Physics Of Low Dimensional Semiconductors

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Semiconductor Quantum Optoelectronics

COHEN MCNEIL

The Physics of Low-dimensional Semiconductors World Scientific Publishing Company
Focuses on several of the most active areas in modern semiconductor physics, including resonant tunnelling and superlattice phenomena and the topics of ballistic transport, quantized conductance, and anomalous magnetoresistance effects in laterally gated two-dimensional electron systems. Actual and potential applications of low dimensional structur.
Low Dimensional Semiconductor Structures Springer Nature
The author develops the effective-mass theory of excitons in low-dimensional semiconductors and describes numerical methods for calculating the optical absorption including Coulomb interaction, geometry, and external fields. The theory is applied to Fano resonances in low-dimensional semiconductors and the Zener breakdown in superlattices. Comparing theoretical results with experiments, the book is essentially self-contained; it is a hands-on approach with detailed derivations, worked examples, illustrative figures, and computer programs. The book is clearly structured and will be valuable as an advanced-level self-study or course book for graduate students, lecturers, and researchers.
Excitons in Low-Dimensional Semiconductors Springer
The discovery of the quantized and fractional Quantum Hall Effect phenomena is among the most important physics findings in the latter half of this century. The precise quantization of the

electrical resistance involved in the quantized Hall effect phenomena has led to the new definition of the resistance standard and has metrologically affected all of science and technology. This resource consists of contributions from the top researchers in the field who present recent experimental and theoretical developments. Each chapter is self-contained and includes its own set of references guiding readers to original papers and further reading on the topic.

Low-dimensional Semiconductors Academic Press

Starting with the first transistor in 1949, the world has experienced a technological revolution which has permeated most aspects of modern life, particularly over the last generation. Yet another such revolution looms up before us with the newly developed capability to control matter on the nanometer scale. A truly extraordinary research effort, by scientists, engineers, technologists of all disciplines, in nations large and small throughout the world, is directed and vigorously pressed to develop a full understanding of the properties of matter at the nanoscale and its possible applications, to bring to fruition the promise of nanostructures to introduce a new generation of electronic and optical devices. The physics of low dimensional semiconductor structures, including heterostructures, superlattices, quantum wells, wires and dots is reviewed and their modeling is discussed in detail. The truly exceptional material, Graphene, is reviewed; its functionalization and Van der Waals interactions are included here. Recent research on optical studies of quantum dots and on the physical properties of one-dimensional quantum wires is also reported. Chapters on fabrication of nanowire – based nanogap devices by the dielectrophoretic assembly approach. The broad spectrum of research reported here incorporates chapters on nanoengineering and nanophysics. In its presentation of tutorial chapters as well as advanced research on nanostructures, this book is ideally suited to meet the needs of newcomers to the field as well as experienced researchers interested in viewing colleagues' recent advances.

Intense Terahertz Excitation of Semiconductors Springer Science & Business Media

This invaluable textbook presents the basic elements needed to understand and research into semiconductor physics. It deals with elementary excitations in bulk and low-dimensional semiconductors, including quantum wells, quantum wires and quantum dots. The basic principles underlying optical nonlinearities are developed, including excitonic and many-body plasma effects. Fundamentals of optical bistability, semiconductor lasers, femtosecond excitation, the optical Stark effect, the semiconductor photon echo, magneto-optic effects, as well as bulk and quantum-confined Franz–Keldysh effects, are covered. The material is presented in sufficient detail for graduate students and researchers with a general background in quantum mechanics. This fifth edition includes an additional chapter on 'Quantum Optical Effects' where the theory of quantum optical effects in semiconductors is detailed. Besides deriving the 'semiconductor luminescence equations' and the expression for the stationary luminescence spectrum, results are presented to show the importance of Coulombic effects on the semiconductor luminescence and to elucidate the role of excitonic populations.

A Compendium of Solid State Theory Springer
The development and application of low-dimensional semiconductors have been rapid and spectacular during the past decade. Ever improving epitaxial growth and device fabrication techniques have allowed access to some remarkable new physics in quantum confined structures while a plethora of new devices has emerged. The field of optoelectronics in particular has benefited from these advances both in terms of improved performance and the invention of fundamentally new types of device, at a time when the use of optics and lasers in telecommunications, broadcasting, the Internet, signal processing, and computing has been rapidly expanding. An appreciation of the physics of quantum and dynamic electronic processes in confined structures is key to the understanding of many of the latest devices and their continued development. Semiconductor Quantum Optoelectronics covers new physics and the latest device developments in low-dimensional semiconductors. It allows those who already have some familiarity with semiconductor physics and devices to broaden and expand their knowledge into new and expanding topics in low-dimensional semiconductors. The book provides pedagogical coverage of selected areas of new and pertinent physics of low-dimensional structures and presents some optoelectronic devices presently under development. Coverage includes material and band structure issues and the physics of ultrafast, nonlinear, coherent, intersubband, and intracavity phenomena. The book emphasizes various devices, including quantum wells, visible, quantum cascade, and mode-locked lasers; microcavity LEDs and VCSELs; and detectors and logic elements. An underlying theme is high-speed phenomena and devices for increased system bandwidths.
Devices Based on Low-Dimensional Semiconductor Structures Oxford University Press on Demand
This book is a comprehensive text on the physics of semiconductors and nanostructures for a large spectrum of students at the final undergraduate level studying physics, material science and electronics engineering. It offers introductory and advanced courses on solid state and semiconductor physics on one hand and the physics of low dimensional semiconductor structures on the other in a single text book. Key Features Presents basic concepts of quantum theory, solid state physics, semiconductors, and quantum nanostructures such as quantum well, quantum wire, quantum dot and superlattice In depth description of semiconductor heterojunctions, lattice strain and modulation doping technique Covers transport in nanostructures under an electric and magnetic field with the topics: quantized conductance, Coulomb blockade, and integer and fractional quantum Hall effect Presents the optical processes in nanostructures under a magnetic field Includes illustrative problems with hints for solutions in each chapter Physics of Semiconductors and Nanostructures will be helpful to students initiating PhD work in the field of semiconductor nanostructures and devices. It follows a unique tutorial approach meeting the requirements of students who find learning the concepts difficult and want to study from a physical perspective.
Physics of Low-Dimensional Semiconductor Structures Clarendon Press

Oaxaca, Mexico, was the place chosen by a large international group of scientists to meet and discuss on the recent advances on the understanding of the physical prop- ties of low dimensional systems; one of the most active fields of research in condensed matter in the last years. The International Symposium on the Physics of Low Dim- sions took place in January 16-20, 2000. The group of scientists converging into the historical city of Oaxaca, in the state of the same name, had come from Argentina, Chile, Venezuela, several places in Mexico, Canada, U. S. A. , England, France, Italy, Germany, Russia, and Switzerland. The presentations at the workshop provided sta- of-art reviews of many of the most important problems, currently under study. Equally important to all the participants in the workshop was the fact that we had come to honor a friend, Hans Christoph Siegmann, on his sixty-fifth birthday. This Festschrift recognizes the intellectual leadership of Professor Siegmann in the field and as a sincere homage to his qualities as an exceptional friend, college and mentor. Those who have had the privilege to work closely with Hans Christoph have been deeply impressed by his remarkable analytic mind as well as by his out of range kindness and generosity. Hans Christoph has contributed to the understanding of the difficult and very important problem of the magnetic properties of finite systems: surfaces, thin films, heterostructures.

Quantum Wells Taylor & Francis

This book deals with the Effective Electron Mass (EEM) in low dimensional semiconductors. The materials considered are quantum confined non-linear optical, III-V, II-VI, GaP, Ge, PtSb2, zero-gap, stressed, Bismuth, carbon nanotubes, GaSb, IV-VI, Te, II-V, Bi2Te3, Sb, III-V, II-VI, IV-VI semiconductors and quantized III-V, II-VI, IV-VI and HgTe/CdTe superlattices with graded interfaces and effective mass superlattices. The presence of intense electric field and the light waves change the band structure of optoelectronic semiconductors in fundamental ways, which have also been incorporated in the study of the EEM in quantized structures of optoelectronic compounds that control the studies of the quantum effect devices under strong fields. The importance of measurement of band gap in optoelectronic materials under strong electric field and external photo excitation has also been discussed in this context. The influence of crossed electric and quantizing magnetic fields on the EEM and the EEM in heavily doped semiconductors and their nanostructures is discussed. This book contains 200 open research problems which form the integral part of the text and are useful for both Ph. D aspirants and researchers in the fields of solid-state sciences, materials science, nanoscience and technology and allied fields in addition to the graduate courses in modern semiconductor nanostructures. The book is written for post graduate students, researchers and engineers, professionals in the fields of solid state sciences, materials science, nanoscience and technology, nanostructured materials and condensed matter physics.

Growth and Optical Properties of Wide-Gap II-VI Low-Dimensional Semiconductors Springer

This textbook presents the basic elements needed to understand and engage in research in semiconductor physics. It deals with elementary excitations in bulk and low-dimensional semiconductors, including quantum wells, quantum wires and quantum dots. The basic principles underlying optical

nonlinearities are developed, including excitonic and many-body plasma effects. The fundamentals of optical bistability, semiconductor lasers, femtosecond excitation, optical Stark effect, semiconductor photon echo, magneto-optic effects, as well as bulk and quantum-confined Franz-Keldysh effects are covered. The material is presented in sufficient detail for graduate students and researchers who have a general background in quantum mechanics. Request Inspection Copy

Advanced Electronic Technologies and Systems Based on Low-Dimensional Quantum Devices Cambridge University Press

Physics of Semiconductor Devices covers both basic classic topics such as energy band theory and the gradual-channel model of the MOSFET as well as advanced concepts and devices such as MOSFET short-channel effects, low-dimensional devices and single-electron transistors. Concepts are introduced to the reader in a simple way, often using comparisons to everyday-life experiences such as simple fluid mechanics. They are then explained in depth and mathematical developments are fully described. Physics of Semiconductor Devices contains a list of problems that can be used as homework assignments or can be solved in class to exemplify the theory. Many of these problems make use of Matlab and are aimed at illustrating theoretical concepts in a graphical manner.

Low-dimensional Structures in Semiconductors Springer Science & Business Media

The purpose of this collective book is to present a non-exhaustive survey of sp- related phenomena in semiconductors with a focus on recent research. In some sense it may be regarded as an updated version of theOpticalOrientation book, which was entirely devoted to spin physics in bulk semiconductors. During the 24 years that have elapsed, we have witnessed, on the one hand, an extraordinary development in the wonderful semiconductor physics in two dim- sions with the accompanying revolutionary applications. On the other hand, during the last maybe 15 years there was a strong revival in the interest in spin phen- ena, in particular in low-dimensional semiconductor structures. While in the 1970s and 1980s the entire world population of researchers in the ?eld never exceeded 20 persons, now it can be counted by the hundreds and the number of publications by the thousands. This explosive growth is stimulated, to a large extent, by the hopes that the electron and/or nuclear spins in a semiconductor will help to accomplish the dream of factorizing large numbers by quantum computing and eventually to develop a new spin-based electronics, or “spintronics”. Whether any of this will happen or not, still remains to be seen. Anyway, these ideas have resulted in a large body of interesting and exciting research, which is a good thing by itself. The ?eld of spin physics in semiconductors is extremely rich and interesting with many spectacular effects in optics and transport.

Semiconductor Quantum Optoelectronics Springer Science & Business Media

This textbook provides a theoretical background for contemporary trends in solid-state theory and semiconductor device physics. It discusses advanced methods of quantum mechanics and field theory and is therefore primarily intended for graduate students in theoretical and experimental physics who have already studied electrodynamics, statistical physics, and

quantum mechanics. It also relates solid-state physics fundamentals to semiconductor device applications and includes auxiliary results from mathematics and quantum mechanics, making the book useful also for graduate students in electrical engineering and material science. Key Features: Explores concepts common in textbooks on semiconductors, in addition to topics not included in similar books currently available on the market, such as the topology of Hilbert space in crystals Contains the latest research and developments in the field Written in an accessible yet rigorous manner

Low-Dimensional Structures in Semiconductors World Scientific

Presenting the latest advances in artificial structures, this volume discusses in-depth the structure and electron transport mechanisms of quantum wells, superlattices, quantum wires, and quantum dots. It will serve as an invaluable reference and review for researchers and graduate students in solid-state physics, materials science, and electrical and electronic engineering.

Hot Electrons in Semiconductors Springer Science & Business Media

Low-dimensional semiconductor quantum structures are a major, high-technological development that has a considerable industrial potential. The field is developing extremely rapidly and the present book represents a timely guide to the latest developments in device technology, fundamental properties, and some remarkable applications. The content is largely tutorial, and the book could be used as a textbook. The book deals with the physics, fabrication, characteristics and performance of devices based on low-dimensional semiconductor structures. It opens with fabrication procedures. The fundamentals of quantum structures and electro-optical devices are dealt with extensively. Nonlinear optical devices are discussed from the point of view of physics and applications of exciton saturation in MQW structures. Waveguide-based devices are also described in terms of linear and nonlinear coupling. The basics of pseudomorphic HEMT technology, device physics and materials layer design are presented. Each aspect is reviewed from the elementary basics up to the latest developments. Audience: Undergraduates in electrical engineering, graduates in physics and engineering schools. Useful for active scientists and engineers wishing to update their knowledge and understanding of recent developments.

Charge Transport in Low Dimensional Semiconductor Structures Springer Science & Business Media

This book is a comprehensive text on the physics of semiconductors and nanostructures for a large spectrum of students at the final undergraduate level studying physics, material science and electronics engineering. It offers introductory and advanced courses on solid state and semiconductor physics on one hand and the physics of low dimensional semiconductor structures on the other in a single text book. Key Features Presents basic concepts of quantum theory, solid state physics, semiconductors, and quantum nanostructures such as quantum well, quantum wire, quantum dot and superlattice In depth description of semiconductor heterojunctions, lattice strain and modulation doping technique Covers transport in nanostructures under an electric and magnetic field with the topics: quantized conductance, Coulomb

blockade, and integer and fractional quantum Hall effect Presents the optical processes in nanostructures under a magnetic field Includes illustrative problems with hints for solutions in each chapter Physics of Semiconductors and Nanostructures will be helpful to students initiating PhD work in the field of semiconductor nanostructures and devices. It follows a unique tutorial approach meeting the requirements of students who find learning the concepts difficult and want to study from a physical perspective.

Semiconductor Quantum Optics World Scientific Publishing Company

The composition of modern semiconductor heterostructures can be controlled precisely on the atomic scale to create low-dimensional systems. These systems have revolutionised semiconductor physics, and their impact on technology, particularly for semiconductor lasers and ultrafast transistors, is widespread and burgeoning. This book provides an introduction to the general principles that underlie low-dimensional semiconductors. As far as possible, simple physical explanations are used, with reference to examples from actual devices. The author shows how, beginning with fundamental results from quantum mechanics and solid-state physics, a formalism can be developed that describes the properties of low-dimensional semiconductor systems. Among numerous examples, two key systems are studied in detail: the two-dimensional electron gas, employed in field-effect transistors, and the quantum well, whose optical properties find application in lasers and other opto-electronic devices. The book includes many exercises and will be invaluable to undergraduate and first-year graduate physics or electrical engineering students taking courses in low-dimensional systems or heterostructure device physics.

Physics and Properties of Narrow Gap Semiconductors Springer Science & Business Media

Under certain conditions electrons in a semiconductor become much hotter than the surrounding crystal lattice. When this happens, Ohm's Law breaks down: current no longer increases linearly with voltage and may even decrease. Hot electrons have long been a challenging problem in condensed matter physics and remain important in semiconductor research. Recent advances in technology have led to semiconductors with submicron dimensions, where electrons can be confined to two (quantum well), one (quantum wire), or zero (quantum dot) dimensions. In these devices small voltages heat electrons rapidly, inducing complex nonlinear behavior; the study of hot electrons is central to their further development. This book is the only comprehensive and up-to-date coverage of hot electrons. Intended for both established researchers and graduate students, it gives a complete account of the historical development of the subject, together with current research and future trends, and covers the physics of hot electrons in bulk and low-dimensional device technology. The contributions are from leading scientists in the field and are grouped broadly into five categories: introduction and overview; hot electron-phonon interactions and ultra-fast phenomena in bulk and two-dimensional structures; hot electrons in quantum wires and dots; hot electron tunneling and transport in superlattices; and novel devices based on hot electron transport.

Low-dimensional Semiconductors Springer Science & Business

Media
This volume contains the Proceedings of the NATO Advanced Research Workshop on "Growth and Optical Properties of Wide Gap II-VI Low Dimensional Semiconductors", held from 2 - 6 August 1988 in Regensburg, Federal Republic of Germany, under the auspices of the NATO International Scientific Exchange Programme. Semiconducting compounds formed by combining an element from column II of the periodic table with an element from column VI (so called II-VI Semiconductors) have long promised many optoelectronic devices operating in the visible region of the spectrum. However, these materials have encountered numerous problems including: large number of defects and difficulties in obtaining p- and n-type doping. Advances in new methods of material preparation may hold the key to unlocking the unfulfilled promises. During the workshop a full session was taken up covering the prospects for wide-gap II-VI Semiconductor devices, particularly light emitting ones. The growth of bulk materials was reviewed with the view of considering II-VI substrates for the novel epitaxial techniques such as MOCVD, MBE, ALE, MOMBE and ALE-MBE. The controlled introduction of impurities during non-equilibrium growth to provide control of the doping type and conductivity was emphasized.

Low-dimensional Semiconductors CRC Press
The first edition of "Semiconductor Physics" was published in 1973 by Springer-Verlag Wien-New York as a paperback in the Springer Study Edition. In 1977, a Russian translation by Professor Yu. K. Pozhela and coworkers at Vilnius/USSR was published by Izdatelstvo "MIR", Mo scow. Since then new ideas have been developed in the field of semi conductors such as electron hole droplets, dangling bond saturation in amorphous silicon by hydrogen, or the determination of the fine struc ture constant from surface quantization in inversion layers. New tech niques such as molecular beam epitaxy which has made the realization of the Esaki superlattice possible, deep level transient spectroscopy, and refined a. c. Hall techniques have evolved. Now that the Viennese edition is about to go out of print, Springer-Verlag, Berlin-Heidelberg-New York is giving me the opportunity to include these new subjects in a monograph to appear in the Solid-State Sciences series. Again it has been the intention to cover the field of semiconductor physics comprehensively, although some chapters such as diffusion of hot carriers and their galvanomagnetic phenomena, as well as super conducting degenerate semiconductors and the appendices, had to go for commercial reasons. The emphasis is more on physics than on device as pects.