

Hot Carrier Design Considerations for MOS Devices and Circuits



EDITED BY

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Hot Carrier Design Considerations For Mos Devices And Circuits

Yuhua Cheng, Chenming Hu



Hot Carrier Design Considerations For Mos Devices And Circuits:

Hot Carrier Design Considerations for MOS Devices and Circuits Cheng Wang, 2012-12-06 As device dimensions decrease hot carrier effects which are due mainly to the presence of a high electric field inside the device are becoming a major design concern On the one hand the detrimental effects such as transconductance degradation and threshold shift need to be minimized or if possible avoided altogether On the other hand performance such as the programming efficiency of nonvolatile memories or the carrier velocity inside the devices need to be maintained or improved through the use of submicron technologies even in the presence of a reduced power supply As a result one of the major challenges facing MOS design engineers today is to harness the hot carrier effects so that without sacrificing product performance degradation can be kept to a minimum and a reliable design obtained To accomplish this the physical mechanisms responsible for the degradations should first be experimentally identified and characterized With adequate models thus obtained steps can be taken to optimize the design so that an adequate level of quality assurance in device or circuit performance can be achieved This book addresses these hot carrier design issues for MOS devices and circuits and is used primarily as a professional guide for process development engineers device engineers and circuit designers who are interested in the latest developments in hot carrier degradation modeling and hot carrier reliability design techniques It may also be considered as a reference book for graduate students who have some research interests in this exciting yet sometime controversial field

Electrical Characterization of Silicon-on-Insulator Materials and Devices Sorin Cristoloveanu, Sheng Li, 2013-11-27 Silicon on Insulator is more than a technology more than a job and more than a venture in microelectronics it is something different and refreshing in device physics This book recalls the activity and enthusiasm of our SOI groups Many contributing students have since then disappeared from the SOI horizon Some of them believed that SOI was the great love of their scientific lives others just considered SOI as a fantastic LEGO game for adults We thank them all for kindly letting us imagine that we were guiding them This book was very necessary to many people SOI engineers will certainly be happy indeed if the performance of their SOI components is not always outstanding they can now safely incriminate the relations given in the book rather than their process Martine Gunter and Y S Chang can contemplate at last the amount of work they did with the figures Our SOI accomplices already know how much we borrowed from their expertise and would find it indecent to have their detailed contributions listed Jean Pierre and Dimitris incited the book while sharing their experience in the reliability of floating bodies Our families and friends now realize the SOI capability of dielectrically isolating us for about two years in a BOX Our kids encouraged us to start writing Our wives definitely gave us the courage to stop writing They had a hard time fighting the symptoms of a rapidly developing SOI allergy

Hot-Carrier Effects in MOS Devices Eiji Takeda, Cary Y. Yang, Akemi Miura-Hamada, 1995-11-28 The exploding number of uses for ultrafast ultrasmall integrated circuits has increased the importance of hot carrier effects in manufacturing as well as for other technological applications

They are rapidly moving out of the research lab and into the real world This book is derived from Dr Takeda's book in Japanese Hot Carrier Effects published in 1987 by Nikkei Business Publishers However the new book is much more than a translation Takeda's original work was a starting point for developing this much more complete and fundamental text on this increasingly important topic The new work encompasses not only all the latest research and discoveries made in the fast paced area of hot carriers but also includes the basics of MOS devices and the practical considerations related to hot carriers Chapter one itself is a comprehensive review of MOS device physics which allows a reader with little background in MOS devices to pick up a sufficient amount of information to be able to follow the rest of the book The book is written to allow the reader to learn about MOS Device Reliability in a relatively short amount of time making the text's detailed treatment of hot carrier effects especially useful and instructive to both researchers and others with varying amounts of experience in the field The logical organization of the book begins by discussing known principles then progresses to empirical information and finally to practical solutions Provides the most complete review of device degradation mechanisms as well as drain engineering methods Contains the most extensive reference list on the subject

Selected Semiconductor Research

Ming-Fu Li, 2011 This book on solid state physics has been written with an emphasis on recent developments in quantum many body physics approaches It starts by covering the classical theory of solids and electrons and describes how this classical model has failed The authors then present the quantum mechanical model of electrons in a lattice and they also discuss the theory of conductivity Extensive reviews on the topic are provided in a compact manner so that any non specialist can follow from the beginning The authors cover the system of magnetism in a similar way and various problems in magnetic materials are discussed The book also discusses the Ising chain the Heisenberg model the Kondo effect and superconductivity amongst other relevant topics In the final chapter the authors present some works related to contemporary research topics such as quantum entanglement in many body systems and quantum simulations They also include a short review of some of the possible applications of solid state quantum information in biological systems

Advanced MOS Device Physics Norman Einspruch, 2012-12-02 VLSI Electronics Microstructure Science Volume 18 Advanced MOS Device Physics explores several device physics topics related to metal oxide semiconductor MOS technology The emphasis is on physical description modeling and technological implications rather than on the formal aspects of device theory Special attention is paid to the reliability physics of small geometry MOSFETs Comprised of eight chapters this volume begins with a general picture of MOS technology development from the device and processing points of view The critical issue of hot carrier effects is discussed along with the device engineering aspects of this problem the emerging low temperature MOS technology and the problem of latchup in scaled MOS circuits Several device models that are suitable for use in circuit simulators are also described The last chapter examines novel electron transport effects observed in ultra small MOS structures This book should prove useful to semiconductor engineers involved in different aspects of MOS technology

development as well as for researchers in this field and students of the corresponding disciplines

Linear CMOS RF Power Amplifiers Hector Solar Ruiz, Roc Berenguer Pérez, 2013-09-14 The work establishes the design flow for the optimization of linear CMOS power amplifiers from the first steps of the design to the final IC implementation and tests The authors also focuses on design guidelines of the inductor s geometrical characteristics for power applications and covers their measurement and characterization Additionally a model is proposed which would facilitate designs in terms of transistor sizing required inductor quality factors or minimum supply voltage The model considers limitations that CMOS processes can impose on implementation The book also provides different techniques and architectures that allow for optimization

Physical and Technical Problems of SOI Structures and Devices J.-P. Colinge, Vladimir S. Lysenko, Alexei N. Nazarov, 2012-12-06 In Physical and Technical Problems of SOI Structures and Devices specialists in silicon on insulator technology from both East and West meet for the first time giving the reader the chance to become acquainted with work from the former Soviet Union hitherto only available in Russian and barely available to western scientists Keynote lectures and state of the art presentations give a wide ranging panorama of the challenges posed by SOI materials and devices material fabrication techniques characterisation device and circuit issues

High-Performance Digital VLSI Circuit Design Richard X. Gu, Khaled M. Sharaf, Mohamed I. Elmasry, 2012-12-06 High Performance Digital VLSI Circuit Design is the first book devoted entirely to the design of digital high performance VLSI circuits CMOS BiCMOS and bipolar circuits are covered in depth including state of the art circuit structures Recent advances in both the computer and telecommunications industries demand high performance VLSI digital circuits Digital processing of signals demands high speed circuit techniques for the GHz range The design of such circuits represents a great challenge one that is amplified when the power supply is scaled down to 3.3 V Moreover the requirements of low power high performance circuits adds an extra dimension to the design of such circuits High Performance Digital VLSI Circuit Design is a self contained text introducing the subject of high performance VLSI circuit design and explaining the speed power tradeoffs The first few chapters of the book discuss the necessary background material in the area of device design and device modeling respectively High performance CMOS circuits are then covered especially the new all N logic dynamic circuits Propagation delay times of high speed bipolar CML and ECL are developed analytically to give a thorough understanding of various interacting process device and circuit parameters High current phenomena of bipolar devices are also addressed as these devices typically operate at maximum currents for limited device area Different new high performance BiCMOS circuits are presented and compared to their conventional counterparts These new circuits find direct applications in the areas of high speed adders frequency dividers sense amplifiers level shifters input output clock buffers and PLLs The book concludes with a few system application examples of digital high performance VLSI circuits Audience A vital reference for practicing IC designers Can be used as a text for graduate and senior undergraduate students in the area

Thin Film Transistor

Technologies (TFTT VII) Yue Kuo,2005 Quality and Reliability of Technical Systems Alessandro Birolini,2013-03-14

High reliability maintainability and safety are expected from complex equipment and systems To build these characteristics into an item failure rate and failure mode analyses have to be performed early in the design phase starting at the component level and have to be supported by a set of design guidelines for reliability and maintainability as well as by extensive design reviews Before production qualification tests of prototypes must ensure that quality and reliability targets have been reached In the production phase processes and procedures have to be selected and monitored to assure the required quality level For many systems availability requirements must also be satisfied In these cases stochastic processes can be used to investigate and optimize availability including logistical support This book presents the state of the art of the methods and procedures necessary for a cost and time effective quality and reliability assurance during the design and production of equipment and systems It takes into consideration that 1 Quality and reliability assurance of complex equipment and systems requires that all engineers involved in a project undertake a set of specific activities from the definition to the operating phase which are performed concurrently to achieve the best performance quality and reliability for given cost and time schedule targets

Silicon Nitride and Silicon Dioxide Thin Insulating Films M. Jamal Deen,1997 Istfa '98 ASM

International,1998-01-01 **Materials Reliability in Microelectronics VII: Volume 473** J. Joseph Clement,1997-10-20

The inexorable drive for increased integrated circuit functionality and performance places growing demands on the metal and dielectric thin films used in fabricating these circuits as well as spurring demand for new materials applications and processes This book directly addresses issues of widespread concern in the microelectronics industry smaller feature sizes new materials and new applications that challenge the reliability of new technologies While the book continues the focus on issues related to interconnect reliability such as electromigration and stress particular emphasis is placed on the effects of microstructure An underlying theme is understanding the importance of interactions among different materials and associated interfaces comprising a single structure with dimensions near or below the micrometer scale Topics include adhesion and fracture gate oxide growth and oxide interfaces surface preparation and gate oxide reliability oxide degradation and defects micro structure texture and reliability novel measurement techniques interconnect performance and reliability modeling electromigration and interconnect reliability and stress and stress relaxation Reliability Engineering

Elsayed A. Elsayed,2021-01-07 Get a firm handle on the engineering reliability process with this insightful and complete resource Named one of the Best Industrial Management eBooks of All Time by BookAuthority As featured on CNN Forbes and Inc BookAuthority identifies and rates the best books in the world based on recommendations by thought leaders and experts The newly and thoroughly revised 3rd Edition of Reliability Engineering delivers a comprehensive and insightful analysis of this crucial field Accomplished author professor and engineer Elsayed A Elsayed includes new examples and end of chapter problems to illustrate concepts new chapters on resilience and the physics of failure revised chapters on reliability

and hazard functions and more case studies illustrating the approaches and methodologies described within The book combines analyses of system reliability estimation for time independent and time dependent models with the construction of the likelihood function and its use in estimating the parameters of failure time distribution It concludes by addressing the physics of failures mechanical reliability and system resilience along with an explanation of how to ensure reliability objectives by providing preventive and scheduled maintenance and warranty policies This new edition of Reliability Engineering covers a wide range of topics including Reliability and hazard functions like the Weibull Model the Exponential Model the Gamma Model and the Log Logistic Model among others System reliability evaluations including parallel series series parallel and mixed parallel systems The concepts of time and failure dependent reliability within both repairable and non repairable systems Parametric reliability models including types of censoring and the Exponential Weibull Lognormal Gamma Extreme Value Half Logistic and Rayleigh Distributions Perfect for first year graduate students in industrial and systems engineering Reliability Engineering 3rd Edition also belongs on the bookshelves of practicing professionals in research laboratories and defense industries The book offers a practical and approachable treatment of a complex area combining the most crucial foundational knowledge with necessary and advanced topics

MOSFET Modeling & BSIM3 User's Guide Yuhua Cheng, Chenming Hu, 2007-05-08 Circuit simulation is essential in integrated circuit design and the accuracy of circuit simulation depends on the accuracy of the transistor model BSIM3v3 BSIM for Berkeley Short channel IGFET Model has been selected as the first MOSFET model for standardization by the Compact Model Council a consortium of leading companies in semiconductor and design tools In the next few years many fabless and integrated semiconductor companies are expected to switch from dozens of other MOSFET models to BSIM3 This will require many device engineers and most circuit designers to learn the basics of BSIM3 MOSFET Modeling BSIM3 User's Guide explains the detailed physical effects that are important in modeling MOSFETs and presents the derivations of compact model expressions so that users can understand the physical meaning of the model equations and parameters It is the first book devoted to BSIM3 It treats the BSIM3 model in detail as used in digital analog and RF circuit design It covers the complete set of models i e I V model capacitance model noise model parasitics model substrate current model temperature effect model and non quasi static model MOSFET Modeling BSIM3 User's Guide not only addresses the device modeling issues but also provides a user's guide to the device or circuit design engineers who use the BSIM3 model in digital analog circuit design RF modeling statistical modeling and technology prediction This book is written for circuit designers and device engineers as well as device scientists worldwide It is also suitable as a reference for graduate courses and courses in circuit design or device modelling Furthermore it can be used as a textbook for industry courses devoted to BSIM3 MOSFET Modeling BSIM3 User's Guide is comprehensive and practical It is balanced between the background information and advanced discussion of BSIM3 It is helpful to experts and students alike

Advanced MOS Devices and their Circuit Applications Ankur Beohar, Ribu

Mathew, Abhishek Kumar Upadhyay, Santosh Kumar Vishvakarma, 2024-01-08 This text comprehensively discusses the advanced MOS devices and their circuit applications with reliability concerns Further an energy efficient Tunnel FET based circuit application will be investigated in terms of the output voltage power efficiency energy consumption and performances using the device circuit co design approach The book Discusses advanced MOS devices and their circuit design for energy efficient systems on chips SoCs Covers MOS devices materials and related semiconductor transistor technologies for the next generation ultra low power applications Examines the use of field effect transistors for biosensing circuit applications and covers reliability design considerations and compact modeling of advanced low power MOS transistors Includes research problem statements with specifications and commercially available industry data in the appendix Presents Verilog A model based simulations for circuit analysis The volume provides detailed discussions of DC and analog RF characteristics effects of trap assisted tunneling TAT for reliability analysis spacer underlap engineering methodology doping profile analysis and work function techniques It further covers novel MOS devices including FinFET Graphene field effect transistor Tunnel FETs and Flash memory devices It will serve as an ideal design book for senior undergraduate students graduate students and academic researchers in the fields including electrical engineering electronics and communication engineering computer engineering materials science nanoscience and nanotechnology JJAP ,2000 Proceedings of the Third Symposium on Silicon Nitride and Silicon Dioxide Thin Insulating Films Vikram J. Kapoor, William D. Brown, 1994 *Compact Models for Integrated Circuit Design* Samar K. Saha, 2018-09-03 Compact Models for Integrated Circuit Design Conventional Transistors and Beyond provides a modern treatise on compact models for circuit computer aided design CAD Written by an author with more than 25 years of industry experience in semiconductor processes devices and circuit CAD and more than 10 years of academic experience in teaching compact modeling courses this first of its kind book on compact SPICE models for very large scale integrated VLSI chip design offers a balanced presentation of compact modeling crucial for addressing current modeling challenges and understanding new models for emerging devices Starting from basic semiconductor physics and covering state of the art device regimes from conventional micron to nanometer this text Presents industry standard models for bipolar junction transistors BJTs metal oxide semiconductor MOS field effect transistors FETs FinFETs and tunnel field effect transistors TFETs along with statistical MOS models Discusses the major issue of process variability which severely impacts device and circuit performance in advanced technologies and requires statistical compact models Promotes further research of the evolution and development of compact models for VLSI circuit design and analysis Supplies fundamental and practical knowledge necessary for efficient integrated circuit IC design using nanoscale devices Includes exercise problems at the end of each chapter and extensive references at the end of the book Compact Models for Integrated Circuit Design Conventional Transistors and Beyond is intended for senior undergraduate and graduate courses in electrical and electronics engineering as well as for researchers and practitioners working in the area of electron devices However even those

unfamiliar with semiconductor physics gain a solid grasp of compact modeling concepts from this book **Japanese**
Journal of Applied Physics ,2005

Whispering the Secrets of Language: An Psychological Quest through **Hot Carrier Design Considerations For Mos Devices And Circuits**

In a digitally-driven world where displays reign supreme and immediate interaction drowns out the subtleties of language, the profound strategies and mental subtleties concealed within words frequently get unheard. Yet, set within the pages of **Hot Carrier Design Considerations For Mos Devices And Circuits** a charming literary prize pulsating with organic feelings, lies an exceptional journey waiting to be undertaken. Penned by an experienced wordsmith, this marvelous opus encourages visitors on an introspective journey, softly unraveling the veiled truths and profound impact resonating within ab muscles material of every word. Within the psychological depths of the touching review, we will embark upon a sincere exploration of the book is core subjects, dissect their interesting writing design, and fail to the effective resonance it evokes heavy within the recesses of readers hearts.

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