

# **FILE PDF THE PHYSICS OF LOW DIMENSIONAL SEMICONDUCTORS AN INTRODUCTION**

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## **The Physics Of Low Dimensional Semiconductors An Introduction Introduction**

### **The Physics of Low-dimensional Semiconductors**

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.

### **Low-dimensional Semiconductors**

This text is a first attempt to pull together the whole of semiconductor science and technology since 1970 in so far as semiconductor multilayers are concerned. Material, technology, physics and device issues are described with approximately equal emphasis, and form a single coherent point of view. The subject matter is the concern of over half of today's active semiconductor scientists and technologists, the remainder working on bulk semiconductors and devices. It is now routine to design and the prepare semiconductor multilayers at a time, with independent control over the dropping and composition in each layer. In turn these multilayers can be patterned with features that as a small as a few atomic layers in lateral extent. The resulting structures open up many new ares of exciting solid state and quantum physics. They have also led to whole new generations of electronic and optoelectronic devices whose superior performance relates back to the multilayer structures. The principles established in the field have several decades to go, advancing towards the ultimate of materials engineering, the design and preparation of solids atom by atom. The book should appeal equally to physicists, electronic engineers and materials scientists.

### **Low-dimensional Semiconductors**

It is now routine to design and prepare semiconductor multilayers one atomic layer at a time, with independent control over the doping and composition approaching atomic-scale resolution in each layer. In turn, these multilayers can be patterned with features that are as small as only a few atomic layers in lateral extent. These resulting structures not only have led to new generations of electronic and optoelectronic

devices offering superior performance, but also have opened up many new areas of exciting solid state and quantum physics. This book collates the whole of semiconductor science and technology relating to semiconductor multilayers since 1970, and points the way towards the ultimate of materials engineering - the design and preparation of solids atom by atom. Materials, technology, physics, and device issues are covered in detail, making this work ideal for physicists, electronic engineers, and materials scientists alike.

## **Low-Dimensional Semiconductor Structures**

Low-Dimensional Semiconductor Structures provides a seamless, atoms-to-devices introduction to the latest quantum heterostructures. It covers their fabrication, their electronic, optical and transport properties, their role in exploring physical phenomena, and their utilization in devices. The authors begin with a detailed description of the epitaxial growth of semiconductors. They then deal with the physical behaviour of electrons and phonons in low-dimensional structures. A discussion of localization effects and quantum transport phenomena is followed by coverage of the optical properties of quantum wells. They then go on to discuss non-linear optics in quantum heterostructures. The final chapters deal with semiconductor lasers, mesoscopic devices, and high-speed heterostructure devices. The book contains many exercises and comprehensive references. It is suitable as a textbook for graduate-level courses in electrical engineering and applied physics. It will also be of interest to engineers involved in the development of semiconductor devices.

## **Low-dimensional Semiconductors**

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.

## **Physics of Low-Dimensional Semiconductor Structures**

This volume contains the Proceedings of the NATO Advanced Research Workshop on "Growth and Optical Properties of Wide Gap II-VI Low Dimensional Semiconductors"

## **Growth and Optical Properties of Wide-Gap II–VI Low-Dimensional Semiconductors**

A recent major development in high technology, and one which bears considerable industrial potential, is the advent of low-dimensional semiconductor quantum structures. The research and development activity in this field is moving fast and it is thus important to afford scientists and engineers the opportunity to get updated by the best experts in the field. The present book draws together the latest developments in the fabrication technology of quantum structures, as well as a competent and extensive review of their fundamental properties and some remarkable applications. The book is based on a set of lectures that introduce different aspects of the basic knowledge available, it has a tutorial content and could be used as a textbook. Each aspect is reviewed, from elementary concepts up to the latest developments. Audience: Undergraduates and graduates in electrical engineering and physics schools. Also for active scientists and engineers, updating their knowledge and understanding of the frontiers of the technology.

## **Fabrication, Properties and Applications of Low-Dimensional Semiconductors**

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**

This book surveys recent theoretical and experimental studies of optical properties of low-dimensional materials. As an extended version of *Optical Properties of Low-Dimensional Materials* (Volume 1, published in 1995 by World Scientific), Volume 2 covers a wide range of interesting low-dimensional materials including both inorganic and organic systems, such as disordered polymers, deformable molecular crystals, dilute magnetic semiconductors, SiGe/Si short-period superlattices, GaAs quantum wires, semiconductor microcavities, and photonic crystals. There are excellent review articles by promising researchers in each field. All the materials introduced in this book yield new optical phenomena originating from their mesoscopic and low-dimensional electronic characters and electron-lattice couplings, which offer a new research field of materials science as well as condensed-matter and optical physics. Volumes 1 and 2 are interrelated but can be read independently. They are pitched at the level of graduate students and are useful to both students and scientists.

## **Optical Properties of Low-dimensional Materials**

Experimental progress over the past few years has made it possible to test a number of fundamental physical concepts related to the motion of electrons in low dimensions. The production and experimental control of novel structures with typical sizes in the sub-micrometer regime has now become possible. In particular, semiconductors are widely used in order to confine the motion of electrons in two-dimensional heterostructures. The quantum Hall effect was one of the first highlights of the new physics that is revealed by this confinement. In a further step of the technological development in semiconductor-heterostructures, other artificial devices such as quasi one-dimensional 'quantum wires' and 'quantum dots' (artificial atoms) have also been produced. These structures again differ very markedly from three- and two-dimensional systems, especially in relation to the transport of electrons and the interaction with light. Although the technological advances and the experimental skills connected with these new structures are progressing extremely fast, our theoretical understanding of the physical effects (such as the quantum Hall effect) is still at a very rudimentary level. In low-dimensional structures, the interaction of electrons with one another and with other degrees of freedoms such as lattice vibrations or light gives rise to new phenomena that are very different from those familiar in the bulk material. The theoretical formulation of the electronic transport properties of small devices may be considered well-established, provided interaction processes are neglected.

## **Low-Dimensional Systems**

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"

## **Semiconductor Physics**

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 properties 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 Dimensions 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 state-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, colleague 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.

## **Physics of Low Dimensional Systems**

Narrow gap semiconductors are the most important materials for the preparation of advanced modern infrared systems. They often operate at the extremes of the rules of semiconductor science. This book offers clear descriptions of crystal growth and the fundamental structure and properties of these unique materials. Topics covered include band structure, optical and transport properties, and lattice vibrations and spectra. A thorough treatment of the properties of low-dimensional systems and their relation to infrared applications is provided.

## **Physics and Properties of Narrow Gap Semiconductors**

This book covers the physics of semiconductors on an introductory level, assuming that the reader already has some knowledge of condensed matter physics. Crystal structure, band structure, carrier transport, phonons, scattering processes and optical properties are presented for typical semiconductors such as silicon, but III-V and II-VI compounds are also included. In view of the increasing importance of wide-gap semiconductors, the electronic and optical properties of these materials are dealt with too.

## **Introduction to Semiconductor Physics**

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 Semiconductors and Nanostructures**

Provides a multidisciplinary introduction to quantum mechanics, solid state physics, advanced devices, and fabrication Covers wide range of topics in the same style and in the same notation Most up to date developments in semiconductor physics and nano-engineering Mathematical derivations are carried through in detail with emphasis on clarity Timely application areas such as biophotonics , bioelectronics

## **Fundamentals of Solid State Engineering**

This book provides one of the most rigorous treatments of compound semiconductor device physics yet published. A complete understanding of modern devices requires a working knowledge of low-dimensional

physics, the use of statistical methods, and the use of one-, two-, and three-dimensional analytical and numerical analysis techniques. With its systematic and detailed\*\*discussion of these topics, this book is ideal for both the researcher and the student. Although the emphasis of this text is on compound semiconductor devices, many of the principles discussed will also be useful to those interested in silicon devices. Each chapter ends with exercises that have been designed to reinforce concepts, to complement arguments or derivations, and to emphasize the nature of approximations by critically evaluating realistic conditions. One of the most rigorous treatments of compound semiconductor device physics yet published\*\*Essential reading for a complete understanding of modern devices\*\*Includes chapter-ending exercises to facilitate understanding

## **Compound Semiconductor Device Physics**

This book reviews up-to-date ideas of how the luminescence radiation in semiconductors originates and how to analyze it experimentally. The book fills a gap between general textbooks on optical properties of solids and specialized monographs on luminescence. It is unique in its coherent treatment of the phenomenon of luminescence from the very introductory definitions, from light emission in bulk crystalline and amorphous materials to the advanced chapters that deal with semiconductor nano objects, including spectroscopy of individual nanocrystals. The theory of radiative recombination channels in semiconductors is considered on a level of intuitive physical understanding rather than rigorous quantum mechanical treatment. The book is based on teaching and written in the style of a graduate text with plenty of tutorial material, illustrations, and problem sets at chapter ends. It is designed predominantly for students in physics, optics, optoelectronics and materials science.

## **Luminescence Spectroscopy of Semiconductors**

Modern Semiconductor Quantum Physics has the following constituents: (1) energy band theory: pseudopotential method (empirical and ab initio); density functional theory; quasi-particles; LCAO method; k.p method; spin-orbit splitting; effective mass and Luttinger parameters; strain effects and deformation potentials; temperature effects. (2) Optical properties: absorption and exciton effect; modulation spectroscopy; photo luminescence and photo luminescence excitation; Raman scattering and polaritons; photoionization. (3) Defects and Impurities: effective mass theory and shallow impurity states; deep state cluster method, super cell method, Green's function method; carrier recombination kinetics; trapping transient measurements; electron spin resonance; electron lattice interaction and lattice relaxation effects; multi-phonon nonradiative recombination; negative U center, DX center and EL2 Defects. (4) Semiconductor surfaces: two dimensional periodicity and surface reconstruction; surface electronic states; photo-electron spectroscopy; LEED, STM and other experimental methods. (5) Low-dimensional structures: Heterojunctions, quantum wells; superlattices, quantum-confined Stark effect and Wannier-Stark ladder effects; resonant tunneling, quantum Hall effect, quantum wires and quantum dots. This book can be used as an advanced textbook on semiconductor physics for graduate students in physics and electrical engineering departments. It is also useful as a research reference for solid state scientists and semiconductor device engineers.

## **Modern Semiconductor Quantum Physics**

This volume contains a sequence of reviews presented at the NATO Advanced Study Institute on 'Low Dimensional Structures in Semiconductors ... from Basic Physics to Applications.' This was part of the International School of Materials Science and 1990 at the Ettore Majorana Centre in Sicily. Technology held in July Only a few years ago, Low Dimensional Structures was an esoteric concept, but now it is apparent they are likely to play a major role in the next generation of electronic devices. The theme of the School acknowledged this rapidly developing maturity.' The contributions to the volume consider not only the essential physics, but take a wider view of the topic, starting from material growth and processing, then progressing right through to applications with some discussion of the likely use of low dimensional devices in

systems. The papers are arranged into four sections, the first of which deals with basic concepts of semiconductor and low dimensional systems. The second section is on growth and fabrication, reviewing MBE and MOVPE methods and discussing the achievements and limitations of techniques to reduce structures into the realms of one and zero dimensions. The third section covers the crucial issue of interfaces while the final section deals with devices and device physics.

## **Low-Dimensional Structures in Semiconductors**

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.

## **Physics of Low-Dimensional Semiconductor Structures**

This book originated out of a desire to provide students with an instrument which might lead them from knowledge of elementary classical and quantum physics to modern theoretical techniques for the analysis of electron transport in semiconductors. The book is basically a textbook for students of physics, material science, and electronics. Rather than a monograph on detailed advanced research in a specific area, it intends to introduce the reader to the fascinating field of electron dynamics in semiconductors, a field that, through its applications to electronics, greatly contributed to the transformation of all our lives in the second half of the twentieth century, and continues to provide surprises and new challenges. The field is so extensive that it has been necessary to leave aside many subjects, while others could be dealt with only in terms of their basic principles. The book is divided into five major parts. Part I moves from a survey of the fundamentals of classical and quantum physics to a brief review of basic semiconductor physics. Its purpose is to establish a common platform of language and symbols, and to make the entire treatment, as far as possible, self-contained. Parts II and III, respectively, develop transport theory in bulk semiconductors in semiclassical and quantum frames. Part IV is devoted to semiconductor structures, including devices and mesoscopic coherent systems. Finally, Part V develops the basic theoretical tools of transport theory within the modern nonequilibrium Green-function formulation, starting from an introduction to second-quantization formalism.

## **Theory of Electron Transport in Semiconductors**

Graduate text with comprehensive treatment of semiconductor device physics and engineering, and descriptions of real optoelectronic devices.

## **The Physics of Semiconductors**

Introduction to Solid-State Electronics combines a modern presentation of semiconductor physics with a description of the principles of semiconductor devices. It unites the authors' extensive teaching and research experience with the requirements of an introductory graduate course in Solid-State Electronics for engineering students. Since a crystal is an object of high symmetry, some simple techniques—which do not require knowledge of the mathematical groups at the professional level—are used for the application of symmetry to the analysis of band structures. The textbook outlines the properties of low-dimensional structures in parallel with those of bulk materials. The authors have made the mathematical derivations both as self-contained and as simple as possible without using arguments of the type “it can be easily shown that...” This technique is just one of many that enables the book to provide a clear, comprehensive understanding of the main properties of semiconductors and their relations to device structures.

## **Introduction to Solid-state Electronics**

As the first comprehensive introduction into the rapidly evolving field of spintronics, this textbook covers ferromagnetism in nano-electrodes, spin injection, spin manipulation, and the practical use of these effects in next-generation electronics. Based on foundations in quantum mechanics and solid state physics this textbook guides the reader to the forefront of research and development in the field, based on repeated lectures given by the author. From the content: Low-dimensional semiconductor structures Magnetism in solids Diluted magnetic semiconductors Magnetic electrodes Spin injection Spin transistor Spin interference Spin Hall effect Quantum spin Hall effect Topological insulators Quantum computation with electron spins

## **Optical Investigations of Low-dimensional Semiconductor Structures**

This book discusses the essential properties of carbon nanotubes and 2D graphene systems. The book focuses on the fundamental excitation properties of a large range of graphene-related materials, presenting a new theoretical framework that couples electronic properties and e-e Coulomb interactions together in order to thoroughly explore Coulomb excitations and decay rates in carbon-nanotube-related systems. This book is aimed at researchers in nanomaterials and high-level students in physics, science and material engineering. It will serve as the ideal reference text for scientists working on carbon nanotubes, and will thoroughly expand the reader's knowledge of the application of carbon nanotube technology to graphene-based materials and the technological potential thereof. Key Features: \uffeff Covers many graphene-related systems, such as, 1D-3D carbon nanotube systems, layered graphenes, and other 2D materials. Presents a generalized theoretical model for essential excitation properties. Presents comprehensive theoretical results for fundamental and applied sciences. Presents reliable and complete results in the diversified many-body properties. Provides potential applications for graphene-based electronic and plasmonic devices.

## **Semiconductor Spintronics**

This book reviews the current status of research and development in dilute III-V nitrides. It covers major developments in this new class of materials within 24 chapters from prominent research groups. The book integrates materials science and applications in optics and electronics in a unique way. It is valuable both as a reference work for researchers and as a study text for graduate students.

## **Rich Quasiparticle Properties Low Dimensional**

Quantum Heterostructures provides a detailed description of the key physical and engineering principles of quantum semiconductor heterostructures. Blending important concepts from physics, materials science, and electrical engineering, it also explains clearly the behavior and operating features of modern microelectronic and optoelectronic devices. The authors begin by outlining the trends that have driven development in this field, most importantly the need for high-performance devices in computer, information, and communications technologies. They then describe the basics of quantum nanoelectronics, including various transport mechanisms. In the latter part of the book, they cover novel microelectronic devices, and optical devices based on quantum heterostructures. The book contains many homework problems and is suitable as a textbook for undergraduate and graduate courses in electrical engineering, physics, or materials science. It will also be of great interest to those involved in research or development in microelectronic or optoelectronic devices.

## **Dilute III-V Nitride Semiconductors and Material Systems**

This book explains and evaluates methods used to grow and characterise low-dimensional semiconductor structures. It is based on course material developed in association with the London University Interdisciplinary Research Centre for Semiconductor Materials. It is written for graduates in physics, materials science and electrical engineering working in the research and development of semiconductors.

## **Quantum Heterostructures**

Solid State Physics is a textbook for students of physics, material science, chemistry, and engineering. It is the state-of-the-art presentation of the theoretical foundations and application of the quantum structure of matter and materials. This second edition provides timely coverage of the most important scientific breakthroughs of the last decade (especially in low-dimensional systems and quantum transport). It helps build readers' understanding of the newest advances in condensed matter physics with rigorous yet clear mathematics. Examples are an integral part of the text, carefully designed to apply the fundamental principles illustrated in the text to currently active topics of research. Basic concepts and recent advances in the field are explained in tutorial style and organized in an intuitive manner. The book is a basic reference work for students, researchers, and lecturers in any area of solid-state physics. Features additional material on nanostructures, giving students and lecturers the most significant features of low-dimensional systems, with focus on carbon allotropes Offers detailed explanation of dissipative and nondissipative transport, and explains the essential aspects in a field, which is commonly overlooked in textbooks Additional material in the classical and quantum Hall effect offers further aspects on magnetotransport, with particular emphasis on the current profiles Gives a broad overview of the band structure of solids, as well as presenting the foundations of the electronic band structure. Also features reported with new and revised material, which leads to the latest research

## **Growth and Characterisation of Semiconductors**

Modern electronic devices and novel materials often derive their extraordinary properties from the intriguing, complex behavior of large numbers of electrons forming what is known as an electron liquid. This book provides an in-depth introduction to the physics of the interacting electron liquid in a broad variety of systems, including metals, semiconductors, artificial nano-structures, atoms and molecules. One, two and three dimensional systems are treated separately and in parallel. Different phases of the electron liquid, from the Landau Fermi liquid to the Wigner crystal, from the Luttinger liquid to the quantum Hall liquid are extensively discussed. Both static and time-dependent density functional theory are presented in detail. Although the emphasis is on the development of the basic physical ideas and on a critical discussion of the most useful approximations, the formal derivation of the results is highly detailed and based on the simplest, most direct methods.

## **Solid State Physics**

Quantum mechanics transcends and supplants classical mechanics at the atomic and subatomic levels. It provides the underlying framework for many subfields of physics, chemistry and materials science, including condensed matter physics, atomic physics, molecular physics, quantum chemistry, particle physics, and nuclear physics. It is the only way we can understand the structure of materials, from the semiconductors in our computers to the metal in our automobiles. It is also the scaffolding supporting much of nanoscience and nanotechnology. The purpose of this book is to present the fundamentals of quantum theory within a modern perspective, with emphasis on applications to nanoscience and nanotechnology, and information-technology. As the frontiers of science have advanced, the sort of curriculum adequate for students in the sciences and engineering twenty years ago is no longer satisfactory today. Hence, the emphasis on new topics that are not included in older reference texts, such as quantum information theory, decoherence and dissipation, and on applications to nanotechnology, including quantum dots, wires and wells. This book provides a novel approach to Quantum Mechanics whilst also giving readers the requisite background and training for the scientists and engineers of the 21st Century who need to come to grips with quantum phenomena The fundamentals of quantum theory are provided within a modern perspective, with emphasis on applications to nanoscience and nanotechnology, and information-technology Older books on quantum mechanics do not contain the amalgam of ideas, concepts and tools necessary to prepare engineers and scientists to deal with the new facets of quantum mechanics and their application to quantum information science and nanotechnology As the frontiers of science have advanced, the sort of curriculum adequate for students in the sciences and engineering twenty years ago is no longer satisfactory today There are many excellent quantum



mechanics books available, but none have the emphasis on nanotechnology and quantum information science that this book has

## **Low-dimensional Structures in Semiconductors**

This book encapsulates the fundamental quantum processes of importance to the physics and technology of semiconductors. This new edition is expanded by the addition of a new chapter on Phonon processes. The author has also made additions to the existing chapters. Besides being a useful reference for workers in the field this book will be a valuable text for postgraduate courses.

## **Quantum Theory of the Electron Liquid**

The dramatic impact of low dimensional semiconductor structures on current and future device applications cannot be overstated. Research over the last decade has highlighted the use of quantum engineering to achieve previously unknown limits for device performance in research laboratories. The modified electronic structure of semiconductor quantum structures results in transport and optical properties, which differ from those of constituent bulk materials. The possibility to tailor properties, such as bandgap, strain, band offset etc., of two-dimensional (2D) semiconductors, e. g. quantum wells, for specific purposes has had an extensive impact on the electronics, which has resulted in a dramatic renewal process. For instance, 2D structures are today used in a large number of high speed electronics and optoelectronic applications (e. g. detectors, light emitting diodes, modulators, switches and lasers) and in daily life, in e. g. LED-based traffic lights, CD-players, cash registers. The introduction of impurities, also in very small concentrations, in a semiconductor can change its optical and electrical properties entirely. This attribute of the semiconductor is utilized in the manifoldness of their applications. This fact constitutes the principal driving force for investigation of the properties of the impurities in semiconductors. While the impurities in bulk materials have been investigated for a long time, and their properties are fairly well established by now, the corresponding studies of impurities in quantum wells is a more recent research area.

## **Quantum Mechanics with Applications to Nanotechnology and Information Science**

A review of the fundamentals of quantified semiconductor structures (first seen as an introductory chapter in Volume 24 of "Semiconductors and Semimetals"), which covers the basics of electronic states, optical interactions and quantum transport in two-dimensional quantified systems.

## **Quantum Processes in Semiconductors**

This is an overview of different models and mechanisms developed to describe the capture and relaxation of carriers in quantum-dot systems. Despite their undisputed importance, the mechanisms leading to population and energy exchanges between a quantum dot and its environment are not yet fully understood. The authors develop a first-order approach to such effects, using elementary quantum mechanics and an introduction to the physics of semiconductors. The book results from a series of lectures given by the authors at the Master's level.

## **Impurities Confined in Quantum Structures**

Theory of Growth and Characterization of Low-dimensional Semiconductor Structures

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