

NANO SCIENCE  
AND TECHNOLOGY

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# Mesoscopic Physics and Electronics



Springer

# Mesoscopic Physics And Electronics

**Paolo Bettotti**



## **Mesoscopic Physics And Electronics:**

**Mesoscopic Physics and Electronics** Tsuneya Ando, Yasuhiko Arakawa, Kazuhito Furuya, Susumu Komiyama, Hisao Nakashima, 2012-12-06 Semiconductor technology has developed considerably during the past several decades. The exponential growth in microelectronic processing power has been achieved by a constant scaling down of integrated circuits. Smaller feature sizes result in increased functional density, faster speed and lower costs. One key ingredient of the LSI technology is the development of the lithography and microfabrication. The current minimum feature size is already as small as 0.2  $\mu\text{m}$ , beyond the limit imposed by the wavelength of visible light and rapidly approaching fundamental limits. The next generation of devices is highly likely to show unexpected properties due to quantum effects and fluctuations. The device which plays an important role in LSIs is MOSFETs, metal oxide semiconductor field effect transistors. In MOSFETs, an inversion layer is formed at the interface of silicon and its insulating oxide. The inversion layer provides a unique two-dimensional 2D system in which the electron concentration is controlled almost freely over a very wide range. Physics of such 2D systems was born in the mid 1960s together with the development of MOSFETs. The integer quantum Hall effect was first discovered in this system.

**Introduction to Mesoscopic Physics** Joseph Imry, 1997-02-13 Mesoscopic physics refers to the physics of structures larger than a nanometer (one billionth of a meter) but smaller than a micrometer (one millionth of a meter). This size range is the stage on which the exciting new research on submicroscopic and electronic and mechanical devices is being done. This research often crosses the boundary between physics and engineering, since engineering such tiny electronic components requires a firm grasp of quantum physics. Applications for the future may include such wonders as microscopic robot surgeons that travel through the blood stream to repair clogged arteries, submicroscopic actuators and builders, and supercomputers that fit on the head of a pin. The world of the future is being planned and built by physicists, engineers, and chemists working in the microscopic realm. This book can be used as the main text in a course on mesoscopic physics or as a supplementary text in electronic devices, semiconductor devices, and condensed matter physics courses.

*Mesoscopic Electronics in Solid State Nanostructures* Thomas Heinzel, 2008-07-11 This text treats electronic transport in the regime where conventional textbook models are no longer applicable, including the effect of electronic phase coherence, energy quantization, and single electron charging. This second edition is completely updated and expanded and now comprises new chapters on spin electronics and quantum information processing, transport in inhomogeneous magnetic fields, organic molecular electronics, and applications of field effect transistors. The book also provides an overview of semiconductor processing technologies and experimental techniques. With a number of examples and problems with solutions, this is an ideal introduction for students and beginning researchers in the field. This book is a useful tool too for the experienced researcher to get a summary of recent developments in solid state nanostructures. I applaud the author for a marvellous contribution to the scientific community of mesoscopic electronics. Prof. K. Ensslin, Solid State Physics Laboratory.

ETH Zurich     Mesoscopic Physics and Electronics Tsuneya Ando,1995     *Electronic Transport in Mesoscopic Systems*  
 Supriyo Datta,1997-05-15 Advances in semiconductor technology have made possible the fabrication of structures whose dimensions are much smaller than the mean free path of an electron This book gives a thorough account of the theory of electronic transport in such mesoscopic systems After an initial chapter covering fundamental concepts the transmission function formalism is presented and used to describe three key topics in mesoscopic physics the quantum Hall effect localisation and double barrier tunnelling Other sections include a discussion of optical analogies to mesoscopic phenomena and the book concludes with a description of the non equilibrium Green s function formalism and its relation to the transmission formalism Complete with problems and solutions the book will be of great interest to graduate students of mesoscopic physics and nanoelectronic device engineering as well as to established researchers in these fields

*Mesoscopic physics and electronics* ,1995     **Handbook of Nanoscience, Engineering, and Technology** William A. Goddard III,Donald Brenner,Sergey Edward Lyshevski,Gerald J Iafrate,2007-05-03 The ability to study and manipulate matter at the nanoscale is the defining feature of 21st century science The first edition of the standard setting Handbook of Nanoscience Engineering and Technology saw the field through its infancy Reassembling the preeminent team of leading scientists and researchers from all areas of nanoscience and nanote     *Electronic Structure of Clusters* ,1998-04-10  
 Advances in Quantum Chemistry publishes surveys of current developments in the rapidly developing field of quantum chemistry a field that falls between the historically established areas of mathematics physics chemistry and biology With invited reviews written by leading international researchers each presenting new results this quality serial provides a single vehicle for following progress in this interdisciplinary area     Introducing Molecular Electronics Gianaurelio Cuniberti,Giorgos Fagas,Klaus Richter,2006-05-21 Klaus von Klitzing Max Planck Institut fur Festk orperforschung Heisenbergstra e 1 70569 Stuttgart Germany Already many Cassandras have prematurely announced the end of the silicon roadmap and yet conventional semiconductor based transistors have been continuously shrinking at a pace which has brought us to nowadays cheap and powerful microelectronics However it is clear that the traditional scaling laws cannot be applied if unwanted tunnel phenomena or ballistic transport dominate the device properties It is generally expected that a combination of silicon CMOS devices with molecular structure will dominate the eld of nanoelectronics in 20 years The visionary ideas of atomic or molecular scale electronics already date back thirty years but only recently advanced nanotechnology including e g scanning tunneling methods and mechanically controllable break junctions have enabled to make distinct progress in this direction On the level of f damentalresearch stateofthearttechniquesallowtomanipulate imageand probecharge transportthroughuni molecularsystemsinanincreasinglyc trolled way Hence molecular electronics is reaching a stage of trustable and reproducible experiments This has lead to a variety of physical and chemical phenomena recently observed for charge currents owing through molecular junctions posing new challenges to theory As a result a still

increasing number of open questions determines the future agenda in this field Nanodevices for Photonics and Electronics Paolo Bettotti, 2015-12-23 Photonics and electronics are endlessly converging into a single technology by exploiting the possibilities created by nanostructuring of materials and devices. It is expected that next generation optoelectronic devices will show great improvements in terms of performance, flexibility, and energy consumption. The main limits of nanoelectronics will be the energy consumption and the heat dissipation.

**Condensed Matter Theories** Susana Hernandez, John W. Clark, Jr., 2002-01-25 Drawn from the 24th International Workshop on Condensed Matter Theories, Buenos Aires, Sep 2000, these 45 papers were centered on the concepts and techniques of condensed matter physics, also addressing broad issues of common concern for theorists who apply advanced many-particle methods in other areas of physics. Five primary topics are covered by the contributions: quantum liquids, boson condensates, strongly correlated electron systems, superconductivity and superfluidity, and phase transitions. Some of the examples of specific questions addressed include shot noise of mesoscopic quantum systems, heat transport in superlattices, transitions from noncollinear to collinear structures in a magnetic multilayer model, order-disorder transitions in a vortex lattice, perturbation theory in the one-phase region of an electron-ion system, and nonlinear dynamics in metal clusters. c. Book News Inc.

**Organic Electroluminescence** Qisheng Zhang, Le Zhang, 2025-08-19 Unique reference on the fundamentals, applications, and latest research in electroluminescence of organic molecules. Organic Electroluminescence provides a comprehensive overview of organic electroluminescent materials from their structure-property relationships to the outlook of improved device performance. Divided into three parts, the first section of the book covers fundamental aspects of OLEDs, such as history, structures, properties, and operating and aging mechanisms. The second section provides quantum chemical and experimental insights into correlations between device performance, material characteristics, molecular physical parameters, and molecular structure. The last section is devoted to improving device performance in real-world applications using molecular and device simulations. Featuring contributions from experts from around the world, Organic Electroluminescence discusses sample topics including: Fundamental concepts in the fields of display organic electronics, molecular photochemistry, and quantum chemistry; Device fabrication, characterization, and simulation techniques; Physical and chemical processes in OLEDs, including charge injection and transport, exciton generation and decay, reversible dipole reorientation, and chemical reactions; Physical and chemical properties of organic semiconductors in solutions and thin films, including photoluminescence, quantum yield, excited state lifetime, and redox potential; Single-molecule and condensed-matter simulations, including vertical transition, nonradiative decay, spin-orbital and spin-phonon coupling, bond dissociation, and charge transfer. Organic Electroluminescence delivers advanced information for professionals seeking a thorough reference on the subject and for students learning about OLEDs.

**Nanomaterials** A.S. Edelstein, R.C. Cammarata, 1998-01-01 Nanomaterials: Synthesis, Properties, and Applications provides a comprehensive introduction to nanomaterials from how to make them to example properties, processing techniques, and applications. Contributions by leading international researchers

and teachers in academic government and industrial institutions in nanomaterials provide an accessible guide for newcomers to the field The coverage ranges from isolated clusters and small particles to nanostructured materials multilayers and nanoelectronics The book contains a wealth of references for further reading Individual chapters deal with relevant aspects of the underlying physics materials science and physical chemistry *Introduction to Mesoscopic Physics* Yoseph Imry, 1997 Mesoscopic physics refers to the physics of structures larger than a nanometer one billionth of a meter but smaller than a micrometer one millionth of a meter This size range is the stage on which the exciting new research on submicroscopic and electronic and mechanical devices is being done This research often crosses the boundary between physics and engineering since engineering such tiny electronic components requires a firm grasp of quantum physics Applications for the future may include such wonders as microscopic robot surgeons that travel through the blood stream to repair clog **Low**

**Dimensional Structures Prepared by Epitaxial Growth or Regrowth on Patterned Substrates** K. Eberl, Pierre M. Petroff, Piet Demeester, 2012-12-06 Proceedings of the NATO Advanced Research Workshop Ringberg in Rottach Egern Germany February 20 24 1995 **Quantum Dots** T. Chakraborty, 1999-11-30 This book deals with the electronic and optical properties of two low dimensional systems quantum dots and quantum antidots and is divided into two parts Part one is a self contained monograph which describes in detail the theoretical and experimental background for exploration of electronic states of the quantum confined systems Starting from the single electron picture of the system the book describes various experimental methods that provide important information on these systems Concentrating on many electron systems theoretical developments are described in detail and their experimental consequences are also discussed The field has witnessed an almost explosive growth and some of the future directions of explorations are highlighted towards the end of the monograph The subject matter is dealt with in such a way that it is both accessible to beginners and useful for expert researchers as a comprehensive review of most of the developments in the field Furthermore the book contains 37 reprinted articles which have been selected to provide a first hand picture of the overall developments in the field The early papers have been arranged to portray the developments chronologically and the more recent papers provide an overview of future direction in the research **Carbon Nanotube Electronics** Ali Javey, Jing Kong, 2009-04-21 This book provides a complete overview of the field of carbon nanotube electronics It covers materials and physical properties synthesis and fabrication processes devices and circuits modeling and finally novel applications of nanotube based electronics The book introduces fundamental device physics and circuit concepts of 1 D electronics At the same time it provides specific examples of the state of the art nanotube devices **Handbook of Single-Molecule Electronics** Kasper Moth-Poulsen, 2016-01-05 Single molecule electronics has evolved as a vibrant research field during the last two decades The vision is to be able to create electronic components at the highest level of miniaturization the single molecule This book compiles and details cutting edge research with contributions from chemists physicists theoreticians and engineers It cov **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

**Single-Molecule Electronics** Manabu Kiguchi, 2016-05-23 This book presents a multidisciplinary approach to single molecule electronics It includes a complete overview of the field from the synthesis and design of molecular candidates to the prevalent experimental techniques complemented by a detailed theoretical description This all inclusive strategy provides the reader with the much needed perspective to fully understand the far reaching ramifications of single molecule electronics In addition a number of state of the art topics are discussed including single molecule spectro electrical methods electrochemical DNA sequencing technology and single molecule chemical reactions As a result of this integrative effort this publication may be used as an introductory textbook to both graduate and advanced undergraduate students as well as researchers with interests in single molecule electronics organic electronics surface science and nanoscience

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