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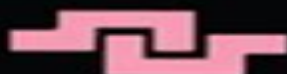
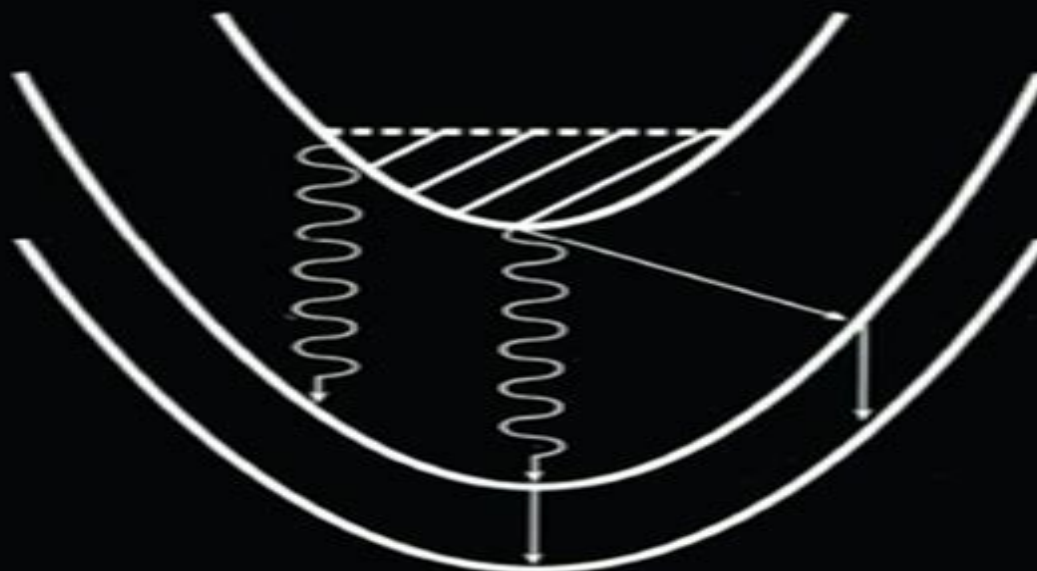
From Quantum Physics to Smart Devices

edited by

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Semiconductor Quantum Optoelectronics

Kevin F. Brennan



Semiconductor Quantum Optoelectronics:

Semiconductor Quantum Optoelectronics A. Miller, 2020-12-17 The development and application of low dimensional semiconductors have been rapid and spectacular during the past decade Ever improving epitaxial growth and device fabrication techniques have allowed access to some remarkable new physics in quantum confined structures while a plethora of new devices has emerged The field of optoelectronics in particular has benefited from these advances both in terms of improved performance and the invention of fundamentally new types of device at a time when the use of optics and lasers in telecommunications broadcasting the Internet signal processing and computing has been rapidly expanding An appreciation of the physics of quantum and dynamic electronic processes in confined structures is key to the understanding of many of the latest devices and their continued development Semiconductor Quantum Optoelectronics covers new physics and the latest device developments in low dimensional semiconductors It allows those who already have some familiarity with semiconductor physics and devices to broaden and expand their knowledge into new and expanding topics in low dimensional semiconductors The book provides pedagogical coverage of selected areas of new and pertinent physics of low dimensional structures and presents some optoelectronic devices presently under development Coverage includes material and band structure issues and the physics of ultrafast nonlinear coherent intersubband and intracavity phenomena The book emphasizes various devices including quantum wells visible quantum cascade and mode locked lasers microcavity LEDs and VCSELs and detectors and logic elements An underlying theme is high speed phenomena and devices for increased system bandwidths

Semiconductor Quantum Optoelectronics Alan Miller, M. Ebrahimzadeh, Majid Ebrahimzadeh, D. M. Finlayson, 1999 This book combines new physics and the latest device developments in low dimensional semiconductors The development and application of low dimensional semiconductors has been rapid and spectacular during the past decade Ever improving epitaxial growth and device fabrication techniques have allowed access to some remarkable new physics in quantum confined structures while in parallel a plethora of new devices have emerged The field of optoelectronics in particular has benefited from these advances both in terms of improved performance and the invention of fundamentally new types of device at a time when the use of optics and lasers in telecommunications broadcasting the internet signal processing and computing has been rapidly expanding An appreciation of the physics of quantum and dynamical electronic processes in confined structures is key to the understanding of many of the latest devices and involvement in their continued development This book allows those who already have some familiarity with semiconductor physics and devices to broaden and expand their knowledge into new and expanding topics in low dimensional semic

[The Physics of Semiconductors](#) Kevin F. Brennan, 1999-02-13 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 discusses 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

Spin-based Optoelectronics with Semiconductor Quantum Dots Pablo Aschhoff, 2012 *Quantum Heterostructures* Vladimir Vasil'evich Mitin, Viacheslav Kochelap, Michael A. Stroscio, 1999-07-13 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

Semiconductor Photonics of Nanomaterials and Quantum Structures Arash Rahimi-Iman, 2021-04-23 This book introduces the wider field of functional nanomaterials sciences with a strong emphasis on semiconductor photonics Whether you are studying photonic quantum devices or just interested in semiconductor nanomaterials and their benefits for optoelectronic applications this book offers you a pedagogical overview of the relevant subjects along with topical reviews The book discusses different yet complementary studies in the context of ongoing international research efforts delivering examples from both fundamental and applied research to a broad readership In addition a hand full of useful optical techniques for the characterization of semiconductor quantum structures and materials are addressed Moreover nanostructuring methods for the production of low dimensional systems which exhibit advantageous properties predominantly due to quantum effects are summarized Science and engineering professionals in the interdisciplinary domains of nanotechnology photonics materials sciences and quantum physics can familiarize themselves with selected highlights with eyes towards photonic applications in the fields of two dimensional materials research light matter interactions and quantum technologies

Nonlinear and Nonequilibrium Dynamics of Quantum-Dot Optoelectronic Devices Benjamin Lingnau, 2015-12-14 This thesis sheds light on the unique dynamics of optoelectronic devices based on

semiconductor quantum dots The complex scattering processes involved in filling the optically active quantum dot states and the presence of charge carrier nonequilibrium conditions are identified as sources for the distinct dynamical behavior of quantum dot based devices Comprehensive theoretical models which allow for an accurate description of such devices are presented and applied to recent experimental observations The low sensitivity of quantum dot lasers to optical perturbations is directly attributed to their unique charge carrier dynamics and amplitude phase coupling which is found not to be accurately described by conventional approaches The potential of quantum dot semiconductor optical amplifiers for novel applications such as simultaneous multi state amplification ultra wide wavelength conversion and coherent pulse shaping is investigated The scattering mechanisms and the unique electronic structure of semiconductor quantum dots are found to make such devices prime candidates for the implementation of next generation optoelectronic applications which could significantly simplify optical telecommunication networks and open up novel high speed data transmission schemes

Semiconductor Quantum Well Intermixing J. T. Lie, 2000-01-18 Semiconductor Quantum Well Intermixing is an international collection of research results dealing with several aspects of the diffused quantum well DFQW ranging from Physics to materials and device applications The material covered is the basic interdiffusion mechanisms of both cation and anion groups as well as the properties of band structure

Quantum Dot Optoelectronic Devices Peng Yu, Zhiming M. Wang, 2020-04-16 This book captures cutting edge research in semiconductor quantum dot devices discussing preparation methods and properties and providing a comprehensive overview of their optoelectronic applications Quantum dots QDs with particle sizes in the nanometer range have unique electronic and optical properties They have the potential to open an avenue for next generation optoelectronic methods and devices such as lasers biomarker assays field effect transistors LEDs photodetectors and solar concentrators By bringing together leaders in the various application areas this book is both a comprehensive introduction to different kinds of QDs with unique physical properties as well as their preparation routes and a platform for knowledge sharing and dissemination of the latest advances in a novel area of nanotechnology

Quantum Theory of the Optical and Electronic Properties of Semiconductors Hartmut Haug, Stephan W Koch, 1993-04-16 This substantially revised second edition of the Quantum Theory of the Optical and Electronic Properties of Semiconductors presents the basic elements needed to understand and engage in research in semiconductor physics In this edition misprints have been corrected and new and more detailed material has been added In order to treat the valence band structure of semiconductors an introduction to the $k \cdot p$ theory and the related description in terms of the Luttinger Hamiltonian was included An introductory chapter on mesoscopic semiconductor structures was added which discusses the envelope function approximation and the modification caused by the spatial quantum confinement In many chapters the results are developed in parallel first for bulk material and then for quasi two dimensional quantum wells and for quasi one dimensional quantum wires Semiconductor quantum dots are treated in a separate chapter The discussion of time dependent and coherent

phenomena in semiconductors has been considerably extended by including a section dealing with the theoretical description of photon echoes in semiconductors After the discussion of semiconductor laser physics optical bistability and electroabsorption in semiconductors a new chapter on magneto absorption has been added in which magneto excitons and magneto plasmas in two dimensional systems are discussed The chapter on electron kinetics due to the interaction with longitudinal optical phonons has been extended and a discussion on carrier carrier collisions has been added to the chapter dealing with the semiconductor bloch equations The material is presented in sufficient detail for graduate students and researchers who have a general background in quantum mechanics Request Inspection Copy Contents Oscillator Model Atom in a Classical Light Field Periodic Lattice of Atoms Free Carrier Transitions Mesoscopic Semiconductor Structures Ideal Quantum Gases Interacting Electron Gas Plasmons and Plasma Screening Retarded Green's Function for Electrons Excitons Polaritons Semiconductor Bloch Equations Optical Quasi Equilibrium Nonlinearities Optical Bistability The Semiconductor Laser Coherent Effects in Semiconductors Free Carrier Electroabsorption Exciton Electroabsorption Magneto Optics Semiconductor Quantum Dots Kinetics with Phonon Scattering Appendix A Field Quantization Appendix B Nonequilibrium Green's Functions Readership Solid state physicists engineers materials and optical scientists

Physical Models of Semiconductor Quantum Devices Ying Fu, 2013-08-29 The science and technology relating to nanostructures continues to receive significant attention for its applications to various fields including microelectronics nanophotonics and biotechnology This book describes the basic quantum mechanical principles underlining this fast developing field From the fundamental principles of quantum mechanics to nanomaterial properties from device physics to research and development of new systems this title is aimed at undergraduates graduates postgraduates and researchers

III-Nitride Semiconductor Optoelectronics, 2017-01-05 III Nitride Semiconductor Optoelectronics covers the latest breakthrough research and exciting developments in the field of III nitride compound semiconductors It includes important topics on the fundamentals of materials growth characterization and optoelectronic device applications of III nitrides Bulk quantum well quantum dot and nanowire heterostructures are all thoroughly explored Contains the latest breakthrough research in III nitride optoelectronics Provides a comprehensive presentation that covers the fundamentals of materials growth and characterization and the design and performance characterization of state of the art optoelectronic devices Presents an in depth discussion on III nitride bulk quantum well quantum dot and nanowire technologies

Single Semiconductor Quantum Dots Peter Michler, 2009-06-13 This book reviews recent advances in the field of semiconductor quantum dots via contributions from prominent researchers in the scientific community Special focus is given to optical quantum optical and spin properties of single quantum dots

Semiconductor Materials for Optoelectronics and LTMBE Materials J.P. Hirtz, C. Whitehouse, H.P. Meier, H.J. von Bardeleben, M.O. Manasreh, 2016-07-29 These three day symposia were designed to provide a link between specialists from university or industry who work in different fields of semiconductor optoelectronics

Symposium A dealt with topics including epitaxial growth of III V II VI IV VI Si based structures selective area localized and non planar epitaxy shadow mask epitaxy bulk and new optoelectronic materials polymers for optoelectronics Symposium B dealt with III V epitaxial layers grown by low temperature molecular beam epitaxy a subject which has undergone rapid development in the last three years

Optoelectronics P. Predeep, 2011-10-05 Optoelectronics Devices and Applications is the second part of an edited anthology on the multifaceted areas of optoelectronics by a selected group of authors including promising novices to experts in the field Photonics and optoelectronics are making an impact multiple times as the semiconductor revolution made on the quality of our life In telecommunication entertainment devices computational techniques clean energy harvesting medical instrumentation materials and device characterization and scores of other areas of R

Optoelectronics - Recent Advances Touseef Para, 2024-03-13 Embark on a journey through the cutting edge world of optoelectronics with Optoelectronics Recent Advances This anthology explores the diverse realms of light and electronics from fundamental insights to groundbreaking advancements Discover the future of quantum information processing gold nanorod assembly and more This collection of seven chapters brings together leading minds offering a glimpse into the transformative potential of recent optoelectronic research Whether you re a curious reader or a seasoned researcher Optoelectronics Recent Advances invites you to witness the brilliance where ideas shine bright

Nanoscale Compound Semiconductors and their Optoelectronics Applications Vijay B. Pawade, Sanjay J. Dhoble, Hendrik C. Swart, 2022-01-21 Nanoscale Compound Semiconductors and their Optoelectronics Applications provides the basic and fundamental properties of nanoscale compound semiconductors and their role in modern technological products The book discusses all important properties of this important category of materials such as their optical properties size dependent properties and tunable properties Key methods are reviewed including synthesis techniques and characterization strategies The role of compound semiconductors in the advancement of energy efficient optoelectronics and solar cell devices is also discussed The book also touches on the photocatalytic property of the materials by doping with graphene oxides an emerging and new pathway Covers all relevant types of nanoscale compound semiconductors for optoelectronics including their synthesis properties and applications Provides historical context and review of emerging trends in semiconductor technology particularly emphasizing advances in non toxic semiconductor materials for green technologies Reviews emerging applications of nanoscale compound semiconductor based devices in optoelectronics energy and environmental sustainability

Electronic and Optoelectronic Properties of Semiconductor Structures Jasprit Singh, 2007-03-26 A graduate textbook presenting the underlying physics behind devices that drive today s technologies The book covers important details of structural properties bandstructure transport optical and magnetic properties of semiconductor structures Effects of low dimensional physics and strain two important driving forces in modern device technology are also discussed In addition to conventional semiconductor physics the book discusses self assembled structures mesoscopic structures and the developing field of

spintronics The book utilizes carefully chosen solved examples to convey important concepts and has over 250 figures and 200 homework exercises Real world applications are highlighted throughout the book stressing the links between physical principles and actual devices Electronic and Optoelectronic Properties of Semiconductor Structures provides engineering and physics students and practitioners with complete and coherent coverage of key modern semiconductor concepts A solutions manual and set of viewgraphs for use in lectures are available for instructors from solutions.cambridge.org

Lights and Semiconductors: A Guide to Optoelectronic Devices Pasquale De Marco, 2025-04-11 In a world illuminated by digital screens and powered by renewable energy optoelectronic devices have become an integral part of our daily lives This comprehensive guide delves into the fascinating realm of optoelectronics unveiling the intricate relationship between light and semiconductors and empowering readers to harness the immense potential of this rapidly evolving field With a focus on fundamental principles materials and applications this book provides a thorough understanding of the inner workings of optoelectronic devices from light emitting diodes LEDs that illuminate our homes and cities to solar cells that convert sunlight into electricity Discover the mechanisms behind light absorption emission and scattering and delve into the captivating world of lasers witnessing the remarkable coherence and directionality of laser light Explore the intricacies of photodetectors the eyes of machines that convert light into electrical signals and unravel the secrets of optical amplifiers the unsung heroes that boost light signals over vast distances Gain insights into optoelectronic integrated circuits OEICs the seamless fusion of optics and electronics on a microscopic scale and discover the diverse applications of optoelectronic sensors ranging from industrial automation to healthcare diagnostics Peer into the future of optoelectronics where emerging technologies promise to reshape industries and redefine the boundaries of human ingenuity Witness the potential of novel materials and devices and explore the ethical considerations surrounding the responsible development and use of optoelectronics This book is an essential resource for students researchers and engineers seeking a comprehensive understanding of optoelectronic devices and their applications With its clear explanations engaging examples and insightful discussions this guide illuminates the path towards a brighter more connected and sustainable future powered by the transformative power of optoelectronics If you like this book write a review on google books

Defects in Optoelectronic Materials Kazumi Wada, 2022-09-16 Defects in Optoelectronic Materials bridges the gap between device process engineers and defect physicists by describing current problems in device processing and current understanding of these defects based on defect physics The volume covers defects and their behaviors in epitaxial growth in various processes such as plasma processing deposition and implantation and in device degradation This book also provides graduate students cutting edge information on devices and materials interaction

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