

# Nanoelectronics And Information Technology

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Graphene Nanoelectronics - Hassan Raza 2012-03-05

Graphene is a perfectly two-dimensional single-atom thin membrane with zero bandgap. It has attracted huge attention due to its linear dispersion around the Dirac point, excellent transport properties, novel magnetic characteristics, and low spin-orbit coupling. Graphene and its nanostructures may have potential applications in spintronics, photonics, plasmonics and electronics. This book brings together a team of experts to provide an overview of the most advanced topics in theory, experiments, spectroscopy and applications of graphene and its nanostructures. It covers the state-of-the-art in tutorial-like and review-like manner to make the book useful not only to experts, but also newcomers and graduate students.

Superlattice to Nanoelectronics - Raphael Tsu 2010-10-22

Written by one of the founders of this field, this book provides a historical overview of the invention of superlattice, one of the most important devices of the second half of the twentieth century. In addition to describing the fundamental concepts, this completely revised and updated edition provides new insights in the field of man-made solids. Written by one of the founders of this field Delivers over 20% new material, including new research and new technological applications Provides a basic understanding of the physics involved from first principles, while adding new depth, using basic mathematics and an explanation of the background essentials

Integrated Nanoelectronics - Vinod Kumar Khanna 2016-09-16

Keeping nanoelectronics in focus, this book looks at interrelated fields namely nanomagnetism, nanophotonics, nanomechanics and nanobiotechnology, that go hand-in-hand or are likely to be utilized in future in various ways for backing up or strengthening nanoelectronics. Complementary nanosciences refer to the alternative nanosciences that can be combined with nanoelectronics. The book brings students and researchers from multiple disciplines (and therefore with disparate levels of knowledge, and, more importantly, lacunae in this knowledge) together and to expose them to the essentials of integrative nanosciences. The central idea is that the five identified disciplines overlap significantly and arguably cohere into one fundamental nanotechnology discipline. The book caters to interdisciplinary readership in contrast to many of the existing nanotechnology related books that relate to a specific discipline. The book lays special emphasis on nanoelectronics since this field has advanced most rapidly amongst all the nanotechnology disciplines and with significant commercial pervasion. In view of the significant impact that nanotechnology is predicted to have on society, the topics and their interrelationship in this book are of considerable interest and immense value to students, professional engineers, and reserachers.

Nanoelectronic Device Applications Handbook - James E. Morris 2017-11-22

Nanoelectronic Device Applications Handbook gives a comprehensive snapshot of the state of the art in nanodevices for nanoelectronics applications. Combining breadth and depth, the book includes 68 chapters on topics that range from nano-scaled complementary metal-oxide-semiconductor (CMOS) devices through recent developments in nano capacitors and AlGaAs/GaAs devices. The contributors are world-renowned experts from academia and industry from around the globe. The handbook explores current research into potentially disruptive technologies for a post-CMOS world. These include: Nanoscale advances in current MOSFET/CMOS technology Nano capacitors for applications such as electronics packaging and humidity sensors Single electron transistors and other electron tunneling devices Quantum cellular automata and

nanomagnetic logic Memristors as switching devices and for memory Graphene preparation, properties, and devices Carbon nanotubes (CNTs), both single CNT and random network Other CNT applications such as terahertz, sensors, interconnects, and capacitors Nano system architectures for reliability Nanowire device fabrication and applications Nanowire transistors Nanodevices for spintronics The book closes with a call for a new generation of simulation tools to handle nanoscale mechanisms in realistic nanodevice geometries. This timely handbook offers a wealth of insights into the application of nanoelectronics. It is an invaluable reference and source of ideas for anyone working in the rapidly expanding field of nanoelectronics.

Introduction to Microelectronics to Nanoelectronics - Manoj Kumar Majumder 2020-11-25

Focussing on micro- and nanoelectronics design and technology, this book provides thorough analysis and demonstration, starting from semiconductor devices to VLSI fabrication, designing (analog and digital), on-chip interconnect modeling culminating with emerging non-silicon/ nano devices. It gives detailed description of both theoretical as well as industry standard HSPICE, Verilog, Cadence simulation based real-time modeling approach with focus on fabrication of bulk and nano-devices. Each chapter of this proposed title starts with a brief introduction of the presented topic and ends with a summary indicating the futuristic aspect including practice questions. Aimed at researchers and senior undergraduate/graduate students in electrical and electronics engineering, microelectronics, nanoelectronics and nanotechnology, this book: Provides broad and comprehensive coverage from Microelectronics to Nanoelectronics including design in analog and digital electronics. Includes HDL, and VLSI design going into the nanoelectronics arena. Discusses devices, circuit analysis, design methodology, and real-time simulation based on industry standard HSPICE tool. Explores emerging devices such as FinFETs, Tunnel FETs (TFETs) and CNTFETs including their circuit co-designing. Covers real time illustration using industry standard Verilog, Cadence and Synopsys simulations.

Computer Arithmetics for Nanoelectronics - Vlad P. Shmerko 2018-10-03

Emphasizes the Basic Principles of Computational Arithmetic and Computational Structure Design Taking an interdisciplinary approach to the nanoscale generation of computer devices and systems, Computer Arithmetics for Nanoelectronics develops a consensus between computational properties provided by data structures and phenomenological properties of nano and molecular technology. Covers All Stages of the Design Cycle, from Task Formulation to Molecular-Based Implementation The book introduces the theoretical base and properties of various data structures, along with techniques for their manipulation, optimization, and implementation. It also assigns the computational properties of logic design data structures to 3D structures, furnishes information-theoretical measures and design aspects, and discusses the testability problem. The last chapter presents a nanoscale prospect for natural computing based on assorted computing paradigms from nature. Balanced Coverage of State-of-the-Art Concepts, Techniques, and Practices Up-to-date, comprehensive, and pragmatic in its approach, this text provides a unified overview of the relationship between the fundamentals of digital system design, computer architectures, and micro- and nanoelectronics. *Nanotechnology* - Rainer Waser 2008-07-21

This second of two volumes on applications in information technology is divided into two main sections. The first covers logic devices and concepts, ranging from advanced and non-conventional CMOS and semiconductor nanowire devices, via various spin-controlled logic devices and concepts involving carbon nanotubes, organic thin films, as well as single organic molecules, right up to the visionary idea of

intramolecular computation. The second part, architectures and computational concepts, discusses biologically inspired structures and quantum cellular automata, finishing off by summarizing the main principles and current approaches to coherent solid-state-based quantum computation.

**Advanced Nanoelectronics** - Razali Ismail 2018-09-03

While theories based on classical physics have been very successful in helping experimentalists design microelectronic devices, new approaches based on quantum mechanics are required to accurately model nanoscale transistors and to predict their characteristics even before they are fabricated. Advanced Nanoelectronics provides research information on advanced nanoelectronics concepts, with a focus on modeling and simulation. Featuring contributions by researchers actively engaged in nanoelectronics research, it develops and applies analytical formulations to investigate nanoscale devices. The book begins by introducing the basic ideas related to quantum theory that are needed to better understand nanoscale structures found in nanoelectronics, including graphenes, carbon nanotubes, and quantum wells, dots, and wires. It goes on to highlight some of the key concepts required to understand nanotransistors. These concepts are then applied to the carbon nanotube field effect transistor (CNTFET). Several chapters cover graphene, an unzipped form of CNT that is the recently discovered allotrope of carbon that has gained a tremendous amount of scientific and technological interest. The book discusses the development of the graphene nanoribbon field effect transistor (GNRFET) and its use as a possible replacement to overcome the CNT chirality challenge. It also examines silicon nanowire (SiNW) as a new candidate for achieving the downscaling of devices. The text describes the modeling and fabrication of SiNW, including a new top-down fabrication technique. Strained technology, which changes the properties of device materials rather than changing the device geometry, is also discussed. The book ends with a look at the technical and economic challenges that face the commercialization of nanoelectronics and what universities, industries, and government can do to lower the barriers. A useful resource for professionals, researchers, and scientists, this work brings together state-of-the-art technical and scientific information on important topics in advanced nanoelectronics.

Nanoelectronics and Materials Development - Abhijit Kar 2016-07-27

The current edited book presents some of the most advanced research findings in the field of nanotechnology and its application in materials development in a very concise form. The main focus of the book is dragged toward those materials where electronic properties are manipulated for development of advanced materials. We have discussed about the extensive usage of nanotechnology and its impact on various facets of the chip-making practice from materials to devices such as basic memory, quantum dots, nanotubes, nanowires, graphene-like 2D materials, and CIGS thin-film solar cells as energy-harvesting devices. Researchers as well as students can gain valuable insights into the different processing of nanomaterials, characterization procedures of the materials in nanoscale, and their different functional properties and applications.

**Advanced Nanoelectronics** - Muhammad Mustafa Hussain 2019-01-04

Brings novel insights to a vibrant research area with high application potential?covering materials, physics, architecture, and integration aspects of future generation CMOS electronics technology Over the last four decades we have seen tremendous growth in semiconductor electronics. This growth has been fueled by the matured complementary metal oxide semiconductor (CMOS) technology. This comprehensive book captures the novel device options in CMOS technology that can be realized using non-silicon semiconductors. It discusses germanium, III-V materials, carbon nanotubes and graphene as semiconducting materials for three-dimensional field-effect transistors. It also covers non-conventional materials such as nanowires and nanotubes. Additionally, nanoelectromechanical switches-based mechanical relays and wide bandgap semiconductor-based terahertz electronics are reviewed as essential add-on electronics for enhanced communication and computational capabilities. Advanced Nanoelectronics: Post-Silicon Materials and Devices begins with a discussion of the future of CMOS. It continues with comprehensive chapter coverage of: nanowire field effect transistors; two-dimensional materials for electronic applications; the challenges and breakthroughs of the integration of germanium into modern CMOS; carbon nanotube logic technology; tunnel field effect transistors; energy efficient computing with negative capacitance; spin-based devices for logic, memory and non-Boolean architectures; and terahertz properties and applications of GaN. -Puts forward

novel approaches for future, state-of-the-art, nanoelectronic devices -Discusses emerging materials and architectures such as alternate channel material like germanium, gallium nitride, 1D nanowires/tubes, 2D graphene, and other dichalcogenide materials and ferroelectrics -Examines new physics such as spintronics, negative capacitance, quantum computing, and 3D-IC technology -Brings together the latest developments in the field for easy reference -Enables academic and R&D researchers in semiconductors to "think outside the box" and explore beyond silica An important resource for future generation CMOS electronics technology, Advanced Nanoelectronics: Post-Silicon Materials and Devices will appeal to materials scientists, semiconductor physicists, semiconductor industry, and electrical engineers.

**Nanoelectronics and Photonics** - Anatoli Korokin 2008-09-23

Nanoelectronics and Photonics provides a fundamental description of the core elements and problems of advanced and future information technology. The authoritative book collects a series of tutorial chapters from leaders in the field covering fundamental topics from materials to devices and system architecture, and bridges the fundamental laws of physics and chemistry of materials at the atomic scale with device and circuit design and performance requirements.

**Integrated Interconnect Technologies for 3D Nanoelectronic Systems** - Muhannad S. Bakir 2008-11-30

This cutting-edge book on off-chip technologies puts the hottest breakthroughs in high-density compliant electrical interconnects, nanophotonics, and microfluidics at your fingertips, integrating the full range of mathematics, physics, and technology issues together in a single comprehensive source. You get full details on state-of-the-art I/O interconnects and packaging, including mechanically compliant I/O approaches, fabrication, and assembly, followed by the latest advances and applications in power delivery design, analysis, and modeling. The book explores interconnect structures, materials, and packages for achieving high-bandwidth off-chip electrical communication, including optical interconnects and chip-to-chip signaling approaches, and brings you up to speed on CMOS integrated optical devices, 3D integration, wafer stacking technology, and through-wafer interconnects.

**Semiconductor-On-Insulator Materials for Nanoelectronics Applications** - Alexei Nazarov 2011-03-03

"Semiconductor-On-Insulator Materials for NanoElectronics Applications" is devoted to the fast evolving field of modern nanoelectronics, and more particularly to the physics and technology of nanoelectronic devices built on semiconductor-on-insulator (SemOI) systems. The book contains the achievements in this field from leading companies and universities in Europe, USA, Brazil and Russia. It is articulated around four main topics: 1. New semiconductor-on-insulator materials; 2. Physics of modern SemOI devices; 3. Advanced characterization of SemOI devices; 4. Sensors and MEMS on SOI. "Semiconductor-On-Insulator Materials for NanoElectronics Applications" is useful not only to specialists in nano- and microelectronics but also to students and to the wider audience of readers who are interested in new directions in modern electronics and optoelectronics.

NANO-CHIPS 2030 - Boris Murmann 2020-06-08

In this book, a global team of experts from academia, research institutes and industry presents their vision on how new nano-chip architectures will enable the performance and energy efficiency needed for AI-driven advancements in autonomous mobility, healthcare, and man-machine cooperation. Recent reviews of the status quo, as presented in CHIPS 2020 (Springer), have prompted the need for an urgent reassessment of opportunities in nanoelectronic information technology. As such, this book explores the foundations of a new era in nanoelectronics that will drive progress in intelligent chip systems for energy-efficient information technology, on-chip deep learning for data analytics, and quantum computing. Given its scope, this book provides a timely compendium that hopes to inspire and shape the future of nanoelectronics in the decades to come.

The Physics of Nanoelectronics - Tero T. Heikkilä 2013-02-01

Advances in nanotechnology have allowed physicists and engineers to miniaturize electronic structures to the limit where finite-size related phenomena start to impact their properties. This book discusses such phenomena and models made for their description. The book starts from the semiclassical description of nonequilibrium effects, details the scattering theory used for quantum transport calculations, and explains the main interference effects. It also describes how to treat fluctuations and correlations, how interactions

affect transport through small islands, and how superconductivity modifies these effects. The last two chapters describe new emerging fields related with graphene and nanoelectromechanics. The focus of the book is on the phenomena rather than formalism, but the book still explains in detail the main models constructed for these phenomena. It also introduces a number of electronic devices, including the single-electron transistor, the superconducting tunnel junction refrigerator, and the superconducting quantum bit.

*Microelectronics to Nanoelectronics* - Anupama B. Kaul 2017-12-19

Composed of contributions from top experts, *Microelectronics to Nanoelectronics: Materials, Devices and Manufacturability* offers a detailed overview of important recent scientific and technological developments in the rapidly evolving nanoelectronics arena. Under the editorial guidance and technical expertise of noted materials scientist Anupama B. Kaul of California Institute of Technology's Jet Propulsion Lab, this book captures the ascent of microelectronics into the nanoscale realm. It addresses a wide variety of important scientific and technological issues in nanoelectronics research and development. The book also showcases some key application areas of micro-electro-mechanical-systems (MEMS) that have reached the commercial realm. Capitalizing on Dr. Kaul's considerable technical experience with micro- and nanotechnologies and her extensive research in prestigious academic and industrial labs, the book offers a fresh perspective on application-driven research in micro- and nanoelectronics, including MEMS. Chapters explore how rapid developments in this area are transitioning from the lab to the market, where new and exciting materials, devices, and manufacturing technologies are revolutionizing the electronics industry. Although many micro- and nanotechnologies still face major scientific and technological challenges and remain within the realm of academic research labs, rapid advances in this area have led to the recent emergence of new applications and markets. This handbook encapsulates that exciting recent progress by providing high-quality content contributed by international experts from academia, leading industrial institutions—such as Hewlett-Packard—and government laboratories including the U.S. Department of Energy's Sandia National Laboratory. Offering something for everyone, from students to scientists to entrepreneurs, this book showcases the broad spectrum of cutting-edge technologies that show significant promise for electronics and related applications in which nanotechnology plays a key role.

**CMOS Nanoelectronics** - Nadine Collaert 2012-09-19

This book covers one of the most important device architectures that have been widely researched to extend the transistor scaling: FinFET. Starting with theory, the book discusses the advantages and the integration challenges of this device architecture. It addresses in detail the topics such as high-density fin patterning, gate stack design, and source/drain engineering, which have been considered challenges for the integration of FinFETs. The book also addresses circuit-related aspects, including the impact of variability on SRAM design, ESD design, and high-T operation. It discusses a new device concept: the junctionless nanowire FET.

**Nanoelectronic Devices for Hardware and Software Security** - BALWINDER. SINGH RAJ (ARUN KUMAR.) 2021-10-21

This book has comprehensive coverage of the principles, basic concepts, structure, modelling, practices, and circuit applications of nanoelectronics in hardware/software security. It will also cover the future research directions in this domain. In this evolving era nanotechnology is converting semiconductor devices dimensions from micron technology to nanotechnology. Nanoelectronics would be the key enabler for innovation in nanoscale devices, circuits and systems. The motive of this research book is to provide relevant theoretical frameworks that include device physics, modeling, circuit design and the latest developments in the experimental fabrication in the field of nanotechnology for hardware/software security. There are numerous challenges in development of models for nanoscale devices (e.g. FinFET, Gate-All-around devices, TFET etc.), Short Channel Effects, Fringing Effects, High leakage current and power dissipation, etc. This book will help in identifying areas where we are facing many challenges and applying many nano devices and circuits techniques to address hardware/software security aspects.

**Micro- and Nanoelectronics** - Tomasz Brozek 2017-12-19

*Micro- and Nanoelectronics: Emerging Device Challenges and Solutions* presents a comprehensive overview of the current state of the art of micro- and nanoelectronics, covering the field from fundamental science and material properties to novel ways of making nanodevices. Containing contributions from experts in both industry and academia, this cutting-edge text: Discusses emerging silicon devices for CMOS technologies,

fully depleted device architectures, characteristics, and scaling Explains the specifics of silicon compound devices (SiGe, SiC) and their unique properties Explores various options for post-CMOS nanoelectronics, such as spintronic devices and nanoionic switches Describes the latest developments in carbon nanotubes, iii-v devices structures, and more Micro- and Nanoelectronics: Emerging Device Challenges and Solutions provides an excellent representation of a complex engineering field, examining emerging materials and device architecture alternatives with the potential to shape the future of nanotechnology.

**Quantum Nanoelectronics** - Edward L. Wolf 2015-11-20

A tutorial coverage of electronic technology, starting from the basics of condensed matter and quantum physics. Experienced author Ed Wolf presents established and novel devices like Field Effect and Single Electron Transistors, and leads the reader up to applications in data storage, quantum computing, and energy harvesting. Intended to be self-contained for students with two years of calculus-based college physics, with corresponding fundamental knowledge in mathematics, computing and chemistry.

*Selected Advances in Nanoelectronic Devices* - Mojtaba Joodaki 2012-08-15

Nanoelectronics, as a true successor of microelectronics, is certainly a major technology boomer in the 21st century. This has been shown by its several applications and also by its enormous potential to influence all areas of electronics, computers, information technology, aerospace defense, and consumer goods. Although the current semiconductor technology is projected to reach its physical limit in about a decade, nanoscience and nanotechnology promise breakthroughs for the future. The present books provides an in-depth review of the latest advances in the technology of nanoelectronic devices and their developments over the past decades. Moreover, it introduces new concepts for the realization of future nanoelectronic devices. The main focus of the book is on three fundamental branches of semiconductor products or applications: logic, memory, and RF and communication. By pointing out to the key technical challenges, important aspects and characteristics of various designs are used to illustrate mechanisms that overcome the technical barriers. Furthermore, by comparing advantages and disadvantages of different designs, the most promising solutions are indicated for each application.

**Introduction to Nanoelectronics** - Vladimir V. Mitin 2008

A comprehensive textbook on nanoelectronics covering the underlying physics, nanostructures, nanomaterials and nanodevices.

**Emerging Nanoelectronic Devices** - An Chen 2014-11-12

*Emerging Nanoelectronic Devices* focuses on the future direction of semiconductor and emerging nanoscale device technology. As the dimensional scaling of CMOS approaches its limits, alternate information processing devices and microarchitectures are being explored to sustain increasing functionality at decreasing cost into the indefinite future. This is driving new paradigms of information processing enabled by innovative new devices, circuits, and architectures, necessary to support an increasingly interconnected world through a rapidly evolving internet. This original title provides a fresh perspective on emerging research devices in 26 up to date chapters written by the leading researchers in their respective areas. It supplements and extends the work performed by the Emerging Research Devices working group of the International Technology Roadmap for Semiconductors (ITRS). Key features: • Serves as an authoritative tutorial on innovative devices and architectures that populate the dynamic world of "Beyond CMOS" technologies. • Provides a realistic assessment of the strengths, weaknesses and key unknowns associated with each technology. • Suggests guidelines for the directions of future development of each technology. • Emphasizes physical concepts over mathematical development. • Provides an essential resource for students, researchers and practicing engineers.

**Introductory Nanoelectronics** - Vinod Kumar Khanna 2020-07-21

This introductory text develops the reader's fundamental understanding of core principles and experimental aspects underlying the operation of nanoelectronic devices. The author makes a thorough and systematic presentation of electron transport in quantum-confined systems such as quantum dots, quantum wires, and quantum wells together with Landauer-Büttiker formalism and non-equilibrium Green's function approach. The coverage encompasses nanofabrication techniques and characterization tools followed by a comprehensive exposition of nanoelectronic devices including resonant tunneling diodes, nanoscale MOSFETs, carbon nanotube FETs, high-electron-mobility transistors, single-electron transistors, and

heterostructure optoelectronic devices. The writing throughout is simple and straightforward, with clearly drawn illustrations and extensive self-study exercises for each chapter. Introduces the basic concepts underlying the operation of nanoelectronic devices. Offers a broad overview of the field, including state-of-the-art developments. Covers the relevant quantum and solid-state physics and nanoelectronic device principles. Written in lucid language with accessible mathematical treatment. Includes extensive end-of-chapter exercises and many insightful diagrams.

**Nanoelectronics and Information Technology** - Rainer Waser 2012-05-29

This outstanding textbook provides an introduction to electronic materials and device concepts for the major areas of current and future information technology. On about 1,000 pages, it collects the fundamental concepts and key technologies related to advanced electronic materials and devices. The obvious strength of the book is its encyclopedic character, providing adequate background material instead of just reviewing current trends. It focuses on the underlying principles which are illustrated by contemporary examples. The third edition now holds 47 chapters grouped into eight sections. The first two sections are devoted to principles, materials processing and characterization methods. Following sections hold contributions to relevant materials and various devices, computational concepts, storage systems, data transmission, imaging systems and displays. Each subject area is opened by a tutorial introduction, written by the editor and giving a rich list of references. The following chapters provide a concise yet in-depth description in a given topic. Primarily aimed at graduate students of physics, electrical engineering and information technology as well as material science, this book is equally of interest to professionals looking for a broader overview. Experts might appreciate the book for having quick access to principles as well as a source for getting insight into related fields.

**Metrology and Diagnostic Techniques for Nanoelectronics** - Zhiyong Ma 2017-03-27

Nanoelectronics is changing the way the world communicates, and is transforming our daily lives. Continuing Moore's law and miniaturization of low-power semiconductor chips with ever-increasing functionality have been relentlessly driving R&D of new devices, materials, and process capabilities to meet performance, power, and cost requirements. This book covers up-to-date advances in research and industry practices in nanometrology, critical for continuing technology scaling and product innovation. It holistically approaches the subject matter and addresses emerging and important topics in semiconductor R&D and manufacturing. It is a complete guide for metrology and diagnostic techniques essential for process technology, electronics packaging, and product development and debugging—a unique approach compared to other books. The authors are from academia, government labs, and industry and have vast experience and expertise in the topics presented. The book is intended for all those involved in IC manufacturing and nanoelectronics and for those studying nanoelectronics process and assembly technologies or working in device testing, characterization, and diagnostic techniques.

**2D Materials for Nanoelectronics** - Michel Houssa 2016-05-05

Major developments in the semiconductor industry are on the horizon through the use of two-dimensional (2D) materials, such as graphene and transition metal dichalcogenides, for integrated circuits (ICs). 2D Materials for Nanoelectronics is the first comprehensive treatment of these materials and their applications in nanoelectronic devices. Comprised of chapters authored by internationally recognised researchers, this book: Discusses the use of graphene for high-frequency analog circuits Explores logic and photonic applications of molybdenum disulfide (MoS<sub>2</sub>) Addresses novel 2D materials including silicene, germanene, stanene, and phosphorene Considers the use of 2D materials for both field-effect transistors (FETs) and logic circuits Provides background on the simulation of structural, electronic, and transport properties from first principles 2D Materials for Nanoelectronics presents extensive, state-of-the-art coverage of the fundamental and applied aspects of this exciting field.

**Plasmonic Nanoelectronics and Sensing** - Er-Ping Li 2014-02-13

Plasmonic nanostructures provide new ways of manipulating the flow of light with nanostructures and nanoparticles exhibiting optical properties never before seen in the macro-world. Covering plasmonic technology from fundamental theory to real world applications, this work provides a comprehensive overview of the field. • Discusses the fundamental theory of plasmonics, enabling a deeper understanding of plasmonic technology • Details numerical methods for modeling, design and optimization of plasmonic

nanostructures • Includes step-by-step design guidelines for active and passive plasmonic devices, demonstrating the implementation of real devices in the standard CMOS nanoscale electronic-photonic integrated circuit to help cut design, fabrication and characterisation time and cost • Includes real-world case studies of plasmonic devices and sensors, explaining the benefits and downsides of different nanophotonic integrated circuits and sensing platforms. Ideal for researchers, engineers and graduate students in the fields of nanophotonics and nanoelectronics as well as optical biosensing.

**Nanotechnology and Nanoelectronics** - Wolfgang Fahrner 2005-12-05

Split a human hair thirty thousand times, and you have the equivalent of a nanometer. The aim of this work is to provide an introduction into nanotechnology for the scientifically interested. However, such an enterprise requires a balance between comprehensibility and scientific accuracy. In case of doubt, preference is given to the latter. Much more than in microtechnology – whose fundamentals we assume to be known – a certain range of engineering and natural sciences are interwoven in nanotechnology. For instance, newly developed tools from mechanical engineering are essential in the production of nanoelectronic structures. Vice versa, mechanical shifts in the nanometer range demand piezoelectric-operated actuators. Therefore, special attention is given to a comprehensive presentation of the matter. In our time, it is no longer sufficient to simply explain how an electronic device operates; the materials and procedures used for its production and the measuring instruments used for its characterization are equally important. The main chapters as well as several important sections in this book end in an evaluation of future prospects. Unfortunately, this way of separating description from reflection and speculation could not be strictly maintained. So times, the complete description of a device calls for discussion of its inherent potential; the hasty reader in search of the general perspective is therefore advised to study this work's technical chapters as well.

**More than Moore** - Guo Qi Zhang 2010-01-23

In the past decades, the mainstream of microelectronics progression was mainly powered by Moore's law focusing on IC miniaturization down to nano scale. However, there is a fast increasing need for "More than Moore" (MtM) products and technology that are based upon or derived from silicon technologies, but do not simply scale with Moore's law. This book provides new vision, strategy and guidance for the future technology and business development of micro/nanoelectronics.

**Numerical Methods for Time-Resolved Quantum Nanoelectronics** - Joseph Weston 2017-08-21

This thesis develops novel numerical techniques for simulating quantum transport in the time domain and applies them to pertinent physical systems such as flying qubits in electronic interferometers and superconductor/semiconductor junctions hosting Majorana bound states (the key ingredient for topological quantum computing). In addition to exploring the rich new physics brought about by time dependence, the thesis also develops software that can be used to simulate nanoelectronic systems with arbitrary geometry and time dependence, offering a veritable toolbox for exploring this rapidly growing domain.

**Nanoelectronics** - Robert Puers 2017-06-19

Offering first-hand insights by top scientists and industry experts at the forefront of R&D into nanoelectronics, this book neatly links the underlying technological principles with present and future applications. A brief introduction is followed by an overview of present and emerging logic devices, memories and power technologies. Specific chapters are dedicated to the enabling factors, such as new materials, characterization techniques, smart manufacturing and advanced circuit design. The second part of the book provides detailed coverage of the current state and showcases real future applications in a wide range of fields: safety, transport, medicine, environment, manufacturing, and social life, including an analysis of emerging trends in the internet of things and cyber-physical systems. A survey of main economic factors and trends concludes the book. Highlighting the importance of nanoelectronics in the core fields of communication and information technology, this is essential reading for materials scientists, electronics and electrical engineers, as well as those working in the semiconductor and sensor industries.

**Electrical Atomic Force Microscopy for Nanoelectronics** - Umberto Celano 2019-08-01

The tremendous impact of electronic devices on our lives is the result of continuous improvements of the billions of nanoelectronic components inside integrated circuits (ICs). However, ultra-scaled semiconductor devices require nanometer control of the many parameters essential for their fabrication. Through the years,

this created a strong alliance between microscopy techniques and IC manufacturing. This book reviews the latest progress in IC devices, with emphasis on the impact of electrical atomic force microscopy (AFM) techniques for their development. The operation principles of many techniques are introduced, and the associated metrology challenges described. Blending the expertise of industrial specialists and academic researchers, the chapters are dedicated to various AFM methods and their impact on the development of emerging nanoelectronic devices. The goal is to introduce the major electrical AFM methods, following the journey that has seen our lives changed by the advent of ubiquitous nanoelectronics devices, and has extended our capability to sense matter on a scale previously inaccessible.

*Introduction to the Physics of Nanoelectronics* - Seng Ghee Tan 2012-03-28

This book provides an introduction to the physics of nanoelectronics, with a focus on the theoretical aspects of nanoscale devices. The book begins with an overview of the mathematics and quantum mechanics pertaining to nanoscale electronics, to facilitate the understanding of subsequent chapters. It goes on to encompass quantum electronics, spintronics, Hall effects, carbon and graphene electronics, and topological physics in nanoscale devices. Theoretical methodology is developed using quantum mechanical and non-equilibrium Green's function (NEGF) techniques to calculate electronic currents and elucidate their transport properties at the atomic scale. The spin Hall effect is explained and its application to the emerging field of spintronics – where an electron's spin as well as its charge is utilised – is discussed. Topological dynamics and gauge potential are introduced with the relevant mathematics, and their application in nanoelectronic systems is explained. Graphene, one of the most promising carbon-based nanostructures for nanoelectronics, is also explored. Begins with an overview of the mathematics and quantum mechanics pertaining to nanoscale electronics Encompasses quantum electronics, spintronics, Hall effects, carbon and graphene electronics, and topological physics in nanoscale devices Comprehensively introduces topological dynamics and gauge potential with the relevant mathematics, and extensively discusses their application in nanoelectronic systems

*Single-Atom Nanoelectronics* - Enrico Prati 2016-04-19

Single-Atom Nanoelectronics covers the fabrication of single-atom devices and related technology, as well as the relevant electronic equipment and the intriguing new phenomena related to single-atom and single-electron effects in quantum devices. It also covers the alternative approaches related to both silicon- and carbon-based technologies, also from the point of view of large-scale industrial production. The publication provides a comprehensive picture of the state of the art at the cutting edge and constitutes a milestone in the emerging field of beyond-CMOS technology. Although there are numerous publications on nanoelectronics, no book highlights the effect of a single atom on device performance, which can be beneficial for making extensive use of CMOS technologies. This book is the first to deal with topics related to single-atom control, which is the final frontier for nanoelectronics.

**Nanoelectronics and Nanosystems** - Karl Goser 2013-04-17

An accessible introduction for electronic engineers, computer scientists and physicists. The overview covers all aspects from underlying technologies to circuits and systems. The challenge of nanoelectronics is not only to manufacture minute structures but also to develop innovative systems for effective integration of the billions of devices. On the system level, various architectures are presented and important features of systems, such as design strategies, processing power, and reliability are discussed. Many specific technologies are presented, including molecular devices, quantum electronic devices, resonant tunnelling devices, single electron devices, superconducting devices, and even devices for DNA and quantum

computing. The book also compares these devices with current silicon technologies and discusses limits of electronics and the future of nanosystems.

**Nanoelectronics** - 2018-10-05

Nanoelectronics: Devices, Circuits and Systems explores current and emerging trends in the field of nanoelectronics, from both a devices-to-circuits and circuits-to-systems perspective. It covers a wide spectrum and detailed discussion on the field of nanoelectronic devices, circuits and systems. This book presents an in-depth analysis and description of electron transport phenomenon at nanoscale dimensions. Both qualitative and analytical approaches are taken to explore the devices, circuit functionalities and their system applications at deep submicron and nanoscale levels. Recent devices, including FinFET, Tunnel FET, and emerging materials, including graphene, and its applications are discussed. In addition, a chapter on advanced VLSI interconnects gives clear insight to the importance of these nano-transmission lines in determining the overall IC performance. The importance of integration of optics with electronics is elucidated in the optoelectronics and photonic integrated circuit sections of this book. This book provides valuable resource materials for scientists and electrical engineers who want to learn more about nanoscale electronic materials and how they are used. Shows how electronic transport works at the nanoscale level Demonstrates how nanotechnology can help engineers create more effective circuits and systems Assesses the most commonly used nanoelectronic devices, explaining which is best for different situations

**Nanoelectronics** - Mircea Dragoman 2009

This revised edition provides a current, unified treatment of the research, technology, and applications fueling the rapid growth of nanoelectronics. It features numerous updates, including expanded discussions on nanomaterials, micro and nano cantilevers, and spintronics.

**Nanoelectronics Fundamentals** - Hassan Raza 2019-11-26

This book covers the state of the art in the theoretical framework, computational modeling, and the fabrication and characterization of nanoelectronics devices. It addresses material properties, device physics, circuit analysis, system design, and a range of applications. A discussion on the nanoscale fabrication, characterization and metrology is also included. The book offers a valuable resource for researchers, graduate students, and senior undergraduate students in engineering and natural sciences, who are interested in exploring nanoelectronics from materials, devices, systems, and applications perspectives.

**Nanoelectronics and Information Technology** - Rainer Waser 2003-04-09

Providing an introduction to electronic materials and device concepts for the major areas of current and future information technology, the value of this book lies in its focus on the underlying principles. Illustrated by contemporary examples, these basic principles will hold, despite the rapid developments in this field, especially emphasizing nanoelectronics. There is hardly any field where the links between basic science and application are tighter than in nanoelectronics & information technology. As an example, the design of resonant tunneling transistors, single electron devices or molecular electronic structures is simply inconceivable without delving deep into quantum mechanics. This textbook is primarily aimed at students of physics, electrical engineering and information technology, as well as material science in their 3rd year and higher. It is equally of interest to professionals wanting a broader overview of this hot topic. "Nanoelectronics and Information Technology" by Rainer Waser and his colleagues is an outstanding compendium of information about an exciting new field. Owing to its high quality and complete coverage of the many topics in this area, this well referenced book will have a long and very useful life as a primary text for students experienced and new in nanoelectronics. It is a very impressive book." (Richard Siegel)