Cmos And Beyond Logic Switches For Terascale Integrated Circuits

This book constitutes the proceedings of the International Conference on Information and Communication Technologies held in Kochi, Kerala, India in September 2010.

This book provides a comprehensive reference for everything that has to do with digital circuits. The author focuses equally on all levels of abstraction. He tells a bottom-up story from the physics level to the finished product level. The aim is to provide a full account of the experience of designing, fabricating, understanding, and testing a microchip. The content is structured to be very accessible and self-contained, allowing readers with diverse backgrounds to read as much or as little of the book as needed. Beyond a basic foundation of mathematics and physics, the book makes no assumptions about prior knowledge. This allows someone new to the field to read the book from the beginning. It also means that someone using the book as a reference will be able to answer their questions without referring to any external sources.

Circuits for Emerging Technologies Beyond CMOS New exciting opportunities are abounding in the field of body area networks, wireless communications, data networking, and optical imaging. In response to these developments, top-notch international experts in industry and academia present Circuits at the Nanoscale: Communications, Imaging, and Sensing. This volume, unique in both its scope and its focus, addresses the state-of-the-art in integrated circuit design in the context of emerging systems. A must for anyone serious about circuit design for future technologies, this book discusses emerging materials that can take system performance beyond standard CMOS. These include Silicon on Insulator (SOI), Silicon Germanium (SiGe), and Indium Phosphide (InP). Three-dimensional CMOS integration and co-integration with Microelectromechanical (MEMS) technology and radiation sensors are described as well. Topics in the book are divided into comprehensive sections on emerging design techniques, mixed-signal CMOS circuits, circuits for communications, and circuits for imaging and sensing. Dr. Krzysztof Iniewski is a director at CMOS Emerging Technologies, Inc., a consulting company in Vancouver, British Columbia. His current research interests are in VLSI ciruits for medical applications. He has published over 100 research papers in international journals and conferences, and he holds 18 international patents granted in the United States, Canada, France, Germany, and Japan. In this volume, he has assembled the contributions of over 60 world-reknown experts who are at the top of their field in the world of circuit design, advancing the bank of knowledge for all who work in this exciting and burgeoning area.

This textbook provides a comprehensive, fully-updated introduction to the essentials of nanometer CMOS integrated circuits. It includes aspects of scaling to even beyond 12nm CMOS technologies and designs. It clearly describes the fundamental CMOS operating principles and presents substantial insight into the various aspects of design implementation and application. Coverage includes all associated disciplines of nanometer CMOS ICs, including physics, lithography, technology, design, memories, VLSI, power consumption, variability, reliability and signal integrity, testing, yield, failure analysis, packaging, scaling trends and road blocks. The text is based upon in-house Philips, NXP Semiconductors, Applied Materials, ASML, IMEC, ST-Ericsson, TSMC, etc., courseware, which, to date, has been completed by more than 4500 engineers working in a large variety of related disciplines: architecture, design, test, fabrication process, packaging, failure analysis and software.

More than 150 articles explore the latest advances in science and technology For more than 45 years, this annual publication has made information on the latest trends and developments in science and technology accessible to non-specialists through concise, well-illustrated articles. Readers will find 150 articles from 200+ leaders in their respective fields covering disciplines from Astronomy to Zoology. The Yearbook will be of interest to students, writers, researchers, professionals, and general readers.

Recognizing that innovation is the key to international competitiveness in the 21st century, policymakers around the world are seeking more effective ways to translate scientific and technological knowledge into new products, processes, and businesses. They have initiated major programs, often with substantial funding, that are designed to attract, nurture, and support innovation and high-technology industries within their national economies. To help U.S. policymakers become more aware of these developments, a committee of the National Academies' Board on Science, Technology, and Economic Policy undertook a review of the goals, concept, structure, operation, funding levels, and evaluation efforts of significant innovation programs around the world. As a part of this effort, the committee identified Flanders, a region of Belgium with substantial autonomy, which is recognized for its comprehensive approach to innovation. Based on initial meetings in Washington and Brussels, and with the endorsement of Flanders Vice Minister-President Fientje Moerman, it was agreed to organize a conference that would review regional innovation policies in the context of the policies and programs of the Flanders government, and their interaction with those of the European Union. This book provides a summary of that symposium.

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.

Crash Course in Digital Technology teaches the basics of digital electronics theory and circuits in an easy-to-understand format. Each chapter includes learning objectives, clear explanations and examples, and an end-of-chapter self-quiz. The drill-and-review software included with the book allows learners to test themselves on the contents of each chapter, providing a second reinforcement of the material. A final chapter teaches the basics of troubleshooting digital circuits. With the two other Crash Course books, Electronics Technology and Microprocessor Technology, this book forms a complete course in electronics and microcomputer technology appropriate for technical schools, industrial training, and hobbyists. Louis Frenzel is an experienced electronics engineer and educator, as well as the author of many magazine articles and texts. He is currently an instructor at Austin Community College in Austin, Texas. Drill-and-review software included Clear, easy format Self-paced introduction to digital electronics

Design technology to address the new and vast problem of heterogeneous embedded systems design while remaining compatible

with standard "More Moore" flows, i.e. capable of simultaneously handling both silicon complexity and system complexity, represents one of the most important challenges facing the semiconductor industry today and will be for several years to come. While the micro-electronics industry, over the years and with its spectacular and unique evolution, has built its own specific design methods to focus mainly on the management of complexity through the establishment of abstraction levels, the emergence of device heterogeneity requires new approaches enabling the satisfactory design of physically heterogeneous embedded systems for the widespread deployment of such systems. Heterogeneous Embedded Systems, compiled largely from a set of contributions from participants of past editions of the Winter School on Heterogeneous Embedded Systems Design Technology (FETCH), proposes a necessarily broad and holistic overview of design techniques used to tackle the various facets of heterogeneity in terms of technology and opportunities at the physical level, signal representations and different abstraction levels, architectures and components based on hardware and software, in all the main phases of design (modeling, validation with multiple models of computation, synthesis and optimization). It concentrates on the specific issues at the interfaces, and is divided into two main parts. The first part examines mainly theoretical issues and focuses on the modeling, validation and design techniques themselves. The second part illustrates the use of these methods in various design contexts at the forefront of new technology and architectural developments.

CMOS and BeyondCambridge University Press

This book provides a comprehensive overview of current research on memristors, memcapacitors and, meminductors. In addition to an historical overview of the research in this area, coverage includes the theory behind memristive circuits, as well as memcapacitance, and meminductance. Details are shown for recent applications of memristors for resistive random access memories, neuromorphic systems and hybrid CMOS/memristor circuits. Methods for the simulation of memristors are demonstrated and an introduction to neuromorphic modeling is provided.

This book introduces new logic primitives for electronic design automation tools. The author approaches fundamental EDA problems from a different, unconventional perspective, in order to demonstrate the key role of rethinking EDA solutions in overcoming technological limitations of present and future technologies. The author discusses techniques that improve the efficiency of logic representation, manipulation and optimization tasks by taking advantage of majority and biconditional logic primitives. Readers will be enabled to accelerate formal methods by studying core properties of logic circuits and developing new frameworks for logic reasoning engines.

This book contains extended and revised versions of the best papers presented at the 24th IFIP WG 10.5/IEEE International Conference on Very Large Scale Integration, VLSI-SoC 2016, held in Tallinn, Estonia, in September 2016. The 11 papers included in the book were carefully reviewed and selected from the 36 full papers presented at the conference. The papers cover a wide range of topics in VLSI technology and advanced research. They address the latest scientific and industrial results and developments as well as future trends in the field of System-on-Chip (SoC) Design.

A transistor-level, design-intensive overview of high speed and high frequency monolithic integrated circuits for wireless and broadband systems from 2 GHz to 200 GHz, this comprehensive text covers high-speed, RF, mm-wave, and optical fibre circuits using nanoscale CMOS, SiGe BiCMOS, and III-V technologies. Step-by-step design methodologies, end-of chapter problems, and practical simulation and design projects are provided, making this an ideal resource for senior undergraduate and graduate courses in circuit design. With an emphasis on device-circuit topology interaction and optimization, it gives circuit designers and students alike an in-depth understanding of device structures and process limitations affecting circuit performance.

This book explores emerging topics in atomic- and nano-scale electronics after the era of Moore's Law, covering both the physical principles behind, and technological implementations for many devices that are now expected to become key elements of the future of nanoelectronics beyond traditional complementary metal-oxide semiconductors (CMOS). Moore's law is not a physical law itself, but rather a visionary prediction that has worked well for more than 50 years but is rapidly coming to its end as the gate length of CMOS transistors approaches the length-scale of only a few atoms. Thus, the key question here is: "What is the future for nanoelectronics beyond CMOS?" The possible answers are found in this book. Introducing novel quantum devices such as atomic–scale electronic devices, ballistic devices, memristors, superconducting devices, this book also presents the reader with the physical principles underlying new ways of computing, as well as their practical implementation. Topics such as quantum computing, neuromorphic computing are highlighted here as some of the most promising candidates for ushering in a new era of atomic-scale electronics beyond CMOS.

This volume describes the design of relay-based circuit systems from device fabrication to circuit micro-architectures. This book is ideal for both device engineers as well as circuit system designers, and highlights the importance of co-design across design hierarchies when trying to optimize system performance (in this case, energy-efficiency). The book will also appeal to researchers and engineers focused on semiconductor, integrated circuits, and energy efficient electronics.

The main focus of this book is ULSI front-end technology. It covers from the early history of semiconductor science & technology from 1874 to state-of-the-art FINFET technology in 2016. Some ULSI back-end technology is also covered, for example, the science and technology of MIM capacitors for analog CMOS has been included in this book. Contents: PrefaceAuthor BiographyIntroduction to the History of SemiconductorsHistory of MOS TechnologyCMOS Switching Speed Characterization and An Overview Regarding How to Speed Up CMOSLow Power CMOS EngineeringAnalog CMOS TechnologyIndex Readership: The book is useful for researchers in semiconductor technology especially practicing engineers. Keywords: Semiconductor;Integrated Circuits;CMOS;High Speed;Low Power;Digital;Analog;Mixed-Signal;Planar Technology;FINFET;MIM CapacitorReview: Key Features: The book is readable for beginnersThe book is useful for semiconductor technology historiansThe book is useful for practicing engineers

This issue describes processing, materials and equipment for CMOS front-end integration including gate stack, source/drain and channel engineering. Topics: strained Si/SiGe and Si/SiGe on insulator; high-mobility channels including III-V¿s, etc.; nanowires and carbon nanotubes; high-k dielectrics, metal and FUSI gate electrodes; doping/annealing for ultra-shallow junctions; low-resistivity contacts; advanced deposition (e.g. ALD, CVD, MBE), RTP, UV, plasma and laser-assisted processes.

This textbook for courses in Digital Systems Design introduces students to the fundamental hardware used in modern

computers. Coverage includes both the classical approach to digital system design (i.e., pen and paper) in addition to the modern hardware description language (HDL) design approach (computer-based). Using this textbook enables readers to design digital systems using the modern HDL approach, but they have a broad foundation of knowledge of the underlying hardware and theory of their designs. This book is designed to match the way the material is actually taught in the classroom. Topics are presented in a manner which builds foundational knowledge before moving onto advanced topics. The author has designed the presentation with learning Goals and assessment at its core. Each section addresses a specific learning outcome that the student should be able to "do" after its completion. The concept checks and exercise problems provide a rich set of assessment tools to measure student performance on each outcome. During the ten years since the appearance of the groundbreaking, bestselling first edition of The Electronics Handbook, the field has grown and changed tremendously. With a focus on fundamental theory and practical applications, the first edition guided novice and veteran engineers along the cutting edge in the design, production, installation, operation, and maintenance of electronic devices and systems. Completely updated and expanded to reflect recent advances, this second edition continues the tradition. The Electronics Handbook, Second Edition provides a comprehensive reference to the key concepts, models, and equations necessary to analyze, design, and predict the behavior of complex electrical devices, circuits, instruments, and systems. With 23 sections that encompass the entire electronics field, from classical devices and circuits to emerging technologies and applications, The Electronics Handbook, Second Edition not only covers the engineering aspects, but also includes sections on reliability, safety, and engineering management. The book features an individual table of contents at the beginning of each chapter, which enables engineers from industry, government, and academia to navigate easily to the vital information they need. This is truly the most comprehensive, easy-to-use reference on electronics available. This issue of ECS Transactions covers emerging materials, process and technology options for large-area silicon wafers to enhance advanced IC performance or to enable revolutionary device structures with entirely new functionalities. Topics : high-mobility channel materials, (e.g. strained Si/Ge, compound semiconductors and graphene), high-performance gate stacks and low-resistivity junctions and contacts on new, Si-compatible materials; new materials and processes for 3-D (TSV) integration ; synthesis of nano-structures including wires, pores and membranes of Si-compatible materials; novel MEMS/NEMS structures and their integration with the mainstream Si-IC technology. Includes coverage of forefront fields such as cell and molecular biology, environmental science, genetics, information technology, nanotechnology, chemistry, and theoretical physics An extensive subject index makes finding information fast and easy Features numerous cross-references to the McGraw-Hill Encyclopedia of Science & Technology and bibliographies of key literature after each article 250+ images, diagrams, and tables enhance the text The 2nd edition of defect oriented testing has been extensively updated. New chapters on Functional, Parametric Defect Models and Inductive fault Analysis and Yield Engineering have been added to provide a link between defect sources and yield. The chapter on RAM testing has been updated with focus on parametric and SRAM stability testing. Similarly, newer material has been incorporated in digital fault modeling and analog testing chapters. The strength of Defect Oriented Testing for nano-Metric CMOS VLSIs lies in its industrial relevance. Get up to speed with the future of logic switch design with this indispensable overview of the most promising successors to modern CMOS transistors. Learn how to overcome existing design challenges using novel device concepts, presented using an in-depth, accessible, tutorial-style approach. Drawing on the expertise of leading researchers from both industry and academia, and including insightful contributions from the developers of many of these alternative logic devices, new concepts are introduced and discussed from a range of different viewpoints, covering all the necessary theoretical background and developmental context. Covering cutting-edge developments with the potential to overcome existing limitations on transistor performance, such as tunneling field-effect transistors (TFETs), alternative charge-based devices, spin-based devices, and more exotic approaches, this is essential reading for academic researchers, professional engineers, and graduate students working with semiconductor devices and technology. Power supply current monitoring to detect CMOS IC defects during production testing quietly laid down its roots in the mid-1970s. Both Sandia Labs and RCA in the United States and Philips Labs in the Netherlands practiced this procedure on their CMOS ICs. At that time, this practice stemmed simply from an intuitive sense that CMOS ICs showing abnormal quiescent power supply current (IDDQ) contained defects. Later, this intuition was supported by data and analysis in the 1980s by Levi (RACD, Malaiya and Su (SUNY-Binghamton), Soden and Hawkins (Sandia Labs and the University of New Mexico), Jacomino and co-workers (Laboratoire d'Automatique de Grenoble), and Maly and co-workers (Carnegie Mellon University). Interest in IDDQ testing has advanced beyond the data reported in the 1980s and is now focused on applications and evaluations involving larger volumes of ICs that improve quality beyond what can be achieved by previous conventional means. In the conventional style of testing one attempts to propagate the logic states of the suspended nodes to primary outputs. This is done for all or most nodes of the circuit. For sequential circuits, in particular, the complexity of finding suitable tests is very high. In comparison, the IDDQ test does not observe the logic states, but measures the integrated current that leaks through all gates. In other words, it is like measuring a patient's temperature to determine the state of health. Despite perceived advantages, during the years that followed its initial announcements, skepticism about the practicality of IDDQ testing prevailed. The idea, however, provided a great opportunity to researchers. New results on test generation, fault simulation, design for testability, built-in self-test, and diagnosis for this style of testing have since been reported. After a decade of research, we are definitely closer to practice. Design exibility and power consumption in addition to the cost, have always been the most important issues in design of integrated circuits (ICs), and are the main concerns of this research, as well. Energy Consumptions: Power dissipation (P) and energy consumption are - diss pecially importantwhen there is a limited amountof power budgetor limited source of

energy. Very common examples are portable systems where the battery life time depends on system power consumption. Many different techniques have been - veloped to reduce or manage the circuit power consumption in this type of systems. Ultra-low power (ULP) applications are another examples where power dissipation is the primary design issue. In such applications, the power budget is so restricted that very special circuit and system level design techniquesare needed to satisfy the requirements. Circuits employed in applications such as wireless sensor networks (WSN), wearable battery powered systems [1], and implantable circuits for biol- ical applications need to consume very low amount of power such that the entire system can survive for a very long time without the need for changingor recharging battery[2–4]. Using newpowersupplytechniquessuchas energyharvesting[5]and printable batteries [6], is another reason for reducing power dissipation. Devel- ing special design techniques for implementing low power circuits [7–9], as well as dynamic power management (DPM) schemes [10] are the two main approaches to control the system power consumption. Design Flexibility: Design exibility is the other important issue in modern in- grated systems.

This book considers the design and development of nanoelectronic computing circuits, systems and architectures focusing particularly on memristors, which represent one of today's latest technology breakthroughs in nanoelectronics. The book studies, explores, and addresses the related challenges and proposes solutions for the smooth transition from conventional circuit technologies to emerging computing memristive nanotechnologies. Its content spans from fundamental device modeling to emerging storage system architectures and novel circuit design methodologies, targeting advanced non-conventional analog/digital massively parallel computational structures. Several new results on memristor modeling, memristive interconnections, logic circuit design, memory circuit architectures, computer arithmetic systems, simulation software tools, and applications of memristors in computing are presented. High-density memristive data storage combined with memristive circuit-design paradigms and computational tools applied to solve NP-hard artificial intelligence problems, as well as memristive arithmetic-logic units, certainly pave the way for a very promising memristive era in future electronic systems. Furthermore, these graph-based NP-hard problems are solved on memristive networks, and coupled with Cellular Automata (CA)-inspired computational schemes that enable computation within memory. All chapters are written in an accessible manner and are lavishly illustrated. The book constitutes an informative cornerstone for young scientists and a comprehensive reference to the experienced reader, hoping to stimulate further research on memristive devices, circuits, and systems.

CMOS Test and Evaluation: A Physical Perspective is a single source for an integrated view of test and data analysis methodology for CMOS products, covering circuit sensitivities to MOSFET characteristics, impact of silicon technology process variability, applications of embedded test structures and sensors, product yield, and reliability over the lifetime of the product. This book also covers statistical data analysis and visualization techniques, test equipment and CMOS product specifications, and examines product behavior over its full voltage, temperature and frequency range.

Get up to speed with the future of logic switch design with this indispensable introduction to post-CMOS technologies. This book offers a comprehensive review of the state-of-the-art in innovative Beyond-CMOS nanodevices for developing novel functionalities, logic and memories dedicated to researchers, engineers and students. The book will particularly focus on the interest of nanostructures and nanodevices (nanowires, small slope switches, 2D layers, nanostructured materials, etc.) for advanced More than Moore (RF-nanosensors-energy harvesters, on-chip electronic cooling, etc.) and Beyond-CMOS logic and memories applications.

This collection of important papers provides a comprehensive overview of low-power system design, from component technologies and circuits to architecture, system design, and CAD techniques. LOW POWER CMOS DESIGN summarizes the key low-power contributions through papers written by experts in this evolving field.

One of the greatest challenges facing human civilization is the provision of secure, affordable energy without causing catastrophic environmental damage. As the world's largest economy, and as a world leader in energy technologies, the United States is a particularly important case. In the light of increased competition from other countries (particularly China), growing concerns about the local and global environmental impacts of the energy system, an ever-present interest in energy security, and the realization that technological innovation takes place in a complex ecosystem involving a wide range of domestic and international actors, this volume provides a comprehensive and analytical assessment of the role that the U.S. government should play in energy technology innovation. It will be invaluable for policy makers in energy innovation and for researchers studying energy innovation, future energy technologies, climate-change mitigation, and innovation management. It will also act as a supplementary textbook for courses on energy and innovation.

Radiation-induced soft errors are a major concern for modern digital circuits, especially memory elements. Unlike large Random Access Memories that can be protected using error-correcting codes and bit interleaving, soft error protection of sequential elements, i.e. latches and flip-flops, is challenging. Traditional techniques for designing soft-error-resilient sequential elements generally address single node errors, or Single Event Upsets (SEUs). However, with technology scaling, the charge deposited by a single particle strike can be simultaneously collected and shared by multiple circuit nodes, resulting in Single Event Multiple Upsets (SEMUs). In this work, we target SEMUs by presenting a design framework for soft-error-resilient sequential cell design with an overview of existing circuit and layout techniques for soft error mitigation, and introducing a new soft error resilience layout design principle called LEAP, or Layout Design through Error-Aware Transistor Positioning. We then discuss our application of LEAP to the SEU-immune Dual Interlocked Storage Cell (DICE) by implementing a new sequential element layout called LEAP-DICE, retaining the original DICE circuit topology. We compare the soft error performance of SEU-immune flip-flops with the LEAP-DICE flip-flop using a test chip in 180nm CMOS under 200-MeV proton radiation and conclude that 1) our LEAP-DICE flip-flop encounters on average 2,000X and 5X fewer errors compared to a conventional D flip-flop and our reference DICE flip-flop, respectively; 2) our LEAP-DICE flip-flop has the best soft error performance among all existing SEU-immune flip-flops; 3) In the

evaluation of our design framework, we also discovered new soft error effects related to operating conditions such as voltage scaling, clock frequency setting and radiation dose.

Microelectronic Test Structures for CMOS Technology and Products addresses the basic concepts of the design of test structures for incorporation within test-vehicles, scribe-lines, and CMOS products. The role of test structures in the development and monitoring of CMOS technologies and products has become ever more important with the increased cost and complexity of development and manufacturing. In this timely volume, IBM scientists Manjul Bhushan and Mark Ketchen emphasize high speed characterization techniques for digital CMOS circuit applications and bridging between circuit performance and characteristics of MOSFETs and other circuit elements. Detailed examples are presented throughout, many of which are equally applicable to other microelectronic technologies as well. The authors' overarching goal is to provide students and technology practitioners alike a practical guide to the disciplined design and use of test structures that give unambiguous information on the parametrics and performance of digital CMOS technology.

A unique guide to using both modeling and simulation in digital systems design Digital systems design requires rigorous modeling and simulation analysis that eliminates design risks and potential harm to users. Introduction to Digital Systems: Modeling, Synthesis, and Simulation Using VHDL introduces the application of modeling and synthesis in the effective design of digital systems and explains applicable analytical and computational methods. Through step-by-step explanations and numerous examples, the author equips readers with the tools needed to model, synthesize, and simulate digital principles using Very High Speed Integrated Circuit Hardware Description Language (VHDL) programming. Extensively classroom-tested to ensure a fluid presentation, this book provides a comprehensive overview of the topic by integrating theoretical principles, discrete mathematical models, computer simulations, and basic methods of analysis. Topical coverage includes: Digital systems modeling and simulation Integrated logic Boolean algebra and logic Logic function optimization Number systems Combinational logic VHDL design concepts Sequential and synchronous sequential logic Each chapter begins with learning objectives that outline key concepts that follow, and all discussions conclude with problem sets that allow readers to test their comprehension of the presented material. Throughout the book, VHDL sample codes are used to illustrate circuit design, providing guidance not only on how to learn and master VHDL programming, but also how to model and simulate digital circuits. Introduction to Digital Systems is an excellent book for courses in modeling and simulation, operations research, engineering, and computer science at the upper-undergraduate and graduate levels. The book also serves as a valuable resource for researchers and practitioners in the fields of operations research, mathematical modeling, simulation, electrical engineering, and computer science.

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.

This research monograph focuses on the design of arithmetic circuits in Quantum Dot Cellular Automata (QCA). Using the fact that the 3-input majority gate is a primitive in QCA, the book sets out to discover hitherto unknown properties of majority logic in the context of arithmetic circuit designs. The pursuit for efficient adders in QCA takes two forms. One involves application of the new results in majority logic to existing adders. The second involves development of a custom adder for QCA technology. A QCA adder named as hybrid adder is proposed and it is shown that it outperforms existing multi-bit adders with respect to area and delay. The work is extended to the design of a low-complexity multiplier for signed numbers in QCA. Furthermore the book explores two aspects unique to QCA technology, namely thermal robustness and the role of interconnects. In addition, the book introduces the reader to QCA layout design and simulation using QCADesigner. Features & Benefits: This research-based book: ·Introduces the reader to Quantum Dot Cellular Automata, an emerging nanotechnology. ·Explores properties of majority logic. ·Demonstrates application of the properties to design efficient arithmetic circuits. ·Guides the reader towards layout design and simulation in QCADesigner.

The Frontiers in Materials Editorial Office team are delighted to present the second edition of the "Rising Stars" article collection, "Frontiers in Materials: Rising Stars 2020", showcasing the high-quality work of internationally recognized researchers in the early stages of their independent careers. All Rising Star researchers featured within this collection were individually nominated by the Topic Editors in recognition of their potential to influence the future directions of their respective fields. The work presented here highlights the diversity of research performed across the entire breadth of the materials science and engineering field and presents advances in theory, experimentation, and methodology with applications for solving compelling problems. This Editorial features the corresponding author(s) of each paper published within this important collection, ordered by section alphabetically, highlighting them as the great researchers of the future. The Frontiers in Materials Editorial Office team would like to thank each researcher who contributed their work to this collection. We would also like to personally thank the Topic Editors for their exemplary leadership of this article collection;

their strong support and passion for this important, community-driven collection has ensured its success and global impact. Emily Young Journal Development Manager

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