

H. Kalt
M. Hetterich (Eds.)

Optics of Semiconductors and Their Nanostructures



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Optics Of Semiconductors And Their Nanostructures

Bob D. Guenther, Duncan Steel



Optics Of Semiconductors And Their Nanostructures:

Optics of Semiconductors and Their Nanostructures Heinz Kalt, Michael Hetterich, 2013-04-09 In recent years the field of semiconductor optics has been pushed to several extremes The size of semiconductor structures has shrunk to dimensions of a few nanometers the semiconductor light interaction is studied on timescales as fast as a few femtoseconds and transport properties on a length scale far below the wavelength of light have been revealed These advances were driven by rapid improvements in both semiconductor and optical technologies and were further facilitated by progress in the theoretical description of optical excitations in semiconductors This book written by leading experts in the field provides an up to date introduction to the optics of semiconductors and their nanostructures so as to help the reader understand these exciting new developments It also discusses recently established applications such as blue light emitters as well as the quest for future applications in areas such as spintronics quantum information processing and third generation solar cells *Optical Spectroscopy of Semiconductor Nanostructures* Eougenious L. Ivchenko, 2005 This volume looks at optical spectroscopy of semiconductor nanostructures Some of the topics it covers include kingdom of nanostructures quantum confinement in low dimensional systems resonant light reflection and transmission and absorption

Second Order Non-linear Optics of Silicon and Silicon Nanostructures O. A. Aktsipetrov, I. M. Baranova, K. N. Evtyukhov, 2018-09-03 The theory and practice of the non linear optics of silicon are inextricably linked with a variety of areas of solid state physics particularly semiconductor physics However the current literature linking these fields is scattered across various sources and is lacking in depth Second Order Non linear Optics of Silicon and Silicon Nanostructures describes the physical properties of silicon as they apply to non linear optics while also covering details of the physics of semiconductors The book contains six chapters that focus on The physical properties and linear optics of silicon Basic theoretical concepts of reflected second harmonics RSH The authors theory of the generation of RSH at the non linear medium linear medium interface An analytical review of work on the non linear optics of silicon The results of non linear optical studies of silicon nanostructures A theory of photoinduced electronic processes in semiconductors and their influence on RSH generation The book also includes methodological problems and a significant amount of reference data It not only reflects the current state of research but also provides a single thorough source of introductory information for those who are becoming familiar with non linear optics Second Order Non linear Optics of Silicon and Silicon Nanostructures is a valuable contribution to the fields of non linear optics semiconductor physics and microelectronics as well as a useful resource for a wide range of readers from undergraduates to researchers *Optical Properties of Semiconductor Nanostructures* Marcin L. Sadowski, Marek Potemski, Marian Grynberg, 2012-12-06 Optical methods for investigating semiconductors and the theoretical description of optical processes have always been an important part of semiconductor physics Only the emphasis placed on different materials changes with time Here a large number of papers are devoted to quantum dots presenting the theory spectroscopic

investigation and methods of producing such structures Another major part of the book reflects the growing interest in diluted semiconductors and II IV nanosystems in general There are also discussions of the fascinating field of photonic crystals Classical low dimensional systems such as GsAs GaAlAs quantum wells and heterostructures still make up a significant part of the results presented and they also serve as model systems for new phenomena New materials are being sought and new experimental techniques are coming on stream in particular the combination of different spectroscopic modalities

Quantum Optics with Semiconductor Nanostructures Frank Jahnke, 2012-07-16 An understanding of the interaction between light and matter on a quantum level is of fundamental interest and has many applications in optical technologies The quantum nature of the interaction has recently attracted great attention for applications of semiconductor nanostructures in quantum information processing Quantum optics with semiconductor nanostructures is a key guide to the theory experimental realisation and future potential of semiconductor nanostructures in the exploration of quantum optics Part one provides a comprehensive overview of single quantum dot systems beginning with a look at resonance fluorescence emission Quantum optics with single quantum dots in photonic crystal and micro cavities are explored in detail before part two goes on to review nanolasers with quantum dot emitters Light matter interaction in semiconductor nanostructures including photon statistics and photoluminescence is the focus of part three whilst part four explores all solid state quantum optics crystal nanobeam cavities and quantum dot microcavity systems Finally part five investigates ultrafast phenomena including femtosecond quantum optics and coherent optoelectronics with quantum dots With its distinguished editor and international team of expert contributors Quantum optics with semiconductor nanostructures is an essential guide for all those involved with the research development manufacture and use of semiconductors nanodevices lasers and optical components as well as scientists researchers and students A key guide to the theory experimental realisation and future potential of semiconductor nanostructures in the exploration of quantum optics Chapters provide a comprehensive overview of single quantum dot systems nanolasers with quantum dot emitters and light matter interaction in semiconductor nanostructures Explores all solid state quantum optics crystal nanobeam cavities and quantum dot microcavity systems and investigates ultrafast phenomena

Optics of Semiconductor Nanostructures Fritz Henneberger, Stefan Schmitt-Rink, Ernst O. Göbel, 1993-07-15 The contributions of leading international experts assembled in this volume provide an authoritative description of current research in the highly topical area of the optical properties of semiconductor structures in the nanometer range

Semiconductor Nanostructures Dieter Bimberg, 2008-06-03 Reducing the size of a coherently grown semiconductor cluster in all three directions of space to a value below the de Broglie wavelength of a charge carrier leads to complete quantization of the energy levels density of states etc Such quantum dots are more similar to giant atoms in a dielectric cage than to classical solids or semiconductors showing a dispersion of energy as a function of wavevector Their electronic and optical properties depend strongly on their size and shape i e on their geometry By

designing the geometry by controlling the growth of QDs absolutely novel possibilities for material design leading to novel devices are opened This multiauthor book written by world wide recognized leaders of their particular fields and edited by the recipient of the Max Born Award and Medal 2006 Professor Dieter Bimberg reports on the state of the art of the growing of quantum dots the theory of self organised growth the theory of electronic and excitonic states optical properties and transport in a variety of materials It covers the subject from the early work beginning of the 1990s up to 2006 The topics addressed in the book are the focus of research in all leading semiconductor and optoelectronic device laboratories of the world

Semiconductor Optics 2 Heinz Kalt, Claus F. Klingshirn, 2024-03-16 This book provides an introduction to and an overview of the multifaceted area of dynamics and nonlinearities related to optical excitations in semiconductors It is a revised and significantly extended edition of the well established book by C Klingshirn split into two volumes and restructured to make it more concise Inserts on important experimental techniques reference to topical research and novel materials as well as consideration of photonic applications support research oriented teaching and learning This book reviews nonlinear optical properties and many body phenomena evoked by high densities of quasi particles in semiconductors Coherent dynamics and relaxation of optical excitations carriers excitons electron hole plasmas etc as well as condensation phenomena are elucidated in these materials A broad overview is provided of seminal research results augmented by detailed descriptions of the relevant experimental techniques e g ultrafast spectroscopy four wave mixing and the Hanbury Brown and Twiss experiment Offering a comprehensive introduction to hot topics in current research polariton condensates valley coherence and single photons to name a few it also discusses applications of the described physical concepts in topical areas such as quantum information photonics spintronics and optoelectronics Covering subjects ranging from physics to materials science and optoelectronics the book provides a lively and comprehensive introduction to semiconductor optics beyond the linear regime With many problems chapter introductions schematic depictions of physical phenomena as well as boxed inserts and a detailed index it is suitable for use in graduate courses in physics and neighboring sciences like material science and optical communication It is also a valuable reference resource for doctoral and advanced researchers

Ultrafast Spectroscopy of Semiconductors and Semiconductor Nanostructures Jagdeep Shah, 1999-06 Ultrafast spectroscopy of semiconductors and semiconductor nanostructures is currently one of the most exciting areas of research in condensed matter physics Remarkable recent progress in the generation of tunable femtosecond pulses has allowed direct investigation of the most fundamental dynamical processes in semiconductors This second edition presents the most striking recent advances in the techniques of ultrashort pulse generation and ultrafast spectroscopy it discusses the physics of relaxation tunneling and transport dynamics in semiconductors and semiconductor nanostructures following excitation by femtosecond laser pulses

Optical Techniques for Solid-State Materials Characterization Rohit P. Prasankumar, Antoinette J. Taylor, 2016-04-19 Over the last century numerous optical techniques have been developed to

characterize materials giving insight into their optical electronic magnetic and structural properties and elucidating such diverse phenomena as high temperature superconductivity and protein folding Optical Techniques for Solid State Materials Characterization provides **Semiconductor Nanocrystals** Alexander L. Efros,D.J. Lockwood,Leonid

Tsybeskov,2013-06-29 A physics book that covers the optical properties of quantum confined semiconductor nanostructures from both the theoretical and experimental points of view together with technological applications Topics to be reviewed include quantum confinement effects in semiconductors optical adsorption and emission properties of group IV III V II VI semiconductors deep etched and self assembled quantum dots nanoclusters and laser applications in optoelectronics

Handbook of Nanostructured Materials and Nanotechnology Hari Singh Nalwa,2000 Nanostructured materials is one of the hottest and fastest growing areas in today s materials science field along with the related field of solid state physics Nanostructured materials and their based technologies have opened up exciting new possibilities for future applications in a number of areas including aerospace automotive x ray technology batteries sensors color imaging printing computer chips medical implants pharmacy and cosmetics The ability to change properties on the atomic level promises a revolution in many realms of science and technology Thus this book details the high level of activity and significant findings are available for those involved in research and development in the field It also covers industrial findings and corporate support This five volume set summarizes fundamentals of nano science in a comprehensive way The contributors enlisted by the editor are at elite institutions worldwide Key Features Provides comprehensive coverage of the dominant technology of the 21st century Written by 127 authors from 16 countries making this truly international First and only reference to cover all aspects of nanostructured materials and nanotechnology OCLC **Optical Generation and Control of Quantum Coherence in**

Semiconductor Nanostructures Gabriela Slavcheva,Philippe Roussignol,2010-06-01 The fundamental concept of quantum coherence plays a central role in quantum physics cutting across disciplines of quantum optics atomic and condensed matter physics Quantum coherence represents a universal property of the quantum systems that applies both to light and matter thereby tying together materials and phenomena Moreover the optical coherence can be transferred to the medium through the light matter interactions Since the early days of quantum mechanics there has been a desire to control dynamics of quantum systems The generation and control of quantum coherence in matter by optical means in particular represents a viable way to achieve this longstanding goal and semiconductor nanostructures are the most promising candidates for controllable quantum systems Optical generation and control of coherent light matter states in semiconductor quantum nanostructures is precisely the scope of the present book Recently there has been a great deal of interest in the subject of quantum coherence We are currently witnessing parallel growth of activities in different physical systems that are all built around the central concept of manipulation of quantum coherence The burgeoning activities in solid state systems and semiconductors in particular have been strongly driven by the unprecedented control of coherence that previously has been

demonstrated in quantum optics of atoms and molecules and is now taking advantage of the remarkable advances in semiconductor fabrication technologies A recent impetus to exploit the coherent quantum phenomena comes from the emergence of the quantum information paradigm *Semiconductor Quantum Dots* Yasuaki Masumoto,T.

Takagahara,2002-05-28 Growth of Self Organized Quantum Dots J S Lee Excitonic Structures and Optical Properties of Quantum Dots Toshihide Takagahara Electron Phonon Interactions in Semiconductor Quantum Dots Toshihide Takagahara Micro Imaging and Single Dot Spectroscopy of Self Assembled Quantum Dots Mitsuru Sugisaki Persistent Spectral Hole Burning in Semiconductor Quantum Dots Yasuaki Masumoto Dynamics of Carrier Relaxation in Self Assembled Quantum Dots Ivan V Ignatiev Igor E Kozin Resonant Two Photon Spectroscopy of Quantum Dots Alexander Baranov Homogeneous Width of Confined Excitons in Quantum Dots Experimental Yasuaki Masumoto Theory of Exciton Dephasing in Semiconductor Quantum Dots Toshihide Takagahara Excitonic Optical Nonlinearity and Weakly Correlated Exciton Pair States Selvakumar V Nair Toshihide Takagahara Coulomb Effects in the Optical Spectra of Highly Excited Semiconductor Quantum Dots

Selvakumar V Nair Device **Hot Carriers in Semiconductor Nanostructures** Jagdeep Shah,2012-12-02 Nonequilibrium hot charge carriers play a crucial role in the physics and technology of semiconductor nanostructure devices This book one of the first on the topic discusses fundamental aspects of hot carriers in quasi two dimensional systems and the impact of these carriers on semiconductor devices The work will provide scientists and device engineers with an authoritative review of the most exciting recent developments in this rapidly moving field It should be read by all those who wish to learn the fundamentals of contemporary ultra small ultra fast semiconductor devices Topics covered include Reduced dimensionality and quantum wells Carrier phonon interactions and hot phonons Femtosecond optical studies of hot carrier Ballistic transport Submicron and resonant tunneling devices Encyclopedia of Modern Optics Bob D. Guenther,Duncan

Steel,2018-02-14 The Encyclopedia of Modern Optics Second Edition Five Volume Set provides a wide ranging overview of the field comprising authoritative reference articles for undergraduate and postgraduate students and those researching outside their area of expertise Topics covered include classical and quantum optics lasers optical fibers and optical fiber systems optical materials and light emitting diodes LEDs Articles cover all subfields of optical physics and engineering such as electro optical design of modulators and detectors This update contains contributions from international experts who discuss topics such as nano photonics and plasmonics optical interconnects photonic crystals and 2D materials such as graphene or holy fibers Other topics of note include solar energy high efficiency LED s and their use in illumination orbital angular momentum quantum optics and information metamaterials and transformation optics high power fiber and UV fiber lasers random lasers and bio imaging Addresses recent developments in the field and integrates concepts from fundamental physics with applications for manufacturing and engineering design Provides a broad and interdisciplinary coverage of specialist areas Ensures that the material is appropriate for new researchers and those working in a new sub field as well as

those in industry Thematically arranged and alphabetically indexed with cross references added to facilitate ease of use

Nano-Structures for Optics and Photonics Baldassare Di Bartolo, John Collins, Luciano Silvestri, 2014-10-06 The contributions in this volume were presented at a NATO Advanced Study Institute held in Erice Italy 4 19 July 2013 Many aspects of important research into nanophotonics plasmonics semiconductor materials and devices instrumentation for bio sensing to name just a few are covered in depth in this volume The growing connection between optics and electronics due to the increasing important role plaid by semiconductor materials and devices find their expression in the term photonics which also reflects the importance of the photon aspect of light in the description of the performance of several optical systems Nano structures have unique capabilities that allow the enhanced performance of processes of interest in optical and photonic devices In particular these structures permit the nanoscale manipulation of photons electrons and atoms they represent a very hot topic of research and are relevant to many devices and applications The various subjects bridge over the disciplines of physics biology and chemistry making this volume of interest to people working in these fields The emphasis is on the principles behind each technique and on examining the full potential of each technique

Quantum Dots Aleksandr Georgievich Tartakovskii, 2012 A comprehensive review of cutting edge solid state research focusing on its prominent example quantum dot nanostructures this book features a broad range of techniques for fabrication of these nano structured semiconductors and control of their quantum properties Written by leading researchers the book considers advanced III V and II VI semiconductor quantum dots QDs realized by self assembly lithography and chemical synthesis novel QD structures in nanowires and graphene and transport and optical methods for control of single QDs

Semiconductor Quantum Dots Yasuaki Masumoto, T. Takagahara, 2014-03-12 Semiconductor quantum dots represent one of the fields of solid state physics that have experienced the greatest progress in the last decade Recent years have witnessed the discovery of many striking new aspects of the optical response and electronic transport phenomena This book surveys this progress in the physics optical spectroscopy and application oriented research of semiconductor quantum dots It focuses especially on excitons multi excitons their dynamical relaxation behaviour and their interactions with the surroundings of a semiconductor quantum dot Recent developments in fabrication techniques are reviewed and potential applications discussed This book will serve not only as an introductory textbook for graduate students but also as a concise guide for active researchers

Semiconductor Nanophotonics Michael Kneissl, Andreas Knorr, Stephan Reitzenstein, Axel Hoffmann, 2020-03-10 This book provides a comprehensive overview of the state of the art in the development of semiconductor nanostructures and nanophotonic devices It covers epitaxial growth processes for GaAs and GaN based quantum dots and quantum wells describes the fundamental optical electronic and vibronic properties of nanomaterials and addresses the design and realization of various nanophotonic devices These include energy efficient and high speed vertical cavity surface emitting lasers VCSELs and ultra small metal cavity nano lasers for applications in multi terabus systems silicon photonic I O engines based on the hybrid

integration of VCSELs for highly efficient chip to chip communication electrically driven quantum key systems based on q bit and entangled photon emitters and their implementation in real information networks and AlGaIn based deep UV laser diodes for applications in medical diagnostics gas sensing spectroscopy and 3D printing The experimental results are accompanied by reviews of theoretical models that describe nanophotonic devices and their base materials The book details how optical transitions in the active materials such as semiconductor quantum dots and quantum wells can be described using a quantum approach to the dynamics of solid state electrons under quantum confinement and their interaction with phonons as well as their external pumping by electrical currents With its broad and detailed scope this book is indeed a cutting edge resource for researchers engineers and graduate level students in the area of semiconductor materials optoelectronic devices and photonic systems

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