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TECHNOLOGY, DEVICES

M. J. KELLY



Low Dimensional Semiconductors Materials Physics Technology Devices

Michael J. Kelly



Low Dimensional Semiconductors Materials Physics Technology Devices:

Low-dimensional Semiconductors M. J. Kelly, 1995-11-23 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 small as a few atomic layers in lateral extent The resulting structures open up many new areas 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* Michael J. Kelly, 1995 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 Semiconductors Michael Joseph Kelly, 1995 **The Physics of Low-dimensional Semiconductors** John H. Davies, 1998 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

Effective Electron Mass in Low-Dimensional Semiconductors Sitangshu Bhattacharya, Kamakhya Prasad Ghatak, 2012-10-06 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

Devices Based on Low-Dimensional Semiconductor Structures M. Balkanski, 2012-12-06 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

Nanoelectronics: Physics, Materials and Devices Angsuman Sarkar, Chandan Kumar Sarkar, Arpan Deyasi, Debashis De, Arezki Benfdila, 2023-01-03 Approx 528 pages Approx 528 pages

Comprehensive Nanoscience and Technology, 2010-10-29 From the Introduction Nanotechnology and its underpinning sciences are progressing with unprecedented rapidity With technical advances in a

variety of nanoscale fabrication and manipulation technologies the whole topical area is maturing into a vibrant field that is generating new scientific research and a burgeoning range of commercial applications with an annual market already at the trillion dollar threshold The means of fabricating and controlling matter on the nanoscale afford striking and unprecedented opportunities to exploit a variety of exotic phenomena such as quantum nanophotonic and nanoelectromechanical effects Moreover researchers are elucidating new perspectives on the electronic and optical properties of matter because of the way that nanoscale materials bridge the disparate theories describing molecules and bulk matter Surface phenomena also gain a greatly increased significance even the well known link between chemical reactivity and surface to volume ratio becomes a major determinant of physical properties when it operates over nanoscale dimensions Against this background this comprehensive work is designed to address the need for a dynamic authoritative and readily accessible source of information capturing the full breadth of the subject Its six volumes covering a broad spectrum of disciplines including material sciences chemistry physics and life sciences have been written and edited by an outstanding team of international experts Addressing an extensive cross disciplinary audience each chapter aims to cover key developments in a scholarly readable and critical style providing an indispensable first point of entry to the literature for scientists and technologists from interdisciplinary fields The work focuses on the major classes of nanomaterials in terms of their synthesis structure and applications reviewing nanomaterials and their respective technologies in well structured and comprehensive articles with extensive cross references It has been a constant surprise and delight to have found amongst the rapidly escalating number who work in nanoscience and technology so many highly esteemed authors willing to contribute Sharing our anticipation of a major addition to the literature they have also captured the excitement of the field itself in each carefully crafted chapter Along with our painstaking and meticulous volume editors full credit for the success of this enterprise must go to these individuals together with our thanks for largely adhering to the given deadlines Lastly we record our sincere thanks and appreciation for the skills and professionalism of the numerous Elsevier staff who have been involved in this project notably Fiona Geraghty Megan Palmer and Greg Harris and especially Donna De Weerd Wilson who has steered it through from its inception We have greatly enjoyed working with them all as we have with each other

Fundamentals of Solid State Engineering Manijeh Razeghi, 2009-03-03 Fundamentals of Solid State Engineering 3rd Edition provides a multi disciplinary introduction to solid state engineering combining concepts from physics chemistry electrical engineering materials science and mechanical engineering Revised throughout this third edition includes new topics such as electron electron and electron phonon interactions in addition to the Kane effective mass method A chapter devoted to quantum mechanics has been expanded to cover topics such as the harmonic oscillator the hydrogen atom the quantum mechanical description of angular momentum and the origin of spin This textbook also features an improved transport theory description which now goes beyond Drude theory discussing the Boltzmann approach Introducing students to the rigorous quantum mechanical way of thinking about

and formulating transport processes this textbook presents the basic physics concepts and thorough treatment of semiconductor characterization technology designed for solid state engineers *Semiconductor Materials* B.G.

Yacobi, 2006-04-18 The technological progress is closely related to the developments of various materials and tools made of those materials Even the different ages have been defined in relation to the materials used Some of the major attributes of the present day age i e the electronic materials age are such common tools as computers and fiber optic telecommunication systems in which semiconductor materials provide vital components for various mic electronic and optoelectronic devices in applications such as computing memory storage and communication The field of semiconductors encompasses a variety of disciplines This book is not intended to provide a comprehensive description of a wide range of semiconductor properties or of a continually increasing number of the semiconductor device applications Rather the main purpose of this book is to provide an introductory perspective on the basic principles of semiconductor materials and their applications that are described in a relatively concise format in a single volume Thus this book should especially be suitable as an introductory text for a single course on semiconductor materials that may be taken by both undergraduate and graduate engineering students This book should also be useful as a concise reference on semiconductor materials for researchers working in a wide variety of fields in physical and engineering sciences **Quantum Wells, Wires and Dots** Paul Harrison, Alex

Valavanis, 2016-06-13 Quantum Wells Wires and Dots provides all the essential information both theoretical and computational to develop an understanding of the electronic optical and transport properties of these semiconductor nanostructures The book will lead the reader through comprehensive explanations and mathematical derivations to the point where they can design semiconductor nanostructures with the required electronic and optical properties for exploitation in these technologies This fully revised and updated 4th edition features new sections that incorporate modern techniques and extensive new material including Properties of non parabolic energy bands Matrix solutions of the Poisson and Schr dinger equations Critical thickness of strained materials Carrier scattering by interface roughness alloy disorder and impurities Density matrix transport modelling Thermal modelling Written by well known authors in the field of semiconductor nanostructures and quantum optoelectronics this user friendly guide is presented in a lucid style with easy to follow steps illustrative examples and questions and computational problems in each chapter to help the reader build solid foundations of understanding to a level where they can initiate their own theoretical investigations Suitable for postgraduate students of semiconductor and condensed matter physics the book is essential to all those researching in academic and industrial laboratories worldwide Instructors can contact the authors directly p harrison shu ac uk a valavanis leeds ac uk for Solutions to the problems **Einstein Relation in Compound Semiconductors and Their Nanostructures** Kamakhya Prasad

Ghatak, Sitangshu Bhattacharya, Debashis De, 2008-11-16 Focusing only on the Einstein relation in compound semiconductors and their nanostructures this book deals with open research problems from carbon nanotubes to quantum wire superlattices

with different band structures and other field assisted systems Introduction to Isotopic Materials Science Vladimir G. Plekhanov, 2018-12-05 This book describes new trends in the nanoscience of isotopic materials science Assuming a background in graduate condensed matter physics and covering the fundamental aspects of isotopic materials science from the very beginning it equips readers to engage in high level professional research in this area The book s main objective is to provide insight into the question of why solids are the way they are either because of how their atoms are bonded with one another because of defects in their structure or because of how they are produced or processed Accordingly it explores the science of how atoms interact connects the results to real materials properties and demonstrates the engineering concepts that can be used to produce or improve semiconductors by design In addition it shows how the concepts discussed are applied in the laboratory The book addresses the needs of researchers graduate students and senior undergraduate students alike Although primarily written for materials science audience it will be equally useful to those teaching in electrical engineering materials science or even chemical engineering or physics curricula In order to maintain the focus on materials concepts however the book does not burden the reader with details of many of the derivations and equations nor does it delve into the details of electrical engineering topics **Inelastic Light Scattering of Semiconductor Nanostructures** Christian Schüller, 2006-09-14 The field of semiconductor nanostructures is of enormous and still growing research interest On one hand they are already realized in mass products such as high electron mobility field effect transistors and quantum well lasers On the other hand they allow in specially tailored systems the investigation of fundamental properties such as many particle interactions of electrons in reduced dimensions This book bridges the gap between general semiconductor textbooks and research articles *Dispersion Relations in Heavily-Doped Nanostructures* Kamakhya Prasad Ghatak, 2015-10-26 This book presents the dispersion relation in heavily doped nano structures The materials considered are III V II VI IV VI GaP Ge Platinum Antimonide stressed GaSb Te II V HgTe CdTe superlattices and Bismuth Telluride semiconductors The dispersion relation is discussed under magnetic quantization and on the basis of carrier energy spectra The influences of magnetic field magneto inversion and magneto nipi structures on nano structures is analyzed The band structure of optoelectronic materials changes with photo excitation in a fundamental way according to newly formulated electron dispersion laws They control the quantum effect in optoelectronic devices in the presence of light The measurement of band gaps in optoelectronic materials in the presence of external photo excitation is displayed The influences of magnetic quantization crossed electric and quantizing fields intense electric fields on the on the dispersion relation in heavily doped semiconductors and super lattices are also discussed This book contains 200 open research problems which form the integral part of the text and are useful for graduate students and researchers The book is written for post graduate students researchers and engineers **Quantum-based Electronic Devices and Systems** Mitra Dutta, Michael A. Stroscio, 1998 This volume includes highlights of the theories and experimental findings that underlie essential phenomena occurring in

quantum based devices and systems as well as the principles of operation of selected novel quantum based electronic devices and systems A number of the emerging approaches to creating new types of quantum based electronic devices and systems are also discussed

Fundamentals of Solid State Engineering M. Razeghi, 2002 Fundamentals of Solid State Engineering 2nd Edition provides a multi disciplinary introduction to solid state engineering combining concepts from physics chemistry electrical engineering materials science and mechanical engineering Revised throughout this third edition includes new topics such as electron electron and electron phonon interactions in addition to the Kane effective mass method A chapter devoted to quantum mechanics has been expanded to cover topics such as the harmonic oscillator the hydrogen atom the quantum mechanical description of angular momentum and the origin of spin This textbook also features an improved transport theory description which now goes beyond Drude theory discussing the Boltzmann approach Introducing students to the rigorous quantum mechanical way of thinking about and formulating transport processes this textbook presents the basic physics concepts and thorough treatment of semiconductor characterization technology designed for solid state engineers Publisher's website

Quantum-based Electronic Devices And Systems, Selected Topics In Electronics And Systems, Vol 14 Mitra Dutta, 1998-10-23 This volume includes highlights of the theories and experimental findings that underlie essential phenomena occurring in quantum based devices and systems as well as the principles of operation of selected novel quantum based electronic devices and systems A number of the emerging approaches to creating new types of quantum based electronic devices and systems are also discussed

Characterization of Carbon Nanotube Based Composites under Consideration of Defects Moones Rahmandoust, Majid R. Ayatollahi, 2015-10-14 This volume presents the characterization methods involved with carbon nanotubes and carbon nanotube based composites with a more detailed look at computational mechanics approaches namely the finite element method Special emphasis is placed on studies that consider the extent to which imperfections in the structure of the nanomaterials affect their mechanical properties These defects may include random distribution of fibers in the composite structure as well as atom vacancies perturbation and doping in the structure of individual carbon nanotubes

Theory of Semiconductor Quantum Devices Fausto Rossi, 2011-01-13 Primary goal of this book is to provide a cohesive description of the vast field of semiconductor quantum devices with special emphasis on basic quantum mechanical phenomena governing the electro optical response of new generation nanomaterials The book will cover within a common language different types of optoelectronic nanodevices including quantum cascade laser sources and detectors few electron exciton quantum devices and semiconductor based quantum logic gates The distinguishing feature of the present volume is a unified microscopic treatment of quantum transport and coherent optics phenomena on ultraspace and time scales as well as of their semiclassical counterparts

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