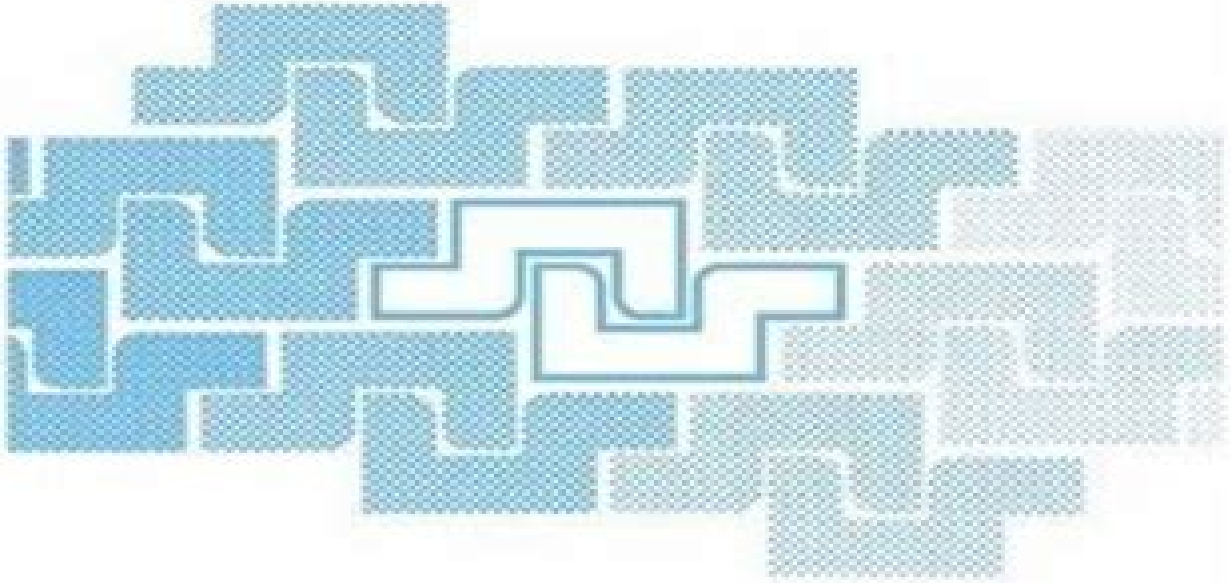

# Molecular Nanowires and Other Quantum Objects

Edited by

Alexandre S. Alexandrov, Jure Demsar and Igor K. Yanson

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# Molecular Nanowires And Other Quantum Objects

Kimberly S. Gehar

**Molecular Nanowires And Other Quantum Objects:**

*Molecular Nanowires and Other Quantum Objects* A. S. Alexandrov,Jure Demsar,Igor K. Yanson,2004-06-02 There is a growing understanding that the progress of the conventional silicon technology will reach its physical engineering and economic limits in about a decade What will take us beyond 2010 are new molecular and other nanotechnologies that require the efforts of trans disciplinary teams of physicists quantum chemists material and computer scientists and engineers This volume represents a unique collection of interdisciplinary review and original papers by experts in molecular nanowires carbon nanotubes mesoscopic super and semiconductors and theorists in the field of strongly correlated electrons and phonons Topics include molecular nanojunctions and electronics mesoscale semiconductors and superconductors carbon nanotubes low dimensional conductors polarons and strongly correlated electrons in nanoobjects quantum theory of nanoscale and new techniques for making nano and mesoscopic sensors and detectors Molecular Electronics Juan Carlos Cuevas,Elke Scheer,2010 1 The birth of molecular electronics 1 1 Why molecular electronics 1 2 A brief history of molecular electronics 1 3 Scope and structure of the book 2 Fabrication of metallic atomic size contacts 2 1 Introduction 2 2 Techniques involving the scanning electron microscope STM 2 3 Methods using atomic force microscopes AFM 2 4 Contacts between macroscopic wires 2 5 Transmission electron microscope 2 6 Mechanically controllable break junctions MCBJ 2 7 Electromigration technique 2 8 Electrochemical methods 2 9 Recent developments 2 10 Electronic transport measurements 2 11 Exercises 3 Contacting single molecules Experimental techniques 3 1 Introduction 3 2 Molecules for molecular electronics 3 3 Deposition of molecules 3 4 Contacting single molecules 3 5 Contacting molecular ensembles 3 6 Exercises 4 The scattering approach to phase coherent transport in nanocontacts 4 1 Introduction 4 2 From mesoscopic conductors to atomic scale junctions 4 3 Conductance is transmission heuristic derivation of the Landauer formula 4 4 Penetration of a potential barrier tunnel effect 4 5 The scattering matrix 4 6 Multichannel Landauer formula 4 7 Shot noise 4 8 Thermal transport and thermoelectric phenomena 4 9 Limitations of the scattering approach 4 10 Exercises 5 Introduction to Green s function techniques for systems in equilibrium 5 1 The Schrodinger and Heisenberg pictures 5 2 Green s functions of a noninteracting electron system 5 3 Application to tight binding Hamiltonians 5 4 Green s functions in time domain 5 5 Exercises 6 Green s functions and Feynman diagrams 6 1 The interaction picture 6 2 The time evolution operator 6 3 Perturbative expansion of causal Green s functions 6 4 Wick s theorem 6 5 Feynman diagrams 6 6 Feynman diagrams in energy space 6 7 Electronic self energy and Dyson s equation 6 8 Self consistent diagrammatic theory the Hartree Fock approximation 6 9 The Anderson model and the Kondo effect 6 10 Final remarks 6 11 Exercises 7 Nonequilibrium Green s functions formalism 7 1 The Keldysh formalism 7 2 Diagrammatic expansion in the Keldysh formalism 7 3 Basic relations and equations in the Keldysh formalism 7 4 Application of Keldysh formalism to simple transport problems 7 5 Exercises 8 Formulas of the electrical current exploiting the Keldysh formalism 8 1 Elastic current microscopic derivation of the Landauer formula 8 2 Current through an interacting

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conduction 19 3 Thermoelectricity in molecular junctions 20 Optical properties of current carrying molecular junctions 20 1 Surface enhanced Raman spectroscopy of molecular junctions 20 2 Transport mechanisms in irradiated molecular junctions 20 3 Theory of photon assisted tunneling 20 4 Experiments on radiation induced transport in atomic and molecular junctions 20 5 Resonant current amplification and other transport phenomena in ac driven molecular junctions 20 6 Fluorescence from current carrying molecular junctions 20 7 Molecular optoelectronic devices 20 8 Final remarks 20 9 Exercises 21 What is missing in this book **Molecular Electronics: An Introduction To Theory And Experiment (2nd Edition)** Elke Scheer,Juan Carlos Cuevas,2017-05-19 Molecular Electronics is self contained and unified in its presentation It can be used as a textbook on nanoelectronics by graduate students and advanced undergraduates studying physics and chemistry In addition included in this new edition are previously unpublished material that will help researchers gain a deeper understanding into the basic concepts involved in the field of molecular electronics Nanoscale Devices - Fundamentals and Applications Rudolf Gross,Anatolie Sidorenko,Lenar Tagirov,2007-05-16 Over the last decade the interest in nanoscale materials and their applications in novel electronic devices have been increasing tremendously This is caused by the unique properties of nanoscale materials and the outstanding performance of nanoscale devices The fascinating and often unrivalled properties of nanoscale materials and devices opened new and sometimes unexpected fields of applications Today the widespread applications range from the detection of explosives drugs and fissionable materials to bio and infrared sensors spintronic devices data storage media magnetic read heads for computer hard disks single electron devices microwave electronic devices and many more This book contains a collection of papers giving insight into the fundamentals and applications of nanoscale devices The main focus is on the synthesis and characterization of nanoscale magnetic materials the fundamental physics and materials aspects of solid state nanostructures the development of novel device concepts and design principles for nanoscale devices as well as on applications in electronics with special emphasis on defence against the threat of terrorism **Nanophysics, Nanoclusters and Nanodevices** Kimberly S. Gehar,2006 Nanotechnology is a catch all description of activities at the level of atoms and molecules that have applications in the real world A nanometre is a billionth of a metre about 1 80 000 of the diameter of a human hair or 10 times the diameter of a hydrogen atom Nanotechnology is now used in precision engineering new materials development as well as in electronics electromechanical systems as well as mainstream biomedical applications in areas such as gene therapy drug delivery and novel drug discovery techniques This book presents the latest research in this frontier field **Carbon Nanotubes and Their Applications** Qing Zhang,2012-04-23 This book overviews the current status of research and development activities of CNTs in nanodevices nanomaterials or nanofabrication This book presents 15 state of the art review articles that cover CNT synthesis technologies for growing highly orientated CNTs chirality pure CNTs and CNTs at a large throughput and low cost CNT assembly techni *Electronic Devices Architectures for the NANO-CMOS Era* Simon Deleonibus,2019-05-08 In this book

internationally recognized researchers give a state of the art overview of the electronic device architectures required for the nano CMOS era and beyond Challenges relevant to the scaling of CMOS nanoelectronics are addressed through different core CMOS and memory device options in the first part of the book The second part reviews new device concepts for nanoelectronics beyond CMOS The book covers the fundamental limits of core CMOS improving scaling by the introduction of new materials or processes new architectures using SOI multigates and multichannels and quantum computing Trends in Nanotubes Research Delores A. Martin,2006 This book talks about a novel way of arranging the atomic structure of a substance so that it can be made thousands of times stronger than in its native state It is often used to make duranium a further ten thousand times stronger Thus a lump of duranium can be made over ten million times stronger than the equivalent block of titanium A one dimensional fullerene a convex cage of atoms with only hexagonal and or pentagonal faces with a cylindrical shape Carbon nanotubes discovered in 1991 by Sumio Iijima resemble rolled up graphite although they can not really be made that way Depending on the direction that the tubes appear to have been rolled quantified by the chiral vector they are known to act as conductors or semiconductors Nanotubes are proving to be useful as molecular components for nanotechnology This book assembles and presents new and important research in the field New Research on Superconductivity Barry P. Martins,2007 Superconductivity is the ability of certain materials to conduct electrical current with no resistance and extremely low losses High temperature superconductors such as La2 xSrxCuOx Tc 40K and YBa2Cu3O7 x Tc 90K were discovered in 1987 and have been actively studied since In spite of an intense world wide research effort during this time a complete understanding of the copper oxide cuprate materials is still lacking Many fundamental questions are unanswered particularly the mechanism by which high Tc superconductivity occurs More broadly the cuprates are in a class of solids with strong electron electron interactions An understanding of such strongly correlated solids is perhaps the major unsolved problem of condensed matter physics with over ten thousand researchers working on this topic High Tc superconductors also have significant potential for applications in technologies ranging from electric power generation and transmission to digital electronics This ability to carry large amounts of current can be applied to electric power devices such as motors and generators and to electricity transmission in power lines For example superconductors can carry as much as 100 times the amount of electricity of ordinary copper or aluminium wires of the same size Many universities research institutes and companies are working to develop high Tc superconductivity applications and considerable progress has been made This volume brings together new leading edge research in the field **Nanorods, Nanotubes, and Nanomaterials Research Progress** Wesley V. Prescott,Arnold I. Schwartz,2008 Nanotechnology is a catch all description of activities at the level of atoms and molecules that have applications in the real world A nanometer is a billionth of a meter about 1 80 000 of the diameter of a human hair or 10 times the diameter of a hydrogen atom Nanotechnology is now used in precision engineering new materials development as well as in electronics electromechanical

systems as well as mainstream biomedical applications in areas such as gene therapy drug delivery and novel drug discovery techniques This new book presents the latest research from around the world on nanorods nanotubes and nanomaterials

*Disruptive Technologies And Muslim Societies: From Ai And Education To Food And Fintech* Shahid Jameel,David C Clary,2025-03-07 This edited volume brings together leading experts to explore the impact of disruptive technologies across a spectrum of Islamic countries and Muslim societies Spanning artificial intelligence science and technology health and education food systems and fintech the seventeen chapters of this collection offer a diverse array of perspectives Contributors to this volume from across the world including Islamic countries such as Malaysia Morocco Pakistan Qatar Saudi Arabia and T rkiye provide in depth analyses revealing how disruptive technologies are transforming Muslim societies and the subtle nuances shaping their impact Together the chapters show that these technologies tend to drive substantial change in Muslim societies but the nature and extent of these shifts vary sometimes mirroring developments in the West but often diverging due to distinct cultural and ethical contexts An essential resource for scholars policymakers and practitioners this book offers valuable insights into the evolving technological landscape of the Islamic World **Dynamical Symmetries for Nanostructures** Konstantin Kikoin,Mikhail Kiselev,Yshai Avishai,2011-12-01 Group theoretical concepts elucidate fundamental physical phenomena including excitation spectra of quantum systems and complex geometrical structures such as molecules and crystals These concepts are extensively covered in numerous textbooks The aim of the present monograph is to illuminate more subtle aspects featuring group theory for quantum mechanics that is the concept of dynamical symmetry Dynamical symmetry groups complement the conventional groups their elements induce transitions between states belonging to different representations of the symmetry group of the Hamiltonian Dynamical symmetry appears as a hidden symmetry in the hydrogen atom and quantum rotator problem but its main role is manifested in nano and meso systems Such systems include atomic clusters large molecules quantum dots attached to metallic electrodes etc They are expected to be the building blocks of future quantum electronic devices and information transmitting algorithms Elucidation of the electronic properties of such systems is greatly facilitated by applying concepts of dynamical group theory *Handbook of Nanoscience, Engineering, and Technology* William A. Goddard III,Donald Brenner,Sergey Edward Lyshevski,Gerald J Iafrate,2002-10-29 Nanotechnology science and engineering spearhead the 21st century revolution that is leading to fundamental breakthroughs in the way materials devices and systems are understood designed made and used With contributions from a host of world class experts and pioneers in the field this handbook sets forth the fundamentals of nanoelectromech **Nano and Molecular Electronics Handbook** Sergey Edward Lyshevski,2018-10-03 There are fundamental and technological limits of conventional microfabrication and microelectronics Scaling down conventional devices and attempts to develop novel topologies and architectures will soon be ineffective or unachievable at the device and system levels to ensure desired performance Forward looking experts continue to search for new paradigms to carry the field

beyond the age of microelectronics and molecular electronics is one of the most promising candidates The Nano and Molecular Electronics Handbook surveys the current state of this exciting emerging field and looks toward future developments and opportunities Molecular and Nano Electronics Explained Explore the fundamentals of device physics synthesis and design of molecular processing platforms and molecular integrated circuits within three dimensional topologies organizations and architectures as well as bottom up fabrication utilizing quantum effects and unique phenomena Technology in Progress Stay current with the latest results and practical solutions realized for nanoscale and molecular electronics as well as biomolecular electronics and memories Learn design concepts device level modeling simulation methods and fabrication technologies used for today s applications and beyond Reports from the Front Lines of Research Expert innovators discuss the results of cutting edge research and provide informed and insightful commentary on where this new paradigm will lead The Nano and Molecular Electronics Handbook ranks among the most complete and authoritative guides to the past present and future of this revolutionary area of theory and technology **Nanotribology and Nanomechanics** Bharat Bhushan,2017-04-05 This textbook and comprehensive reference source and serves as a timely practical introduction to the principles of nanotribology and nanomechanics This 4th edition has been completely revised and updated concentrating on the key measurement techniques their applications and theoretical modeling of interfaces It provides condensed knowledge of the field from the mechanics and materials science perspectives to graduate students research workers and practicing engineers **Advances in III-V Semiconductor Nanowires and Nanodevices** Jianye Li,Deli Wang,Ray R. LaPierre,2011 Semiconductor nanowires exhibit novel electronic and optical properties due to their unique one dimensional structure and quantum confinement effects In particular III V semiconductor nanowires have been of great scientific and technological interest fo **DNA-Based Molecular Electronics** Wolfgang Fritzsche,2004-09-28 The conference focuses on the various applications of DNA for future molecular electronics The main topics are the characterization of DNA conductivity modification of DNA in order to generate biotemplated nanowires and the use of DNA to connect or position other nanostructures such as carbon nanotubes **Handbook of Nanoscience, Engineering, and Technology, Third Edition** William A. Goddard III,Donald Brenner,Sergey Edward Lyshevski,Gerald J Iafrate,2012-06-12 In his 1959 address There is Plenty of Room at the Bottom Richard P Feynman speculated about manipulating materials atom by atom and challenged the technical community to find ways of manipulating and controlling things on a small scale This visionary challenge has now become a reality with recent advances enabling atomistic level tailoring and control of materials Exemplifying Feynman s vision Handbook of Nanoscience Engineering and Technology Third Edition continues to explore innovative nanoscience engineering and technology areas Along with updating all chapters this third edition extends the coverage of emerging nano areas even further Two entirely new sections on energy and biology cover nanomaterials for energy storage devices photovoltaics DNA devices and assembly digital microfluidic lab on a chip and much more This

edition also includes new chapters on nanomagnet logic quantum transport at the nanoscale terahertz emission from Bloch oscillator systems molecular logic electronic optics in graphene and electromagnetic metamaterials With contributions from top scientists and researchers from around the globe this color handbook presents a unified up to date account of the most promising technologies and developments in the nano field It sets the stage for the next revolution of nanoscale manufacturing where scalable technologies are used to manufacture large numbers of devices with complex functionalities

*Toward Functional Nanomaterials* Zhiming M Wang,2010-03-14 This book presents a detailed overview of recent research developments on functional nanomaterials including synthesis characterization and applications This state of the art book is multidisciplinary in scope and international in authorship **Nanotechnology for Electronic Materials and Devices** Anatoli Korkin,Evgeni Gusev,Jan K. Labanowski,Serge Luryi,2010-05-07 The high level of attention and interest of the global community to NANO science and technology to a large extent is linked to the GIGAntic challenges for the c tinuing growth of information technology which sparked an unprecedented level of interdisciplinary and international cooperation among industrial and academic researchers companies IT market rivals and countries including former political and military rivals Microelectronics technologies have reached a new stage in their development The latest miniaturization of electronic devices is approaching atomic dimensions interconnect bottlenecks are limiting circuit speeds new ma rials are being introduced into microelectronics manufacture at an unprecedented rate and alternative technologies to mainstream complementary metal oxide sem conductors CMOSs are being considered The very dynamic stage of science and technology related to the advanced and future electronics and photonics creates a growing gap between the large number of rapid publications and nanotechnology highlights in media on one side and fundamental understanding of underlying phenomena and an adequate evaluation of scientific discoveries and technological innovations on the other side Writing a tutorial book on fundamentals of science and technology for electronics at this time is almost the same level of challenge as writing a history book during a revolution

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