

NANO SCIENCE
AND TECHNOLOGY

D. D. Awschalom
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N. Samarth
(Eds.)

Semiconductor Spintronics and Quantum Computation



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Semiconductor Spintronics And Quantum Computation

Sergey Ganichev, Willi Prettl



Semiconductor Spintronics And Quantum Computation:

Semiconductor Spintronics and Quantum Computation D.D. Awschalom, D. Loss, N. Samarth, 2013-04-17 The past few decades of research and development in solid state semiconductor physics and electronics have witnessed a rapid growth in the drive to exploit quantum mechanics in the design and function of semiconductor devices This has been fueled for instance by the remarkable advances in our ability to fabricate nanostructures such as quantum wells quantum wires and quantum dots Despite this contemporary focus on semiconductor quantum devices a principal quantum mechanical aspect of the electron its spin has it accounts for an added quantum largely been ignored except in as much as quantum mechanical degeneracy In recent years however a new paradigm of electronics based on the spin degree of freedom of the electron has begun to emerge This field of semiconductor spintronics spin transport electronics or spin based electronics places electron spin rather than charge at the very center of interest The underlying basis for this new electronics is the intimate connection between the charge and spin degrees of freedom of the electron via the Pauli principle A crucial implication of this relationship is that spin effects can often be accessed through the orbital properties of the electron in the solid state Examples for this are optical measurements of the spin state based on the Faraday effect and spin dependent transport measurements such as giant magnetoresistance GMR In this manner information can be encoded in not only the electron's charge but also in its spin state i.e.

Semiconductor Spintronics and Quantum Computation D. D. Awschalom, D. Loss, N. Samarth, 2014-01-15 Optoelectronic Structures for Semiconductor Spintronics and Quantum Computation Darron Kuan Hua Young, 2002

Semiconductor Spintronics Thomas Schäpers, 2021-05-10 This revised and expanded edition of the first comprehensive introduction to the rapidly evolving field of spintronics covers ferromagnetism in nano electrodes spin injection spin manipulation and the practical use of these effects in next generation electronics Moreover the book now also includes spin based optics topological materials and insulators and the quantum spin Hall effect Experimental

Aspects of Quantum Computing Henry O. Everitt, 2005-04-01 Practical quantum computing still seems more than a decade away and researchers have not even identified what the best physical implementation of a quantum bit will be There is a real need in the scientific literature for a dialogue on the topic of lessons learned and looming roadblocks This reprint from Quantum Information Processing is dedicated to the experimental aspects of quantum computing and includes articles that 1 highlight the lessons learned over the last 10 years and 2 outline the challenges over the next 10 years The special issue includes a series of invited articles that discuss the most promising physical implementations of quantum computing The invited articles were to draw grand conclusions about the past and speculate about the future not just report results from the present

Wide Bandgap Semiconductor Spintronics Vladimir Litvinov, 2024-04-26 This second edition of the book presents spintronic properties of III V nitride semiconductors As wide bandgap III nitride nanostructures are relatively new materials the book pays particular attention to the difference between zinc blende GaAs and wurtzite GaN based structures

where the Rashba spin orbit interaction plays a crucial role in voltage controlled spin engineering It also deals with topological insulators and discusses electrically driven zero magnetic field spin splitting of surface electrons with respect to the specifics of electron localized spin interaction and voltage controlled ferromagnetism It describes the recently identified zero gap state an anomalous quantum semimetal The book comprises calculation of topological indexes in semiconductor and semimetal phases It compares results that follow from the low energy model and the Bernevig Huges Zhang model which accounts for the full Brillouin zone electron spectrum It also discusses the fractional quantization of Hall conductance and performs the direct calculation of Chern numbers for the inverted GaN InN quantum well determining topological properties by Chern number $C/2$ The book explores and actively discusses semiconductor spintronics and proposes various device implementations along the way Although writings on this topic appear in the current literature this book is focused on the materials science side of the question providing a theoretical background for the most common concepts of spin electron physics It covers generic topics in spintronics without entering into device specifics since its aim is to give instructions to be used in solving problems of a general and specific nature It is intended for graduate students and will serve as an introductory course in this specific field of solid state theory and applications

Handbook of Spintronic

Semiconductors Weimin Chen,Irina Buyanova,2019-05-08 This book provides an in depth review of the rapidly developing field of spintronic semiconductors It covers a broad range of topics including growth and basic physical properties of diluted magnetic semiconductors based on II VI III V and IV semiconductors recent developments in theory and experimental techniques and potential device applications its aim is to provide postgraduate students researchers and engineers a comprehensive overview of our present knowledge and future perspectives of spintronic semiconductors

Isotope-Based Quantum Information Vladimir G. Plekhanov,2012-05-26 The present book provides to the main ideas and techniques of the rapid progressing field of quantum information and quantum computation using isotope mixed materials It starts with an introduction to the isotope physics and then describes of the isotope based quantum information and quantum computation The ability to manipulate and control electron and or nucleus spin in semiconductor devices provides a new route to expand the capabilities of inorganic semiconductor based electronics and to design innovative devices with potential application in quantum computing One of the major challenges towards these objectives is to develop semiconductor based systems and architectures in which the spatial distribution of spins and their properties can be controlled For instance to eliminate electron spin decoherence resulting from hyperfine interaction due to nuclear spin background isotopically controlled devices are needed i e nuclear spin depleted In other emerging concepts the control of the spatial distribution of isotopes with nuclear spins is a prerequisite to implement the quantum bits or qubits Therefore stable semiconductor isotopes are important elements in the development of solid state quantum information There are not only different algorithms of quantum computation discussed but also the different models of quantum computers are presented With numerous

illustrations this small book is of great interest for undergraduate students taking courses in mesoscopic physics or nanoelectronics as well as quantum information and academic and industrial researches working in this field

Manipulating Quantum Coherence in Solid State Systems Michael E. Flatté, Ionel Tifrea, 2007-05-30 This book features the proceedings of the NATO Advanced Study Institute Manipulating Quantum Coherence in Solid State Systems held in Cluj Napoca Romania August 2005 which presented a fundamental introduction to solid state approaches to achieving quantum computation This proceedings volume describes the properties of quantum coherence in semiconductor spin based systems and the behavior of quantum coherence in superconducting systems

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

Semiconductor Optics Claus F. Klingshirn, 2012-07-06 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

Enzyme-Based Computing Systems Evgeny Katz, 2019-06-10 This systematic and comprehensive overview of enzyme based biocomputing is an excellent resource for scientists and engineers working on the design study and applications of enzyme logic systems

Spin Physics in Semiconductors Mikhail I. Dyakonov, 2017-10-04 This book offers an extensive introduction to the extremely rich and intriguing field of spin related phenomena in semiconductors In this second edition all chapters have been updated to include the latest experimental and theoretical research Furthermore it covers the entire field bulk semiconductors two dimensional

semiconductor structures quantum dots optical and electric effects spin related effects electron nuclei spin interactions Spin Hall effect spin torques etc Thanks to its self contained style the book is ideally suited for graduate students and researchers new to the field

Solid State Physics Henry Ehrenreich, Frans Spaepen, 2004-07-17 Solid state physics is the branch of physics that is primarily devoted to the study of matter in its solid phase especially at the atomic level This prestigious serial presents timely and state of the art reviews pertaining to all aspects of solid state physics

Nanowires Anqi Zhang, Gengfeng Zheng, Charles M. Lieber, 2016-07-26 This book provides a comprehensive summary of nanowire research in the past decade from the nanowire synthesis characterization assembly to the device applications In particular the developments of complex modulated nanowire structures the assembly of hierarchical nanowire arrays and the applications in the fields of nanoelectronics nanophotonics quantum devices nano enabled energy and nano bio interfaces are focused Moreover novel nanowire building blocks for the future emerging nanoscience and nanotechnology are also discussed Semiconducting nanowires represent one of the most interesting research directions in nanoscience and nanotechnology with capabilities of realizing structural and functional complexity through rational design and synthesis The exquisite control of chemical composition morphology structure doping and assembly as well as incorporation with other materials offer a variety of nanoscale building blocks with unique properties

Advanced Electrical and Electronics Materials K. M. Gupta, Nishu Gupta, 2015-02-23 This comprehensive and unique book is intended to cover the vast and fast growing field of electrical and electronic materials and their engineering in accordance with modern developments Basic and pre requisite information has been included for easy transition to more complex topics Latest developments in various fields of materials and their sciences engineering processing and applications have been included Latest topics like PLZT vacuum as insulator fiber optics high temperature superconductors smart materials ferromagnetic semiconductors etc are covered Illustrations and examples encompass different engineering disciplines such as robotics electrical mechanical electronics instrumentation and control computer and their inter disciplinary branches A variety of materials ranging from iridium to garnets microelectronics micro alloys to memory devices left handed materials advanced and futuristic materials are described in detail

Handbook of Organic Materials for Electronic and Photonic Devices Oksana Ostroverkhova, 2018-11-30 Handbook of Organic Materials for Electronic and Photonic Devices Second Edition provides an overview of the materials mechanisms characterization techniques structure property relationships and most promising applications of organic materials This new release includes new content on emerging organic materials expanded content on the basic physics behind electronic properties and new chapters on organic photonics As advances in organic materials design fabrication and processing that enabled charge unprecedented carrier mobilities and power conversion efficiencies have made dramatic advances since the first edition this latest release presents a necessary understanding of the underlying physics that enabled novel material design and improved organic device design Provides a comprehensive overview of the materials mechanisms characterization

techniques and structure property relationships of organic electronic and photonic materials Reviews key applications including organic solar cells light emitting diodes electrochemical cells sensors transistors bioelectronics and memory devices New content to reflect latest advances in our understanding of underlying physics to enable material design and device fabrication

Intense Terahertz Excitation of Semiconductors Sergey Ganichev, Willi Prettel, 2006 This work presents the first comprehensive treatment of high power terahertz applications to semiconductors and low dimensional semiconductor structures Terahertz properties of semiconductors are in the centre of scientific activities because of the need of high speed electronics

From Semiclassical Semiconductors to Novel Spintronic Device Halyna Khlyap, 2013-04-03 Dramatic developments in developing semiconductor device technology and nanotechnologies over the last decades has placed increasing demands on the fabrication and design of new electronic devices It is now necessary to implement nanoscale gate geometries to achieve the highest performance standards in new devices The need to understand and model the operation of nano devices is therefore fundamental to future development and optimal design Semiclassical Heterojunctions to Novel Spintronic Devices explains research related to new spintronic devices This E book reports unique results on fabrication and the quite uncommon performance of Si based solar cells with novel contacts chemically deposited on traditionally prepared semiconductor parts of the solar cell details the mechanism behind efficient solar radiation conversion and the thermodynamics involved in theory and practice discusses photonic condensate and relic radiation exotic topics for theoretical astrophysics which also present possible power tools for achieving highly efficient energy conversion This e book is a useful review on the latest achievements in spintronic technology characterization methods and nanoscaled active elements modeling for novel device design and applications The text within this e book serves as a handy resource for graduate and PhD students as well as for professionals interested in the field of semiconductor device technology and modeling as well as spintronics

Functional Materials Dipti Ranjan Sahu, 2019-10-09 Functional materials are important materials for any technological needs and the forefront of materials research Development of functional materials and their effective applications in the frontier fields of cross multidisciplinary research programs is unique This book presents an overview of different types of functional materials including synthesis characterization and application and up to date treatment of functional materials which are needed for structural magnetic polymeric electromagnetic etc applications New topics based on polymeric materials and spintronic materials are given for possible applications The chapters of the book provide a key understanding of functional materials It is suitable for undergraduates graduates and professionals including engineers scientists researchers technicians and technology managers

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