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Theory of Electron Transport in Semiconductors Semiconductor Physics **Introduction to Semiconductor Materials and Devices** *Fundamentals of Semiconductors* **Physical Limitations of Semiconductor Devices Elementary Semiconductor Physics** *Modern Semiconductor Physics and Device Applications* **Spin Physics in Semiconductors Introduction to Semiconductor Physics Semiconductor Physics and Devices** *Epitaxy of Semiconductors* Semiconductor Physics **Semiconductor Physics** Physics of Semiconductor Devices Basic Semiconductor Physics *The Physics of Semiconductors Microwave Semiconductor Devices Basic Semiconductor Physics* **The Physics of Solids** Elementary Solid State Physics *Elementary Electronic Structure* Modern Semiconductor Quantum Physics **Quantum Theory of the Optical and Electronic Properties of Semiconductors** *Microwave Semiconductor Engineering Diodes and Transistors* Fundamentals of Semiconductor Physics and Devices **Semiconductor Physics and Applications Lattice Dynamics and Semiconductor Physics Quantum Theory of the Optical and Electronic Properties of Semiconductors** *High Pressure Semiconductor Physics I* **Compound Semiconductor Device Physics** *Fundamentals of Semiconductor Physics and Devices Advanced Physics of Electron Transport in Semiconductors and Nanostructures* **High Magnetic Fields in Semiconductor Physics III The Physics of Semiconductors** *Advanced Physics of Semiconductors* Semiconductor Manufacturing Technology **Semiconductor Optics** *Semiconductor Optics 1* **Physics, Chemistry and Technology of Solid State Gas Sensor Devices**

Semiconductor Manufacturing Technology Nov 23 2019 This textbook contains all the materials that an engineer needs to know to start a career in the semiconductor industry. It also provides readers with essential background information for semiconductor research. It is written by a professional who has been working in the field for over two decades and teaching the material to university students for the past 15 years. It includes process knowledge from raw material preparation to the passivation of chips in a modular format.

Theory of Electron Transport in Semiconductors Dec 29 2022 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 moderntheoreticaltechniques for the analysisof electrontransport 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 speci?c area, it intends to introduce the reader to the fascinating ?eld of electron dynamics in semiconductors, a ?eld that, through its applications to electronics, greatly contributed to the transformationof all our lives in the second half of the twentieth century, and continues to provide surprises and new challenges. The ?eld 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 ?ve 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 pos- ble, 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 s- tems. 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.

Elementary Semiconductor Physics Jul 24 2022

Modern Semiconductor Physics and Device Applications Jun 23 2022 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

Physical Limitations of Semiconductor Devices Aug 25 2022 Providing an important link between the theoretical knowledge in the field of non-linier physics and practical application problems in microelectronics, the purpose of the book is popularization of the physical approach for reliability assurance. Another unique aspect of the book is the coverage given to the role of local structural defects, their mathematical description, and their impact on the reliability of the semiconductor devices.

Semiconductor Physics Dec 17 2021 It is a pleasure to take the opportunity to express my sincere grati tude to many colleagues who provided valuable hints for improvements, even including lists of misprints (which I hope have now been complete ly eliminated). It is not possible to name all of them, and so I will only mention the interesting discussions over so many years I had with Pro fessor Hans W. Pötzl of the Technical University of Vienna on the oc casion of our common weekly semiconductor seminar. I am grateful to

Professor H.-J. Queisser and Professor M. Cardona for helpful criticism. Special thanks are due to Frau Jitka Fucik for typing and Frau Viktoria Köver for drawing services. The cooperation with Dr. H.K. Lotsch of Springer-Verlag has been a pleasure. Vienna, January 1982 K. Seeger Contents 1. Elementary Properties of Semiconductors . . .. I 1.1 Insulator - Semiconductor - Semimetal - Metal 1 1.2 The Positive Hole ... 3 1.3 Conduction Processes, Compensation, Law ofMass Action 4 Problems . 8 2. Energy Band Structure . 10 2.1 Single and Periodically Repeated Potential Well 10 2.2 Energy Bands by Tight Binding ofElectrons to Atoms 17 2.3 The Brillouin Zone 21 2.4 Constant Energy Surfaces 30 Problems . 33 3. Semiconductor Statistics 34 3.1 Fermi Statistics ... 35 3.2 Occupation Probabilities ofImpurity Levels 39 Problems . 45 4. Charge and Energy Transport in a Nondegenerate Electron Gas.

Fundamentals of Semiconductors Sep 26 2022 Excellent bridge between general solid-state physics textbook and research articles packed with providing detailed explanations of the electronic, vibrational, transport, and optical properties of semiconductors "The most striking feature of the book is its modern outlook ... provides a wonderful foundation. The most wonderful feature is its efficient style of exposition ... an excellent book." Physics Today "Presents the theoretical derivations carefully and in detail and gives thorough discussions of the experimental results it presents. This makes it an excellent textbook both for learners and for more experienced researchers wishing to check facts. I have enjoyed reading it and strongly recommend it as a text for anyone working with semiconductors ... I know of no better text ... I am sure most semiconductor physicists will find this book useful and I recommend it to them." Contemporary Physics Offers much new material: an extensive appendix about the important and by now well-established, deep center known as the DX center, additional problems and the solutions to over fifty of the problems at the end of the various chapters.

Microwave Semiconductor Engineering Jan 06 2021 Joseph F. White has studied, worked, and taught in all aspects of microwave semiconductor materials, control diodes, and circuit applications. He is thoroughly grounded in the physics and math ematics of the field, but has primarily the engineer's viewpoint, combining basic knowledge with experience and ingenuity to gen erate practical designs under constraints of required performance and costs of development and production. As a result of his teach ing experience and numerous technical papers and oral presenta tions, he has developed a clear, well-organized writing style that makes this book easy to use as a self-teaching text, a reference volume, and a design handbook. Dr. White believes that an engineer must have a good understand ing of semiconductor physics, a thorough knowledge of microwave circuit theory, at least an elementary acquaintance with transistor drivers, and the ability to check and refine a microwave circuit on a computer terminal to be qualified for modern, creative design of microwave semiconductor control components. These subjects are well covered in approximately the first half of the book; the second half treats the general and specific design of switches, at tenuators, limiters, duplexers, and phase shifters, with many ex amples drawn from his experience and that of others.

The Physics of Semiconductors Sep 14 2021 Modern fabrication techniques have made it possible to produce semiconductor devices

whose dimensions are so small that quantum mechanical effects dominate their behavior. This book describes the key elements of quantum mechanics, statistical mechanics, and solid-state physics that are necessary in understanding these modern semiconductor devices. The author begins with a review of elementary quantum mechanics, and then describes more advanced topics, such as multiple quantum wells. He then disusses equilibrium and nonequilibrium statistical mechanics. Following this introduction, he provides a thorough treatment of solid-state physics, covering electron motion in periodic potentials, electron-phonon interaction, and recombination processes. The final four chapters deal exclusively with real devices, such as semiconductor lasers, photodiodes, flat panel displays, and MOSFETs. The book contains many homework exercises and is suitable as a textbook for electrical engineering, materials science, or physics students taking courses in solid-state device physics. It will also be a valuable reference for practising engineers in optoelectronics and related areas.

Compound Semiconductor Device Physics May 30 2020 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

Quantum Theory of the Optical and Electronic Properties of Semiconductors Feb 07 2021 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.

Fundamentals of Semiconductor Physics and Devices Nov 04 2020 This book is an introduction to the principles of semiconductor physics, linking its scientific aspects with practical applications. It is addressed to both readers who wish to learn semiconductor physics and those seeking to understand semiconductor devices. It is particularly well suited for those who want to do both.

The Physics of Semiconductors Jan 26 2020 The 4th edition of this highly successful textbook features copious material for a

complete upper-level undergraduate or graduate course, guiding readers to the point where they can choose a specialized topic and begin supervised research. The textbook provides an integrated approach beginning from the essential principles of solid-state and semiconductor physics to their use in various classic and modern semiconductor devices for applications in electronics and photonics. The text highlights many practical aspects of semiconductors: alloys, strain, heterostructures, nanostructures, amorphous semiconductors, and noise, which are essential aspects of modern semiconductor research but often omitted in other textbooks. This textbook also covers advanced topics, such as Bragg mirrors, resonators, polarized and magnetic semiconductors, nanowires, quantum dots, multi-junction solar cells, thin film transistors, and transparent conductive oxides. The 4th edition includes many updates and chapters on 2D materials and aspects of topology. The text derives explicit formulas for many results to facilitate a better understanding of the topics. Having evolved from a highly regarded two-semester course on the topic, The Physics of Semiconductors requires little or no prior knowledge of solid-state physics. More than 2100 references guide the reader to historic and current literature including original papers, review articles and topical books, providing a go-to point of reference for experienced researchers as well.
Diodes and Transistors Dec 05 2020 The book DIODES AND TRANSISTORS is an analytical synthesis of more sources of information, originally presenting two very important electronic circuit elements. It is about the infrastructure and the functionality of two primary electronic components or devices, the diode and the transistor. The book explains basic semiconductor physics to introduce the presentation in details of the fundamental structure and the operating of the two elementary devices made from semiconductors, the diode and the transistor, together with their different types. The rapid growth of the electronics industry over the past 65 years is due in great measure to the development of devices made from semiconductors. The semiconductor devices have built the world of digital electronics, which revolutionized the industry by producing apparatuses, appliances, gadgets, instruments, tools as digital advertisers, digital cameras, digital clocks, digital watches, games, radios, televisions, CCTVs, audio & video players, industry-control, finance-control, geo-measure, cellular phones, computers & accessories etc.
Introduction to Semiconductor Physics Apr 21 2022 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.
Quantum Theory of the Optical and Electronic Properties of Semiconductors Aug 01 2020 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

Basic Semiconductor Physics Oct 15 2021 When the ?rst edition ofBasic Semiconductor Physics was published in 2001, there were already many books, review papers and scienti?c journals de- ing with various aspects of semiconductor physics. Since many of them were dealing with special aspects of newly observed phenomena or with very f- damental physics, it was very di?cult to understand the advanced physics of semiconductors without the detailed knowledge of semiconductor physics. For this purpose the author published the ?rst edition for the readers who are involved with semiconductor research and development. Basic Semiconductor Physics deals with details of energy band structures, e?ective mass eq- tion and k·p perturbation, and then describes very important phenomena in semiconductors such as optical, transport, magnetoresistance, and quantum phenomena. Some of my friends wrote to me that the textbook is not only basic but advanced, and that the title of the book does not re?ect the c- tents. However, I am still convinced that the title is appropriate, because the advanced physics of semiconductor may be understood with the knowledge of the fundamental physics. In addition new and advanced phenomena - served in semiconductors at an early time are becoming well-known and thus classi?ed in basic physics. After the publication of the ?rst edition, many typographical errors have been pointed out and the corrected version was published in 2006. The p- lisher and my friends persuade me to revise the book adding new chapters, keeping the subject at the appropriate level.

Modern Semiconductor Quantum Physics Mar 08 2021 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; effect 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.

High Magnetic Fields in Semiconductor Physics III Feb 25 2020 High magnetic fields have, for a long time, been an important tool in the investigation of the electronic structure of semiconductors. In recent yearsstudies of heterostructures and superlattices have predominated, and this emphasis is reflected in these proceedings. The contributions concentrate on experiments using transport and optical methods, but recent theoretical developments are also covered. Special attention is paid to the quantum Hall effect, including the problem of edge currents, the influence of contacts, and Wigner condensation in the fractional quantum Hall effect regime. The 27 invited contributions by renowned expertsprovide an excellent survey of the field that is complemented by numerous contributed papers.

Semiconductor Optics 1 Sep 21 2019 This revised and updated edition of the well-received book by C. Klingshirn provides an introduction to and an overview of all aspects of semiconductor optics, from IR to visible and UV. It has been split into two volumes and rearranged to offer a clearer structure of the course content. Inserts on important experimental techniques as well as sections on topical research have been added to support research-oriented teaching and learning. Volume 1 provides an introduction to the linear optical properties of semiconductors. The mathematical treatment has been kept as elementary as possible to allow an intuitive approach to the understanding of results of semiconductor spectroscopy. Building on the phenomenological model of the Lorentz oscillator, the book describes the interaction of light with fundamental optical excitations in semiconductors (phonons, free carriers, excitons). It also offers a broad review of seminal research results augmented by concise descriptions of the relevant experimental techniques, e.g., Fourier transform IR spectroscopy, ellipsometry, modulation spectroscopy and spatially resolved methods, to name a few. Further, it picks up on hot topics in current research, like quantum structures, mono-layer semiconductors or Perovskites. The experimental aspects of semiconductor optics are complemented by an in-depth discussion of group theory in solid-state optics. Covering subjects ranging from physics to materials science and optoelectronics, this book provides a lively and comprehensive introduction to semiconductor optics. With over 120 problems, more than 480 figures, abstracts to each chapter, as well as boxed inserts and a detailed index, it is intended for use in graduate courses in physics and neighboring sciences like material science and electrical engineering. It is also a valuable reference resource for doctoral and advanced researchers.

Lattice Dynamics and Semiconductor Physics Sep 02 2020 This review volume consists of scientific articles representing the frontier and most advanced progress in the field of semiconductor physics and lattice dynamics.

Spin Physics in Semiconductors May 22 2022 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 Physics and Applications Oct 03 2020 "The textbook combines a thorough theoretical treatment of the basic physics of semiconductors with applications to practical devices by putting special emphasis on the physical principles upon which these devices operate. - "Graduate students and lecturers in semiconductor physics, condensed matter physics, electromagnetic theory, and quantum mechanics will find this a useful textbook and reference work."--Jacket.

Microwave Semiconductor Devices Aug 13 2021 We have reached the double conclusion: that invention is choice, that this choice is imperatively governed by the sense of scientific beauty. Hadamard (1945), Princeton University Press, by permission. The great majority of all sources and amplifiers of microwave energy, and all devices for receiving or detecting microwaves, use a semiconductor active element. The development of microwave semiconductor devices, de scribed in this book, has proceeded from the simpler, two-terminal, devices such as GUNN or IMPATT devices, which originated in the 1960s, to the sophisticated monolithic circuit MESFET three-terminal active elements, of the 1980s and 1990s. The microwave field has experienced a renais sance in electrical engineering departments in the last few years, and much of this growth has been associated with microwave semiconductor devices. The University of Massachusetts has recently developed a well recognized program in microwave engineering. Much of the momentum for this pro gram has been provided by interaction with industrial companies, and the influx of a large number of industry-supported students. This program had a need for a course in microwave semiconductor devices, which covered the physical aspects, as well as the aspects of interest to the engineer who incorporates such devices in his designs. It was also felt that it would be im portant to introduce the most recently developed devices (HFETs, HBTs, and other advanced devices) as early as possible.

Physics, Chemistry and Technology of Solid State Gas Sensor Devices Aug 21 2019 Research and development of solid state gas sensor devices began in the 1950s with several uncoordinated independent efforts. The number and pace of these investigations later accelerated in response to increasing pressure placed on the environment and public health by industrial activities. Since 1970, several thousand articles have been written on the subject, and laboratories around the globe have introduced novel methodologies and devices to address needs associated with particular technological developments. Despite the rapid development of this important new technology, very little has been done to review and coordinate data related to sensor science and technology itself. Physics, Chemistry

and Technology of Solid State Gas Sensor Devices focuses on the underlying principles of solid state sensor operation and reveals the rich fabric of interdisciplinary science that governs modern sensing devices. Beginning with some historical and scientific background, the text proceeds to a study of the interactions of gases with surfaces. Subsequent chapters present detailed information on the fabrication, performance, and application of a variety of sensors. Types of sensor devices discussed include: Gas-sensitive solid state semiconductor sensors Photonic and photoacoustic gas sensors Fiber optic sensors Piezoelectric quartz crystal microbalance sensors Surface acoustic wave sensors Pyroelectric and thermal sensors For analytical chemists using solid state sensors in environment-related analysis, and for electrical engineers working with solid state sensors, this book will expand and unify their understanding of these devices, both in theory and practice.

Semiconductor Physics and Devices Mar 20 2022 This text aims to provide the fundamentals necessary to understand semiconductor device characteristics, operations and limitations. Quantum mechanics and quantum theory are explored, and this background helps give students a deeper understanding of the essentials of physics and semiconductors.

Semiconductor Physics Jan 18 2022 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.

Elementary Solid State Physics May 10 2021

Advanced Physics of Electron Transport in Semiconductors and Nanostructures Mar 28 2020 This textbook is aimed at second-year graduate students in Physics, Electrical Engineering, or Materials Science. It presents a rigorous introduction to electronic transport in solids, especially at the nanometer scale.Understanding electronic transport in solids requires some basic knowledge of Hamiltonian Classical Mechanics, Quantum Mechanics, Condensed Matter Theory, and Statistical Mechanics. Hence, this book discusses those sub-topics which are required to deal with electronic transport in a single, self-contained course. This will be useful for students who intend to work in academia or the nano/ micro-electronics industry.Further topics covered include: the theory of energy bands in

crystals, of second quantization and elementary excitations in solids, of the dielectric properties of semiconductors with an emphasis on dielectric screening and coupled interfacial modes, of electron scattering with phonons, plasmons, electrons and photons, of the derivation of transport equations in semiconductors and semiconductor nanostructures somewhat at the quantum level, but mainly at the semi-classical level. The text presents examples relevant to current research, thus not only about Si, but also about III-V compound semiconductors, nanowires, graphene and graphene nanoribbons. In particular, the text gives major emphasis to plane-wave methods applied to the electronic structure of solids, both DFT and empirical pseudopotentials, always paying attention to their effects on electronic transport and its numerical treatment. The core of the text is electronic transport, with ample discussions of the transport equations derived both in the quantum picture (the Liouville-von Neumann equation) and semi-classically (the Boltzmann transport equation, BTE). An advanced chapter, Chapter 18, is strictly related to the 'tricky' transition from the time-reversible Liouville-von Neumann equation to the time-irreversible Green's functions, to the density-matrix formalism and, classically, to the Boltzmann transport equation. Finally, several methods for solving the BTE are also reviewed, including the method of moments, iterative methods, direct matrix inversion, Cellular Automata and Monte Carlo. Four appendices complete the text.

Basic Semiconductor Physics Jul 12 2021 A detailed description of the basic physics of semiconductors, with the potential to become as successful as the book by Yu and Cardona in this field. The text covers a wide range of important semiconductor phenomena, from the simple to the advanced.

Fundamentals of Semiconductor Physics and Devices Apr 28 2020 This book is an introduction to the principles of semiconductor physics, linking its scientific aspects with practical applications. It is addressed to both readers who wish to learn semiconductor physics and those seeking to understand semiconductor devices. It is particularly well suited for those who want to do both. Intended as a teaching vehicle, the book is written in an expository manner aimed at conveying a deep and coherent understanding of the field. It provides clear and complete derivations of the basic concepts of modern semiconductor physics. The mathematical arguments and physical interpretations are well balanced: they are presented in a measure designed to ensure the integrity of the delivery of the subject matter in a fully comprehensible form. Experimental procedures and measured data are included as well. The reader is generally not expected to have background in quantum mechanics and solid state physics beyond the most elementary level. Nonetheless, the presentation of this book is planned to bring the student to the point of research/design capability as a scientist or engineer. Moreover, it is sufficiently well endowed with detailed knowledge of the field, including recent developments bearing on submicron semiconductor structures, that the book also constitutes a valuable reference resource. In Chapter 1, basic features of the atomic structures, chemical nature and the macroscopic properties of semiconductors are discussed. The band structure of ideal semiconductor crystals is treated in Chapter 2, together with the underlying one-electron picture and other fundamental concepts. Chapter 2 also provides the requisite background of the tight binding method and the k.p-method, which are later used extensively.

The electron states of shallow and deep centers, clean semiconductor surfaces, quantum wells and superlattices, as well as the effects of external electric and magnetic fields, are treated in Chapter 3. The one- or multi-band effective mass theory is used wherever this method is applicable. A summary of group theory for application in semiconductor physics is given in an Appendix. Chapter 4 deals with the statistical distribution of charge carriers over the band and localized states in thermodynamic equilibrium. Non-equilibrium processes in semiconductors are treated in Chapter 5. The physics of semiconductor junctions (pn-, hetero-, metal-, and insulator-) is developed in Chapter 6 under conditions of thermodynamic equilibrium, and in Chapter 7 under non-equilibrium conditions. On this basis, the most important electronic and opto-electronic semiconductor devices are treated, among them uni- and bi-polar transistors, photodetectors, solar cells, and injection lasers. A summary of group theory for applications in semiconductors is given in an Appendix. Contents:Characterization of SemiconductorsElectronic Structure of Ideal CrystalsElectronic Structure of Semiconductor Crystals with PerturbationsElectron System in Thermodynamic EquilibriumNon-Equilibrium Processes in SemiconductorsSemiconductor Junctions in Thermodynamic EquilibriumSemiconductor Junctions Under Non-Equilibrium Conditions Readership: Undergraduates, graduates and researchers in the fields of physics and engineering. keywords:Semiconductors;Transistor;Devices;Heterojunctions;Microstructures;Band-Structure;Luttinger-Kohn-Model;Kane-Model;Deep-Levels;Transport;Semiconductor Physics;Fundamental Physical Phenomena;General Backround;Characterization of Semiconductor;Electronic Structur of Semiconductors;Semiconductor Junctions the Thermodynamic Equilibrium;Semiconductor Junctions Under Non-Equilibrium Conductions; “… The reader who has only a first acquaintance with semiconductor physics will find that this book has fully detailed explanations of the fundamental physical phenomena, providing a good general background … A brilliant discussion of artifical atomic superstructures of nanometer length scale establishes a link to the most active field of semiconductor physics … In my opinion the book of R Enderlein and N J M Horing Fundamentals of Semiconductor Physics and Devices is a valuable contribution to the modern didactic literature on the physics of semiconductors. Morever, it is of considerable value as a reference for specialists as well.” J T Devreese Professor at the Physics Department University of Antwerpen, Belgium “In Fundamentals of Semiconductor Physics and Devices, R Enderiein and N J M Horing have provided a very extensive and detailed text on the physics underlying semiconductor devices. More so than any other current text, this book provides a greatly expanded discussion of modern tight-binding methods, helping the students to understand these aspects of electronic structure in clear, simple terms. In connection with this the authors offer a very detailed discussion of deep levels in semiconductors, which are so important to semiconducting properties. Also, in the discussion of transport properties, the book goes into much greater depth about nonlinear and nonequilibrium processes than is usual. It is quite a unique contribution, containing the basic physics which tends to be missing from device-oriented books, but going much further into the essentials needed for device development than any solid-state-physics text.” Walter A Harrison Professor of Applied Physics Stanford University, USA

Semiconductor Optics Oct 23 2019 The updated and enlarged new edition of this book provides an introduction to and an overview of semiconductor optics from the IR through the visible to the UV. It includes coverage of linear and nonlinear optical properties, dynamics, magneto- and electrooptics, high-excitation effects, some applications, experimental techniques and group theory. The mathematics is kept as elementary as possible. The subjects covered extend from physics to materials science and optoelectronics. New or updated chapters add coverage of current topics, while the chapters on bulk materials have been revised and updated.
Epitaxy of Semiconductors Feb 19 2022 The extended and revised edition of this textbook provides essential information for a comprehensive upper-level graduate course on the crystalline growth of semiconductor heterostructures. Heteroepitaxy is the basis of today's advanced electronic and optoelectronic devices, and it is considered one of the most important fields in materials research and nanotechnology. The book discusses the structural and electronic properties of strained epitaxial layers, the thermodynamics and kinetics of layer growth, and it describes the major growth techniques: metalorganic vapor-phase epitaxy, molecular-beam epitaxy, and liquid-phase epitaxy. It also examines in detail cubic and hexagonal semiconductors, strain relaxation by misfit dislocations, strain and confinement effects on electronic states, surface structures, and processes during nucleation and growth. Requiring only minimal knowledge of solid-state physics, it provides natural sciences, materials science and electrical engineering students and their lecturers elementary introductions to the theory and practice of epitaxial growth, supported by references and over 300 detailed illustrations. In this second edition, many topics have been extended and treated in more detail, e.g. in situ growth monitoring, application of surfactants, properties of dislocations and defects in organic crystals, and special growth techniques like vapor-liquid-solid growth of nanowires and selective-area epitaxy.
The Physics of Solids Jun 11 2021 This text offers a broad coverage of the physical properties of solids at fundamental level. The quantum-mechanical origins that lead to a wide range of observed properties are discussed. The book also includes a modern treatment of unusual physical states.
Introduction to Semiconductor Materials and Devices Oct 27 2022 This comprehensive introduction to the elementary theory and properties of semiconductors describes the basic physics of semiconductor materials and technologies for fabrication of semiconductor devices. Addresses approaches to modeling and provides details of measurement techniques. Includes numerous illustrative examples and graded problems.
Elementary Electronic Structure Apr 09 2021 This is a revised edition of the 1999 text on the electronic structure and properties of solids, similar in spirit to the well-known 1980 text Electronic Structure and the Properties of Solids. The revisions include an added chapter on glasses, and rewritten sections on spin-orbit coupling, magnetic alloys, and actinides. The text covers covalent semiconductors, ionic insulators, simple metals, and transition-metal and f-shell-metal systems. It focuses on the most important aspects of each system, making what approximations are necessary in order to proceed analytically and obtain formulae for the

properties. Such back-of-the-envelope formulae, which display the dependence of any property on the parameters of the system, are characteristic of Harrison's approach to electronic structure, as is his simple presentation and his provision of all the needed parameters.In spite of the diversity of systems and materials, the approach is systematic and coherent, combining the tight-binding (or atomic) picture with the pseudopotential (or free-electron) picture. This provides parameters ? the empty-core radii as well as the covalent energies ? and conceptual bases for estimating the various properties of all these systems. Extensive tables of parameters and properties are included.The book has been written as a text, with problems at the end of each chapter, and others can readily be generated by asking for estimates of different properties, or different materials, than those treated in the text. In fact, the ease of generating interesting problems reflects the extraordinary utility and simplicity of the methods introduced. Developments since the 1980 publication have made the theory simpler and much more accurate, besides allowing much wider application.
Advanced Physics of Semiconductors Dec 25 2019 This textbook is aimed at second-year graduate students in Physics, Electrical Engineering or Materials Science. It presents a rigorous introduction to electronic transport in solids, especially at the nanometer scale. Understanding electronic transport in solids requires some basic knowledge of Hamiltonian Classical Mechanics, Quantum Mechanics, Condensed Matter Theory, and Statistical Mechanics. Hence this book discusses those sub-topics of these four disciplines which are required to deal with electronic transport in a single, self-contained course. This will be useful for students who intend to work in academia or the nano/micro-electronics industry. Further topics covered include: the theory of energy bands in crystals, of second quantization and elementary excitations in solids, of the dielectric properties of semiconductors with an emphasis on dielectric screening and coupled interfacial modes, on electron scattering with phonons, plasmons, electrons and photons, on the derivation of transport equations in semiconductors and semiconductor nanostructures also at the quantum level. but mainly at the semi-classical level. The text presents examples relevant to current research, thus not only about Si, but also III-V compound semiconductors, nanowires, graphene and graphene nanoribbons. In particular, the text gives major emphasis to plane-wave methods regarding the electronic structure of solids, both DFT and empirical pseudopotentials, always paying attention to their effects on electronic transport and its numerical treatment. The core of the text is electronic transport, with ample discussions on the transport equations derived both in the quantum picture (the Liouville-von Neumann equation) and semi-classically (the Boltzmann transport equation, BTE). Several methods for solving the BTE are also reviewed, including the method of moments, iterative methods, direct matrix inversion, Cellular Automata and Monte Carlo. The first appendix, on the principles of special relativity, is required to understand the ‘minimal’ electromagnetic coupling between electrons and photons and also to introduce the relativistic wave equation for massless spin-1/2 particles. This is of current interest since it is used to describe approximately the electron dispersion in graphene. The second appendix, on alternative interpretations of quantum mechanics, is strictly related to the ‘tricky’ transition from the time-reversible Liouville-von Neumann equation to the time-irreversible Green’s functions, to the density-matrix formalism and, classically, to the

Boltzmann transport equation.

Semiconductor Physics Nov 28 2022 This book will be useful to solid-state scientists, device engineers, and students involved in semiconductor design and technology. It provides a lucid account of band structure, density of states, charge transport, energy transport, and optical processes, along with a detailed description of many devices. It includes sections on superlattices and quantum well structures, the effects of deep-level impurities on transport, and the quantum Hall effect. This 8th edition has been revised and updated, including several new sections.

Physics of Semiconductor Devices Nov 16 2021 This textbook describes the basic physics of semiconductors, including the hierarchy of transport models, and connects the theory with the functioning of actual semiconductor devices. Details are worked out carefully and derived from the basic physical concepts, while keeping the internal coherence of the analysis and explaining the different levels of approximation. Coverage includes the main steps used in the fabrication process of integrated circuits: diffusion, thermal oxidation, epitaxy, and ion implantation. Examples are based on silicon due to its industrial importance. Several chapters are included that provide the reader with the quantum-mechanical concepts necessary for understanding the transport properties of crystals. The behavior of crystals incorporating a position-dependent impurity distribution is described, and the different hierarchical transport models for semiconductor devices are derived (from the Boltzmann transport equation to the hydrodynamic and drift-diffusion models). The transport models are then applied to a detailed description of the main semiconductor-device architectures (bipolar, MOS, CMOS), including a number of solid-state sensors. The final chapters are devoted to the measuring methods for semiconductor-device parameters, and to a brief illustration of the scaling rules and numerical methods applied to the design of semiconductor devices.

High Pressure Semiconductor Physics I Jun 30 2020 Since its inception in 1966, the series of numbered volumes known as Semiconductors and Semimetals has distinguished itself through the careful selection of well-known authors, editors, and contributors. The "Willardson and Beer" Series, as it is widely known, has succeeded in publishing numerous landmark volumes and chapters. Not only did many of these volumes make an impact at the time of their publication, but they continue to be well-cited years after their original release. Recently, Professor Eicke R. Weber of the University of California at Berkeley joined as a co-editor of the series. Professor Weber, a well-known expert in the field of semiconductor materials, will further contribute to continuing the series' tradition of publishing timely, highly relevant, and long-impacting volumes. Some of the recent volumes, such as Hydrogen in Semiconductors, Imperfections in III/V Materials, Epitaxial Microstructures, High-Speed Heterostructure Devices, Oxygen in Silicon, and others promise indeed that this tradition will be maintained and even expanded. Reflecting the truly interdisciplinary nature of the field that the series covers, the volumes in Semiconductors and Semimetals have been and will continue to be of great interest to physicists, chemists, materials scientists, and device engineers in modern industry. Volumes 54 and 55 present contributions by leading

researchers in the field of high pressure semiconductors. Edited by T. Suski and W. Paul, these volumes continue the tradition of well-known but outdated publications such as Brigman's The Physics of High Pressure (1931 and 1949) and High Pressure Physics and Chemistry edited by Bradley. Volumes 54 and 55 reflect the industrially important recent developments in research and applications of semiconductor properties and behavior under desirable risk-free conditions at high pressures. These developments include the advent of the diamond anvil cell technique and the availability of commercial piston cylinder apparatus operating at high hydrostatic pressures. These much-needed books will be useful to both researchers and practitioners in applied physics, materials science, and engineering.