

Table of Contents

Preface

D⁺ Centers in High Magnetic Fields and Quantum Wells

J. Zhu, S.G. Louie and T. Pang 1

Electronic States of Thermal Donors in Semiconductors

C.A.J. Ammerlaan and T. Gregorkiewicz 9

Impurity Control in Silicon Crystals for G-Bit Scale Integration

T. Abe 17

Optical Spectroscopy of Shallow Impurity States in Semiconductor Quantum Wells

B. Monemar, P.O. Holtz, C.I. Harris, P. Bergman, H. Kalt, M. Sundaram, J.L. Merz, A.C. Gossard, K. Köhler and T. Schweizer 29

Extremely Heavy Doping of Carbon in GaAs and InGaAs

M. Konagai 37

Carbon and Silicon Impurity Centers in GaAs

R.C. Newman 45

Non-Equilibrium Point Defects and Diffusion in GaAs and Related Compounds

U.M. Gösele, T.Y. Tan, M. Uematsu and K. Wada 53

Self-Compensation in P, As, and N Doped ZnSe

D.J. Chadi and N. Troullier 61

Vacancies in Semiconductors Characterized by Slow Positron and Their Effect on Electrical Properties

J.L. Lee 67

Effect of External Pressure and Internal Stress on Impurity Diffusion in Silicon

O. Sugino and A. Oshiyama 75

Impurity Vibrations of Carbon-Oxygen Complexes in Crystalline Silicon

C. Kaneta, T. Sasaki and H. Katayama-Yoshida 81

Strong Electron Correlation in Si-OV and Si-V - An Ab Initio Cluster Study -

A.B. van Oosten, A.M. Frens and J. Schmidt 87

Spherical Model of Shallow Acceptor Resonant P_{1/2} States in Cubic Semiconductors

R. Buczko 93

Shallow-Deep Instability of a Hydrogenic Impurity in Quantum Wells

Y. Shinozuka 99

Alloy Broadening of the Acceptor-Related Near-Gap Luminescence in Semiconductor Alloys

J.M. Langer, R. Buczko and A.M. Stoneham 105

Isotopic Dependence of Near-Band-Gap Luminescence from Germanium

G. Davies, E.C. Lightowers, V.I. Ozhogin, K. Itoh, W.L. Hansen and E.E. Haller 111

Neutron Transmutation Doping of Isotopically Controlled Ge

K. Itoh, W.L. Hansen, E.E. Haller, J.W. Farmer and V.I. Ozhogin 117

Zeeman and Landau Spectroscopy of Group III Acceptors in Germanium

G.J. Takacs, R.E.M. Vickers, P. Fisher and C.A. Freeth 123

Zeeman and Piezo-Zeeman Spectroscopy of Zinc and Copper Acceptors in Germanium

A.D. Warner, D.S. Ryan, P. Fisher and C.A. Freeth 129

Hydrogen-Induced Isotope Shift of Dipole Transitions of Shallow Donors in Silicon

J. Hartung and J. Weber 135

The Structure of a Metastable Luminescent Defect in Sulphur-Doped Silicon

M. Singh, G. Davies, E.C. Lightowers and G.D. Watkins 141

Iron-, Manganese- and Chromium-Indium Pairs in Silicon

U. Reislöhner, S. Schwarz and W. Witthuhn 147

Electrical Characteristics of B Doped Ge Film Epitaxially Grown on Si Using Ultraclean Chemical Vapor Deposition

K. Gotoh, J. Murota and S. Ono 153

Self-Modulating Incorporation of Sb in Si/SiGe Superlattices during Molecular Beam Epitaxial Growth

K. Fujita, S. Fukatsu, N. Usami, H. Yaguchi, Y. Shiraki and R. Ito 159

Strong Electron-Phonon Interaction of a Hydrogen-Carbon Complex and the Motion of Isolated Hydrogen in Si	
Y. Kamiura, T. Okashita, Y. Nishiyama and F. Hashimoto	165
Piezo-Magneto-Resistivity of Si-B in the Hopping Regime	
M. Stöhr, P. Janiszewski and J.A. Chroboczek	171
Photoluminescence Measurements of a Beryllium-Related Deep Center in Silicon	
J.D. Campion, K.G. McGuigan, M.O. Henry and M.H. Nazaré	177
Accurate Evaluation Techniques of the Interstitial Oxygen Concentrations in the Oxygen Precipitated and the Low-Resistivity CZ-Si Crystals	
Y. Kitagawara, K. Takamizawa and T. Takenaka	183
Measurement of Interstitial Oxygen Striations in Silicon Single Crystals Using the Micro-FTIR Method	
E. Iino, I. Fusegawa and H. Yamagishi	189
The Dynamics of the Non-Radiative Triplet State of the (V-O)⁰ Defect in Silicon: Evidence for a Radical Pair Mechanism	
A.M. Frens, M.E. Braat, A.B. van Oosten and J. Schmidt	195
Carbon-Oxygen Complexes and Oxygen Precipitation in Silicon Crystals Observed by Low-Temperature Infrared Absorption	
Y. Shirakawa, H. Yamada-Kaneta and T. Ogawa	201
Shifts of the Infrared Absorption Peaks of Oxygen in Silicon Caused by Germanium-Doping	
H. Yamada-Kaneta, C. Kaneta and T. Ogawa	207
Observation of Five Additional Thermal Donors and Kinetics of Thermal Donor Formation and Annihilation at Temperatures above 500°C in Czochralski-Grown Si	
W. Götz, G. Pensl and W. Zulehner	213
Ultrashallow Hydrogen-Like Thermal Donors in Silicon Crystals	
A. Hara, M. Aoki, T. Fukuda and A. Ohsawa	219
Formation of Oxygen Clusters in Quenched Cz- and MCz-Si Crystals	
A. Ikari, H. Haga, O. Yoda, A. Uedono and Y. Ujihira	225
Simulation of Oxygen Precipitation and Denuded Zone Formation during Thermal Anneals	
M. Schrems	231
Characterization of Excimer Laser Annealing of Arsenic Implanted Silicon	
T. Akane, S. Matsumoto and I. Mizushima	237
Heavily Arsenic Doping into Si by ArF Excimer Laser Irradiation Using Tertiarybutylarsine (tBAs)	
S.F. Chichibu, T. Nii, T. Akane and S. Matsumoto	243
Effective-Mass-Like Excited Pseudo-Donor States of a Complex Metastable Defect in Silicon	
J.H. Svensson, E. Janzén, O. Kordina and B. Monemar	249
Zeeman Study of 735meV Photoluminescence Band in Iron-Doped Silicon	
M.I. Cálao and M.C. Carmo	255
Thermal Process Dependence of Chromium Donor/Acceptor in Silicon	
M. Takiyama, S. Ohtsuka and M. Tachimori	261
Co-Acceptor Complexes in Si	
A.-. Van Bavel and G. Langouche	267
Defect Observation in Silicon Surface Layers by Surface Wave Resonance in RHEED	
K. Ueda	273
Differential Hall-Effect Spectroscopy of Rare-Earth Impurities (Ce, Er) in Silicon	
H. Nakayama, A. Matsuura, M. Kohno and T. Nishino	279
Dispersion in Bound Exciton Binding Energy via Coupling to Interface Localization Potentials in GaAs/AlGaAs Quantum Wells	
C.I. Harris, B. Monemar, P.O. Holtz, M. Sundaram, J.L. Merz and A.C. Gossard	285
Impurities and Point Defects in GaAs and AlAs Grown by Atomic Layer Epitaxy	
K. Ikuta, H. Yokoyama and N. Inoue	291
Partial Ferromagnetic Order in p-Type (In, Mn) as Diluted Magnetic III-V Semiconductors	
H. Ohno, H. Mune-kata, T. Penney, S. von Molnár and L. Chang	297
Yb Intra-4f-Shell Luminescence in Yb- and Zn-Doped InP	
A. Taguchi and K. Takahei	303
Infrared Absorption Lines in Hydrogen-Plasma Treated Se-Doped GaAs	
J.H. Svensson and J. Weber	309

Monoenergetic Positron Beam Study of Heavily Si-Doped GaAs Grown by MOCVD Using Tertiarybutylarsine	
S.F. Chichibu, A. Iwai, Y. Nakahara, S. Matsumoto, H. Higuchi, L. Wei and S. Tanigawa	315
Anti-Stokes Photoluminescence Related to the Deep Donor States in Si Double δ-Doped $\text{Al}_x\text{Ga}_{1-x}\text{As}$	
M.R. Junnarkar, E. Yamaguchi and T. Saku	321
Shallow Donor Bound State in an AlAs/GaAs Quantum Well with - X Mixing	
E.A. de Andrada e Silva, D. Wang and I.C.d. Cunha Lima	327
Optical Studies of Excitons in Be-Doped GaAs/AlGaAs Symmetric Coupled Double Quantum Wells	
Q.X. Zhao, T. Westgaard, B. Monemar, B.O. Fimland and K. Johannessen	333
Hydrogen Passivation of Shallow Impurities in GaAs/AlGaAs Quantum Wells	
C.I. Harris, M. Stutzmann and K. Köhler	339
Multi-Level Dynamics between Below-Gap States in Heavily Doped Quantum Wells by Time-Resolved and Selectively-Excited Photoluminescence	
N. Kamata, E. Kanoh, T. Ohsaki and K. Yamada	345
Deep Electron Trap Studies of GaAlAs/GaAs Single and Multiple Quantum Well Lasers Fabricated on Si Substrate by MOCVD	
L. Lu, J. Zhou, W. Zhang and M. Umeno	351
Optical Absorption Lines in Heat-Treated GaAs	
M. Suezawa and K. Sumino	357
Te-Related Donor States in $\text{Al}_x\text{Ga}_{1-x}\text{As}$	
J.G. Kang, Q. Huang, K. Hoshikawa and T. Fukuda	363
Shallow Donor States in InP - Electron-Spin-Resonance Induced Overhauser Shift -	
K. Murakami, T. Ohyanagi, K. Hara and K. Masuda	369
Donor Concentration Dependence of GaP Luminescence	
T. Monteiro, E. Pereira, F. Domingues-Adame and J. Piqueras	375
Various Configurations of Silicon-Related Defects in GaAs	
Y. Okada and K. Fujii	381
Si Doping of GaAs Grown by Molecular Beam Epitaxy on Different Substrate Orientations	
L. Pavesi, I. Harrison, F. Piazza and M. Henini	387
The Effect of Arsenic Vapor Pressure on Site Distribution of Silicon in Gallium Arsenide Grown by the Gradient Freeze Method	
K. Fujii, F. Orito and H. Fujita	393
Fermi Level Effect and Vacancy Contribution to the Outdiffusion of Si in GaAs	
H.-. You, U.M. Gösele and T.Y. Tan	399
Carbon in LEC Grown GaAs Crystals	
Y. Otoki, M. Sahara, S. Shinzawa and S. Kuma	405
The Study of Defects Induced by the Implantation of O Ions into GaAs by a Slow Positron Beam	
S. Fujii, L. Wei and S. Tanigawa	411
Impurity Diffusion into GaAs through the SiO_2 Protective Layers	
D.K. Gautam, Y. Shimogaki, Y. Nakano and K. Tada	417
Electron Beam Doping of Si and Zn Impurities into GaAs	
T. Wada, M. Takeda and A. Takeda	423
Effect of Hydrogen Passivation on Lightly n-Doped GaAs	
C.J. Chen, Y.H. Chang, T.C. Chen, S.H. Li, Y.F. Chen and H.H. Lin	429
Free-Carrier Saturation in III-V Compound Semiconductors	
E. Tokumitsu and M. Konagai	435
The Sn- and Si-DX Centre Properties in Double Doped (Al,Ga)As	
D.K. Maude, U. Willke, M.L. Fille, P. Gibart and J.C. Portal	441
Multiplicity and Lattice Relaxation of DX Center in AlGaAs: Si Studied by Electron Emission Spectra under Pressure	
K. Takarabe, H. Ashizawa, S. Minomura, H. Kato, Y. Watanabe and K. Matsuda	447
Persistent Photoconductivity and Electric-Field Quenching Related with DX Centers in AlGaAs/GaAs Heterostructure	
K. Aoki	453

Photo-Induced Simultaneous Transformations of Shallow Donors and EL2 States in Semi-Insulating GaAs	
T. Shimizu, H. Kobori, T. Ohyama and E. Otsuka	459
Photoluminescence Study of Yb-Doped InP under Low Temperature and Pressure	
K. Takarabe, S. Minomura, A. Taguchi and K. Takahei	465
Identification of Residual Donors in CdTe Grown by the Bridgman Method	
S. Seto and A. Tanaka	471
Far-Infrared Magneto-Absorption of Donors in the Epitaxial ZnSe Layers on GaAs	
R. Komeda, H. Nakata and T. Ohyama	477
Origin of Carrier Reduction by Annealing in n-Type ZnSe	
T. Miyajima, H. Okuyama, K. Akimoto, L. Wei and S. Tanigawa	483
Photoluminescence Characterization of Defects in CuGaS₂ Crystals	
S. Shirakata, T. Miyazaki and S. Isomura	489
Hall Effect and Infrared Absorption Measurements on Nitrogen Donors in 4H-SiC	
W. Götz, A. Schöner, G. Pensl, W. Suttrop, W.J. Choyke, R.A. Stein and S. Leibenzeder	495
Characterization of Defects in As-Grown and Electron-Irradiated 3C-SiC Epilayers by Using Slow Positrons	
H. Itho, M. Yoshikawa, I. Nashiyama, L. Wei, S. Tanigawa, S. Misawa, H. Okumura and S. Yoshida	501
Localized-Pair Recombination Nature of Visible Luminescence from Anodized Porous-Si	
Y. Mochizuki and M. Mizuta	507
Visible Photoluminescence of Porous Silicon	
H. Nishitani, H. Nakata, T. Ohyama and Y. Fujiwara	513
Photoluminescence due to Zn-O Complexes in Silicon	
J.D. Champion, M.O. Henry, K.G. McGuigan and E.C. Lightowers	519
High-Resolution EPR Spectroscopy of the Si-NL 10 Thermal Donor	
T. Gregorkiewicz, H.H.P.T. Bekman, C.A.J. Ammerlaan, W. Knap, L.C. Brunel and G. Martinez	521
Morphology of Oxide Precipitates in Czochralski Silicon Crystals	
K. Sueoka, N. Ikeda, T. Yamamoto and S. Kobayashi	523
Site Change of Li Atoms in ZnSe by Photoirradiation	
M. Ichimura, T. Wada and S. Fujita	525
Characterization of Impurities in Si(C₂H₅O)₄ for Efficient SiO₂ Production in ULSI Technology	
T. Danno and K. Seki	527