

NANOSCIENCE  
AND TECHNOLOGY

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(Eds.)

# Semiconductor Quantum Dots

Physics, Spectroscopy  
and Applications



Springer

# Semiconductor Quantum Dots Physics Spectroscopy And Applications

**S. Morita, Roland Wiesendanger, E.  
Meyer**



## **Semiconductor Quantum Dots Physics Spectroscopy And Applications:**

Semiconductor Quantum Dots Yasuaki Masumoto, T. Takagahara, 2002-05-28 Growth of Self Organized Quantum Dots J S Lee Excitonic Structures and Optical Properties of Quantum Dots Toshihide Takagahara Electron Phonon Interactions in Semiconductor Quantum Dots Toshihide Takagahara Micro Imaging and Single Dot Spectroscopy of Self Assembled Quantum Dots Mitsuru Sugisaki Persistent Spectral Hole Burning in Semiconductor Quantum Dots Yasuaki Masumoto Dynamics of Carrier Relaxation in Self Assembled Quantum Dots Ivan V Ignatiev Igor E Kozin Resonant Two Photon Spectroscopy of Quantum Dots Alexander Baranov Homogeneous Width of Confined Excitons in Quantum Dots Experimental Yasuaki Masumoto Theory of Exciton Dephasing in Semiconductor Quantum Dots Toshihide Takagahara Excitonic Optical Nonlinearity and Weakly Correlated Exciton Pair States Selvakumar V Nair Toshihide Takagahara Coulomb Effects in the Optical Spectra of Highly Excited Semiconductor Quantum Dots Selvakumar V Nair Device Semiconductor Quantum Dots Yasuaki Masumoto, T. Takagahara, 2014-03-12 Semiconductor quantum dots represent one of the fields of solid state physics that have experienced the greatest progress in the last decade Recent years have witnessed the discovery of many striking new aspects of the optical response and electronic transport phenomena This book surveys this progress in the physics optical spectroscopy and application oriented research of semiconductor quantum dots It focuses especially on excitons multi excitons their dynamical relaxation behaviour and their interactions with the surroundings of a semiconductor quantum dot Recent developments in fabrication techniques are reviewed and potential applications discussed This book will serve not only as an introductory textbook for graduate students but also as a concise guide for active researchers **Semiconductor Nanocrystal Quantum Dots** Andrey Rogach, 2008-09-02 When investigations on semiconductor nanocrystal quantum dots started more than a quarter of a century ago no one ever believed that nanoparticle research would develop into one of the major fields in modern science The basis was laid by studies of photocatalysis and artificial water splitting driven by the former oil crisis These euphorically started activities ebbed away more and more when on one side oil brimmed over again and the scientists on the other did not succeed in the concomitant formation of hydrogen and oxygen At the same time size quantisation was discovered in nanocrystals initiating a fruitful research field on scaling laws of physical and chemical properties of quantum dots Especially optical investigations of semiconductor nanocrystals led to fascinating scientific results and to applications in optoelectronics and biolabeling Advances in spectroscopic measurements were always correlated with advances in synthesis The better the size shape and surface control of the particles was developed the more detailed and precise was the spectroscopic information gained Applications of nanocrystal quantum dots often require assembly processes for the formation of polymer hybrids or thin films For this as well as for the use in biomedical applications new ligand chemistry needed to be developed during the recent past This book gives a very competent view on all these facets of nanocrystal quantum dot research Twelve chapters are written by experts in the fields in a way introducing the respective

concepts and providing comprehensive overview on the current state of the art      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      *Colloidal Quantum Dot Optoelectronics and Photovoltaics* Gerasimos Konstantatos, Edward H. Sargent, 2013-11-07 Capturing the most up to date research in colloidal quantum dot CQD devices this book is written in an accessible style by the world s leading experts The application of CQDs in solar cells photodetectors and light emitting diodes LEDs has developed rapidly over recent years promising to transform the future of clean energy communications and displays This complete guide to the field provides researchers students and practitioners alike with everything they need to understand these developments and begin contributing to future applications Introductory chapters summarise the fundamental physics and chemistry whilst later chapters review the developments that have propelled the field forwards systematically working through key device advances The science of CQD films is explained through the latest physical models of semiconductor transport trapping and recombination whilst the engineering of organic and inorganic multilayered materials is shown to have enabled major advances in the brightness and efficiency of CQD LEDs      **Non-Equilibrium Dynamics of Semiconductors and Nanostructures** Kong-Thon Tsen, 2018-10-03 The advent of the femto second laser has enabled us to observe phenomena at the atomic timescale One area to reap enormous benefits from this ability is ultrafast dynamics Collecting the works of leading experts from around the globe Non Equilibrium Dynamics of Semiconductors and Nanostructures surveys recent developments in a variety of areas in ultrafast dynamics In eight authoritative chapters illustrated by more than 150 figures this book spans a broad range of new techniques and advances It begins with a review of spin dynamics in a high mobility two dimensional electron gas followed by the generation propagation and nonlinear properties of high amplitude ultrashort strain solitons in solids The discussion then turns to nonlinear optical properties of nanoscale artificial dielectrics optical properties of GaN self assembled quantum dots and optical studies of carrier dynamics and non equilibrium optical phonons

in nitride based semiconductors Rounding out the presentation the book examines ultrafast non equilibrium electron dynamics in metal nanoparticles monochromatic acoustic phonons in GaAs and electromagnetically induced transparency in semiconductor quantum wells With its pedagogical approach and practical up to date coverage *Non Equilibrium Dynamics of Semiconductors and Nanostructures* allows you to easily put the material into practice whether you are a seasoned researcher or new to the field *Electron and Nuclear Spin Dynamics in Semiconductor Nanostructures* M. M. Glazov,2018 This book focuses on the main aspects of electron and nuclear spin dynamics in semiconductor nanostructures It summarizes main results of theoretical and experimental studies of interactions in spin systems effects of ultrafast spin manipulation by light phenomena of spin losses and the physics of the omnipresent spin noise **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 **VLSI Micro- and Nanophotonics** El-Hang Lee,Louay Eldada,Manijeh Razeghi,Chennupati Jagadish,2018-09-03 Addressing the growing demand for larger capacity in information technology VLSI Micro and Nanophotonics Science Technology and Applications explores issues of science and technology of micro nano scale photonics and integration for broad scale and chip scale Very Large Scale Integration photonics This book is a game changer in the sense that it is quite possibly the first to focus on VLSI Photonics Very little effort has been made to develop integration technologies for micro nanoscale photonic devices and applications so this reference is an important and necessary early stage perspective on this field New demand for VLSI photonics brings into play various technological and scientific issues as well as evolutionary and revolutionary challenges all of which are discussed in this book These include topics such as miniaturization interconnection and integration of photonic devices at micron submicron and nanometer scales With its disruptive creativity and unparalleled coverage of the photonics revolution in information technology this book should greatly impact the future of micro nano photonics and IT as a whole It offers a comprehensive overview of the science and engineering of micro nanophotonics and photonic integration Many books on micro nanophotonics focus on understanding the properties of individual devices and their related characteristics However this book offers a full perspective from the point of view of integration covering all aspects of benefits and advantages of VLSI scale photonic integration the key technical concept in developing a platform to make individual devices and components useful and practical for various applications *Handbook of Nanophysics* Klaus D. Sattler,2010-09-17 Providing the framework for breakthroughs in nanotechnology this landmark publication is the first comprehensive reference to cover both fundamental and applied physics at the nanoscale After discussing the theoretical principles and measurements of nanoscale systems the organization of the set follows the historical development of nanoscience Each peer reviewed chapter presents a didactic treatment of the physics underlying the nanoscale materials applications and detailed experimental results State of the art scientific content is

enriched with fundamental equations and illustrations many in color      *Advanced Remote Sensing Technology for Covid-19 Monitoring and Forecasting* Maged Marghany, 2025-04-11 This book provides a groundbreaking exploration of satellite remote sensing's role in tracking the mobility and spread of COVID 19 focusing on its origin in Wuhan City It addresses the gap in research by employing advanced techniques like quantum image processing to analyze satellite data and differentiate between COVID 19 related deaths and other causes Additionally it explores conspiracy theories vaccine development through quantum mechanics and the use of quantum computing for detecting pandemic patterns The book also delves into the economic impact of COVID 19 offering a scientific response to geopolitical tensions and media accusations surrounding the pandemic's origins      *Epitaxy of Nanostructures* Vitaly Shchukin, Nikolai N. Ledentsov, Dieter Bimberg, 2013-03-09 The general trend in modern solid state physics and technology is to make things smaller The size of key elements in modern devices approaches the nanometer scale for both vertical and lateral dimensions Ultrathin layers or quantum wells had already gained broad acceptance for applications in micro and optoelectronics by the 1980s However the development of heterostructures with lower dimensionality quantum wires where carriers are confined in two directions and move freely in one and quantum dots where carriers are confined in all three directions took longer It became clear that quantum wire and dot structures constitute the utmost technological challenge whilst providing enormous advantages At the beginning of the 1990s a few outstanding discoveries concerning self organization phenomena at crystal surfaces for direct fabrication of nanostructures led to a change in the major paradigms of semiconductor physics and technology This new approach in epitaxy enables fast parallel fabrication of large densities of quantum dots or wires for almost unlimited material combinations and has become the basis for a powerful new branch of nanotechnology Quantum dots coherent inclusions in a semiconductor matrix with zero dimensional electronic properties persistent up to room temperature have demonstrated fascinating physical properties and given birth to a novel generation of optoelectronic devices and systems

**Self-Assembled Quantum Dots** Zhiming M Wang, 2007-11-29 This multidisciplinary book provides up to date coverage of carrier and spin dynamics and energy transfer and structural interaction among nanostructures Coverage also includes current device applications such as quantum dot lasers and detectors as well as future applications to quantum information processing The book will serve as a reference for anyone working with or planning to work with quantum dots      [Nanoscale Characterisation of Ferroelectric Materials](#) Marin Alexe, Alexei Gruverman, 2013-03-09 Among the main trends in our daily society is a drive for smaller faster cheaper smarter computers with ever increasing memories To sustain this drive the computer industry is turning to nanotechnology as a source of new processes and functional materials which can be used in high performance high density electronic systems Researchers and engineers have been focusing on ferroelectric materials for a long time due to their unique combination of physical properties The ability of ferroelectrics to transform electromagnetic thermal and mechanical energy into electrical charge has been used in a number of electronic applications most recently in

nonvolatile computer memories Classical monographs such as Ferroelectricity by E Fatuzzo and W J Mertz served as a comprehensive introduction into the field for several generations of scientists However to meet the challenges of the nano era a solid knowledge of the ferroelectric properties at the nano scale needs to be acquired While the science of ferroelectrics from micro to larger scale is well established the science of nanoscale ferroelectrics is still terra incognita The properties of materials at the nanoscale show strong size dependence which makes it imperative to perform reliable characterization at this size range One of the most promising approaches is based on the use of scanning probe microscopy SPM which has revolutionized materials research over the last decade

**Nanostructures** Christophe Jean Delerue, Michel Lannoo, 2013-06-29 Progress in nanoscience is becoming increasingly dependent on simulation and modelling This is due to a combination of three factors the reduced size of nano objects the increasing power of computers and the development of new theoretical methods This book represents the first attempt to provide the theoretical background needed by physicists engineers and students to simulate nanodevices semiconductor quantum dots and molecular devices It presents in a unified way the theoretical concepts the more recent semi empirical and ab initio methods and their application to experiments The topics include quantum confinement dielectric and optical properties non radiative processes defects and impurities and quantum transport This guidebook not only provides newcomers with an accessible overview requiring only basic knowledge of quantum mechanics and solid state physics but also provides active researchers with practical simulation tools

Magnetic Microscopy of Nanostructures Herbert Hopster, Hans Peter Oepen, 2006-03-30 A comprehensive collection of overview articles on novel microscopy methods for imaging magnetic structures on the nanoscale Written by leading scientists in the field the book covers synchrotron based methods spin polarized electron methods and scanning probe techniques It constitutes a valuable source of reference for graduate students and newcomers to the field

Fundamentals of Photonics Bahaa E. A. Saleh, Malvin Carl Teich, 2007-03-09 Fundamentals of Photonics A complete thoroughly updated full color second edition Now in a new full color edition Fundamentals of Photonics Second Edition is a self contained and up to date introductory level textbook that thoroughly surveys this rapidly expanding area of engineering and applied physics Featuring a logical blend of theory and applications coverage includes detailed accounts of the primary theories of light including ray optics wave optics electromagnetic optics and photon optics as well as the interaction of photons and atoms and semiconductor optics Presented at increasing levels of complexity preliminary sections build toward more advanced topics such as Fourier optics and holography guided wave and fiber optics semiconductor sources and detectors electro optic and acousto optic devices nonlinear optical devices optical interconnects and switches and optical fiber communications Each of the twenty two chapters of the first edition has been thoroughly updated The Second Edition also features entirely new chapters on photonic crystal optics including multilayer and periodic media waveguides holey fibers and resonators and ultrafast optics including femtosecond optical pulses ultrafast nonlinear optics and optical solitons The chapters on optical

interconnects and switches and optical fiber communications have been completely rewritten to accommodate current technology Each chapter contains summaries highlighted equations exercises problems and selected reading lists Examples of real systems are included to emphasize the concepts governing applications of current interest *Nanoelectrodynamics* Hitoshi Nejo, 2013-03-14 Many books on mesoscopic systems have been published as progress has continued in the fields of nanoscience and nanotechnology The focus in these books is mainly on quantum mechanical behavior in artificial electronic systems fabricated by nanometer scale structuring Such quantum mechanical behavior is projected to macroscopic observers and the quantum nature can be utilized in practical devices Quantum computers another hot topic nowa days are characterized by excitation coherence properties among nanostructures and the ability to maintain excitations is very important when using the characteristics as information In that sense the device is described as a microscopic system and some processes occur before being projected to macroscopic observers In this book the authors try to describe not only the techniques for fabricating nanostructures but also new directions as regards exciting systems and understanding how energy is dissipated through observation The idea of nano electrodynamics underlying the book is an analogy with the well established classical electrodynamics In contrast to the latter nano electrodynamics is still in its infancy and far from well established When a structure is miniaturized as a device it is essential to have control over energy excitation and dissipation Otherwise when a device is squeezed down beyond a certain size and the energy dissipation becomes overwhelmed the device will eventually collapse It is our aim in this book to provide some thoughts on the task of making devices out of small structures **Applied Physics** ,2003 Noncontact Atomic Force Microscopy S. Morita,Roland Wiesendanger,E. Meyer,2012-12-06 Since 1995 the noncontact atomic force microscope NC AFM has achieved remarkable progress Based on nanomechanical methods the NC AFM detects the weak attractive force between the tip of a cantilever and a sample surface This method has the following characteristics it has true atomic resolution it can measure atomic force interactions i e it can be used in so called atomic force spectroscopy AFS it can also be used to study insulators and it can measure mechanical responses such as elastic deformation This is the first book that deals with all of the emerging NC AFM issues



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