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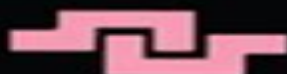
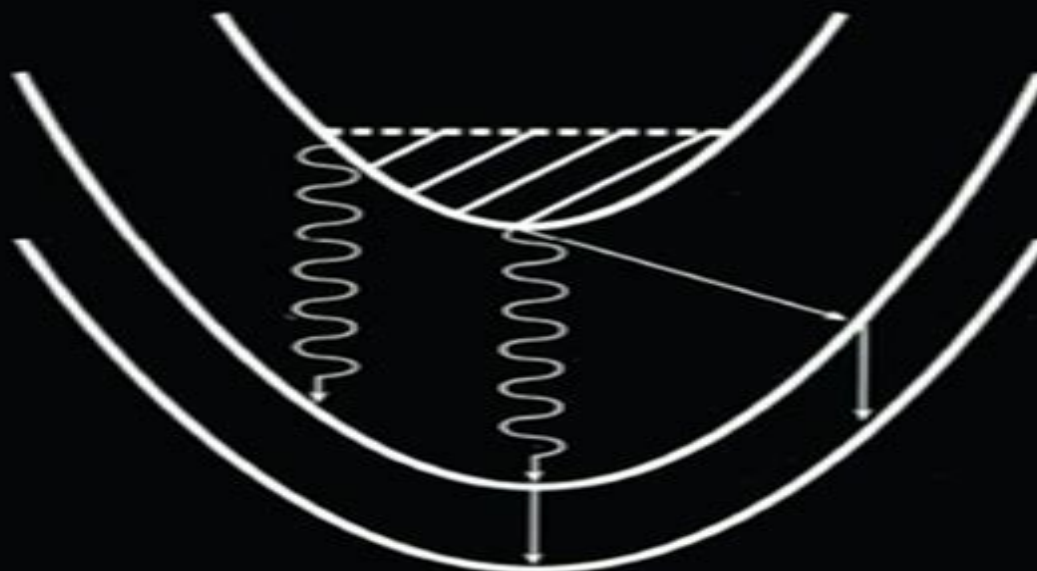
From Quantum Physics to Smart Devices

edited by

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D. M. FINLAYSON



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Semiconductor Quantum Optoelectronics

Arash Rahimi-Iman



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 in 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 *Spin-based Optoelectronics with Semiconductor Quantum Dots* Pablo Asshoff, 2012 **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

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

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 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

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 **Physical Models of Semiconductor Quantum Devices** Ying Fu, M. Willander, 1999 This detailed book addresses three main areas of solid state electronics providing an insight into the state of the art in material and device research that will be of interest to all those involved in compound semiconductors *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 **Physics of Optoelectronics** Michael A. Parker, 2018-10-03 Physics of Optoelectronics focuses on the properties of optical fields and their interaction with matter Understanding that lasers LEDs and photodetectors clearly exemplify this interaction the author begins with an introduction to lasers LEDs and the rate equations then describes the emission and detection processes The book summarizes and reviews the mathematical background of the quantum theory embodied in the Hilbert space These concepts highlight the abstract form of the linear algebra for vectors and operators supplying the pictures that make the subject more intuitive A chapter on dynamics includes a brief review of the formalism for discrete sets of particles and continuous media It also covers the quantum theory necessary for the study of optical fields transitions and semiconductor gain This volume supplements the description of lasers and LEDs by examining the fundamental nature of the light that these devices produce It includes an analysis of quantized electromagnetic fields and illustrates inherent quantum noise in terms of Poisson and sub Poisson statistics It explains matter light interaction in terms of time dependent perturbation theory and Fermi's golden rule and concludes with a detailed discussion of semiconductor emitters and detectors **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 *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

Quantum Theory Of The Optical And Electronic Properties Of Semiconductors (3rd Edition) Hartmut Haug, Stephan W Koch, 1994-10-31 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

Optoelectronics Emmanuel Rosencher, Borge Vinter, 2002-05-30 Optoelectronics first published in 2002 is a practical and self contained textbook written for graduate students and engineers

Semiconductor Optics Claus F. Klingshirn, 1997-02-03 Semiconductor Optics provides an introduction to and an overview of semiconductor optics from the IR through the visible to the UV including linear and nonlinear optical properties dynamics magneto and electrooptics high excitation effects some applications experimental techniques and group theory Mathematics is kept as elementary as possible enough for an intuitive understanding of the experimental results and techniques treated The subjects covered extend from physics to materials science and optoelectronics

Physics of Optoelectronic Devices Shun Lien Chuang, 1995-09-08 Emphasizes the theory of semiconductor optoelectronic devices demonstrating comparisons between theoretical and experimental results Presents such important topics as semiconductor heterojunctions and band structure calculations near the band edges for bulk and quantum well semiconductors Details semiconductor lasers including double heterostructure stripe geometry gain guided semiconductor distributed feedback and surface emitting Systematically investigates high speed modulation of semiconductor lasers using linear and nonlinear gains Features new subjects such as the theories on the band structures of strained semiconductors and strained quantum well lasers Covers key areas behind the operation of semiconductor lasers modulators and photodetectors An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department

Physics of Photonic Devices Shun Lien Chuang, 2009-01-20 The most up to date book available on the physics of photonic devices This new edition of Physics of Photonic Devices incorporates

significant advancements in the field of photonics that have occurred since publication of the first edition *Physics of Optoelectronic Devices* New topics covered include a brief history of the invention of semiconductor lasers the Lorentz dipole method and metal plasmas matrix optics surface plasma waveguides optical ring resonators integrated electroabsorption modulator lasers and solar cells It also introduces exciting new fields of research such as surface plasmonics and micro ring resonators the theory of optical gain and absorption in quantum dots and quantum wires and their applications in semiconductor lasers and novel microcavity and photonic crystal lasers quantum cascade lasers and GaN blue green lasers within the context of advanced semiconductor lasers *Physics of Photonic Devices Second Edition* presents novel information that is not yet available in book form elsewhere Many problem sets have been updated the answers to which are available in an all new Solutions Manual for instructors Comprehensive timely and practical *Physics of Photonic Devices* is an invaluable textbook for advanced undergraduate and graduate courses in photonics and an indispensable tool for researchers working in this rapidly growing field

Theory of Optical Processes in Semiconductors Prasanta Kumar Basu, P. K. Basu, 2003

Semiconductor optoelectronic devices are at the heart of all information generation and processing systems and are likely to be essential components of future optical computers With more emphasis on optoelectronics and photonics in graduate programmes in physics and engineering there is a need for a text providing a basic understanding of the important physical phenomena involved Such a training is necessary for the design optimization and search for new materials devices and application areas This book provides a simple quantum mechanical theory of important optical processes i.e. band to band intersubband and excitonic absorption and recombination in bulk quantum wells wires dots superlattices and strained layers including electro optic effects The classical theory of absorption quantization of radiation and band picture based on k p perturbation has been included to provide the necessary background Prerequisites for the book are a knowledge of quantum mechanics and solid state theory Problems have been set at the end of each chapter some of which may guide the reader to study processes not covered in the book The application areas of the phenomena are also indicated

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Table of Contents Semiconductor Quantum Optoelectronics

1. Understanding the eBook Semiconductor Quantum Optoelectronics
 - The Rise of Digital Reading Semiconductor Quantum Optoelectronics
 - Advantages of eBooks Over Traditional Books
2. Identifying Semiconductor Quantum Optoelectronics
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Semiconductor Quantum Optoelectronics
 - User-Friendly Interface
4. Exploring eBook Recommendations from Semiconductor Quantum Optoelectronics
 - Personalized Recommendations
 - Semiconductor Quantum Optoelectronics User Reviews and Ratings
 - Semiconductor Quantum Optoelectronics and Bestseller Lists
5. Accessing Semiconductor Quantum Optoelectronics Free and Paid eBooks
 - Semiconductor Quantum Optoelectronics Public Domain eBooks

- Semiconductor Quantum Optoelectronics eBook Subscription Services
- Semiconductor Quantum Optoelectronics Budget-Friendly Options
- 6. Navigating Semiconductor Quantum Optoelectronics eBook Formats
 - ePub, PDF, MOBI, and More
 - Semiconductor Quantum Optoelectronics Compatibility with Devices
 - Semiconductor Quantum Optoelectronics Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Semiconductor Quantum Optoelectronics
 - Highlighting and Note-Taking Semiconductor Quantum Optoelectronics
 - Interactive Elements Semiconductor Quantum Optoelectronics
- 8. Staying Engaged with Semiconductor Quantum Optoelectronics
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Semiconductor Quantum Optoelectronics
- 9. Balancing eBooks and Physical Books Semiconductor Quantum Optoelectronics
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Semiconductor Quantum Optoelectronics
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Semiconductor Quantum Optoelectronics
 - Setting Reading Goals Semiconductor Quantum Optoelectronics
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Semiconductor Quantum Optoelectronics
 - Fact-Checking eBook Content of Semiconductor Quantum Optoelectronics
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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