Logic Non Volatile Memory The Nvm Solutions From Ememory International Series On Advances In Solid State Electronics

CAMACHO KENNY

Novel Non-Volatile Memory Devices Based on Magnetic Semiconductor Nanostructures for Terabit Integration Woodhead Publishing
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.
Plunkett's Engineering & Research Industry Almanac 2007: Engineering & Research Industry Market Research, Statistics, Trends & Leading Companies BoD – Books on Demand
This book offers the first comprehensive view on integrated circuit and system design for the Internet of Things (IoT), and in particular for the tiny nodes at its edge. The authors provide a fresh perspective on how the IoT will evolve based on recent and foreseeable trends in the semiconductor industry, highlighting the key challenges, as well as the opportunities for circuit and system innovation to address them. This book describes what the IoT really means from the design point of view, and how the constraints imposed by applications translate into integrated circuit requirements and design guidelines. Chapter contributions equally come from industry and academia. After providing a system perspective on IoT nodes, this book focuses on state-of-the-art design techniques for IoT applications, encompassing the fundamental sub-systems encountered in Systems on Chip for IoT: ultra-low power digital architectures and circuits low- and zero-leakage memories (including emerging technologies) circuits for hardware security and authentication System on Chip design methodologies on-chip power management and energy harvesting ultra-low power analog interfaces and analog-digital conversion short-range radios miniaturized battery technologies packaging and assembly of IoT integrated systems (on silicon and non-silicon substrates). As a common thread, all chapters conclude with a prospective view on the foreseeable evolution of the related technologies for IoT. The concepts developed throughout the book are exemplified by two IoT node system demonstrations from industry. The unique balance between breadth and depth of this book: enables expert readers quickly to develop an understanding of the specific challenges and state-of-the-art solutions for IoT, as well as their evolution in the foreseeable future provides non-experts with a comprehensive introduction to integrated circuit design for IoT, and serves as an excellent starting point for further learning, thanks to the broad coverage of topics and selected references makes it very well suited for practicing engineers and

scientists working in the hardware and chip design for IoT, and as textbook for senior undergraduate, graduate and postgraduate students (familiar with analog and digital circuits).

Logic Non-volatile Memory: The Nvm Solutions For Ememory Springer

With CMOS technology scaling reaching its limitations rigorous research of alternate and competent technologies is paramount to push the boundaries of computing. Spintronic and resistive memories have proven to be effective alternatives in terms of area, power and performance to CMOS because of their non-volatility, ability for logic computing and easy integration with CMOS. However, deeper investigations to understand their physical phenomenon and improve their properties such as writability, stability, reliability, endurance, uniformity with minimal device-device variations is necessary for deployment as memories in commercial applications. Application of these technologies beyond memory and logic are investigated in this thesis i.e. for security of integrated circuits and systems and special purpose memories. We proposed a spintonic based special purpose memory for search applications, present design analysis and techniques to improve the performance for larger word lengths upto 256 bits. Salient characteristics of RRAM is studied and exploited in the design of widely accepted hardware security primitives such as Physically Unclonable Function (PUF) and True Random Number Generators (TRNG). Vulnerability of these circuits to adversary attacks and countermeasures are proposed. Proposed PUF can be implemented within 1T-1R conventional memory architecture which offers area advantages compared to RRAM memory and cross bar array PUFs with huge number of challenge response pairs. Potential application of proposed strong arbiter PUF in the Internet of things is proposed and performance is evaluated theoretically with valid assumptions on the maturity of RRAM technology. Proposed TRNG effectively utilizes the random telegraph noise in RRAM current to generate random bit stream. TRNG is evaluated for sufficient randomness in the random bit stream generated. Vulnerability and countermeasures to adversary attacks are also studied. Finally, in thesis we investigated and extended the application of emerging non-volatile memory technologies for search and security in integrated circuits and systems.

Phase Change Devices for Nonvolatile Logic Springer

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.

Introduction to Logic Circuits & Logic Design with Verilog Plunkett Research, Ltd.

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.

Nonvolatile Memory Design Institute of Electrical & Electronics Engineers(IEEE)

Would you like to add the capabilities of the Non-Volatile Memory (NVM) as a storage element in your silicon integrated logic circuits, and as a trimming sector in your high voltage driver and other silicon integrated analog circuits? Would you like to learn how to embed the NVM into your silicon integrated circuit products to improve their performance?This book is written to help you.It provides comprehensive instructions on fabricating the NVM using the same processes you are using to fabricate your logic integrated circuits. We at our eMemory company call this technology the embedded Logic NVM. Because embedded Logic NVM has simple fabrication processes, it has replaced the conventional NVM in many traditional and new applications, including LCD driver, LED driver, MEMS controller, touch panel controller, power management unit, ambient and motion sensor controller, micro controller unit (MCU), security ID setting tag, RFID, NFC, PC camera controller, keyboard controller, and mouse controller. The recent explosive growth of the Logic NVM indicates that it will soon dominate all NVM applications. The embedded Logic NVM was invented and has been implemented in users' applications by the 200+ employees of our eMemory company, who are also the authors and author-assistants of this book.This book covers the following Logic NVM products: One Time Programmable (OTP) memory, Multiple Times Programmable (MTP) memory, Flash memory, and Electrically Erasable Programmable Read Only Memory (EEPROM). The fundamentals of the NVM are described in this book, which include: the physics and operations of the memory transistors, the basic building block of the memory cells and the access circuits.All of these products have been used continuously by the industry worldwide. In-depth readers can attain expert proficiency in the implementation of the embedded Logic NVM technology in their products.

Development and Investigation of Novel Logic-in-Memory and Nonvolatile Logic Circuits Utilizing Hafnium Oxide-Based Ferroelectric Field-Effect Transistors John Wiley & Sons

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.

Machine Learning and Non-volatile Memories Springer Science & Business Media

Plunketts InfoTech Industry Almanac presents a complete analysis of the technology business, including the convergence of hardware, software, entertainment and telecommunications. This market research tool includes our analysis of the major trends affecting the industry, from the rebound of the global PC and server market, to consumer and enterprise software, to super computers, open systems such as Linux, web services and network equipment. In addition, we provide major statistical tables covering the industry, from computer sector revenues to broadband subscribers to semiconductor industry production. No other source provides this books easy-to-understand comparisons of growth, expenditures, technologies, imports/exports, corporations, research and other vital subjects. The corporate profile section provides in-depth, one-page profiles on each of the top 500 InfoTech companies. We have used our massive databases to provide you with unique, objective analysis of the largest and most exciting companies in: Computer Hardware, Computer Software, Internet Services, E-Commerce, Networking, Semiconductors, Memory, Storage, Information Management and Data Processing. We've been working harder than ever to gather data on all the latest trends in information technology. Our research effort includes an exhaustive study of new technologies and discussions with experts at dozens of innovative tech companies. Purchasers of the printed book or PDF version may receive a free CD-ROM database of the corporate profiles, enabling export of vital corporate data for mail merge and other uses.

Embedded Memories for Nano-Scale VLSIs CRC Press

Not only conventional computer architectures, such as the von-Neumann architecture with its inevitable von-Neumann bottleneck, but likewise the emerging field of edge computing require to substantially decrease the spatial separation of logic and memory units to overcome power and latency shortages. The integration of logic operations into memory units (Logic-in-Memory), as well as memory elements into logic circuits (Nonvolatile Logic), promises to fulfill this request by combining high-speed with low-power operation. Ferroelectric field-effect transistors (FeFETs) based on hafnium oxide prove to be auspicious candidates for the memory elements in applications of that kind, as those nonvolatile memory elements are CMOS-compatible and likewise scalable. This work presents implementations that merge logic and memory by exploiting the natural capability of the FeFET to combine logic functionality (transistor) and memory ability (nonvolatility).

Advances in Non-volatile Memory and Storage Technology Plunkett Research, Ltd.

Device Circuit design of NVMs Emerging Non volatile Memory Circuit Design NVM Device Design Error correction for NVMs Nonvolatile Logic Circuit Design Low Power NVM Circuit NVM Architecture and Systems Non volatile Registers Non volatile Memory Architectures Non volatile Cache Design NVM based Neuromorphic Architectures NVM based Storage NVDIMM NVM Storage Operating System Support for NVM Compiler Optimization for NVM NVM based Storage Software NVM based Databases NVM Controller Design NVM Applications In memory Computing NVM for Big Data Analytics NVM in Mobile Healthcare Applications NVM in Wearable Applications NVM and the Internet of Things

Technology, Entrepreneurs, and Silicon Valley Springer Science & Business Media

Photo-Electroactive Non-Volatile Memories for Data Storage and Neuromorphic Computing summarizes advances in the development of photo-electroactive memories and neuromorphic computing systems, suggests possible solutions to the challenges of device design, and evaluates the prospects for commercial applications. Sections covers developments in electro-photoactive memory, and photonic neuromorphic and in-memory computing, including discussions on design concepts, operation principles and basic storage mechanism of optoelectronic memory devices, potential materials from organic molecules, semiconductor quantum dots to two-dimensional materials with desirable electrical and optical properties, device challenges, and possible strategies. This comprehensive, accessible and up-to-date book will be of particular interest to graduate students and researchers in solid-state electronics. It is an invaluable systematic introduction to the memory characteristics, operation principles and storage mechanisms of the latest reported electro-photoactive memory devices. Reviews the most promising materials to enable emerging computing memory and data storage devices, including one- and two-dimensional materials, metal oxides, semiconductors, organic materials, and more Discusses fundamental mechanisms and design strategies for two- and three-terminal device structures Addresses device challenges and strategies to enable translation of optical and optoelectronic technologies

2016 5th Non-Volatile Memory Systems and Applications Symposium (NVMSA) World Scientific

Semiconductor flash memory is an indispensable component of modern electronic systems which has gained a strategic position in recent decades due to the progressive shift from computing to consumer (and particularly mobile) products as revenue drivers for Integrated Circuits (IC) companies. This book provides a comprehensive overview of the different technological approaches currently being studied to fulfill future memory requirements. Two main research paths are identified and discussed. Different "evolutionary paths" based on the use of new materials (such as silicon nanocrystals for storage nodes and high-k insulators for active dielectrics) and of new transistor structures (such as multi-gate devices) are investigated in order to extend classical floating gate technology to the 32 nm node. "Disruptive paths" based on new storage mechanisms or new technologies (such as phase-change devices, polymer or molecular cross-bar memories) are also covered in order to address 22 nm and smaller IC generations. Finally, the main factors at the origin of these phenomena are identified and analyzed, providing pointers on future research activities and developments in this area.

Emerging Non-volatile Memory Technologies BoD – Books on Demand

In the last few decades, computation power has been increasing, thanks to CMOS scaling, which in turn results in growing demand for high-density memories to meet the large bandwidth requirement. However, CMOS scaling is approaching the end of roadmap and it is experiencing significant challenges such as high power-density, process variation, high standby power, and reliability issues. In addition, the increasing demand for high performance computing (HPC) and integration of multiple cores on a single die have widened the speed gap between logic and memory, that is known as the memory-wall. Process variability and standby power are posing severe obstruction towards SRAM/DRAM scaling to future nodes. On one hand, industry and academia began investigating alternative memory technologies, such as Spin-Torque Transfer RAM (STT-RAM), Domain Wall memory (DWM), Phase-Change RAM (PCRAM), Ferro-electric RAM (FeRAM), Resistive RAM (RRAM), and Magnetic RAM (MRAM). These emerging non-volatile memory technologies offer the speed of SRAM, the high density of DRAM, and the non-volatility of Flash memory. On the other hand, the speed gap between the processor and memory impedes the continuous performance improvement of the traditional von Neumann architecture. In order to address this challenge, extensive amount of research is performed to explore the alternative non-von Neumann architectures based on the concept of computing in memory. Among these memories, spintronic memories (i.e. STTRAM, DWM) have proven to be potential alternatives to replace on-chip SRAM owing to their remarkable high density, zero standby power, high speed,

high endurance and CMOS compatibility. Nevertheless, STTRAM suffers from crucial challenges such as high write energy, long write time and poor sense margin. Furthermore, it suffers from process variation induced write latency and write power degradation. Moreover, the sensitivity of magnets to ambient parameters and data persistence makes the spintronic memories vulnerable to tampering and data leakage. In addition to the aforementioned challenges associated with STTRAM, DWM suffers from shift latency and shift power overhead, aspect ratio mismatch, and segregated read and write heads. The recent experimental studies have revealed that RRAM is a promising alternative to implement main memory due to their small footprint and zero standby power. Therefore, realizing logic operations within RRAM crossbar arrays is a promising approach to implement computing-in-memory systems. However, RRAM crossbar array suffers from sneak-path problem which leads to poor sense margin, higher power consumption, and limited array size. In the first part of this thesis, we propose the circuit and architectural techniques to improve read yield, write latency, write power and data security of STTRAM. We introduce slope sensing, a destructive sensing technique for elimination of the reference resistance variation in order to enhance read yield of STTRAM arrays. Further, we propose a non-destructive sensing scheme which exploits a voltage feedback and boosting (VFAB) approach to develop large sense margin and substantially reduce sensing power. We introduce a novel and adaptive write current boosting to mitigate process variation induced write latency and write power degradation. In this technique, the bits experiencing worst-case write latency are fixed through write current boosting. Next, we investigate data security of STTRAM last level cache under magnetic attack where we apply low-overhead micro-architecture methods to avoid errors in presence of the magnetic attack. In the second part of this thesis, we propose circuit and architectural techniques to overcome the design challenges associated with DWM. We apply layout techniques such as sharing of diffusion, bitlines and shift lines in order to enhance bitcell density. Circuit methods such as merged read-write head for improvement of bitcell density and shift gating to reduce shift power are proposed. Furthermore, we apply the micro-architecture techniques such as cache segregation using a novel replacement policy as well as dynamic current boosting based on workload monitoring in order to mitigate shift power and shift latency. Moreover, adaptive write and shift current boosting is proposed to mitigate process variation induced performance and power degradation.Lastly, we propose a low-power dynamic computing in memory system which can implement various functions in the Sum of Product (SoP) form in RRAM crossbar array architecture. This technique benefits from the nonlinear characteristic of a selector diode for improvement of the sense margin in order to implement higher fan-in logic gates.

Emerging Non-volatile Memory Technologies for Computing and Security Springer

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.

Silicon Non-Volatile Memories Springer Nature

Exa-scale computing needs to re-examine the existing hardware platform that can support intensive data-oriented computing. Since the main bottleneck is from memory, we aim to develop an energy-efficient in-memory computing platform in this book. First, the models of spin-transfer torque magnetic tunnel junction and racetrack memory are presented. Next, we show that the spintronics could be a candidate for future data-oriented computing for storage, logic, and interconnect. As a result, by utilizing spintronics, in-memory-based computing has been applied for data encryption and machine learning. The implementations of in-memory AES, Simon cipher, as well as interconnect are explained in details. In addition, in-memory-based machine learning and face recognition are also illustrated in this book.

Logic Non-volatile Memory Woodhead Publishing

Advances in Nonvolatile Memory and Storage Technology, Second Edition, addresses recent developments in the non-volatile memory spectrum, from fundamental understanding, to technological aspects. The book provides up-to-date information on the current memory technologies as related by leading experts in both academia and industry. To reflect the rapidly changing field, many new chapters have been included to feature the latest in RRAM technology, STT-RAM, memristors and more. The new edition describes the emerging technologies including oxide-based ferroelectric memories, MRAM technologies, and 3D memory. Finally, to further widen the discussion on the applications space, neuromorphic computing aspects have been included. This book is a key resource for postgraduate students and academic researchers in physics, materials science and electrical engineering. In addition, it will be a valuable tool for research and development managers concerned with electronics, semiconductors, nanotechnology, solid-state memories, magnetic materials, organic materials and portable electronic devices. Discusses emerging devices and research trends, such as neuromorphic computing and oxide-based ferroelectric memories Provides an overview on developing nonvolatile memory and storage technologies and explores their strengths and weaknesses Examines improvements to flash technology, charge trapping and resistive random access memory

Ferroelectric Field Effect Transistor Non-volatile Memory: Cell Evaluation Considering Write Disturb and A New Approach For Logic-In-Memory McGraw Hill Professional

For the technological progress in communication technology it is necessary that the advanced studies in circuit and software design are accompanied with recent results of the technological research and physics in order to exceed its limitations. This book is a guide which treats many components used in mobile communications, and in particular focuses on non-volatile memories. It emerges following the conducting line of the non-volatile memory in the wireless system: On the one hand it develops the foundations of the interdisciplinary issues needed for design analysis and testing of the system. On the other hand it deals with many of the problems appearing when the systems are realized in industrial production. These cover the difficulties from the mobile system to the different types of non-volatile memories. The book explores memory cards, multichip technologies, and algorithms of the software management as well as error handling. It also presents techniques of assurance for the single components and a guide through the Datasheet lectures.

TCAD Simulation of Logic Non-Volatile Memory Based on Nanosheet Structure Plunkett Research, Ltd.

As conventional memory technologies such as DRAM and Flash run into scaling challenges, architects and system designers are forced to look at alternative technologies for building future computer systems. This synthesis lecture begins by listing the requirements for a next generation memory technology and briefly surveys the landscape of novel non-volatile memories. Among these, Phase Change Memory (PCM) is emerging as a leading contender, and the authors discuss the material, device, and circuit advances underlying this exciting technology. The lecture then describes architectural solutions to enable PCM for main memories. Finally, the authors explore the impact of such byte-addressable non-volatile memories on future storage and system designs. Table of Contents: Next Generation Memory Technologies / Architecting PCM for Main Memories / Tolerating Slow Writes in PCM / Wear Leveling for Durability / Wear Leveling Under Adversarial Settings / Error Resilience in Phase Change Memories / Storage and System Design With Emerging Non-Volatile Memories

Sixth Biennial IEEE Nonvolatile Memory Technology Conference Springer Nature

This book presents the basics of both NAND flash storage and machine learning, detailing the storage problems the latter can help to solve. At a first sight, machine learning and non-volatile memories seem very far away from each other. Machine learning implies mathematics, algorithms and a lot of computation; non-volatile memories are solid-state devices used to store information, having the amazing capability of retaining the information even without power supply. This book will help the reader understand how these two worlds can work together, bringing a lot of value to each other. In particular, the book covers two main fields of application: analog neural networks (NNs) and solid-state drives (SSDs). After reviewing the basics of machine learning in Chapter 1, Chapter 2 shows how neural networks can mimic the human brain; to accomplish this result, neural networks have to perform a specific computation called vector-by-matrix (VbM) multiplication, which is particularly power hungry. In the digital domain, VbM is implemented by means of logic gates which dictate both the area occupation and the power consumption; the combination of the two poses serious challenges to the hardware scalability, thus limiting the size of the neural network itself, especially in terms of the number of processable inputs and outputs. Non-volatile memories (phase change memories in Chapter 3, resistive memories in Chapter 4, and 3D flash memories in Chapter 5 and Chapter 6) enable the analog implementation of the VbM (also called “neuromorphic architecture”), which can easily beat the equivalent digital implementation in terms of both speed and energy consumption. SSDs and flash memories are strictly coupled together; as 3D flash scales, there is a significant amount of work that has to be done in order to optimize the overall performances of SSDs. Machine learning has emerged as a viable solution in many stages of this process. After introducing the main flash reliability issues, Chapter 7 shows both supervised and un-supervised machine learning techniques that can be applied to NAND. In addition, Chapter 7 deals with algorithms and techniques for a pro-active reliability management of SSDs. Last but not least, the last section of Chapter 7 discusses the next challenge for machine learning in the context of the so-called computational storage. No doubt that machine learning and non-volatile memories can help each other, but we are just at the beginning of the journey; this book helps researchers understand the basics of each field by providing real application examples, hopefully, providing a good starting point for the next level of development.

Non-Volatile In-Memory Computing by Spintronics Springer

This book introduces readers to the latest advances in sensing technology for a broad range of non-volatile memories (NVMs). Challenges across the memory technologies are highlighted and their solutions in mature technology are discussed, enabling innovation of sensing technologies for future NVMs. Coverage includes sensing techniques ranging from well-established NVMs such as hard disk, flash, Magnetic RAM (MRAM) to emerging NVMs such as ReRAM, STTRAM, FeRAM and Domain Wall Memory will be covered.

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