K. Lischka</i>	
<b>Photoluminescence Quenching Spectroscopy of Trap-Mediated Er<sup>3+</sup> Excitation Mechanisms in Er-Implanted GaN</b> .....	<b>667</b>
<i>S.J. Rhee, S. Kim, X. Li, J.J. Coleman, and S.G. Bishop</i>	
<b>Photoluminescence Characterization of p-Type GaN:Mg</b> .....	<b>673</b>
<i>Dorina Corlatan, Joachim Krüger, Christian Kisielowski, Ralf Klockenbrink, Yihwan Kim, G.S. Sudhir, Yann Peyrot, Michael Rubin, and Eicke R. Weber</i>	
<b>Luminescence Properties of Si-Doped GaN and Evidence of Compensating Defects as the Origin of the Yellow Luminescence</b> .....	<b>679</b>
<i>I.D. Goepfert, E.F. Schubert, and J.M. Redwing</i>	
<b>High-Temperature Photoluminescence and Photoluminescence Excitation Spectroscopy of Er-Doped Gallium Nitride</b> .....	<b>685</b>
<i>U. Hömmerich, Myo Thaik, T. Robinson-Brown, J.D. MacKenzie, C.R. Abernathy, S.J. Pearton, R.G. Wilson, R.N. Schwartz, and J.M. Zavada</i>	
<b>Photoluminescence Excitation Study of LO-Phonon-Assisted Excitonic Transitions in GaN</b> .....	<b>691</b>
<i>S.J. Hwang, Y.H. Cho, J.J. Song, W. Shan, and Y.C. Chang</i>	
<b>Cubic InN Inclusions as the Cause for the Unusually Weak Pressure Shift of the Luminescence in InGaN</b> .....	<b>697</b>
<i>Piotr Perlin, Bernard A. Weinstein, Niels E. Christensen, Iza Gorczyca, Valentin Iota, Tadeusz Suski, Przemek Wisniewski, M. Osinski, and P.G. Eliseev</i>	
<b>Cross-Sectional Cathodoluminescence of GaN Epitaxial Films</b> .....	<b>703</b>
<i>M. Herrera Zaldivar, P. Fernández, and J. Piqueras</i>	
<b>Carbon and Hydrogen-Induced Yellow Luminescence in Gallium Nitride Grown by Halide Vapor-Phase Epitaxy</b> .....	<b>709</b>
<i>R. Zhang and T.F. Kuech</i>	
<b>Probing the Indium Mole Fraction in an InGaN Epilayer by Depth-Resolved Cathodoluminescence</b> .....	<b>715</b>
<i>C. Trager-Cowan, P.G. Middleton, A. Mohammed, K.P. O'Donnell, W. Van der Stricht, I. Moerman, and P. Demeester</i>	
<b>Temperature Dependence of the Fundamental Bandgap in Hexagonal GaN</b> .....	<b>719</b>
<i>H. Herr, V. Alex, and J. Weber</i>	

<b>Luminescence of a New Material: GaN Grown on NdGaO<sub>3</sub></b> .....	<b>725</b>
<i>K.P. Korona, K. Pakula, A. Wyszomolek, J.M. Baranowski, J.P. Bergman, B. Monemar, T. Lukaszewicz, and Z. Luczynski</i>	
<b>Isoelectronic Traplike Luminescence Centers of InGaN</b> .....	<b>731</b>
<i>H. Kanie, H. Koami, T. Kawano, and T. Totsuka</i>	
<b>InGaN Quantum Dots Fabricated on AlGaIn Surfaces - Growth Mechanism and Optical Properties</b> .....	<b>737</b>
<i>H. Hirayama, S. Tanaka, P. Ramvall, and Y. Aoyagi</i>	
 <b><u>PART VIII: CHARACTERIZATION, ELEMENTAL AND STRESS ANALYSIS</u></b>	
<b>*Elemental Analysis on Group-III Nitrides Using Heavy Ion ERD</b> .....	<b>745</b>
<i>G. Dollinger, S. Karsch, O. Ambacher, H. Angerer, A. Bergmaier, O. Schmelmer, and M. Stutzmann</i>	
<b>Observation of Native Ga Vacancies in GaN by Positron Annihilation</b> .....	<b>757</b>
<i>K. Saarinen, T. Laine, S. Kuisma, J. Nissilä, P. Hautojärvi, L. Dobrzynski, J.M. Baranowski, K. Pakula, R. Stepniewski, M. Wojdak, A. Wyszomolek, T. Suski, M. Leszczynski, I. Grzegory, and S. Porowski</i>	
<b>Local Electronic Structure of Defects in GaN From Spatially Resolved Electron Energy-Loss Spectroscopy</b> .....	<b>763</b>
<i>M.K.H. Natusch, G.A. Botton, R.F. Broom, P.D. Brown, D.M. Tricker, and C.J. Humphreys</i>	
<b>Stress Gradients in Heteroepitaxial Gallium Nitride Films</b> .....	<b>769</b>
<i>J.W. Ager, III, G. Conti, L.T. Romano, and C. Kisielowski</i>	
<b>Compositionally Dependent Band Offsets in AlN/Al<sub>x</sub>Ga<sub>1-x</sub>N Heterojunctions Measured by Using X-ray Photoelectron Spectroscopy</b> .....	<b>775</b>
<i>R.A. Beach, E.C. Piquette, R.W. Grant, and T.C. McGill</i>	
<b>Direct Observation of Atomic Structures of Defects in GaN by High-Resolution Z-Contrast STEM</b> .....	<b>781</b>
<i>Y. Xin, S.J. Pennycook, N.D. Browning, P.D. Nellist, S. Sivanathan, B. Beaumont, J-P. Faurie, and P. Gibart</i>	
<b>Photoemission Study of the Electronic Structure of Wurtzite GaN(0001) Surfaces</b> .....	<b>787</b>
<i>Kevin E. Smith, Sarnjeet S. Dhesi, Cristian B. Stagarescu, James Downes, D. Doppalapudi, and Theodore D. Moustakas</i>	

## PART IX: PHYSICAL MODELING

<b>*Theoretical Investigation of Extended Defects in Group-III Nitrides</b> .....	795
<i>A.F. Wright</i>	
<b>*Excitonic Enhanced Optical Gain of GaN/AlGaN Quantum Wells With Localized States</b> .....	805
<i>Takeshi Uenoyama</i>	
<b>Monte Carlo Calculation of High- and Low-Field <math>Al_xGa_{1-x}N</math> Electron Transport Characteristics</b> .....	815
<i>J.D. Albrecht, R. Wang, P.P. Ruden, M. Farahmand, E. Bellotti, and K.F. Brennan</i>	
<b>Velocity Overshoot and Ballistic Electron Transport in Wurtzite Indium Nitride</b> .....	821
<i>B.E. Foutz, S.K. O'Leary, M.S. Shur, L.F. Eastman, and U.V. Bhapkar</i>	
<b>An Investigation of the Electron Escape Time Within a Biased AlGaIn/GaN Quantum Well</b> .....	827
<i>Kevin R. Lefebvre and A.F.M. Anwar</i>	
<b>Structural and Electronic Properties of GaN/Al Interfaces</b> .....	833
<i>S. Picozzi, A. Continenza, S. Massidda, and A.J. Freeman</i>	
<b>Acceptor Binding Energies in GaN and AlN</b> .....	839
<i>Francisco Mireles and Sergio E. Ulloa</i>	
<b>The Velocity-Field Characteristic of Indium Nitride</b> .....	845
<i>S.K. O'Leary, B.E. Foutz, M.S. Shur, L.F. Eastman, and U.V. Bhapkar</i>	
<b>Interband Radiative Recombination Calculations in Ternary Nitride Solid Solutions</b> .....	851
<i>A.V. Dmitriev and A.L. Oruzhenikov</i>	
<b><i>Ab Initio</i> Calculations of Second Order Optical Response Functions in Wurtzite GaN and AlN, and Their Short Period Superlattices</b> .....	857
<i>Sergey N. Rashkeev, Walter R.L. Lambrecht, and B. Segall</i>	
<b>Thermal Expansion of GaN and AlN</b> .....	863
<i>Kai Wang and Robert R. Reeber</i>	
<b>Constant Pressure First-Principles Molecular-Dynamics Study on BN, AlN, and GaN</b> .....	869
<i>K. Shimada, T. Sota, and K. Suzuki</i>	
<b>Dislocations in GaN/Sapphire: Their Distribution and Effect on Stress and Optical Properties</b> .....	875
<i>S.C. Jain, K. Pinardi, H.E. Maes, R. Van Overstraeten, M. Willander, and A. Atkinson</i>	

\*Invited Paper

<b>Electron Irradiation-Induced Trap in n-Type GaN</b> .....	<b>881</b>
<i>Z-Q. Fang, J.W. Hensky, D.C. Look, M.P. Mack, R.J. Molnar, and G.D. Via</i>	
<b>Deep Trap Characterization in GaN Using Thermal and Optical Admittance Spectroscopy</b> .....	<b>887</b>
<i>A. Krtschil, H. Witte, M. Lisker, J. Christen, U. Birkle, S. Einfeldt, D. Hommel, M. Topf, and B.K. Meyer</i>	
<b>Uniaxial Stress Effects on Valence-Band Structures of GaN</b> .....	<b>893</b>
<i>A.A. Yamaguchi, Y. Mochizuki, C. Sasaoka, A. Kimura, M. Nido, and A. Usui</i>	
<b>Theory of Interfaces and Surfaces of Wide-Gap Nitrides</b> .....	<b>899</b>
<i>Krzysztof Rapcewicz, Marco Buongiorno Nardelli, Claudia Bungaro, E.L. Briggs, and J. Bernholc</i>	
<b>Theoretical Study of Native Point Defects in AlN and InN</b> .....	<b>905</b>
<i>C. Stampfl and Chris G. Van de Walle</i>	
<b>Band Offsets in GaN/AlN and AlN/SiC Heterojunctions</b> .....	<b>911</b>
<i>Nadia Binggeli, Philippe Ferrara, and Alfonso Baldereschi</i>	
<b>Effects of Substrate Orientation on the Valence-Band Splittings and Valence-Band Offsets in GaN and AlN Films</b> .....	<b>917</b>
<i>J.A. Majewski and M. Städele</i>	
<b>Valence-Band Parameters for Wurtzite GaN and InN</b> .....	<b>923</b>
<i>Y.C. Yeo, T.C. Chong, and M.F. Li</i>	
<b>New Method of Computing Band Offsets and Its Application to AlGaIn/GaN Heterostructures</b> .....	<b>929</b>
<i>Richard T. Webster and A.F.M. Anwar</i>	
<b>Theory of Ga, N, and H Terminated GaN(0001)/(0001̄) Surfaces</b> .....	<b>935</b>
<i>J. Elsner, M. Haugk, R. Gutierrez, and Th. Frauenheim</i>	
<b>Simulation of Vacancy Pairs in GaN Using Tight-Binding Molecular Dynamics</b> .....	<b>941</b>
<i>Derrick E. Boucher, Zoltán A. Gál, Gary G. DeLeo, and W. Beall Fowler</i>	

**PART X: DEVICE PROCESSING, IMPLANTATION, ANNEALING**

<b>*Doping, Activation of Impurities, and Defect Annihilation in GaN by High Pressure Annealing</b> .....	<b>949</b>
<i>T. Suski, J. Jun, M. Leszczynski, H. Teisseyre, I. Grzegory, S. Porowski, J.M. Baranowski, A. Rocket, S. Strite, A. Stonert, A. Turos, H.H. Tan, J.S. Williams, and C. Jagadish</i>	
<b>*GaN Device Processing</b> .....	<b>961</b>
<i>S.J. Pearton, F. Ren, J.C. Zolper, and R.J. Shul</i>	

\*Invited Paper

<b>Laser Processing for Patterned and Freestanding Nitride Films</b> .....	<b>973</b>
<i>M.K. Kelly, O. Ambacher, R. Dimitrov, H. Angerer, R. Handschuh, and M. Stutzmann</i>	
<b>Recent Progress in Implantation and Annealing of GaN and AlGaIn</b> .....	<b>979</b>
<i>J.C. Zolper, J. Han, S.B. Van Deusen, M.H. Crawford, R.M. Biefeld, J. Jun, T. Suski, J.M. Baranowski, and S.J. Pearton</i>	
<b>Phase Separation in InGaIn/GaN Multiple-Quantum-Wells</b> .....	<b>985</b>
<i>M.C. McCluskey, L.T. Romano, B.S. Krusor, D.P. Bour, C. Chua, N.M. Johnson, and Kin Man Yu</i>	
<b>*Selective-Area Etching of GaN and AlGaIn by Thermally Chemical Reaction in Hydrogen Ambient</b> .....	<b>991</b>
<i>K. Hiramatsu, H. Matsushima, H. Hanai, and N. Sawaki</i>	
<b>Photoluminescence of Wet- and Dry-Etched Gallium Nitride</b> .....	<b>997</b>
<i>E.E. Reuter, C. Youtsey, I. Adesida, and S.G. Bishop</i>	
<b>Current Controlled Photoelectrochemical Etching of GaN Leaving Smooth Surfaces</b> .....	<b>1003</b>
<i>T. Rotter, D. Uffmann, J. Ackermann, J. Aderhold, J. Stemmer, and J. Graul</i>	
<b>Fabrication and Optical Pumping of Laser Cavities Made by Cleaving and Wet Chemical Etching</b> .....	<b>1009</b>
<i>D. Stocker, E.F. Schubert, W. Grieshaber, J.M. Redwing, K.S. Boutros, J.S. Flynn, and R.P. Vaudo</i>	
<b>Pulsed Laser Etching of GaN and AlN Films</b> .....	<b>1015</b>
<i>H. Chen, R.D. Vispute, V. Talyansky, R. Enck, S.B. Ogale, T. Dahmas, S. Choopun, R.P. Sharma, T. Venkatesan, A.A. Iliadis, L.G. Salamanca-Riba, and K.A. Jones</i>	
<b>Lattice Location and Luminescence Behavior of Rare-Earth Elements Implanted in GaN</b> .....	<b>1021</b>
<i>M. Dalmer, M. Restle, A. Stötzler, U. Vetter, H. Hofsäss, M.D. Bremser, C. Ronning, R.F. Davis, and the Isolde Collaboration</i>	
<b>Characterizations of Mg-Implanted GaN</b> .....	<b>1027</b>
<i>Gou-Chung Chi, B.J. Pong, C.J. Pan, Y.C. Teng, and C.H. Lee</i>	
<b>Luminescence Properties of As, P, and Bi as Isoelectronic Traps in GaN</b> .....	<b>1033</b>
<i>W.M. Jadwisieniczak and H.J. Lozykowski</i>	

**PART XI: DEVICE CHARACTERIZATION, CONTACTS, DEGRADATION**

<b>Aging of InGaIn/AlGaIn/GaN Light-Emitting Diodes</b> .....	<b>1041</b>
<i>A.E. Yunovich, A.N. Kovalev, V.E. Kudryashov, F.I. Manyakhin, and A.N. Turkin</i>	

<b>InGaN Double Heterostructures and DH-LEDs on HVPE GaN-on-Sapphire Substrates</b> .....	<b>1047</b>
<i>K.S. Boutros, J.S. Flynn, V. Phanse, R.P. Vaudo, G.M. Smith, J.M. Redwing, T.R. Tolliver, and N.G. Anderson</i>	
<b>Formation of Ni/Pt/Au Ohmic Contacts to p-GaN</b> .....	<b>1053</b>
<i>Ja-Soon Jang, Hyo-Gun Kim, Kyung-Hyun Park, Chang-Sub Um, Il-Ki Han, Sun-Ho Kim, Heong-Kyu Jang, and Seong-Ju Park</i>	
<b>Materials Characterization on Optically Pumped InGaN/GaN Lasers by Far-Field Measurements and Fourier Analysis of the Emission Spectrum</b> .....	<b>1059</b>
<i>D. Hofstetter, R.L. Thornton, L.T. Romano, D.P. Bour, and N.M. Johnson</i>	
<b>High-Temperature GaN and AlGaIn Photovoltaic Detectors for uv Sensing Applications</b> .....	<b>1065</b>
<i>J.M. Van Hove, P.P. Chow, R. Hickman, II, J.J. Klaassen, A.M. Wowchak, and C.J. Polley</i>	
<b>DC and Microwave Characteristics of High Transconductance AlGaIn/GaN Heterostructure Field-Effect Transistors on SiC Substrates</b> .....	<b>1071</b>
<i>Q. Chen, J.W. Yang, M.A. Khan, A.T. Ping, and I. Adesida</i>	
<b>Ni/Si-Based Ohmic Contacts to p- and n-Type GaN</b> .....	<b>1077</b>
<i>E. Kamińska, A. Piotrowska, A. Barcz, M. Guziewicz, S. Kasjaniuk, M.D. Bremser, R.F. Davis, E. Dynowska, and S. Kwiatkowski</i>	
<b>Ohmic Contact to GaN Grown by MOCVD</b> .....	<b>1083</b>
<i>Dae-Woo Kim, Hong Koo Baik, Cha Yeon Kim, Sung Woo Kim, and Chang Hee Hong</i>	
<b>Experimental Study of Sputter-Deposited Contacts to Gallium Nitride</b> .....	<b>1089</b>
<i>E.C. Piquette, Z.Z. Bandić, and T.C. McGill</i>	
<b>Metal Contacts to n-Al<sub>x</sub>Ga<sub>1-x</sub>N</b> .....	<b>1095</b>
<i>A. Sampath, H.M. Ng, D. Korakakis, and T.D. Moustakas</i>	
<b>Characteristics of GaN Schottky Diode Grown on Sapphire Substrate by MOCVD</b> .....	<b>1101</b>
<i>T. Egawa, H. Ishikawa, K. Yamamoto, T. Jimbo, and M. Umeno</i>	
<b>Selection, Growth, and Characterization of Gate Insulators on MOCVD Gallium Nitride for the Use in High Power Field-Effect Devices</b> .....	<b>1107</b>
<i>R.J. Therrien, O.H. Nam, M.D. Bremser, K. Lithicum, H. Nimil, E.P. Carlson, G. Lucovsky, and R.F. Davis</i>	
<b>Electrical and Optical Characterization of Homojunction Gallium Nitride Light-Emitting Diodes</b> .....	<b>1113</b>
<i>G.M. Laws, J. Morgan, G.B. Ren, I. Harrison, E.C. Larkins, J.W. Orton, S.E. Hooper, T. Cheng, and C.T. Foxon</i>	



<b>Analysis of Optical Gain of Strained Wurtzite <math>\text{In}_x\text{Ga}_{1-x}\text{N}/\text{GaN}</math> Quantum-Well Lasers</b> .....	1119
<i>T.C. Chong, Y.C. Yeo, M.F. Li, and W.J. Fan</i>	
<b>Optical Gain in BGaN Lattice-Matched to (0001)6H-SiC</b> .....	1125
<i>T. Honda, M. Tsubamoto, Y. Kuga, and H. Kawanishi</i>	
<b>Breakdown Behavior of AlGaIn MSM uv Photodetectors</b> .....	1131
<i>S. Liang, Y. Liu, Y. Lu, M. Schurman, C.A. Tran, and I. Ferguson</i>	
<b>Gallium Nitride Multioperate Optoelectronic Devices</b> .....	1137
<i>V.G. Sidorov, A.G. Drizhuk, and D.V. Sidorov</i>	

**PART XII: INJECTION LASER DIODES AND APPLICATIONS**

<b>*InGaN/GaN/AlGaIn-Based Laser Diodes With an Estimated Lifetime of Longer Than 10,000 Hours</b> .....	1145
<i>Shuji Nakamura</i>	
<b>*Nitride Laser Diodes With InGaIn-Based MQW Structures</b> .....	1157
<i>Lisa Sugiura, Johji Nishi, Masaaki Onomura, Shin-ya Nunoue, Kazuhiko Itaya, and Masayuki Ishikawa</i>	
<b>*Status of Nitride-Based Light-Emitting and Laser Diodes on SiC</b> .....	1169
<i>K. Doverspike, G.E. Bulman, S.T. Sheppard, H.S. Kong, M. Leonard, H. Dieringer, T.W. Weeks, Jr., J. Edmond, J.D. Brown, J.T. Swindle, J.F. Schetzina, Y-K. Song, M. Kuball, and A. Nurmikko</i>	
<b>The First Nitride Laser Diode on Silicon Carbide</b> .....	1179
<i>J.D. Brown, J.T. Swindell, M.A.L. Johnson, Zhonghai Yu, J.F. Schetzina, G.E. Bulman, K. Doverspike, S.T. Sheppard, T.W. Weeks, M. Leonard, H.S. Kong, H. Dieringer, C. Carter, and J.A. Edmond</i>	
<b>*InGaIn Laser Diodes Grown on SiC Substrates Using Low-Pressure Metalorganic Vapor-Phase Epitaxy</b> .....	1185
<i>A. Kuramata, K. Domen, R. Soejima, K. Horino, S. Kubota, and T. Tanahashi</i>	
<b>Pulsed Operation of Cleaved-Facet InGaIn Laser Diodes</b> .....	1197
<i>R.K. Sink, A.C. Abare, P. Kozodoy, M.P. Mack, S. Keller, L.A. Coldren, S.P. DenBaars, and J.E. Bowers</i>	
<b>*Application of Blue Diode Lasers to Printing</b> .....	1203
<i>R.D. Bringans</i>	
<b>Author Index</b> .....	1211
<b>Subject Index</b> .....	1219

\*Invited Paper