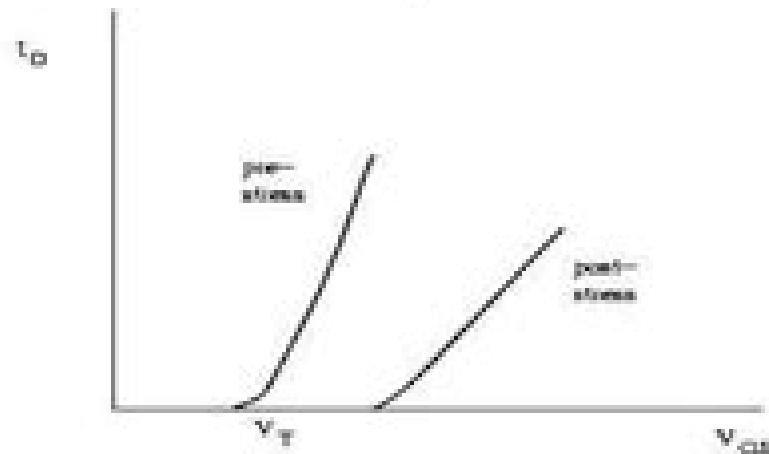
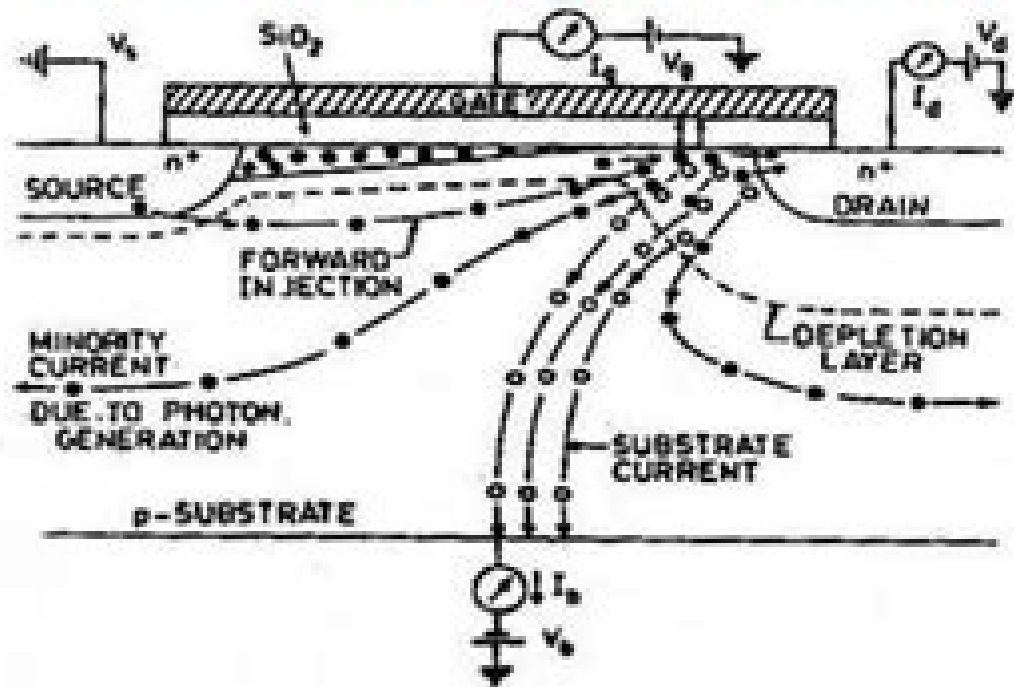


# Hot-Carrier Effects in MOS Devices



# Hot Carrier Effects In Mos Devices

**Eiji Takeda, Cary Y. Yang, Cary Y.-W.  
Yang, Akemi Miura-Hamada**



## **Hot Carrier Effects In Mos Devices:**

**Hot-Carrier Effects in MOS Devices** Eiji Takeda, Cary Y. Yang, Cary Y.-W. Yang, Akemi Miura-Hamada, 1995 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

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

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

*Two Dimensional Modeling of Hot Carrier Effects in MOS Devices* Rajat Rakkhit, 1988

*Ionizing Radiation Effects in MOS Devices and Circuits* T. P. Ma, Paul V. Dressendorfer, 1989-04-18 The first comprehensive overview describing the effects of ionizing radiation on MOS devices as well as how to design fabricate and test integrated circuits intended for use in a radiation environment Also addresses process induced radiation effects in the fabrication of high density circuits Reviews the history of radiation hard technology providing background information for those new to the field Includes a comprehensive review of the literature and an annotated listing of research activities in radiation hardness research

*Modeling and Simulation of Hot-carrier Effects in MOS Devices and Circuits* Peter Maurice Lee, 1990

**Modeling Hot-carrier Effects in MOS Devices Using Energy Balance Equations** Sai Krishna Mukundan, 1999

**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 **Reliability**

**Characterisation of Electrical and Electronic Systems**, 2014-12-24 This book takes a holistic approach to reliability engineering for electrical and electronic systems by looking at the failure mechanisms testing methods failure analysis characterisation techniques and prediction models that can be used to increase reliability for a range of devices The text describes the reliability behavior of electrical and electronic systems It takes an empirical scientific approach to reliability engineering to facilitate a greater understanding of operating conditions failure mechanisms and the need for testing for a more realistic characterisation After introducing the fundamentals and background to reliability theory the text moves on to describe the methods of reliability analysis and characterisation across a wide range of applications Takes a holistic approach to reliability engineering Looks at the failure mechanisms testing methods failure analysis characterisation techniques and prediction models that can be used to increase reliability Facilitates a greater understanding of operating conditions failure mechanisms and the need for testing for a more realistic characterisation *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 *Device and Circuit Cryogenic Operation for Low Temperature Electronics* Francis Balestra, G. Ghibaudo, 2013-11-11 Device and Circuit Cryogenic Operation for Low Temperature Electronics is a first in reviewing the performance and physical mechanisms of advanced devices and circuits at cryogenic temperatures that can be

used for many applications The first two chapters cover bulk silicon and SOI MOSFETs The electronic transport in the inversion layer the influence of impurity freeze out the special electrical properties of SOI structures the device reliability and the interest of a low temperature operation for the ultimate integration of silicon down to nanometer dimensions are described The next two chapters deal with Silicon Germanium and III V Heterojunction Bipolar Transistors as well as III V High Electron Mobility Transistors HEMT The basic physics of the SiGe HBT and its unique cryogenic capabilities the optimization of such bipolar devices and the performance of SiGe HBT BiCMOS technology at liquid nitrogen temperature are examined The physical effects in III V semiconductors at low temperature the HEMT and HBT static high frequency and noise properties and the comparison of various cooled III V devices are also addressed The next chapter treats quantum effect devices made of silicon materials The major quantum effects at low temperature quantum wires quantum dots as well as single electron devices and applications are investigated The last chapter overviews the performances of cryogenic circuits and their applications The low temperature properties and performance of inverters multipliers adders operational amplifiers memories microprocessors imaging devices circuits and systems sensors and read out circuits are analyzed Device and Circuit Cryogenic Operation for Low Temperature Electronics is useful for researchers engineers Ph D and M S students working in the field of advanced electron devices and circuits new semiconductor materials and low temperature electronics and physics

**CMOS VLSI Engineering** James B. Kuo, Ker-Wei Su, 2013-04-17 Silicon On Insulator SOI CMOS technology has been regarded as another major technology for VLSI in addition to bulk CMOS technology Owing to the buried oxide structure SOI technology offers superior CMOS devices with higher speed high density and reduced second order effects for deep submicron low voltage low power VLSI circuits applications In addition to VLSI applications and because of its outstanding properties SOI technology has been used to realize communication circuits microwave devices BICMOS devices and even fiber optics applications CMOS VLSI Engineering Silicon On Insulator addresses three key factors in engineering SOI CMOS VLSI processing technology device modelling and circuit designs are all covered with their mutual interactions Starting from the SOI CMOS processing technology and the SOI CMOS digital and analog circuits behaviors of the SOI CMOS devices are presented followed by a CAD program ST SPICE which incorporates models for deep submicron fully depleted mesa isolated SOI CMOS devices and special purpose SOI devices including polysilicon TFTs CMOS VLSI Engineering Silicon On Insulator is written for undergraduate senior students and first year graduate students interested in CMOS VLSI It will also be suitable for electrical engineering professionals interested in microelectronics

**FinFET Devices for VLSI Circuits and Systems** Samar K. Saha, 2020-07-15 To surmount the continuous scaling challenges of MOSFET devices FinFETs have emerged as the real alternative for use as the next generation device for IC fabrication technology The objective of this book is to provide the basic theory and operating principles of FinFET devices and technology an overview of FinFET device architecture and manufacturing processes and detailed formulation of FinFET

electrostatic and dynamic device characteristics for IC design and manufacturing. Thus this book caters to practicing engineers transitioning to FinFET technology and prepares the next generation of device engineers and academic experts on mainstream device technology at the nanometer nodes. *Comprehensive Semiconductor Science and Technology*, 2011-01-28

Semiconductors are at the heart of modern living. Almost everything we do be it work travel communication or entertainment all depend on some feature of semiconductor technology. Comprehensive Semiconductor Science and Technology Six Volume Set captures the breadth of this important field and presents it in a single source to the large audience who study make and exploit semiconductors. Previous attempts at this achievement have been abbreviated and have omitted important topics. Written and Edited by a truly international team of experts this work delivers an objective yet cohesive global review of the semiconductor world. The work is divided into three sections. The first section is concerned with the fundamental physics of semiconductors showing how the electronic features and the lattice dynamics change drastically when systems vary from bulk to a low dimensional structure and further to a nanometer size. Throughout this section there is an emphasis on the full understanding of the underlying physics. The second section deals largely with the transformation of the conceptual framework of solid state physics into devices and systems which require the growth of extremely high purity nearly defect free bulk and epitaxial materials. The last section is devoted to exploitation of the knowledge described in the previous sections to highlight the spectrum of devices we see all around us. Provides a comprehensive global picture of the semiconductor world. Each of the work s three sections presents a complete description of one aspect of the whole. Written and Edited by a truly international team of experts. **Low-Voltage SOI CMOS VLSI Devices and Circuits** James B. Kuo, Shih-Chia Lin, 2004-04-05

A practical comprehensive survey of SOI CMOS devices and circuits for microelectronics engineers. The microelectronics industry is becoming increasingly dependent on SOI CMOS VLSI devices and circuits. This book is the first to address this important topic with a practical focus on devices and circuits. It provides an up to date survey of the current knowledge regarding SOI device behaviors and describes state of the art low voltage CMOS VLSI analog and digital circuit techniques. Low Voltage SOI CMOS VLSI Devices and Circuits covers the entire field from basic concepts to the most advanced ideas. Topics include SOI device behavior fundamental and floating body effects hot carrier effects sensitivity reliability self heating breakdown ESD dual gate devices accumulation mode devices short channel effects and narrow channel effects. Low voltage SOI digital circuits floating body effects DRAM SRAM static logic dynamic logic gate array CPU frequency divider and DSP. Low voltage SOI analog circuits op amps filters ADC DAC sigma delta modulators RF circuits VCO mixers low noise amplifiers and high temperature circuits. With over 300 references to the state of the art and over 300 important figures on low voltage SOI CMOS devices and circuits this volume serves as an authoritative reliable resource for engineers designing these circuits in high tech industries. *Electronic Devices and Integrated Circuits* AJAY KUMAR SINGH, 2011-11-04

This book now in its Second Edition provides a basis for understanding the characteristics working

principle operation and limitations of semi conductor devices In this new edition many sections are re written to present the concepts related to device physics in more clearer and easy to understand manner The primary objective of this textbook is to provide all the relevant topics on the semiconductor materials and semiconductor devices in a single volume It includes enough mathematical expressions to provide a good foundation for the basic understanding of the semiconductor devices It covers not only the state of the art devices but also future approaches that go beyond the current technology Designed primarily as a text for the postgraduate students of physics and electronics the book would also be useful for the undergraduate students of electronics and electrical engineering and electronics and communication engineering Highlights of the Book Includes topics on the latest technologies Covers important points in each chapter Provides a number of solved and unsolved problems along with explanation type questions Emphasizes on the mathematical derivation

**Advanced CMOS Process Technology** J Pimbley, 2012-12-02 Advanced CMOS Process Technology is part of the VLSI Electronics Microstructure Science series The main topic of this book is complementary metal oxide semiconductor or CMOS technology which plays a significant part in the electronics systems The topics covered in this book range from metallization isolation techniques reliability and yield The volume begins with an introductory chapter that discusses the microelectronics revolution of the 20th century Then Chapter 2 puts focus on the CMOS devices and circuit background discussing CMOS capacitors and field effect transistors Metallization topics and concepts are covered in Chapter 3 while isolation techniques are tackled in Chapter 4 Long term reliability of CMOS is the topic covered in Chapter 5 Finally the ability of semiconductor technology to yield circuits is discussed in Chapter 6 The book is particularly addressed to engineers scientists and technical managers

**Reliability and Failure of Electronic Materials and Devices** Milton Ohring, Lucian Kasprzak, 2014-10-14 Reliability and Failure of Electronic Materials and Devices is a well established and well regarded reference work offering unique single source coverage of most major topics related to the performance and failure of materials used in electronic devices and electronics packaging With a focus on statistically predicting failure and product yields this book can help the design engineer manufacturing engineer and quality control engineer all better understand the common mechanisms that lead to electronics materials failures including dielectric breakdown hot electron effects and radiation damage This new edition adds cutting edge knowledge gained both in research labs and on the manufacturing floor with new sections on plastics and other new packaging materials new testing procedures and new coverage of MEMS devices Covers all major types of electronics materials degradation and their causes including dielectric breakdown hot electron effects electrostatic discharge corrosion and failure of contacts and solder joints New updated sections on failure physics on mass transport induced failure in copper and low k dielectrics and on reliability of lead free reduced lead solder connections New chapter on testing procedures sample handling and sample selection and experimental design Coverage of new packaging materials including plastics and composites

*Semiconductor Devices* Amal Banerjee, 2023-10-16 This book examines in detail how a



semiconductor device is designed and fabricated to satisfy best the requirements of the target application The author presents and explains both basic and state of art semiconductor industry standards used in large small signal equivalent circuit models for semiconductor devices that electronics engineers routinely use in their design calculations The presentation includes detailed step by step information on how a semiconductor device is fabricated and the very sophisticated supporting technologies used in the process flow The author also explains how standard laboratory equipment can be used to extract useful performance metrics of a semiconductor device

**Silicon-Based Material and Devices, Two-Volume Set** Hari Singh Nalwa, 2001-06-13 This book covers a broad spectrum of the silicon based materials and their device applications This book provides a broad coverage of the silicon based materials including different kinds of silicon related materials their processing spectroscopic characterization physical properties and device applications This two volume set offers a selection of timely topics on silicon materials namely those that have been extensively used for applications in electronic and photonic technologies The extensive reference provides broad coverage of silicon based materials including different types of silicon related materials their processing spectroscopic characterization physical properties and device applications Fourteen chapters review the state of the art research on silicon based materials and their applications to devices This reference contains a subset of articles published in AP s recently released Handbook of Advanced Electronic and Photonic Materials and Devices 2000 ISBN 012 5137451 ten volumes by Dr Hari Nalwa This two volume work strives to present a highly coherent coverage of silicon based material uses in the vastly dynamic arena of silicon chip research and technology Key Features Covers silicon based materials and devices Include types of materials their processing fabrication physical properties and device applications Role of silicon based materials in electronic and photonic technology A very special topic presented in a timely manner and in a format

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web remove from heat add apricots and let sit at least 15 minutes heat oven to 325 degrees in a tagine dutch oven or heavy bottomed pot with a tightfitting lid warm 2 tablespoons oil over medium heat until hot working in batches add lamb to pot leaving room around each piece this will help them brown

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web jun 16 2020 christine benlafquih distribute some of the spice mixture over the meat and onions you can use up to 2 3 of the mixture at this step concentrating the seasoning on the onions so the spices will meld with the oil and liquids to make a rich flavorful sauce the reserved spices will be used to season the vegetables