

# Table of Contents

## Chapter 1: SiC Bulk Growth

### 1.1 Hexagonal SiC

<b>Quality Aspects for the Production of SiC Bulk Crystals</b> T.L. Straubinger, M. Rasp, E. Schmitt and A.D. Weber	3
<b>An Inserted Epitaxial Layer for SiC Single Crystal Growth by the Physical Vapor Transport Method</b> J.D. Seo, J.H. An, J.G. Kim, J.K. Kim, M.O. Kyun, W.J. Lee, I.S. Kim, B.C. Shin and K.R. Ku	9
<b>Growth and Characterization of <sup>13</sup>C Enriched 4H-SiC for Fundamental Materials Studies</b> Y.S. Jang, S.A. Sakwe, P.J. Wellmann, S. Juillaguet, H. Peyre, J. Camassel and J.W. Steeds	13
<b>Growth and Characterization of High-Quality 6H-SiC (0115) Bulk Crystals</b> O. Filip, B.M. Epelbaum, M. Bickermann and A. Winnacker	17
<b>Growth Induced Stacking Fault Formation in 4H-SiC</b> D. Siche, M. Albrecht, H.J. Rost and A. Sendzik	21
<b>Hydrogen Effect on SiC Single Crystal Prepared by the Physical Vapor Transport Method</b> J.G. Kim, J.H. An, J.D. Seo, J.K. Kim, M.O. Kyun, W.J. Lee, I.S. Kim, B.C. Shin and K.R. Ku	25

### 1.2 3C-SiC

<b>Effect of Growth Conditions on Cubic Silicon Carbide Crystals Grown from Silicon Solution</b> J. Eid, J.L. Sentailler, B. Ferrand, G. Rolland, M. Burdin, R. Lewandowska and J. Camassel	29
--	----

## Chapter 2: SiC Epitaxy

### 2.1 Homoepitaxial Growth

<b>Growth and Electrical Characterization of 4H-SiC Epilayers</b> T. Kimoto, K. Danno, T. Hori and H. Matsunami	35
<b>Growth of SiC from a Liquid Phase at Low Temperature</b> G. Ferro, M. Soueidan, O. Kim-Hak, F. Cauwet and Y. Monteil	41
<b>Thick Epilayer for Power Devices</b> A. Henry, J. ul Hassan, H. Pedersen, F.C. Beyer, P. Bergman, S. Andersson, E. Janzén and P. Godignon	47
<b>4H-SiC Epitaxial Layers Grown on On-Axis Si-Face Substrate</b> J. ul Hassan, P. Bergman, A. Henry, H. Pedersen, P.J. McNally and E. Janzén	53
<b>A Designed Experiment Approach to Improvement and Understanding of the SiC Epitaxial Growth Process</b> J.D. Oliver and B.H. Ponczak	57
<b>Analysis of SiC CVD Growth in a Horizontal Hot-Wall Reactor by Experiment and 3D Modelling</b> Y. Shishkin, R.L. Myers-Ward, S.E. Sadow, A. Galyukov, A.N. Vorob'ev, D. Brovin, D. Bazarevskiy, R.A. Talalaev and Y. Makarov	61
<b>Boron Doping during Vapor-Liquid-Solid Growth of Homoepitaxial 4H-SiC Layers</b> M. Soueidan, G. Ferro, B. Nsouli, N. Habka, V. Soulière, G. Younes, K. Zahraman, J.M. Bluet and Y. Monteil	65
<b>Comparison of Chlorine Based In Situ Etching of 4H SiC Substrates</b> M.F. MacMillan, M.J. Loboda, J.W. Wan, G.Y. Chung, E.P. Carlson, M.J. Spaulding and D. Deese	69
<b>CVD of 6H-SiC on Non-Basal Quasi Polar Faces</b> Y. Shishkin, S.P. Rao, O. Kordina, I. Agafonov, A.A. Maltsev, J. ul Hassan, A. Henry, C. Moisson and S.E. Sadow	73

<b>Developing an Effective and Robust Process for Manufacturing Bipolar SiC Power Devices</b> J.J. Sumakeris, B.A. Hull, M.J. O'Loughlin, M. Skowronski and V. Balakrishna	77
<b>Development of High Growth Rate SiC Epi-Reactor with Controlled Thermal Gradient</b> M. Ito, H. Tsuchida, I. Kamata and L. Storasta	81
<b>Effect of Additional Silane on In Situ H<sub>2</sub> Etching prior to 4H-SiC Homoepitaxial Growth</b> K. Kojima, S. Kuroda, H. Okumura and K. Arai	85
<b>Epitaxial Growth of 4H-SiC on (000-1) C-Face Substrates by Cold-Wall and Hot-Wall Chemical Vapor Deposition</b> R.A. Stein, B. Thomas and C. Hecht	89
<b>Film Morphology and Process Conditions in Epitaxial Silicon Carbide Growth via Chlorides Route</b> M. Masi, A. Veneroni, A. Fiorucci, F. La Via, G. Foti, M. Mauceri, S. Leone, G. Pistone, G. Condorelli, G. Abbondanza, G.L. Valente and D. Crippa	93
<b>Growth and Photoluminescence Study of Aluminium Doped SiC Epitaxial Layers</b> H. Pedersen, A. Henry, J. ul Hassan, P. Bergman and E. Janzén	97
<b>High Quality Uniform SiC Epitaxy for Power Device Applications</b> J. Zhang, E. Romano, J. Mazzola, S.G. Sunkari, C. Hoff, I. Sankin and M.S. Mazzola	101
<b>High SiC Growth Rate Obtained by Vapour-Liquid-Solid Mechanism</b> N. Boutarek, D. Chaussende and R. Madar	105
<b>Homoepitaxial Growth of 4H-SiC Multi-Epilayers and its Application to UV Detection</b> X.F. Liu, G.S. Sun, Y.M. Zhao, J. Ning, J.Y. Li, L. Wang, W.S. Zhao, M.C. Luo and J.M. Li	109
<b>Homoepitaxial Growth of Vanadium-Doped 4H-SiC Using Bis-Trimethylsilylmethane and Verrocene Precursors</b> H.K. Song, H.S. Seo, J.H. Moon, J.H. Yim, J.H. Lee, S.Y. Kwon, H.J. Na and H.J. Kim	113
<b>Improved Mesa Designs for the Growth of Thin 4H-SiC Homoepitaxial Cantilevers</b> A.J. Trunek, P.G. Neudeck and D.J. Spry	117
<b>In Situ Mass Spectrometry for Chemical Identification in SiC Epitaxial Deposition</b> B.H. Ponczak, J.D. Oliver, S. Cho and G.W. Rubloff	121
<b>In Situ Measurement of Nitrogen during Growth of 4H-SiC by CVD</b> B.L. VanMil, K.K. Lew, R.L. Myers-Ward, R.T. Holm, D.K. Gaskill and C.R. Eddy	125
<b>Low Trap Concentration and Low Basal-Plane Dislocation Density in 4H-SiC Epilayers Grown at High Growth Rate</b> T. Hori, K. Danno and T. Kimoto	129
<b>Low-Temperature Halo-Carbon Homoepitaxial Growth of 4H-SiC: Morphology, Doping, and Role of HCl Additive</b> H.D. Lin, G. Melnychuk, J.L. Wyatt and Y. Koshka	133
<b>Optimisation of Epitaxial Layer Growth with HCl Addition by Optical and Electrical Characterization</b> L. Calcagno, G. Izzo, G. Litrico, G. Galvagno, A. Firrincieli, S. Di Franco, M. Mauceri, S. Leone, G. Pistone, G. Condorelli, F. Portuese, G. Abbondanza, G. Foti and F. La Via	137
<b>Progress in Cold-Wall Epitaxy for 4H-SiC High-Power Devices</b> L.B. Rowland, G. Dunne, J. Fronheiser and S.I. Soloviev	141
<b>Scaling of Chlorosilane SiC CVD to Multi-Wafer Epitaxy System</b> J.W. Wan, M.J. Loboda, M.F. MacMillan, G.Y. Chung, E.P. Carlson and V.M. Torres	145
<b>Selective Epitaxial Growth of 4H-SiC with SiO<sub>2</sub> Mask by Low-Temperature Halo-Carbon Homoepitaxial Method</b> B. Krishnan, H. Das, H.D. Lin and Y. Koshka	149
<b>SiC Epitaxial Layers Grown by Sublimation Method and their Electrical Properties</b> C.K. Park, G.S. Lee, J.Y. Lee, M.O. Kyun, W.J. Lee, B.C. Shin and S. Nishino	153
<b>Very High Growth Rate Epitaxy Processes with Chlorine Addition</b> F. La Via, S. Leone, M. Mauceri, G. Pistone, G. Condorelli, G. Abbondanza, F. Portuese, G. Galvagno, S. Di Franco, L. Calcagno, G. Foti, G.L. Valente and D. Crippa	157
<b>2.2 Heteroepitaxial Growth</b>	
<b>SiC Heteropolytype Structures Grown by Sublimation Epitaxy</b> A.A. Lebedev	161
<b>Carbonization of Porous Silicon for 3C-SiC Growth</b> A.V. Vasin, Y. Ishikawa, N. Shibata, J. Salonen and V.P. Lehto	167

<b>Carbonization Study of Different Silicon Orientations</b> A. Severino, C. Bongiorno, S. Leone, M. Mauceri, G. Pistone, G. Condorelli, G. Abbondanza, F. Portuese, G. Foti and F. La Via	171
<b>Growth and Study of Thick 3C-SiC Epitaxial Layers Produced by Epitaxy on 6H-SiC Substrates</b> A.A. Lebedev, V.V. Zelenin, P.L. Abramov, E.V. Bogdanova, S.P. Lebedev, D.K. Nel'son, B.S. Razbirin, M.P. Scheglov, A.S. Tregubova, M. Syväjärvi and R. Yakimova	175
<b>Heavily Doped Polycrystalline 3C-SiC Growth on SiO<sub>2</sub>/Si (100) Substrates for Resonator Applications</b> G.S. Sun, J. Ning, X.F. Liu, Y.M. Zhao, J.Y. Li, L. Wang, W.S. Zhao and L. Wang	179
<b>Hetero-Epitaxial Growth of 3C-SiC on Si (111) by Plasma Assisted CVD</b> H. Shimizu and A. Kato	183
<b>How to Grow 3C-SiC Single Domain on <math>\alpha</math>-SiC(0001) by Vapor-Liquid-Solid Mechanism</b> M. Soueidan, O. Kim-Hak, G. Ferro, P. Chaudouët, D. Chaussende, B. Nsouli and Y. Monteil	187
<b>Increased Growth Rates of 3C-SiC on Si (100) Substrates via HCl Growth Additive</b> M. Reyes, Y. Shishkin, S. Harvey and S.E. Saddow	191
<b>Initial Growth in 3C-SiC Sublimation Epitaxy on 6H-SiC</b> M. Syväjärvi, N. Sritirawisarn and R. Yakimova	195
<b>Mechanism of Orientation Selection for the Growth Of (111) Twin Boundary Free 3C-SiC Single Crystals on Hexagonal Basis</b> L. Latu-Romain, D. Chaussende, L. Rapenne, M. Pons and R. Madar	199
<b>Morphology and Stress Control in UHVCVD of 3C-SiC(100) on Si</b> J. Pezoldt, C. Förster, T. Stauden, V. Cimalla, F.M. Morales, C. Zgheib, P.M. Masri and O. Ambacher	203
<b>Trends in Dopant Incorporation for 3C-SiC Films on Silicon</b> M. Zielinski, M. Portail, H. Peyre, T. Chassagne, S. Ndiaye, B. Boyer, A. Leycuras and J. Camassel	207
 <b>Chapter 3: SiC Characterization and Theory</b>	 211
<b>3.1 Structural</b>	
<b>Mosaicity and Wafer Bending in SiC Wafers as Measured by Double and Triple Crystal X-Ray Rocking Curve and Peak Position Maps</b> K.W. Kirchner, K.A. Jones, M.A. Derenge, M. Dudley and A.R. Powell	213
<b>6H-SiC Crystals Grown in [015] and [001] Directions Characterized by High Energy Triple-Axis X-Ray Diffraction</b> M. Stockmeier, R. Hock, O. Filip, B.M. Epelbaum, A. Winnacker and A. Magerl	219
<b>Absence of Dislocation Motion in 3C-SiC pn Diodes under Forward Bias</b> K.M. Speer, D.J. Spry, A.J. Trunek, P.G. Neudeck, M.A. Crimp, J.T. Hile, C. Burda and P. Pirouz	223
<b>An X-Ray Topographic Analysis of the Crystal Quality of Globally Available SiC Wafers</b> I. Brazil, P.J. McNally, N. Ren, L. O'Reilly, A. Danilewsky, T.O. Tuomi, A. Lankinen, A. Säynätjaki, R. Simon, S.I. Soloviev, L.B. Rowland and P.M. Sandvik	227
<b>Behavior of Basal Plane Dislocations and Low Angle Grain Boundary Formation in Hexagonal Silicon Carbide</b> Y. Chen, G. Dhanaraj, W.M. Vetter, R.H. Ma and M. Dudley	231
<b>Comparative Investigation between X-Ray Diffraction and Cross Polarization Mapping of 4H-SiC Wafers Off-Cut 4° Towards (11-20)</b> D.K. Gaskill, M.A. Mastro, K.K. Lew, B.L. VanMil, R.L. Myers-Ward, R.T. Holm and C.R. Eddy	235
<b>Defect and Growth Analysis of SiC Bulk Single Crystals with High Nitrogen Doping</b> T. Kato, T. Miura, K. Wada, E. Hozomi, H. Taniguchi, S.I. Nishizawa and K. Arai	239
<b>Defect Etching of Non-Polar and Semi-Polar Faces in SiC</b> S.A. Sakwe, Y.S. Jang and P.J. Wellmann	243
<b>Dislocation in 4H n<sup>+</sup> SiC Substrates and their Relationship with Epilayer Defects</b> P. Wu, E. Emorhokpor, M. Yoganathan, T. Kerr, J. Zhang, E. Romano and I. Zwieback	247
<b>Distinction of the Nuclei of Shockley Faults in 4H-SiC{0001} pin Diodes by Electroluminescence Imaging</b> R. Ishii, T. Miyanagi, I. Kamata, H. Tsuchida, K. Nakayama and Y. Sugawara	251

<b>Epitaxial Growth on Metal Bonded SiC Substrates: Transmission Electron Microscopy and Photoluminescence</b>	
I. Matko, B. Chenevier, J.M. Bluet, R. Madar, F. Letertre and W. Saikaly	255
<b>Impact of n-Type versus p-Type Doping on Mechanical Properties and Dislocation Evolution during SiC Crystal Growth</b>	
P.J. Wellmann, P. Hens, S.A. Sakwe, D. Queren, R. Müller, K. Durst and M. Göken	259
<b>Influence of Growth Temperature on the Evolution of Dislocations during PVT Growth of Bulk SiC Single Crystals</b>	
S.A. Sakwe and P.J. Wellmann	263
<b>In Situ X-Ray Measurements of Defect Generation during PVT Growth of SiC</b>	
K. Konias, R. Hock, M. Stockmeier, P.J. Wellmann, M. Miller, S. Ossege and A. Magerl	267
<b>Migration of Dislocations in 4H-SiC Epilayers during the Ion Implantation Process</b>	
H. Tsuchida, I. Kamata, M. Nagano, L. Storasta and T. Miyanagi	271
<b>Nondestructive Analysis of Stacking Faults in 4H-SiC Bulk Wafers by Room-Temperature Photoluminescence Mapping under Deep UV Excitation</b>	
N. Hoshino, M. Tajima, T. Hayashi, T. Nishiguchi, H. Kinoshita and H. Shiomi	275
<b>Partial Dislocations under Forward Bias in SiC</b>	
G. Savini, A.A. El Barbary, M.I. Heggie and S. Öberg	279
<b>Properties of Thermally Etched 4H-SiC by Chlorine-Oxygen System</b>	
T. Hatayama, S. Takenami, H. Yano, Y. Uraoka and T. Fuyuki	283
<b>The D<sub>I</sub> Defect is Associated with a Stacking Fault?</b>	
K.A. Jones, T.S. Zheleva, R.D. Vispute and S.S. Hullavarad	287
<b>Trends in Commercially Available SiC Substrates</b>	
J.D. Oliver	291
<b>Whole-Wafer Mapping of Dislocations in 4H-SiC Epitaxy</b>	
R.E. Stahlbush, K.X. Liu, Q. Zhang and J.J. Sumakeris	295
<b>XRD and Photoluminescence Whole-Wafer Mapping of 4H-SiC Wafers</b>	
T. Ryan, J. Hennessy, C. Harrison, S.Y. Wang, G. Webster and A. Majima	299
<b>XRD Characterization of the 6H-SiC Single Crystal Grown from Si-C-Ti Ternary Solution</b>	
N. Yashiro, K. Kusunoki, K. Kamei and A. Yauchi	303

### 3.2 Optical and Electrical

<b>(Nitrogen-Vacancy)-Complex Formation in SiC: Experiment and Theory</b>	
G. Pensl, F. Schmid, S.A. Reshanov, H.B. Weber, M. Bockstedte, A. Mattausch, O. Pankratov, T. Ohshima and H. Itoh	307
<b>Photoluminescence Investigation of Defects Created by Electron Bombardment of 4H-SiC</b>	
J.W. Steeds	313
<b>A Study of the D<sub>II</sub> Defect after Electron Irradiation and Annealing of 4H SiC</b>	
W. Sullivan and J.W. Steeds	319
<b>Carrier Lifetime Analysis by Microwave Photoconductive Decay (<math>\mu</math>-PCD) for 4H SiC Epitaxial Wafers</b>	
G.Y. Chung, M.J. Loboda, M.F. MacMillan, J.W. Wan and D.M. Hansen	323
<b>Contactless Electrical Defect Characterization and Topography of a-Plane Grown Epitaxial Layers</b>	
M. Wagner, E. Mustafa, S. Hahn, M. Syväjärvi, R. Yakimova, S. Jang, S.A. Sakwe and P.J. Wellmann	327
<b>Deep Levels in Electron-Irradiated n- and p-type 4H-SiC Investigated by Deep Level Transient Spectroscopy</b>	
K. Danno and T. Kimoto	331
<b>Dependence of DAP Emission Properties on Impurity Concentrations in N-/B-co-doped 6H-SiC</b>	
S. Murata, Y. Nakamura, T. Maeda, Y. Shibata, M. Ikuta, M. Sugiura, S. Nitta, M. Iwaya, S. Kamiyama, H. Amano, I. Akasaki, M. Yoshimoto, T. Furusho and H. Kinoshita	335
<b>Determination of Impact Ionization Coefficients Measured from 4H Silicon Carbide Avalanche Photodiodes</b>	
W.S. Loh, C.M. Johnson, J.S. Ng, P.M. Sandvik, S. Arthur, S.I. Soloviev and J. David	339
<b>Electrical and Structural Properties of Al-Implanted and Annealed 4H-SiC</b>	
M. Obernhofer, M. Krieger, F. Schmid, H.B. Weber, G. Pensl and A. Schöner	343

<b>Electrical Characterisation of 4H-SiC Epitaxial Samples Treated by Hydrogen or Helium</b> L. Ottaviani, D. Barakel, E.B. Yakimov and M. Pasquinelli	347
<b>Electric-Field Screening Effects in the Micro-Photoluminescence Spectra of As-Grown Stacking Faults in 4H-SiC</b> S. Juillaguet, T. Guillet, R. Bardoux, J. Camassel and T. Chassagne	351
<b>EPR, ESE and Pulsed ENDOR Study of Nitrogen Related Centers in 4H-SiC Wafers Grown by Different Technologies</b> E.N. Kalabukhova, S.N. Lukin, D.V. Savchenko, W.C. Mitchel, S. Greulich-Weber, U. Gerstmann, A. Pöppl, J. Hoentsch, E. Rauls, Y. Rozentzveig, E.N. Mokhov, M. Syväjärvi and R. Yakimova	355
<b>Excess Carrier Lifetimes in a Bulk p-Type SiC Wafer Measured by the Microwave Photoconductivity Decay Method</b> M. Kawai, T. Mori, M. Kato, M. Ichimura, S. Sumie and H. Hashizume	359
<b>FTIR Ellipsometry Analysis of the Internal Stress in SiC/Si MEMS</b> J. Pezoldt, C. Förster, V. Cimalla, F. Will, R. Stephan, K. Brueckner, M.A. Hein and O. Ambacher	363
<b>Impurity Conduction in Silicon Carbide</b> M. Krieger, K. Semmelroth, H.B. Weber, G. Pensl, M. Rambach and L. Frey	367
<b>Influence of Cooling Rate after High Temperature Annealing on Deep Levels in High-Purity Semi-Insulating 4H-SiC</b> A. Gällström, B. Magnusson, P. Carlsson, N.T. Son, A. Henry, F.C. Beyer, M. Syväjärvi, R. Yakimova and E. Janzén	371
<b>Investigation of Charge Carrier Lifetime Temperature-Dependence in 4H-SiC Diodes</b> A. Udal and E. Velmre	375
<b>Mechanisms of Decrease in Hole Concentration in Al-Doped 4H-SiC by Irradiation of 200 keV Electrons</b> H. Matsuura, N. Minohara, Y. Inagawa, M. Takahashi, T. Ohshima and H. Itoh	379
<b>Micro-Photoluminescence Mapping of Defect Structures in SiC Wafers</b> J. Hennessy and T. Ryan	383
<b>Micro-Raman Investigation of Defects in a 4H-SiC Homoepilayer</b> X.F. Liu, G.S. Sun, J.M. Li, Y.M. Zhao, J.Y. Li, L. Wang, W.S. Zhao, M.C. Luo and Y.P. Zeng	387
<b>Nitrogen Donor Aggregation in 4H-SiC: g-Tensor Calculations</b> U. Gerstmann, E. Rauls, S. Greulich-Weber, E.N. Kalabukhova, D.V. Savchenko, A. Pöppl and F. Mauri	391
<b>Nonequilibrium Carrier Dynamics in DPB-Free 3C-SiC Layer Studied by Dynamic Grating Technique in Wide Excitation and Temperature Range</b> K. Neimontas, K. Jarašiūnas, M. Soueidan, G. Ferro and Y. Monteil	395
<b>Optical and Electron Paramagnetic Resonance Study of Sponge Silicon Carbide Prepared by Direct Synthesis</b> V.S. Kiselov, E.N. Kalabukhova, S.N. Lukin, A.A. Sitnikov, V.A. Yukhymchyk and R. Yakimova	399
<b>Optical Investigation of Cubic SiC Layers Grown on Hexagonal SiC Substrates by CVD and VLS</b> N. Habka, V. Soulière, J.M. Bluet, M. Soueidan, G. Ferro and Y. Monteil	403
<b>Photoluminescence of 6H-SiC Nanostructures</b> J. Botsoa, J.M. Bluet, V. Lysenko, O. Marty, D. Barbier and G. Guillot	407
<b>Properties of Different Room-Temperature Photoluminescence Bands in 4H-SiC Substrates Investigated by Mapping Techniques</b> B. Krishnan, S.K. Chanda and Y. Koshka	411
<b>Raman Spectra of a 4H-SiC Epitaxial Layer on Porous and Non-Porous 4H-SiC Substrates</b> M.J. Clouter, Y. Ke, R.P. Devaty, W.J. Choyke, Y. Shishkin and S.E. Sadow	415
<b>Reverse Biased Electrochemical Etching of SiC-SBD</b> K. Nishikawa, Y. Maeyama, Y. Fukuda, M. Shimizu, M. Sato and H. Iwakuro	419
<b>Simultaneous Determination of the Carrier Concentration, Mobility and Thickness of SiC Homo-Epilayers Using Terahertz Reflectance Spectroscopy</b> S. Oishi, Y. Hijikata, H. Yaguchi and S. Yoshida	423
<b>Temperature Dependence of the Band-Edge Injection Electroluminescence of 3C-SiC pn Structure</b> A.M. Strel'chuk, A.A. Lebedev, N.S. Savkina and A.N. Kuznetsov	427

<b>The Premature Breakdown in 6H-SiC p-n Junction</b> V.I. Sankin, A.M. Monakhov and P.P. Shkrebiy	431
<b>Theory of the Stark Effect on the Donor Levels in 4H Silicon Carbide</b> I.G. Ivanov and E. Janzén	435
<b>3.3 Defects</b>	
<b>Point Defects and their Aggregation in Silicon Carbide</b> A. Gali, T. Hornos, M. Bockstedte and T. Frauenheim	439
<b>A Theoretical Study on Aluminium-Related Defects in SiC</b> T. Hornos, A. Gali, N.T. Son and E. Janzén	445
<b>Deep Acceptor Levels of the Carbon Vacancy-Carbon Antisite Pairs in 4H-SiC</b> P. Carlsson, N.T. Son, T. Umeda, J. Isoya and E. Janzén	449
<b>Electron Paramagnetic Resonance Study of Carbon Antisite-Vacancy Pair in p-Type 4H-SiC</b> T. Umeda, N. Morishita, T. Ohshima, H. Itoh and J. Isoya	453
<b>Evaluation of Unintentionally Doped Impurities in Silicon Carbide Substrates Using Neutron Activation Analysis</b> T. Ohshima, O. Tokunaga, M. Issiki, F. Sasajima and H. Itoh	457
<b>Influence Of Growth Conditions on Irradiation Induced Defects in 4H-SiC</b> I. Pintilie, K. Irmscher, U. Grossner, B.G. Svensson and B. Thomas	461
<b>Intrinsic Defects in Semi-Insulating SiC: Deep Levels and their Roles in Carrier Compensation</b> N.T. Son, P. Carlsson, B. Magnusson and E. Janzén	465
<b>New Insight in Scandium-Mediated Growth Techniques: Sc-Related Defects in 4H-SiC and 6H-SiC</b> U. Gerstmann, S. Greulich-Weber, E. Rauls, J.M. Spaeth, E.N. Kalabukhova, E.N. Mokhov and F. Mauri	469
<b>Point Defects in 4H SiC Grown by Halide Chemical Vapor Deposition</b> M.E. Zvanut, H.J. Chung, A.Y. Polyakov and M. Skowronski	473
<b>SIMS Investigation of Ge Incorporation in 3C-SiC Layers Grown from Ge-Si Melts</b> H. Peyre, N. Habka, V. Soulière, M. Soueidan, G. Ferro, Y. Monteil and J. Camassel	477
<b>Atomic Crack Defects Developing at Silicon Carbide Surfaces Studied by STM, Synchrotron Radiation-Based <math>\mu</math>-spot XPS and LEEM</b> P. Soukiassian, F. Amy, C. Brylinski, T.O. Mentès and A. Locatelli	481
<b>Sodium Enhanced Oxidation of Si-Face 4H-SiC: A Method to Remove Near Interface Traps</b> E.Ö. Sveinbjörnsson, F. Allerstam, H.Ö. Ólafsson, G. Gudjónsson, D. Dochev, T. Rödle and R. Jos	487
<b>Ab Initio Study of Clean and Hydrogen-Saturated Unreconstructed SiC{0001} Surfaces</b> A. Mattausch, T. Dannecker and O. Pankratov	493
<b>An Approach to Model Temperature Effects of Interface Traps in 4H-SiC</b> R.R. Rao, S. Balaji, K. Matocha and V. Tilak	497
<b>Conductive Atomic Force Microscopy Studies on the Reliability of Thermally Oxidized SiO<sub>2</sub>/4H-SiC</b> P. Fiorenza, R. Lo Nigro, V. Raineri and D. Salinas	501
<b>Electronic Properties of Thermally Oxidized Single-Domain 3C-SiC/6H-SiC Grown by Vapour-Liquid-Solid Mechanism</b> K.K. Lee, G. Pensl, M. Soueidan and G. Ferro	505
<b>Ellipsometric and MEIS Studies of 4H-SiC/Si/SiO<sub>2</sub> and 4H-SiC/SiO<sub>2</sub> Interfaces for MOS Devices</b> O. Guy, T.E. Jenkins, M. Lodzinski, A. Castaing, S.P. Wilks, P. Bailey and T.C.Q. Noakes	509
<b>Etching of 4° and 8° 4H-SiC Using Various Hydrogen-Propane Mixtures in a Commercial Hot-Wall CVD Reactor</b> K.K. Lew, B.L. VanMil, R.L. Myers-Ward, R.T. Holm, C.R. Eddy and D.K. Gaskill	513
<b>Formation of Deep Traps at the 4H-SiC/SiO<sub>2</sub> Interface when Utilizing Sodium Enhanced Oxidation</b> F. Allerstam, G. Gudjónsson, E.Ö. Sveinbjörnsson, T. Rödle and R. Jos	517
<b>Generation of Amorphous SiO<sub>2</sub>/SiC Interface Structure by the First-Principles Molecular Dynamics Simulation</b> A. Miyashita, T. Ohnuma, M. Iwasawa, H. Tsuchida and M. Yoshikawa	521

<b>Initial Stages of the Graphite-SiC(0001) Interface Formation Studied by Photoelectron Spectroscopy</b>	
K.V. Emtsev, T. Seyller, F. Speck, L. Ley, P. Stojanov, J.D. Riley and R.C.G. Leckey	525
<b>Nanowire Reconstruction on the 4H-SiC(1102) Surface</b>	
M. Hetzel, C. Virojanadara, W.J. Choyke and U. Starke	529
<b>Structure of the 3C-SiC(100) 5x2 Surface Reconstruction Investigated by Synchrotron Radiation Based Grazing Incidence X-Ray Diffraction</b>	
M. Silly, H. Enriquez, J. Roy, M. D'Angelo, P. Soukiassian, T. Schuelli, M. Noblet and G. Renaud	533
<b>The Al<sub>2</sub>O<sub>3</sub>/4H-SiC Interface Investigated by Thermal Dielectric Relaxation Current Technique</b>	
M. Avice, U. Grossner, O. Nilsen, H. Fjellvåg and B.G. Svensson	537
<b>The Mechanism of Interface State Passivation by NO</b>	
P. Deák, T. Hornos, C. Thill, J. Knaup, A. Gali and T. Frauenheim	541
<b>Two Dimensional Imaging of the Laterally Inhomogeneous Au/4H-SiC Schottky Barrier by Conductive Atomic Force Microscopy</b>	
F. Giannazzo, F. Roccaforte, S.F. Liotta and V. Raineri	545
<b>XPS Study of the Electronic Properties of the Ce/4H-SiC Interface, and the Formation of the SiO<sub>2</sub>/Ce<sub>2</sub>Si<sub>2</sub>O<sub>7</sub>/4H-SiC Interface Structure upon Oxidation</b>	
M. Kildemo, U. Grossner, B.G. Svensson and S. Raaen	549
<b>Chapter 4: SiC Processing</b>	553
<b>4.1 Doping and Implantation</b>	
<b>Control of the Flatband Voltage of 4H-SiC Metal-Oxide Semiconductor (MOS) Capacitors by Co-Implantation of Nitrogen and Aluminum</b>	
T. Frank, S. Beljakowa, G. Pensl, T. Kimoto and V.V. Afanas'ev	555
<b>Post-Implantation Annealing of SiC: Relevance of the Heating Rate</b>	
R. Nipoti	561
<b>Achieving Low Sheet Resistance from Implanted P-Type Layers in 4H-SiC Using High Temperature Graphite Capped Annealing</b>	
Y. Wang, P.A. Losee, S. Balachandran, I. Bhat, T.P. Chow, Y. Wang, B.J. Skromme, J.K. Kim and E.F. Schubert	567
<b>Analysis of the Electrical Activation of P<sup>+</sup> Implanted Layers as a Function of the Heating Rate of the Annealing Process</b>	
M. Canino, F. Giannazzo, F. Roccaforte, A. Poggi, S. Solmi, V. Raineri and R. Nipoti	571
<b>Comparison of Graphite and BN/AlN Annealing Caps for Ion Implanted SiC</b>	
K.A. Jones, M.C. Wood, T.S. Zheleva, K.W. Kirchner, M.A. Derenge, A. Bolonikov, T.S. Sudarshan, R.D. Vispute, S.S. Hullavarad and S. Dhar	575
<b>Electrical Properties of N Ion Implanted Layer in 3C-SiC(100) Grown on Self-Standing 3C-SiC Substrate</b>	
E. Taguchi, Y. Suzuki and M. Satoh	579
<b>Encapsulating Annealing of N<sup>+</sup> Implanted 4H-SiC by Diamond-Like-Carbon Film</b>	
S. Miyagawa, T. Suzuki, T. Kudo and M. Satoh	583
<b>High Temperature Implantation of Aluminum in 4H Silicon Carbide</b>	
M. Rambach, A.J. Bauer and H. Ryssel	587
<b>Isochronal Annealing Study of Deep Levels in Hydrogen Implanted p-Type 4H-SiC</b>	
G. Alfieri and T. Kimoto	591
<b>Modification of Surface Layer during High Temperature Annealing and its Effects on the SiC Diode Characteristics</b>	
W. Bahng, H.J. Cheong, I.H. Kang, S.J. Kim, S.C. Kim, S.J. Joo and N.K. Kim	595
<b>Peculiarities of Neutron-Transmutation Phosphorous Doping of SiC Enriched with <sup>30</sup>Si Isotope: Electron Paramagnetic Resonance Study</b>	
I.V. Ilyin, M.V. Muzafarova, P.G. Baranov, B.Y. Ber, A.N. Ionov, E.N. Mokhov, P.A. Ivanov, M.A. Kaliteevskii and P.S. Kop'ev	599
<b>Reduction of Traps and Improvement of Carrier Lifetime in SiC Epilayer by Ion Implantation</b>	
L. Storasta and H. Tsuchida	603

<b>Selenium and Tellurium Double Donors in SiC</b> S.A. Reshanov, H.B. Weber, G. Pensl, A. Schöner and H. Nagasawa	607
<b>Use of Graphite Cap to Reduce Unwanted Post-Implantation Annealing Effects in SiC</b> E. Oliviero, M. Lazar, H. Vang, C. Dubois, P. Cremillieu, J.L. Leclercq, J. Dazord and D. Planson	611
<b>4.2 Dielectrics and Passivation Layers</b>	
<b>Dynamical Simulation of SiO<sub>2</sub>/4H-SiC(0001) Interface Oxidation Process: from First-Principles</b> T. Ohnuma, A. Miyashita, M. Iwasawa, M. Yoshikawa and H. Tsuchida	615
<b>Trap Assisted Gas Sensing Mechanism in MISiC Capacitors</b> A.B. Horsfall, M.H. Weng, R. Mahapatra and N.G. Wright	621
<b>4H-SiC Metal-Oxide-Semiconductor (MOS) Capacitors Fabricated by Oxidation in a Tungsten Lamp Furnace in Combination with a Microwave Plasma and Subsequent Deposition of Al<sub>2</sub>O<sub>3</sub></b> S. Beljakowa, T. Frank, G. Pensl, K.Y. Gao, F. Speck and T. Seyller	627
<b>A Comparative Study of Surface Passivation on SiC BJTs with High Current Gain</b> H.S. Lee, M. Domeij, C. Zetterling, M. Östling and E.Ö. Sveinbjörnsson	631
<b>Acceleration Factors in Acceleration Life Test of Thermal Oxides on 4H-SiC Wafers</b> J. Senzaki, A. Shimozato and K. Fukuda	635
<b>Characterization of MOS Capacitors Fabricated on n-type 4H-SiC Implanted with Nitrogen at High Dose</b> A. Poggi, F. Moscatelli, Y. Hijikata, S. Solmi, M. Sanmartin, F. Tamarri and R. Nipoti	639
<b>Electrical Properties of Atomic-Layer-Deposited La<sub>2</sub>O<sub>3</sub>/Thermal-Nitrided SiO<sub>2</sub> Stacking Dielectric on 4H-SiC(0001)</b> J.H. Moon, K.Y. Cheong, D.I. Eom, H.K. Song, J.H. Yim, J.H. Lee, H.J. Na, W. Bahng, N.K. Kim and H.J. Kim	643
<b>Electrical Properties of Metal-Oxide-Semiconductor (MOS) Structures on 4H-SiC(0001) Formed by Oxidizing Pre-Deposited Si<sub>x</sub>N<sub>y</sub></b> J.H. Moon, D.H. Kim, H.K. Song, J.H. Yim, W. Bahng, N.K. Kim, K.S. Seo and H.J. Kim	647
<b>Fabrication of MOS Capacitors by Wet Oxidation of p-Type 4H-SiC Preamorphized by Nitrogen Ion Implantation</b> Y. Hijikata, S. Yoshida, F. Moscatelli, A. Poggi, S. Solmi, S. Cristiani and R. Nipoti	651
<b>Growth and Properties of Gadolinium Oxide Dielectric Layers on Silicon Carbide for High-K Application</b> A. Fissel, M. Czernohorsky, R. Dagrís and H.J. Osten	655
<b>Interface Properties of SiO<sub>2</sub>/4H-SiC(0001) with Large Off-Angles Formed by N<sub>2</sub>O Oxidation</b> H. Saitoh, A. Seki, A. Manabe and T. Kimoto	659
<b>Modification of SiO<sub>2</sub>/4H-SiC Interface Properties by High-Pressure H<sub>2</sub>O Vapor Annealing</b> D. Takeda, H. Yano, T. Hatayama, Y. Uraoka and T. Fuyuki	663
<b>Optimizing the Thermally Oxidized 4H-SiC MOS Interface for P-Channel Devices</b> M.K. Das, S.K. Haney, C. Jonas, Q.C.J. Zhang and S.H. Ryu	667
<b>Study of Polyimide Films as Passivation for High Temperature High Voltage Silicon Carbide Devices</b> S. Diahm, M.L. Locatelli and T. Lebey	671
<b>Time-Dependent Dielectric Breakdown of Thermal Oxides on 4H-SiC</b> K. Matocha and R. Beaupre	675
<b>Trap Assisted Conduction in High K Dielectric Capacitors on 4H-SiC</b> M.H. Weng, R. Mahapatra, A.B. Horsfall, N.G. Wright, P.G. Coleman and C.P. Burrows	679
<b>X-Ray and AFM Analysis of Al<sub>2</sub>O<sub>3</sub> Deposited by ALCVD on n-Type 4H-SiC</b> U. Grossner, M. Servidori, M. Avice, O. Nilsen, H. Fjellvåg, R. Nipoti and B.G. Svensson	683
<b>4.3 Contacts, Etching and Packaging</b>	
<b>A Case for High Temperature, High Voltage SiC Bipolar Devices</b> A.K. Agarwal	687
<b>Ab Initio Study of the Structural and Electronic Properties of the Graphene/SiC{0001} Interface</b> A. Mattausch and O. Pankratov	693

<b>Development of Low Resistance Al/Ti Stacked Metal Contacts to p-Type 4H-SiC</b> M.R. Jennings, A. Pérez-Tomás, D. Walker, L. Zhu, P.A. Losee, W. Huang, S. Balachandran, O. Guy, J.A. Covington, T.P. Chow and P.A. Mawby	697
<b>Electronic Structure of Graphite/6H-SiC Interfaces</b> T. Seyller, K.V. Emtsev, F. Speck, K.Y. Gao and L. Ley	701
<b>Evaluation of Specific Contact Resistance of Al, Ti, and Ni Contacts to N Ion Implanted 3C-SiC(100)</b> Y. Suzuki, E. Taguchi, S. Nagata and M. Satoh	705
<b>High Temperature Direct Double Side Cooled Inverter Module for Hybrid Electric Vehicle Application</b> C. Buttay, C.M. Johnson, J. Rashid, F. Udrea, G. Amaratunga, P. Tappin, N.G. Wright, P. Ireland, T. Yamamoto, Y. Takeuchi and R.K. Malhan	709
<b>Interface Reactions and Electrical Properties of Ta/4H-SiC Contacts</b> Y. Cao, S.A. Pérez-García and L. Nyborg	713
<b>Low Resistance Cathode Metallization and Die-Bonding in Silicon Carbide P-N Junction Diodes</b> T.H. Kim, S.Y. Lee, J.S. Lee, D.I. Suh, N.K. Cho, W. Bahng, N.K. Kim, S.Y. Choi, H.J. Kim and S.K. Lee	717
<b>Low Specific Contact Resistance to 3C-SiC Grown on (100) Si Substrates</b> A.E. Bazin, T. Chassagne, J.F. Michaud, A. Leycuras, M. Portail, M. Zielinski, E. Collard and D. Alquier	721
<b>Nanolayered Au/Ti/Al Ohmic Contacts to P-Type SiC: Electrical, Morphological and Chemical Properties Depending on the Contact Composition</b> L. Kolaklieva, R. Kakanakov, I. Avramova and T. Marinova	725
<b>Plasma Etching for Backside Wafer Thinning of SiC</b> K.M. Robb	729
<b>Sloped Sidewalls in 4H-SiC Mesa Structure Formed by a Cl<sub>2</sub>-O<sub>2</sub> Thermal Etching</b> S. Takenami, T. Hatayama, H. Yano, Y. Uraoka and T. Fuyuki	733
<b>The Schottky Parameter Test for Combined Diffusion Welded and Sputter Large Area Contacts</b> O. Korolkov, N. Sleptsuk, T. Rang, A. Syrkin and V. Dmitriev	737
<b>4.4 Porous SiC</b>	
<b>Nano-Columnar Pore Formation in the Photo-Electrochemical Etching of n-Type 6H SiC</b> Y. Ke, R.P. Devaty and W.J. Choyke	741
<b>Porosity Dependence of the Velocity of Surface and Bulk Acoustic Waves in Porous Silicon Carbide Films</b> C.K. Young, G.T. Andrews, M.J. Clouter, Y. Ke, W.J. Choyke and R.P. Devaty	745
<b>4.5 Surface Treatment</b>	
<b>Damage-Free Planarization of 4H-SiC (0001) by Catalyst-Referred Etching</b> H. Hara, Y. Sano, H. Mimura, K. Arima, A. Kubota, K. Yagi, J. Murata and K. Yamauchi	749
<b>High Throughput SiC Wafer Polishing with Good Surface Morphology</b> T. Kato, K. Wada, E. Hozomi, H. Taniguchi, T. Miura, S.I. Nishizawa and K. Arai	753
<b>Polishing Characteristics of 4H-SiC Si-Face and C-Face by Plasma Chemical Vaporization Machining</b> Y. Sano, M. Watanabe, K. Yamamura, K. Yamauchi, T. Ishida, K. Arima, A. Kubota and Y. Mori	757
<b>Chapter 5: SiC Devices</b>	
761	
<b>5.1 Transistors</b>	
<b>4H-SiC Planar MESFETs on High-Purity Semi-Insulating Substrates</b> J.H. Yim, H.K. Song, J.H. Moon, H.S. Seo, J.H. Lee, H.J. Na, J.B. Lee and H.J. Kim	763
<b>4H-SiC Power BJTs with High Current Gain and Low On-Resistance</b> H.S. Lee, M. Domeij, C. Zetterling and M. Östling	767
<b>9 kV 4H-SiC IGBTs with 88 mΩ·cm<sup>2</sup> of R<sub>diff, on</sub></b> Q.C.J. Zhang, C. Jonas, B. Heath, M.K. Das, S.H. Ryu, A.K. Agarwal and J.W. Palmour	771

<b>A Comparison of High Temperature Performance of SiC DMOSFETs and JFETs</b> S.H. Ryu, S. Krishnaswami, B.A. Hull, B. Heath, F. Husna, J. Richmond, A.K. Agarwal, J.W. Palmour and J.D. Scofield	775
<b>Critical Reliability Issues for SiC Power MOSFETs Operated at High Temperature</b> S. Tanimoto, T. Suzuki, A. Hanamura, M. Hoshi, T. Shinohara and K. Arai	779
<b>Electrical Properties of p-Channel MOSFETs Fabricated on 4H- and 6H-SiC</b> M. Okamoto, M. Tanaka, T. Yatsuo and K. Fukuda	783
<b>Fabrication and Characterization of 4H-SiC MOSFET with MOCVD-Grown Al<sub>2</sub>O<sub>3</sub> Gate Insulator</b> S. Hino, T. Hatayama, N. Miura, T. Oomori and E. Tokumitsu	787
<b>Hall Effect and Admittance Measurements of n-Channel 6H-SiC MOSFETs</b> K.K. Lee, M. Laube, T. Ohshima, H. Itoh and G. Pensl	791
<b>High Frequency 4H-SiC MOSFETs</b> G. Gudjonsson, F. Allerstam, P.Å. Nilsson, H. Hjelmgren, E.Ö. Sveinbjörnsson, H. Zirath, T. Rödle and R. Jos	795
<b>High Temperature Characterisation of 4H-SiC VJFET</b> P. Bhatnagar, N.G. Wright, A.B. Horsfall, K. Vassilevski, C.M. Johnson, M.J. Uren, K.P. Hilton, A.G. Munday and A.J. Hydes	799
<b>Improvement of Electrical Characteristics of Ion Implanted 4H-SiC MESFET on a Semi-Insulating Substrate</b> S. Katakami, M. Ogata, S. Ono and M. Arai	803
<b>Increased Channel Mobility in 4H-SiC UMOSFETs Using On-Axis Substrates</b> H. Yano, H. Nakao, T. Hatayama, Y. Uraoka and T. Fuyuki	807
<b>Investigation of Drain Current Saturation in 4H-SiC MOSFETs</b> G. Pennington, S. Potbhare, N. Goldsman, D.B. Habersat, A.J. Lelis, J.M. McGarrity and C.R. Ashman	811
<b>Lateral 4H-SiC MOSFETs with Low On-Resistance by Using Two-Zone Double RESURF Structure</b> M. Noborio, J. Suda and T. Kimoto	815
<b>Low Output Capacitance 1500V 4H-SiC MOSFETs with 8 mΩ·cm<sup>2</sup> Specific On-Resistance</b> K. Matocha, J. Tucker, S. Arthur, M. Schutten, J. Nasadoski, J. Glaser and L. Stevanovic	819
<b>Numerical Investigation of the DC and RF Performances for a 4H-SiC Double Delta-Doped Channel MESFET Having Various Delta-Doping Concentrations</b> I.H. Kang, W. Bahng, S.C. Kim, S.J. Joo and N.K. Kim	823
<b>Realization of Low On-Resistance 4H-SiC Power MOSFETs by Using Retrograde Profile in P-Body</b> K. Fujihira, N. Miura, T. Watanabe, Y. Nakao, N. Yutani, K. Ohtsuka, M. Imaizumi, T. Takami and T. Oomori	827
<b>SiC Field Effect Transistor Technology Demonstrating Prolonged Stable Operation at 500 °C</b> P.G. Neudeck, D.J. Spry, L.Y. Chen, R.S. Okojie, G.M. Beheim, R.D. Meredith and T.L. Ferrier	831
<b>SiC MOSFET Channel Mobility Dependence on Substrate Doping and Temperature Considering High Density of Interface Traps</b> A. Pérez-Tomás, M.R. Jennings, P.A. Mawby, J.A. Covington, P. Godignon, J. Millan and N. Mestres	835
<b>Simulation Study of High-k Materials for SiC Trench MOSFETs</b> P. Tappin, R. Mahapatra, N.G. Wright, P. Bhatnagar and A.B. Horsfall	839
<b>Temperature Stability of Heteropolytypic 6H/3C FETs</b> C.C. Chen, A.B. Horsfall, N.G. Wright and K. Vassilevski	843
<b>Time Dependent Trapping and Generation-Recombination of Interface Charges: Modeling and Characterization for 4H-SiC MOSFETs</b> S. Potbhare, N. Goldsman, G. Pennington, A.J. Lelis and J.M. McGarrity	847
<b>5.2 Unipolar Diodes</b>	
<b>Reliability of SiC Power Devices Against Cosmic Radiation-Induced Failure</b> G. Soelkner, W. Kaindl, M. Treu and D. Peters	851
<b>600 V 100 A 4H-SiC Junction Barrier Schottky Diode with Guard Rings Termination</b> T. Yamamoto, T. Endo, N. Kato, H. Nakamura and T. Sakakibara	857

<b>Breakdown Voltage Characteristics of FLR-Assisted SiC-SBD Formed by Aluminum Metal Junction Edge Termination</b>	
S.J. Kim, Y.S. Choi, S.J. Yu, S.C. Kim, W. Bahng and K.H. Lee	861
<b>Comparison between Schottky Diodes with Oxide Ramp Termination on Silicon Carbide and Diamond</b>	
G. Brezeanu, M. Brezeanu, F. Udrea, G. Amaratunga, C. Boianceanu, M. Badila, K. Zekentes and A. Visoreanu	865
<b>FLR Geometry Dependence of Breakdown Voltage Characteristics for JBS-Assisted FLR SiC-SBD</b>	
S.J. Kim, S. Kim, S.C. Kim, I.H. Kang, K.H. Lee and T. Matsuoka	869
<b>High Voltage Silicon Carbide Schottky Diodes with Single Zone Junction Termination Extension</b>	
K. Vassilevski, I.P. Nikitina, A.B. Horsfall, N.G. Wright, A.G. O'Neill, K.P. Hilton, A.G. Munday, A.J. Hydes, M.J. Uren and C.M. Johnson	873
<b>Improvement of SBD Electronic Characteristics Using Sacrificial Oxidation Removing the Degraded Layer from SiC Surface after High Temperature Annealing</b>	
A. Kinoshita, T. Nishi, T. Yatsuo and K. Fukuda	877
<b>Simulation, Fabrication and Characterization of 4H-SiC Floating Junction Schottky Barrier Diodes (Super-SBDs)</b>	
C. Ota, J. Nishio, T. Hatakeyama, T. Shinohe, K. Kojima, S.I. Nishizawa and H. Ohashi	881
<b>The Influence of In-Grown Stacking Faults on the Reverse Current-Voltage Characteristics of 4H-SiC Schottky Barrier Diodes</b>	
S. Harada and Y. Namikawa	885
<b>5.3 Bipolar Diodes</b>	
<b>Bipolar SiC-Diodes – Challenges Arising from Physical and Technological Aspects</b>	
W. Bartsch, H. Mitlehner and S. Gediga	889
<b>Progress on the Development of 10 kV 4H-SiC Pin Diodes for High Current/High Voltage Power Handling Applications</b>	
B.A. Hull, J.J. Sumakeris, M.K. Das, J. Richmond and J.W. Palmour	895
<b>1.2 kV Pin Diodes with SiCrystal Epiwafer</b>	
H. Vang, C. Raynaud, P. Brosselard, M. Lazar, P. Cremillieu, J.L. Leclercq, S. Scharnholz, D. Planson and J. Chante	901
<b>Behaviour of 4H-SiC pin Diodes Studied by Numerical Device Simulation</b>	
D. Werber, P. Borthen and G. Wachutka	905
<b>Coupling between the Raman Spectroscopy and Photoemission Microscopy Techniques: Investigation of Defects in Biased 4H-SiC pin Diodes</b>	
A. Thuair, M. Mermoux, E. Bano, A. Crisci, F. Baillet and K. Zekentes	909
<b>Degradation of Charge Collection Efficiency Obtained for 6H-SiC n<sup>+</sup>p Diodes Irradiated with Gold Ions</b>	
T. Ohshima, T. Satoh, M. Oikawa, S. Onoda, S. Hishiki, T. Hirao, T. Kamiya, T. Yokoyama, A. Sakamoto, R. Tanaka, I. Nakano, G. Wagner and H. Itoh	913
<b>Effects of Very High Neutron Fluence Irradiation on p<sup>+</sup>n Junction 4H-SiC Diodes</b>	
F. Moscatelli, A. Scorzoni, A. Poggi, M. Passini, G. Pizzocchero and R. Nipoti	917
<b>Electrical Characterization of High Voltage 4H-SiC pin Diodes Fabricated Using a Low Basal-Plane Dislocations Process</b>	
P.A. Ivanov, M.E. Levinshtein, M.S. Boltovets, V.A. Krivutsa, J.W. Palmour, M.K. Das and B.A. Hull	921
<b>Evaluation of Termination Techniques for 4H-SiC Pin Diodes and Trench JFETs</b>	
A. Mihaila, F. Udrea, S.J. Rashid, G. Amaratunga, M. Kataoka, Y. Takeuchi and R.K. Malhan	925
<b>Fabrication of pn-Junction Diode for N<sup>+</sup> Implanted 4H-SiC(0001) Annealed by EBAS</b>	
A. Egami, M. Shibagaki, A. Kumagai, K. Numajiri, S. Miyagawa, T. Kudo, S. Uchiumi and M. Satoh	929
<b>Microwave p-i-n Diodes Fabricated on 4H-SiC Material Grown by Sublimation Epitaxy in Vacuum</b>	
N. Camara, L.P. Romanov, A.V. Kirillov, M.S. Boltovets, A.A. Lebedev, V.V. Zelenin, M. Kayambaki and K. Zekentes	933
<b>Potential Benefits of Silicon Carbide Zener Diodes Used as Components of Intrinsically Safe Barriers</b>	
P. Lark, K. Vassilevski, I.P. Nikitina, G.J. Phelps, A.B. Horsfall and N.G. Wright	937

## 5.4 Sensors and Detectors

### 4H-SiC High Temperature Spectrometers

E.V. Kalinina, N.B. Strokan, A.M. Ivanov, A. Sadohin, A. Azarov, V. Kossov, R. Yafaev and S. Lashaev 941

### 4H-SiC Schottky Array Photodiodes for UV Imaging Application Based on the Pinch-off Surface Effect

A. Sciuto, F. Roccaforte, S. Di Franco, V. Raineri, S.F. Liotta, S. Billotta, G. Bonanno and M. Belluso 945

### Fabrication and Test of 3C-SiC Electrostatic Resonators

M. Placidi, P. Godignon, J. Esteve, N. Mestres and G. Abadal 949

### Study of Dark Currents in 4H-SiC UV APDs with Separate Absorption and Multiplication Regions

S.I. Soloviev, H.Y. Cha, J. Grande and P.M. Sandvik 953

### Surface Functionalization of SiC for Biosensor Applications

R.M. Petoral Jr., G.R. Yazdi, C. Vahlberg, M. Syväjärvi, A. Lloyd Spetz, K. Uvdal and R. Yakimova 957

### The Influence of the Extreme Fluences of 8 MeV Protons on Characteristics of SiC Nuclear Detectors Produced by Al Implantation

A.M. Ivanov, N.B. Strokan, A.A. Lebedev and V.V. Kozlovski 961

## 5.5 Circuits and Applications

### SiC-Based Power Converters for High Temperature Applications

965

### Analysis of Novel Packaging Techniques for High Power Electronics in SiC

S.J. Rashid, C.M. Johnson, F. Udrea, A. Mihaila, G. Amaratunga and R.K. Malhan 971

### Comparison of Bipolar and Unipolar SiC Switching Devices for Very High Power Applications

K. Bertilsson and C.I. Harris 975

### Demonstration of High-Voltage SiC VJFET Cascode in a Half-Bridge Inverter

T. McNutt, J. Reichl, H. Hearne, V. Veliadis, M. McCoy, E.J. Stewart, S. Van Campen, C. Clarke, D. Bulgher, D. Katsis, B. Geil and S. Scozzie 979

### Fabrication of a Multi-Chip Module of 4H-SiC RESURF-Type JFETs

H. Tamaso, J. Shinkai, T. Hoshino, H. Tokuda, K. Sawada, K. Fujikawa, T. Masuda, S. Hatsukawa, S. Harada and Y. Namikawa 983

### High Temperature Applications Of 4H-SiC Vertical Junction Field-Effect Transistors And Schottky Diodes

P. Bhatnagar, N.G. Wright, A.B. Horsfall, C.M. Johnson, M.J. Uren, K.P. Hilton, A.G. Munday and A.J. Hydes 987

### High Temperature DC-DC Converter Performance Comparison Using SiC JFETs, BJTs and Si MOSFETs

J.D. Scofield, H. Kosai, B. Jordan, S.H. Ryu, S. Krishnaswami, F. Husna and A.K. Agarwal 991

### Improved Efficiency in Power Factor Correction Circuits with a pn-Gated SiC FET

R.L. Kelley, M.S. Mazzola and W.L. Draper 995

### Microwave p-i-n Diodes and Switches Based on 4H-SiC

K. Zekentes, N. Camara, L.P. Romanov, A.V. Kirillov and M.S. Boltovets 999

### New Diode Designs Compatible with Vertical 4H-SiC JFET Fabrication Process

P. Brosselard, D. Tournier, M. Vellvehi, J. Montserrat, P. Godignon and J. Millan 1003

### OBIC Analysis of Different Edge Terminations of Planar 1.6 kV 4H-SiC Diodes

C. Raynaud, D. Loup, P. Godignon, R.P. Rodriguez, D. Tournier and D. Planson 1007

### Proposed Architecture for SiC Switches and Diodes in a Switch Mode Power Supply

J.M. Hancock 1011

## Chapter 6: Nitrides and Related Materials

1015

### Advances in AlGaIn/GaN/SiC Microwave Devices

M.J. Uren and M. Kuball 1017

<b>A Manipulation of Semiconducting GaN Nanowires by Dielectrophoresis Aligned Assembly Deposition (DAAD)</b>	
S.Y. Lee, T.H. Kim, D.I. Suh, J.E. Park, E.K. Suh, C.H. Hong and S.K. Lee	1023
<b>Current Transport in Ti/Al/Ni/Au Ohmic Contacts to GaN and AlGaN</b>	
F. Iucolano, F. Roccaforte, F. Giannazzo, A. Alberti and V. Raineri	1027
<b>Employing Discontinuous and Continuous Growth Modes for Preparation of AlN Nanostructures on SiC Substrates</b>	
G.R. Yazdi, M. Syväjärvi, R. Vasiliauskas and R. Yakimova	1031
<b>Hot Electron Induced Current Collapse in AlGaN/GaN HEMTs</b>	
A. Nakajima, S. Yagi, M. Shimizu, K. Adachi and H. Okumura	1035
<b>Impact of Acceptor Concentration on Electronic Properties of n<sup>+</sup>-GaN/p<sup>+</sup>-SiC Heterojunction for GaN/SiC Heterojunction Bipolar Transistor</b>	
K. Amari, J. Suda and T. Kimoto	1039
<b>Influence of Micropipe and Domain Boundary in SiC Substrate on the DC Characteristics of AlGaN/GaN HFET</b>	
H. Sazawa, T. Kato, K. Kojima, K. Furuta, K. Hirata, M. Kosaki, M. Kinoshita, T. Mitani, S. Nakashima and H. Okumura	1043