

Contents

Excitons in Semiconductors

<i>Stephan W. Koch, Mackillo Kira</i>	1
1 Introduction	1
2 Absorption Spectroscopy	2
3 Photoluminescence	7
4 Terahertz Spectroscopy	10
5 Conclusions	16
References	17

Hot Excitons in ZnSe Quantum Wells

<i>Hui Zhao, Heinz Kalt</i>	19
1 Introduction	19
2 Hot-Exciton Formation and Spectroscopy	20
3 Energy Relaxation of Hot Excitons	28
4 Hot-Exciton Transport	31
5 Conclusions	41
References	42

Probing Localized Excitons

by Speckle Analysis of Resonant Light Scattering

<i>Wolfgang Langbein, Gerrit Kocherscheidt, Roland Zimmermann</i>	47
1 Introduction	47
2 The Concepts of Speckle Analysis of Resonant Emission	47
3 Theoretical Description of Localized Excitons	51
4 Density Matrix Formulation of Exciton Scattering and Light Emission	53
5 Time-Resolved Speckle Analysis	58
6 Spectrally Resolved Speckle Analysis	64
7 Spectral Interferometry	66
8 Conclusion and Outlook	70
References	71

Donor-Related Exciton Luminescence in Wide-Bandgap Semiconductors: Diamond, Zinc Oxide, and Gallium Nitride

<i>Rolf Sauer, Klaus Thonke</i>	73
1 Introduction	73
2 Diamond	73
3 Donors in ZnO and GaN: Determination of Ionization Energies from Photoluminescence (PL) Spectra	86
References	102

Spectroscopy of Biexcitons and Trions in II–VI Quantum Dots

<i>Ulrike Woggon</i>	107
1 Introduction	107
2 Biexcitons in Nanocrystals	112
3 Biexcitons in Self-Organized Islands	120
4 Trion Properties in Quantum Dots	125
5 Dynamics of Single Excitons, Biexcitons, and Trions	126
6 Summary and Outlook	128
References	129

Dynamics of Excitons and Exciton Complexes in Wide-Gap Semiconductors

<i>Jürgen Gutowski, Hans-Georg Breunig, Tobias Voss</i>	133
1 Introduction	133
2 Dynamics of Excitons, Trions and Biexcitons in Low-Dimensional Wide-Gap Semiconductors	134
3 Coherent Optics and Higher Coulomb Correlations in the Exciton Range of Wide-Gap Semiconductors	139
References	154

Quantum Kinetics and Femtosecond Spectroscopy – The Discovery of Slowness

<i>Hartmut Haug</i>	159
1 Quantum Kinetic Regime	159
2 Non-equilibrium Many-Body Theory and Quantum Kinetics	162
3 Time-Dependent Screening of the Phonon and Coulomb Interactions	164
References	169

Extreme Nonlinear Optics in Semiconductors

<i>Martin Wegener</i>	171
1 Extreme Nonlinear Optics of Two-Level Systems	171
2 Intraband Effects	180
3 Two Experimental Examples	182
4 Conclusions and Outlook	185
References	187

Nonlinear Semiconductor Microcavities

<i>Hyatt M. Gibbs</i>	189
1 Perturbative Regime: Optical Bistability	189
2 Nonperturbative Regime: Normal-Mode Coupling	190
3 Toward the Strong Coupling Regime	199
4 Conclusions.....	205
References	206

All-Optical Control of Charge and Spin in GaAs:**Densities and Currents**

<i>Martin J. Stevens, Ravi D.R. Bhat, Ali Najmaie, Henry M. van Driel, John E. Sipe, and Arthur L. Smirl</i>	209
1 Introduction	209
2 Theoretical Foundations of Quantum Interference	212
3 Symmetry Predictions: Charge Densities and Spin Densities	223
4 Experimental Coherent Control Techniques	225
5 Control of Charge and Spin Densities: Measurements	227
6 Symmetry Predictions: Charge Currents and Spin Currents	232
7 Electrical Detection of Spin-Polarized Charge Current.....	235
8 Optical Probing of Charge Current and Pure Spin Current	238
9 Summary.....	245
References	245

**Semiconductor Quantum Dots
for Optoelectronic Applications**

<i>Tommy W. Berg, Jørn M. Hvam</i>	249
1 Introduction	249
2 Quantum Dot Fundamentals	249
3 Quantum Dot Semiconductor Optical Amplifiers	258
4 Conclusions.....	271
References	272

**GaInNAs: Fundamentals of a New Material System
for Near-Infrared Optoelectronics**

<i>Michael Hetterich</i>	275
1 Introduction to GaInNAs-Based Laser Structures.....	275
2 Band Structure of GaAsN and GaInNAs	277
3 Boundary Conditions for the BAC Model Wave Function in GaInNAs-Based Heterostructures	279
4 BAC Model Calculation of Bound States in GaInNAs Quantum Wells	282
5 Influence of the Local N Environment on the BAC Hamiltonian Parameters	283
6 Conclusion	285
References	286

**Nitride-Based Light Emitting Diodes and Laser Diodes:
Optical Properties and Applications**

<i>Martin Kuball</i>	289
1 Introduction	289
2 Historical Background	290
3 Optical Properties of InN, GaN, AlN and Their Alloys	292
4 Nitride-Based Light Emitting Diodes	296
5 Nitride-Based Laser Diodes	307
6 Conclusions	314
References	314

Thermodynamics of Solar Cells

<i>Peter Würfel</i>	321
1 Introduction	321
2 Heat Engines Operating with Radiation	321
3 Semiconductors	327
4 Semiconductor Devices	332
5 Conclusions	340
References	341

Index	343
--------------------	-----

Optics of Semiconductors and Their Nanostructures

Kalt, H.; Hetterich, M. (Eds.)

2004, XV, 348 p., Hardcover

ISBN: 978-3-540-22068-8