

Mosfet Modeling For Vlsi Simulation Theory And Practice

MOSFET Models for VLSI Circuit Simulation Mosfet Modeling for VLSI Simulation Simulation of Semiconductor Devices and Processes, Vol. 5 Simulation of Semiconductor Devices and Processes Multigrid Methods for Process Simulation Latest Advances in Electrothermal Models Technology CAD Systems Soft Errors Electronics IEEE International Conference on Electronics, Circuits and Systems Simulation in Research and Development Circuit Theory and Design Catalog PSEUDO-BOOLEAN LOGIC CIRCUITS Digital Technical Journal of Digital Equipment Corporation BioMEMS and Nanotechnology Computational and Combinatorial Methods in Systems Theory The Summary of Engineering Research Modeling and Simulation Peterson's Graduate Programs in Engineering and Applied Sciences, 1996 Narain D. Arora Narain Arora Siegfried Selberherr Siegfried Selberherr Wolfgang Joppich Krzysztof Głrecki Franz Fasching Jean-Luc Autran Michael Olorunfunmi Kolawole International Association for Mathematics and Computers in Simulation R. Boite University of Colorado Boulder John P. Hayes Christopher I. Byrnes University of Illinois at Urbana-Champaign. Office of Engineering Publications Peterson's Guides MOSFET Models for VLSI Circuit Simulation Mosfet Modeling for VLSI Simulation Simulation of Semiconductor Devices and Processes, Vol. 5 Simulation of Semiconductor Devices and Processes Multigrid Methods for Process Simulation Latest Advances in Electrothermal Models Technology CAD Systems Soft Errors Electronics IEEE International Conference on Electronics, Circuits and Systems Simulation in Research and Development Circuit Theory and Design Catalog PSEUDO-BOOLEAN LOGIC CIRCUITS Digital Technical Journal of Digital Equipment Corporation BioMEMS and Nanotechnology Computational and Combinatorial Methods in Systems Theory The Summary of Engineering Research Modeling and Simulation Peterson's Graduate Programs in Engineering and Applied Sciences, 1996 *Narain D. Arora Narain Arora Siegfried Selberherr Siegfried Selberherr Wolfgang Joppich Krzysztof Głrecki Franz Fasching Jean-Luc Autran Michael Olorunfunmi Kolawole International Association for Mathematics and Computers in Simulation R. Boite University of Colorado Boulder John P. Hayes Christopher I. Byrnes University of Illinois at Urbana-Champaign. Office of Engineering Publications Peterson's Guides*

metal oxide semiconductor mos transistors are the basic building block of mos integrated circuits i c very large scale integrated vlsi circuits using mos technology have emerged as the dominant technology in the semiconductor industry over the past decade the complexity of mos ic s has increased at an astonishing rate this is realized mainly through the reduction of mos transistor dimensions in addition to the improvements in processing today vlsi circuits with over 3 million transistors on a chip with effective or electrical channel lengths of 0.5 microns are in volume production designing such complex chips is virtually impossible without simulation tools which help to predict circuit behavior before actual circuits are fabricated however the utility of simulators as a tool for the design and analysis of circuits depends on the adequacy of the device models used in the simulator this problem is further aggravated by the technology trend towards smaller and smaller device dimensions which increases the complexity of the models there is extensive literature available on modeling these short channel devices however there is a lot of confusion too often it is not clear what model to use and which model parameter values are important and how to determine them after working over 15 years in the field of semiconductor device modeling i have felt the need for a book which can fill the gap between the theory and the practice of mos transistor modeling this book is an attempt in that direction

a reprint of the classic text this book popularized compact modeling of electronic and semiconductor devices and components for college and graduate school classrooms and manufacturing engineering over a decade ago the first comprehensive book on mos transistor compact modeling it was the most cited among similar books in the area and remains the most frequently cited today the coverage is device physics based and continues to be relevant to the latest advances in mos transistor modeling this is also the only book that discusses in detail how to measure device model parameters required for circuit simulations the book deals with the mos field effect transistor mosfet models that are derived from basic semiconductor theory various models are developed ranging from simple to more sophisticated models that take into account new physical effects observed in submicron transistors used in today s 1993 mos vlsi technology the assumptions used to arrive at the models are emphasized so that the accuracy of the models in describing the device characteristics are clearly understood due to the importance of designing reliable circuits device reliability models are also

covered understanding these models is essential when designing circuits for state of the art mos ics

the fifth international conference on simulation of semiconductor devices and processes sisdep 93 continues a series of conferences which was initiated in 1984 by k board and d r j owen at the university college of wales swansea where it took place a second time in 1986 its organization was succeeded by g baccarani and m rudan at the university of bologna in 1988 and w fichtner and d aemmer at the federal institute of technology in zurich in 1991 this year the conference is held at the technical university of vienna austria september 7 9 1993 this conference shall provide an international forum for the presentation of out standing research and development results in the area of numerical process and de vice simulation the miniaturization of today s semiconductor devices the usage of new materials and advanced process steps in the development of new semiconduc tor technologies suggests the design of new computer programs this trend towards more complex structures and increasingly sophisticated processes demands advanced simulators such as fully three dimensional tools for almost arbitrarily complicated geometries with the increasing need for better models and improved understand ing of physical effects the conference on simulation of semiconductor devices and processes brings together the simulation community and the process and device en gineers who need reliable numerical simulation tools for characterization prediction and development

it was about 1985 when both of the authors started their work using multigrid methods for process simulation problems this happened in dependent from each other with a completely different background and different intentions in mind at this time some important monographs appeared or have been in preparation there are the three classical ones from our point of view the so called 1984 guide 12j by brandt the multi grid methods and applications 49j by hackbusch and the so called fundamentals 132j by stiiben and trottenberg stiiben and trottenberg in 132j state a delayed acceptance resent ments with respect to multigrid algorithms they complain nevertheless even today s situation is still unsatisfactory in several respects if this is true for the development of standard methods it applies all the more to the area of really difficult complex applications in spite of all the above mentioned publications and without ignoring important theoretical and practical improvements of multigrid this situa tion has not yet changed dramatically this statement is made under the condition that a numerical principle like multigrid is accepted if there exist professional programs for research and production purposes professional in this context stands for solving complex technical prob lems in an industrial environment by a large community of users such a use demands not only for fast solution methods but also requires a high robustness with respect to the physical parameters of the problem

this book is devoted to the latest advances in the area of electrothermal modelling of electronic components and networks it contains eight sections by different teams of authors these sections contain the results of a electro thermal simulations of sic power mosfets using a spice like simulation program b modelling thermal properties of inductors taking into account the influence of the core volume on the efficiency of heat removal c investigations into the problem of inserting a temperature sensor in the neighbourhood of a chip to monitor its junction temperature d computations of the internal temperature of power leds situated in modules containing multiple power leds taking into account both self heating in each power led and mutual thermal couplings between each diode e analyses of dc dc converters using the electrothermal averaged model of the diode transistor switch including an igbt and a rapid switching diode f electrothermal modelling of sic power bjts g analysis of the efficiency of selected algorithms used for solving heat transfer problems at nanoscale h analysis related to thermal simulation of the test structure dedicated to heat diffusion investigation at the nanoscale

as the cost of developing new semiconductor technology at ever higher bit gate densities continues to grow the value of using accurate tcad simu lation tools for design and development becomes more and more of a necessity to compete in today s business the ability to tradeoff wafer starts in an advanced piloting facility for simulation analysis and optimization utilizing a virtual fab s w tool set is a clear economical asset for any semiconductor development company consequently development of more sophisticated accurate physics based and easy to use device and process modeling tools will receive continuing attention over the coming years the cost of maintaining and paying for one s own internal modeling tool development effort however has caused many semiconductor development companies to consider replacing some or all of their internal tool development effort with the purchase of vendor modeling tools while some notably larger companies have insisted on maintaining their own internal modeling tool development organization others have elected to depend totally on the tools offered by the tcad vendors and have consequently reduced their mod eling staffs to a bare minimal support function others are seeking to combine the best of their internally developed tool suite with robust proven tools provided by the vendors hoping to achieve a certain synergy as well as

savings through this approach in the following sections we describe ibm s internally developed suite of tcad modeling tools and show several applications of the use of these tools

soft errors are a multifaceted issue at the crossroads of applied physics and engineering sciences soft errors are by nature multiscale and multiphysics problems that combine not only nuclear and semiconductor physics material sciences circuit design and chip architecture and operation but also cosmic ray physics natural radioactivity issues particle detection and related instrumentation soft errors from particles to circuits addresses the problem of soft errors in digital integrated circuits subjected to the terrestrial natural radiation environment one of the most important primary limits for modern digital electronic reliability covering the fundamentals of soft errors as well as engineering considerations and technological aspects this robust text discusses the basics of the natural radiation environment particle interactions with matter and soft error mechanisms details instrumentation developments in the fields of environment characterization particle detection and real time and accelerated tests describes the latest computational developments modeling and simulation strategies for the soft error rate estimation in digital circuits explores trends for future technological nodes and emerging devices soft errors from particles to circuits presents the state of the art of this complex subject providing comprehensive knowledge of the complete chain of the physics of soft errors the book makes an ideal text for introductory graduate level courses offers academic researchers a specialized overview and serves as a practical guide for semiconductor industry engineers or application engineers

this book gives clear explanations of the technical aspects of electronics engineering from basic classical device formulations to the use of nanotechnology to develop efficient quantum electronic systems as well as being up to date this book provides a broader range of topics than found in many other electronics books this book is written in a clear accessible style and covers topics in a comprehensive manner this book s approach is strongly application based with key mathematical techniques introduced helpful examples used to illustrate the design procedures and case studies provided where appropriate by including the fundamentals as well as more advanced techniques the author has produced an up to date reference that meets the requirements of electronics and communications students and professional engineers features discusses formulation and classification of integrated circuits develops a hierarchical structure of functional logic blocks to build more complex digital logic circuits outlines the structure of transistors bipolar jfet mosfet or mos cmos their processing techniques their arrangement forming logic gates and digital circuits optimal pass transistor stages of buffered chain sources and types of noise and performance of designed circuits under noisy conditions explains data conversion processes choice of the converter types and inherent errors describes electronic properties of nanomaterials the crystallites size reduction effect and the principles of nanoscale structure fabrication outlines the principles of quantum electronics leading to the development of lasers masers reversible quantum gates and circuits and applications of quantum cells and fabrication methods including self assembly quantum dot cellular automata and tunneling superconducting circuits and describes quantum error correction techniques problems are provided at the end of each chapter to challenge the reader s understanding

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