

Table of Contents

Preface

Silicon Wafer Requirements for ULSI Device Processing F. Illuzzi	1
Orthogonal Defect Solutions for Silicon Crystal Growth and Wafer Processing R.J. Falster	9
On the Mechanism of Defect Suppression in Nitrogen-Doped Silicon Single Crystals W. von Ammon, R. Hölzl, J. Virbulis, E. Dornberger, R. Schmolke and D. Gräf	17
Diffusion Coefficient and Equilibrium Concentration of Point Defects in Silicon Crystals, Estimated via Grown-in Defect Behavior K. Nakamura, T. Saishoji and J. Tomioka	25
The Effects of Impurities on Extended Defects in Cz Silicon Crystals Grown under Interstitial-Rich Conditions K. Terashima and H. Noguchi	35
Modeling of Impurity Transport and Point Defect Formation during Cz Si Crystal Growth V.V. Kalaev, V.A. Zabelin and Y. Makarov	41
Effect of Heavy Carbon, Nitrogen and Boron Doping on Oxygen Precipitation Behavior in Silicon Epitaxial Wafers K. Sueoka, M. Akatsuka, M. Yonemura, T. Ono, E. Asayama, Y. Koike and S. Sadamitsu	49
Carbon-Oxygen-Related Complexes in Irradiated and Heat-Treated Silicon: IR Absorption Studies L.I. Murin, V.P. Markevich, J.L. Lindström, M. Kleverman, J. Hermansson, T. Hallberg and B.G. Svensson	57
Infrared Absorption Analysis of Nitrogen in Czochralski Silicon Y. Yamanaka, H. Harada, K. Tanahashi, T. Mikayama and N. Inoue	63
Role of Nitrogen-Related Complexes in the Formation of Defects in N-Cz Silicon Wafers A. Karoui, F.S. Karoui, D.R. Yang and G.A. Rozgonyi	69
Optical Properties of Oxygen Agglomerates in Silicon S. Binetti, S. Pizzini, E. Leoni, R. Somaschini, A. Castaldini and A. Cavallini	75
Positron Annihilation Studies of Oxygen Precipitation in Silicon and of Nano-Precipitates in Si-Rich SiO₂ Films: Role of Vacancy-Like Defects R.S. Brusa, W. Deng, G.P. Karwasz and A. Zecca	81
Silicon Isotope Shifts of the 648-cm⁻¹ Infrared Absorption Line of Oxygen in Silicon H. Yamada-Kaneta	87
Thermal Donors in Silicon Implanted with Rare Earth Impurities V.V. Emtsev, C.A.J. Ammerlaan, B.A. Andreev, G.A. Oganessian, D.S. Poloskin, E.I. Shek and N.A. Sobolev	93
Interfacial Oxygen Thermodonor Formation in Plasma-Hydrogenated Silicon G.N. Kamaev, V.V. Bolotov, S.A. Chern'ev and M.D. Efremov	99
Vibrational Modes of Oxygen Dimers in Germanium V.V. Litvinov, L.I. Murin, J.L. Lindström, V.P. Markevich and A.A. Klechko	105
Oxygen Precipitation in Silicon Doped with Tin L.I. Khirunenko, Y.V. Pomozev and M.G. Sosnin	111
Hydrostatic Pressure Effect on Redistribution of Oxygen Atoms in Oxygen-Implanted Silicon A. Misiuk, A. Barcz, J. Ratajczak, I.V. Antonova and J. Jun	115
Elastic Instability of Strained Spherical Precipitates as a Cause of Oxide Platelets in Silicon V.V. Voronkov and R.J. Falster	121
Impact of Hydrogen on Oxygen Precipitation and Gate Oxide Integrity after RTA Processing T. Müller, G. Obermeier, T. Bearda, A. Huber, R. Schmolke, W. von Ammon and W. Lerch	127
Hydrogen Interaction with Transition Metals in Silicon, Studied by Electron Paramagnetic Resonance P.T. Huy and C.A.J. Ammerlaan	133
Raman Spectroscopic Analysis of Hydrogen Plasma Treated Czochralski Silicon R. Job, A.G. Ulyashin and W.R. Fahrner	139

Nitrogen Effect on Hydrogen Penetration into Cz Si during Wet Chemical Etching A.L. Parakhonsky, E.B. Yakimov and D.R. Yang	145
Hydrogen-Related Defects in High-Resistivity Silicon O.A. Soltanovich, O.V. Feklisova and E.B. Yakimov	150
Infra Red Absorption by Hydrogen-Passivated Cracks in Silicon D.V. Kilanov, L.N. Safronov and V.P. Popov	155
Atomistic Study of Boron Clustering in Silicon P. Alippi, P. Ruggerone and L. Colombo	163
Self-Interstitial Kinetics and Transient Phenomena in Si Crystals A. La Magna, S. Coffa, S. Libertino, M. Strobel and L. Colombo	171
Dependence of the Transient Enhanced Diffusion, of B in Si, upon B Concentration and Ion Implanted Dose S. Solmi, G. Mannino, M. Servidori, M. Bersani, L. Mancini, S. Milita, V. Privitera and M. Anderle	177
Interstitial Diffusion Influence upon Two-Dimensional Boron Profiles F. Giannazzo, V. Raineri, V. Privitera and F. Priolo	183
Incorporation, Diffusion and Agglomeration of Carbon in Silicon P. Lavéant, P. Werner, G. Gerth and U.M. Gösele	189
Suppression of Boron Transient Enhanced Diffusion by C Trapping S. Mirabella, A. Coati, S. Scalese, D. De Salvador, S. Pulvirenti, G. Bisognin, E. Napolitani, A. Terrasi, M. Berti, A. Carnera, A.V. Drigo and F. Priolo	195
Thermal Evolution of Extrinsic Defects in Ion Implanted Silicon: Current Understanding and Modelling F. Cristiano, B. Colombeau, C. Bonafos, A. Altibelli, G. Benassayag and A. Claverie	201
Room Temperature Point Defect Migration in Crystalline Si S. Libertino and S. Coffa	207
Electrical Effects of Point Defect Clouds at Dislocations in Silicon, Studied by Deep Level Transient Spectroscopy W. Schröter, V.V. Kveder and H. Hedemann	213
The Effect of Intrinsic Point Defects upon Dislocation Motion in Silicon I.V. Peidous, K.V. Loiko, D.A. Simpson, W.R. Frensley and H.R. Huff	219
Stress-Induced Redistribution of Point Defects in Silicon Device Structures K.V. Loiko, I.V. Peidous, T.E. Harrington and W.R. Frensley	225
Characterization of Interstitial-Related Bulk Defects in p⁻ Silicon Substrates by Epitaxial Deposition R. Schmolke, W. Angelberger, W. von Ammon and H. Bender	231
Monitoring of Defects in Thermal Oxides during Electrical Stress D. Caputo, F. Irrera and F. Palma	237
Formation of Shallow Donors in Stress-Annealed Silicon Implanted with High-Energy Ions I.V. Antonova, E.P. Neustroev, A. Misiuk and V.A. Skuratov	243
A Study of the Conversion of the VO to the VO₂ Defect in Heat-Treated Silicon under Stress C.A. Londos, M. Potsidou, A. Misiuk and I.V. Antonova	249
Passivation of Al/Si Interface by Chemical Treatment: Schottky Barrier Height and Plasma Etch Induced Defects Z.E. Horváth, M. Ádám, P. Godio, G. Borionetti, I.A. Szabó, E. Gombia and V. Van Tuyen	255
Impact of Compressive Stress on the Formation of Thermal Donors in Heat-Treated Silicon A. Misiuk, B.A. Andreev, V.V. Emtsev, C.A. Londos, G.A. Oganessian and D.S. Poloskin	259
Helium Bubble Growth in Silicon: Ripening or Bubble Motion and Coalescence? V.M. Vishnyakov, S.E. Donnelly, G. Carter, R.C. Birtcher and L. Haworth	267
Void Shrinkage during Thermal Oxidation of Silicon V. Raineri, S. Giuffrida and E. Rimini	273
Gettering Induced by Helium Implantation: Application to a Device F. Roqueta, D. Alquier, L. Ventura and B. López	279
Defects Created by Helium Implantation at Different Temperatures in Silicon M. David, E. Oliviero, A. Ratchenkova, N.N. Gerasimenko, A. Declémy, J.F. Barbot, A. van Veen and M.F. Beaufort	285
Damage Evolution in Helium-Hydrogen Co-Implanted (100) Silicon R. Tonini, F. Corni, C. Nobili, G. Ottaviani, F. Cazzaniga and G. Queirolo	291

Gold Gettering by H⁺ or He⁺⁺ Ion Implantation Induced Cavities and Defects in Cz Silicon Wafers	
I. Périchaud, E.B. Yakimov, S. Martinuzzi and C. Dubois	297
Influence of Depth in Helium Desorption from Cavities Induced by ³He Implantation in Silicon	
R. Delamare, E. Ntsoenzok, F. Labohm and A. van Veen	303
Dopant Segregation on Cavities Induced by Helium Implantation: The Case of Boron and Phosphorus	
F. Cayrel, D. Alquier, F. Roqueta, L. Ventura, C. Dubois, R. Jérision and D. Mathiot	309
Hydrogen Redistribution and Void Formation in Hydrogen Plasma Treated Czochralski Silicon	
A.G. Ulyashin, R. Job, W.R. Fahrner, D. Grambole and F. Herrmann	315
Precipitation Kinetics and Recombination Activity of Cu in Si in the Presence of Internal Gettering Sites	
A.A. Istratov, R. Sachdeva, C. Flink, S. Balasubramanian and E.R. Weber	323
Iron Solubility in Boron-Doped Silicon and Fe Gettering Mechanism in p/p⁺ Epitaxial Wafers	
M.B. Shabani, Y. Shiina, S. Shimanuki and F.G. Kirscht	331
Copper-Defect and Copper-Impurity Interactions in Silicon	
S.K. Estreicher, D. West and P. Ordejón	341
Efficiency of Intrinsic Gettering for Copper in Silicon	
S. Isomae, H. Ishida, T. Itoga and K. Hozawa	349
Nickel Gettering in Silicon: Role of Oxygen	
G. Regula, R. El Bouayadi, B. Pichaud and E. Ntsoenzok	355
Electrical Activity of Dislocations in Si Decorated by Ni	
V.V. Kveder, W. Schröter, M. Seibt and A. Sattler	361
Comparison of Nickel and Iron Gettering in Cz Silicon Wafers	
F.G. Kirscht, B. Orschel, S. Rouvimov and M. Shabani	367
Recombination Lifetimes of Iron-Contaminated Silicon Wafers: Characterization Using a Single Set of Capture Cross-Sections	
M. Rommel, G. Zoth, M. Ullrich and H. Ryssel	373
Internal Gettering in Silicon: Experimental and Theoretical Studies Based on Fast and Slow Diffusing Metals	
P. Geranzani, M. Pagani, C. Pello and G. Borionetti	381
The Realization of Uniform and Reliable Intrinsic Gettering in 200mm p- and p/p- Wafers for a Low Thermal Budget 0.18µm Advanced CMOS Logic Process	
M.J. Binns, A. Banerjee, R. Wise, D.J. Myers and T.A. McKenna	387
Application of Gate Oxide Integrity to the Evaluation of the Efficiency of Internal and External Gettering Sites in Si Wafers	
S.V. Koveshnikov, D. Beauchaine, Z.J. Radzimski, L. Ling and K.V. Ravi	393
Defect Engineering and Prevention of Impurity Gettering at R_{p/2} in Ion-Implanted Silicon	
R. Kögler, A. Peeva, J. Kaschny, W. Skorupa and H. Hutter	399
Gettering Technology Based on Porous Silicon	
G. Lamedica, M. Balucani, A. Ferrari, V. Bondarenko, V. Yakovtseva and L. Dolgyi	405
Platinum Silicide Precipitate Formation During Phosphorus Diffusion Gettering in Silicon	
M. Seibt, A. Döller, V.V. Kveder, A. Sattler and A. Zozime	411
Impact of a Cooling Process on the Dopant Activity of Platinum in Silicon	
L. Ventura, B. Pichaud and F. Lanois	417
Radiation Defects and Carrier Lifetime in Tin-Doped n-Type Silicon	
E. Simoen, C. Claeys, A. Kraitichinskii, M. Kras'ko, V.B. Neimash and L.I. Shpinar	425
Ultra Low-Level Ion Implantation Damage Detected by p-n Junctions Biased above Breakdown	
E. Sciacca, S. Lombardo, D. Patti, D. Sanfillippo, C. Di Franco, M. Ghioni, F. Zappa, E. Rimini and S. Cova	431
Radiation-Induced Electronic Defect Levels in High-Resistivity Si Detectors	
E.V. Monakhov, B.S. Avset, A. Hallén and B.G. Svensson	441
p-n Junction Leakage in Neutron-Irradiated Diodes Fabricated in Various Silicon Substrates	
A. Czerwinski, E. Simoen, A. Poyai, C. Claeys and H. Ohyama	447

Radiation Damage in MOS Structures, Irradiated with High-Energy Heavy Ions and Fast Neutrons, with Regard to Charge DLTS and C-V Measurements J. Staňo, V.A. Skuratov and M. Žiška	453
Study of the Effect of Carrier Cross-Sections, on the Leakage Current of Irradiated Silicon Detectors, using the Exchange Charge Model S. Saramad and A. Moussavi-Zarandi	459
Radiation Damage in npn Si Transistors due to High-Temperature Gamma Ray and 1-MeV Electron Irradiation H. Ohyama, T. Hirao, E. Simoen, C. Claeys, M. Nakabayashi and S. Onoda	465
Impact of High-Energy Particle Irradiation on Polycrystalline Silicon Films M. Nakabayashi, H. Ohyama, E. Simoen, C. Claeys, K. Tanaka, K. Kobayashi and K. Miyahara	471
Proton Irradiation Effects on Standard and Oxygenated Silicon Diodes D. Bisello, N. Bacchetta, A. Candelori, A. Kaminski, D. Pantano, R. Rando, I. Stavitski and J. Wyss	477
Existence of an Epitaxially Ordered Phase in the Buried Oxide of SIMOX Wafers T. Shimura, T. Hosoi, K. Fukuda and M. Umeno	485
Hydrogen-Related Phenomena in SOI Fabricated by Using H⁺-Ion Implantation I.V. Antonova, D.V. Nikolaev, O.V. Naumova and V.P. Popov	491
Hydrogen-Induced Shallow Donors in Silicon and Silicon-on-Insulator Structures Formed by Hydrogen Slicing V.P. Popov, D.V. Kilanov, I.V. Antonova, O.V. Naumova, A.P. Stepovik, V.T. Gromov and A. Misiuk	497
Properties of Silicon Film in a Silicon-on-Glass Structure D.V. Kilanov, I.V. Antonova, L.N. Safronov, V.P. Popov, V.I. Obodnikov and E.V. Spesivtsev	503
Structural and Photoluminescence Properties of H⁺ Ion-Implanted Silicon-on-Insulator Structures Formed by Hydrogen Slicing I.E. Tyschenko, A.B. Talochkin, K.S. Zhuravlev, V.I. Obodnikov and V.P. Popov	509
Charge Relaxation at Oxygen-Enriched Silicon Grain Boundaries A.K. Fedotov, A.V. Mazanik and A.G. Ulyashin	515
Characterization of SiC Grown on Si(111) by Supersonic C₆₀ Beams L. Aversa, R. Verucchi, G. Ciullo, A. Boschetti, L. Ferrari, P. Moras, M. Pedio, A. Pesci and S. Iannotta	523
Effects of Pulsed Electron Beam Annealing on Radiation Damage in N Doped a-SiC:H Films Deposited by PECVD J. Huran, I. Hotový, J. Staňo, A.P. Kobzev and N.I. Balalykin	529
Cavities in He-Implanted SiC J.F. Barbot, E. Oliviero, M. David, A. Declémy, C. Blanchard, M.F. Beaufort and A. van Veen	533
Study of Relaxed Si_{0.7}Ge_{0.3} Buffers, Grown on Patterned Silicon Substrates, by Raman Spectroscopy G. Wöhl, E. Kasper, M. Klose, T. Hackbarth, H.-. Herzog and H. Kibbel	539
On the Properties of Divacancies in Si_{1-x}Ge_x L.I. Khirunenkov, Y.V. Pomozev, M.G. Sosnin, N.V. Abrosimov and W. Schröder	545
Kinetics of Surface Processes and Mechanisms of Alloy Intermixing Near Interfaces in Si(Ge)/Si_{1-x}Ge_x Structures Grown by Molecular Beam Epitaxy with Combined Sources L.K. Orlov and N.L. Ivina	551
Influence of Ge Content on Electrical Properties: Sheet Resistance and Hall Mobility in Ion Beam Synthesized Si_{1-x}Ge_x Alloy C. Cerrina, A. Nejim, Y. Wang and P.L.F. Hemment	557
Defect-Related Current Instabilities in InAs/GaAs and AlGaAs/GaAs Structures? Z.E. Horváth, S. Franchi, A. Bosacchi, P. Frigeri, E. Gombia, R. Mosca and V. Van Tuyen	565
Segregation of Mg Implanted into InAs: Influence of the Internal Elastic Stresses O. Velichko, V.A. Dobrushkin, A.K. Fedotov and V.A. Tsurko	569
Defects in CdTe <Cl> Induced by Powerful Laser Radiation D.V. Korbutyak, S.G. Krylyuk, I.M. Kupchak, V.G. Litovchenko, L. Fedorenko, A. Medvid and Y. Hatanaka	575
Phonon-Plasmon Interaction in Tunnelling GaAs/AlAs Superlattices Grown on (311) and (100) Substrates M.D. Efremov, V.A. Volodin, V.A. Sachkov, V.V. Preobrazhenski, B.R. Semyagin, N.N. Ledentsov, V.M. Ustinov, D. Litvinov and D. Gerthsen	581

Radiation-Stimulated Ordering Effect in CdS Crystals B. Pavlyk, B. Tsybulyak and O. Klochan	587
The Laser-Stimulated Modification of the Surfaces of Polycrystalline CdTe Layers A. Baidullaeva, P.E. Mozol and A.I. Vlasenko	593
Electroluminescence of Si Quantum Dots in MOS Structures A. Irrera, G. Franzò, F. Iacona, E.C. Moreira and F. Priolo	601
Blue-Green Photoluminescence from Silicon Dioxide Films Containing Ge⁺ Nanocrystals Formed under Conditions of High Hydrostatic Pressure Annealing I.E. Tyschenko, L. Rebohle, A.B. Talochkin, B.A. Kolesov, M. Voelskow, A. Misiuk and W. Skorupa	607
Silicon Nanoclusters in Thermal Oxide Films on Silicon M.V. Zamoryanskaya and V.I. Sokolov	613
Luminescence from Si Nanocrystals and Er³⁺ Ions Embedded in Resonant Cavities F. Iacona, G. Franzò, E.C. Moreira, D. Pacifici and F. Priolo	617
Temporal Characteristics of the Optical Storage Effect in Si:Er M. Forcales, I.V. Bradley, J.-R. Wells and T. Gregorkiewicz	623
Effect of Selective Doping on Photo- and Electroluminescence Efficiency in Si:Er Structures M. Stepikhova, B. Andreev, V.D. Kuznetsov, Z.F. Krasil'nik, A. Soldatkin, V. Shmagin and M. Bresler	629
The Structure and Photoluminescence of Erbium-Doped Nanocrystalline Silicon Thin Films Produced by Reactive Magnetron Sputtering M.F. Cerqueira, M. Losurdo, M.V. Stepikhova, O. Conde, M.M. Giangregorio, P. Pinto and J.A. Ferreira	637
Defect Engineering in the Technology of Light-Emitting Structures Based on Monocrystalline Si Implanted with Rare Earth Ions N.A. Sobolev	645
Excitation Cross-Section of Erbium in Semiconductor Matrices under Optical Pumping O.B. Gusev, M.S. Bresler, P.E. Pak, I.N. Yassievich, M. Forcales, N.Q. Vinh and T. Gregorkiewicz	651
Spectroscopic Characterisation of Erbium Impurity in Crystalline Silicon C.A.J. Ammerlaan and I. de Maat-Gersdorf	657
Nanocrystal MOS Memories Obtained by LPCVD Deposition of Si Nanograins M. Vulpio, C. Gerardi, S. Lombardo, G. Ammendola, I. Crupi, T. Rossetti, N. Nastasi, G. Mantarro and G. Nicotra	663
Memory Effects in Single-Electron Nanostructures I. Crupi, S. Lombardo, C. Gerardi, G. Ammendola, M. Vulpio, E. Rimini and M. Melanotte	669
Nanocrystal MOS with Silicon-Rich Oxide I. Crupi, S. Lombardo, C. Gerardi, B. Fazio, M. Vulpio, E. Rimini and M. Melanotte	675
Self-Orientation of Silicon Nanocrystals Created under Pulse Laser Impact in Stressed α-Si:H Films on Glass Substrates M.D. Efremov, V.A. Volodin, V.V. Bolotov, A.V. Kretinin, A.K. Gutakovskii, L.I. Fedina and S.A. Kochubei	681
Nucleation of Nanostructures from Surface Defects on Silicon V. Palermo and D. Jones	687
Crystalline Silicon for Solar Cells M. Kittler and W. Koch	695
Measurement of the Normalized Recombination Strength of Dislocations in Multicrystalline Silicon Solar Cells M. Rinio, S. Peters, M. Werner, A. Lawerenz and H.J. Möller	701
Oxygen Annealing Behavior in Multicrystalline Silicon D.R. Yang and H.J. Möller	707
Three-Dimensional Emitter Based on Locally Enhanced Diffusion (TREBLE) Structure: Modeling and Formation S. Bourdais, A. Slaoui, G. Beaucarne, J. Poortmans, E. Christoffel and A. Zerga	713
Effective Gettering Mechanisms in Solar Multicrystalline Materials A.A. Efremov, A.A. Evtukh, N.I. Klyui, V.G. Litovchenko, V. Popov, Y. Rassamakin, A.V. Sarikov, C. Häbeler and W. Koch	719

Strain Characterisation at the nm Scale of Deep Sub-Micron Devices by Convergent-Beam Electron Diffraction	
A. Armigliato, R. Balboni, A. Benedetti, G.P. Carnevale, A.G. Cullis, S. Frabboni and D. Piccolo	727
Gate-Oxide Integrity Evaluation Using Non-Ideal Metal-Oxide-Silicon Capacitor Structures	
T. Mchedlidze	735
Lock-In IR-Thermography – A Novel Tool for Material and Device Characterization	
S. Huth, O. Breitenstein, A. Huber, D. Dantz, U. Lambert and F. Altmann	741
Characterisation of Surface and Near-Surface Regions in High-Purity Cz Si	
A. Castaldini, D. Cavalcoli, A. Cavallini, T. Minarelli and E. Susi	747
A Technique for Delineating Defects in Silicon	
L. Mule'Stagno	753
SEM Vision Periodic Defect Review and Characterization after Inter-Metal Dielectric Deposition	
S. Ventola, J. Fort, F. La Spada and P. Maniscalco	759
Ellipsometric Study of Ion-Implantation Damage in Single-Crystal Silicon - An Advanced Optical Model	
P. Petrik, O. Polgár, T. Lohner, M. Fried, N.Q. Khánh and J. Gyulai	765
Evaluation of Effective Carrier Lifetime in Epitaxial Silicon Layers	
H. Väinölä, J. Storgårds, M. Yli-Koski and J. Sinkkonen	771
Spatial Distribution of Strain and Phases in Si Nano-Indentation Analysed by Raman Mapping	
F. Demangeot, P. Puech, V. Paillard, V. Domnich and Y.G. Gogotsi	777
Structure and Stability of Thin Praseodymium Oxide Layers on Si(001)	
H.J. Müssig, J. Dąbrowski, K. Ignatovich, J.P. Liu, V. Zavodinsky and H.J. Osten	783
Structural Investigations of Praseodymium Oxide Epitaxially Grown on Silicon	
P. Zaumseil, E. Bugiel, J.P. Liu and H.J. Osten	789
1D-ACAR Studies of As-Grown Impurity Centers in Silicon	
N.Y. Arutyunov and V.Y. Trashchakov	795
Characterization of Interfacial States at Silicon Bicrystals	
G.N. Kamaev, S.V. Golod, E.M. Skok, A.K. Fedotov and A.V. Mazanik	801
Minority Carrier Diffusion Lengths in Silicon Doped Gallium Nitride Thin Films Measured by Electron Beam Induced Current	
C. Grazzi, M. Albrecht, H.P. Strunk, Z. Bougrioua and I. Moerman	807