Nonvolatile Memory Technologies With Emphasis On Flash A Comprehensive Guide To Understanding And Using Flash Memory Devices

Physics, Engineering, and Applications
Materials Perspective
Economic Principles of Performance, Cost and Reliability Optimization
Materials, Device and Applications
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Semiconductor Memories
Magnetic, Resistive, and Phase Change
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Volume 1 – Basic and Advanced Devices
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VLSI-Design of Non-Volatile Memories
Gate Stack Engineering for Emerging Polarization based Non-volatile Memories
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Handbook of Thin Film Deposition
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Inside the Circuitry from the Oldest to the Emerging Non-Volatile Memories
Nonvolatile Memory Technologies with Emphasis on Flash
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2019 19th Non Volatile Memory Technology Symposium (NVMTS)
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Phase Change Memory

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Physics, Engineering, and Applications John Wiley & Sons
Metal Oxides for Non-volatile Memory: Materials, Technology and Applications covers the technology and applications of metal oxides (MOx) in non-volatile memory (NVM) technology. The book addresses all types of NVMs, including floating-gate memories, 3-D memories, charge-trapping memories, quantum-dot memories, resistance switching memories and memristors, Mott memories and transparent memories. Applications of MOx in DRAM technology where they play a crucial role to the DRAM evolution are also addressed. The book offers a broad scope, encompassing discussions of materials properties, deposition methods, design and fabrication, and circuit and system level applications of metal oxides to non-volatile memory. Finally, the book addresses one of the most promising materials that may lead to a solution to the challenges in chip size and capacity for memory technologies, particular for mobile applications and embedded systems. Systematically covers metal oxides materials and their properties with memory technology applications, including floating-gate memory, 3-D memory, memristors, and much more Provides an overview on the most relevant deposition methods, including sputtering, CVD, ALD and MBE Discusses the design and fabrication of metal oxides for wide breadth of non-volatile memory applications from 3-D flash technology, transparent memory and DRAM technology
Materials Perspective William Andrew
Kevin Zhang Advancement of semiconductor technology has driven the rapid growth of very large scale integrated (VLSI) systems for increasingly broad applications, incl- ing high-end and mobile computing, consumer electronics such as 3D gaming,

multi-function or smart phone, and various set-top players and ubiquitous sensor and medical devices. To meet the increasing demand for higher performance and lower power consumption in many different system applications, it is often required to have a large amount of on-die or embedded memory to support the need of data bandwidth in a system. The varieties of embedded memory in a given system have alsobecome increasingly more complex, ranging fromstatictodynamic and volatile to nonvolatile. Among embedded memories, six-transistor (6T)-based static random access memory (SRAM) continues to play a pivotal role in nearly all VLSI systems due to its superior speed and full compatibility with logic process technology. But as the technology scaling continues, SRAM design is facing severe challenge in mainta- ing suf?cient cell stability margin under relentless area scaling. Meanwhile, rapid expansion in mobile application, including new emerging application in sensor and medical devices, requires far more aggressive voltage scaling to meet very str- gent power constraint. Many innovative circuit topologies and techniques have been extensively explored in recent years to address these challenges.

Economic Principles of Performance, Cost and Reliability Optimization Springer

COMPUTER ORGANIZATION AND ARCHITECTURE: THEMES AND VARIATIONS stresses the structure of the complete system (CPU, memory, buses and peripherals) and reinforces that core content with an emphasis on divergent examples. This approach to computer architecture is an effective arrangement that provides sufficient detail at the logic and organizational levels appropriate for EE/ECE departments as well as for Computer Science readers. The text goes well beyond the minimal curriculum coverage and introduces topics that are important to anyone involved with computer architecture in a way that is both thought provoking and interesting to all. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Materials, Device and Applications John Wiley & Sons

This comprehensive reference book provides electronics engineers with the technical data and perspective necessary for the intelligent selection, specification, and application of nonvolatile semiconductor memory devices. A "one-stop shopping" tool for the working engineer, this book presents the fundamental aspects of nonvolatile semiconductor memory technologies, devices, reliability, and applications.

Flash Memories Elsevier

VLSI-Design for Non-Volatile Memories is intended for electrical engineers and graduate students who want to enter into the integrated circuit design world. Non-volatile memories are treated as an example to explain general design concepts. Practical illustrative examples of non-volatile memories, including flash types, are showcased to give insightful examples of the discussed design approaches. A collection of photos is included to make the reader familiar with silicon aspects. Throughout all parts of this book, the authors have taken a practical and applications-driven point of view, providing a comprehensive and easily understood approach to all the concepts discussed. Giovanni Campardo and Rino Micheloni have a solid track record of leading design activities at the STMicroelectronics Flash Division. David Novosel is President and founder of Intelligent Micro Design, Inc., Pittsburg, PA.

Semiconductor Memories Wiley-IEEE Press

This book provides students and practicing chip designers with an easy-to-follow yet thorough, introductory treatment of the most promising emerging memories under development in the industry. Focusing on the chip designer rather than the end user, this book offers expanded, up-to-date coverage of emerging memories circuit design. After an introduction on the old solid-state memories and the fundamental limitations soon to be encountered, the working principle and main technology issues of each of the considered technologies (PCRAM, MRAM, FeRAM, ReRAM) are reviewed and a range of topics related to design is explored: the array organization, sensing and writing circuitry, programming algorithms and error correction techniques are reviewed comparing the approach followed and the constraints for each of the technologies considered. Finally the issue of radiation effects on memory devices has been briefly treated. Additionally some considerations are entertained about how emerging memories can find a place in the new memory paradigm required by future electronic systems. This book is an up-to-date and comprehensive introduction for students in courses on memory circuit design or advanced digital courses in VLSI or CMOS circuit design. It also serves as an essential, one-stop resource for academics, researchers and practicing engineers.

Magnetic, Resistive, and Phase Change Springer

This book presents the latest techniques for characterization, modeling and design for nano-scale non-volatile memory (NVM) devices. Coverage focuses on fundamental NVM device fabrication and characterization, internal state identification of memristic dynamics with physics modeling, NVM circuit design and hybrid NVM memory system design-space optimization. The authors discuss design methodologies for nano-scale NVM devices from a circuits/systems perspective, including the general foundations for the fundamental memristic dynamics in NVM devices. Coverage includes physical modeling, as well as the development of a platform to explore novel hybrid CMOS and NVM circuit and system design. • Offers readers a systematic and comprehensive treatment of emerging nano-scale non-volatile memory (NVM) devices; • Focuses on the internal state of NVM memristic dynamics, novel NVM readout and memory cell circuit design and hybrid NVM memory system optimization; • Provides both theoretical analysis and practical examples to illustrate design methodologies; • Illustrates design and analysis for recent developments in spin-toque-transfer, domain-wall racetrack and memristors.

The Essential Guide John Wiley & Sons

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

Volume 1 – Basic and Advanced Devices Springer Science & Business Media

With its comprehensive coverage, this reference introduces readers to the wide topic of resistance switching, providing the knowledge, tools, and methods needed to understand, characterize and apply resistive switching memories. Starting with those materials that display resistive switching behavior, the book explains the basics of resistive switching as well as switching mechanisms and models. An in-depth discussion of memory reliability is followed by chapters on memory cell structures and architectures, while a section on logic gates rounds off the text. An invaluable self-contained book for materials scientists, electrical engineers and physicists dealing with memory research and development.

A Comprehensive Guide for Developers Springer Science & Business

The large scale integration and planar scaling of individual system chips is reaching an expensive limit. If individual chips now, and later terrabyte memory blocks, memory macros, and processing cores, can be tightly linked in optimally designed and processed small footprint vertical stacks, then performance can be increased, power reduced and cost contained. This book

reviews for the electronics industry engineer, professional and student the critical areas of development for 3D vertical memory chips including: gate-all-around and junction-less nanowire memories, stacked thin film and double gate memories, terrabit vertical channel and vertical gate stacked NAND flash, large scale stacking of Resistance RAM cross-point arrays, and 2.5D/3D stacking of memory and processor chips with through-silicon-via connections now and remote links later. Key features: Presents a review of the status and trends in 3-dimensional vertical memory chip technologies. Extensively reviews advanced vertical memory chip technology and development Explores technology process routes and 3D chip integration in a single reference

Emerging Memory Technologies Apress

Presented here is an all-inclusive treatment of Flash technology, including Flash memory chips, Flash embedded in logic, binary cell Flash, and multilevel cell Flash. The book begins with a tutorial of elementary concepts to orient readers who are less familiar with the subject. Next, it covers all aspects and variations of Flash technology at a mature engineering level: basic device structures, principles of operation, related process technologies, circuit design, overall design tradeoffs, device testing, reliability, and applications.

From Fundamentals of Nanoionic Redox Processes to Memristive Device Applications Woodhead Publishing

Offers a comprehensive overview of NAND flash memories, with insights into NAND history, technology, challenges, evolutions, and perspectives Describes new program disturb issues, data retention, power consumption, and possible solutions for the challenges of 3D NAND flash memory Written by an authority in NAND flash memory technology, with over 25 years' experience

VLSI-Design of Non-Volatile Memories Springer

Nanoscale memories are used everywhere. From your iPhone to a supercomputer, every electronic device contains at least one such type. With coverage of current and prototypical technologies, Nanoscale Semiconductor Memories: Technology and Applications presents the latest research in the field of nanoscale memories technology in one place. It also covers a myriad of applications that nanoscale memories technology has enabled. The book begins with coverage of SRAM, addressing the design challenges as the technology scales, then provides design strategies to mitigate radiation induced upsets in SRAM. It discusses the current state-of-the-art DRAM technology and the need to develop high performance sense amplifier circuitry. The text then covers the novel concept of capacitorless 1T DRAM, termed as Advanced-RAM or A-RAM, and presents a discussion on quantum dot (QD) based flash memory. Building on this foundation, the coverage turns to STT-RAM, emphasizing scalable embedded STT-RAM, and the physics and engineering of magnetic domain wall "racetrack" memory. The book also discusses state-of-the-art modeling applied to phase change memory devices and includes an extensive review of RRAM, highlighting the physics of operation and analyzing different materials systems currently under investigation. The hunt is still on for universal memory that fits all the requirements of an "ideal memory" capable of high-density storage, low-power operation, unparalleled speed, high endurance, and low cost. Taking an interdisciplinary approach, this book bridges technological and application issues to provide the groundwork for developing custom designed memory systems.

Springer Science & Business Media

This book is an introduction to the fundamentals of emerging non-volatile memories and provides an overview of future trends in the field. Readers will find coverage of seven important memory technologies, including Ferroelectric Random Access Memory (FeRAM), Ferromagnetic RAM (FMRAM), Multiferroic RAM (MFRAM), Phase-Change Memories (PCM), Oxide-based Resistive RAM (RRAM), Probe Storage, and Polymer Memories. Chapters are structured to reflect diffusions and clashes between different topics. Emerging Non-Volatile Memories is an ideal book for graduate students, faculty, and professionals working in the area of non-volatile memory. This book also: Covers key memory technologies, including Ferroelectric Random Access Memory (FeRAM), Ferromagnetic RAM (FMRAM), and Multiferroic RAM (MFRAM), among others. Provides an overview of non-volatile memory fundamentals. Broadens readers' understanding of future trends in non-volatile memories.

Gate Stack Engineering for Emerging Polarization based Non-volatile Memories Springer Science & Business Media

This book describes the basic technologies and operation principles of charge-trapping non-volatile memories. The authors explain the device physics of each device architecture and provide a concrete description of the materials involved as well as the fundamental properties of the technology. Modern material properties used as charge-trapping layers, for new applications are introduced.

Technology, Testing, and Reliability Woodhead Publishing

The manufacture of flash memory, which is the dominant nonvolatile memory technology, is facing severe technical barriers. So much so, that some emerging technologies have been proposed as alternatives to flash memory in the nano-regime. Nonvolatile Memory Design: Magnetic, Resistive, and Phase Changing introduces three promising candidates: phase-change memory, magnetic random access memory, and resistive random access memory. The text illustrates the fundamental storage mechanism of these technologies and examines their differences from flash memory techniques. Based on the latest advances, the authors discuss key design methodologies as well as the various functions and capabilities of the three nonvolatile memory technologies.

A Comprehensive Guide to Understanding and Using NVSM Devices Springer

This book will educate readers on the theory and application of Phase-Change Memory (aka, PRAM, PCME, PCRAM, C-RAM, Chalcogenide RAM, and Ovonic Unified Memory). This non-volatile computer memory is a major competitor with the ubiquitous flash memory, which suffers from a number of practical problems that the newer Phase-Change Memory hopes to eradicate. This book is appropriate for professional researchers, graduate students, and advanced undergraduates.

Handbook of Thin Film Deposition Wiley-IEEE Press

Information technology is essential to our daily life, and the limitations of silicone based memory systems mean a growing amount of research is focussed on finding an inexpensive alternative to meet our needs and allow the continued development of the industry. Inorganic silicone based technology is increasingly costly and complex and is physically limited by the problems of scaling down. Organic electrical memory devices are comparatively low cost, offer flexibility in terms of chemical structure, are compatible with flexible substrates and allow easy processing. For these reasons polymeric memory nanoscale materials are considered by many to be a potential substitute for conventional semiconductor memory systems. This edited book focusses solely on organic memory devices, providing a full background and overview of the area before bringing the reader up to date with the current and ongoing research in this area. The broad appeal of this book will be applicable to a wide range of researchers and those working in industry, in particular those working in materials, electrical and chemical engineering.

Metal Oxides for Non-volatile Memory John Wiley & Sons

Ferroelectric field effect transistor (FeFET) memories based on a

new type of ferroelectric material (silicon doped hafnium oxide) were studied within the scope of the present work. Utilisation of silicon doped hafnium oxide (Si:HfO2 thin films instead of conventional perovskite ferroelectrics as a functional layer in FeFETs provides compatibility to the CMOS process as well as improved device scalability. The influence of different process parameters on the properties of Si:HfO2 thin films was analysed in order to gain better insight into the occurrence of ferroelectricity in this system. A subsequent examination of the potential of this material as well as its possible limitations with the respect to the application in non-volatile memories followed. The Si:HfO2-based ferroelectric transistors that were fully integrated into the state-of-the-art high-k metal gate CMOS technology were studied in this work for the first time. The memory performance of these devices scaled down to 28 nm gate length was investigated. Special attention was paid to the charge trapping phenomenon shown to significantly affect the device behaviour.

Inside the Circuitry from the Oldest to the Emerging Non-Volatile Memories CRC Press

Ionizing Radiation Effects in Electronics: From Memories to Imagers delivers comprehensive coverage of the effects of ionizing radiation on state-of-the-art semiconductor devices. The book also offers valuable insight into modern radiation-hardening techniques. The text begins by providing important background information on radiation effects, their underlying mechanisms, and the use of Monte Carlo techniques to simulate radiation transport and the effects of radiation on electronics. The book then: Explains the effects of radiation on digital commercial devices, including microprocessors and volatile and nonvolatile memories—static random-access memories (SRAMs), dynamic random-access memories (DRAMs), and Flash memories Examines issues like soft errors, total dose, and displacement damage, together with hardening-by-design solutions for digital circuits, field-programmable gate arrays (FPGAs), and mixed-analog circuits Explores the effects of radiation on fiber optics and imager devices such as complementary metal-oxide-semiconductor (CMOS) sensors and charge-coupled devices (CCDs) Featuring real-world examples, case studies, extensive references, and contributions from leading experts in industry and academia, Ionizing Radiation Effects in Electronics: From Memories to Imagers is suitable both for newcomers who want to become familiar with radiation effects and for radiation experts who are looking for more advanced material or to make effective use of beam time.

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