Analysis And Simulation Of Semiconductor Devices

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Simulation of Submicron Semiconductor Devices Predictive Simulation of Semiconductor Processing Semiconductor Devices Explained Simulation of Semiconductor Processes and Devices 2001 Semiconductor Device Physics and Simulation Simulation of semiconductor devices and processes : proceedings of the International Conference. 5. Fifth International Conference on Simulation of Semiconductor Devices and Processes : held at the Technical University of Vienna, Austria, September 7-9, 1993 Semiconductor Modeling: *S. Selberherr Siegfried Selberherr Heiner Ryssel Fabrizio Bonani Siegfried Selberherr Roland Kircher Carlo Jacoboni C. Moglestue Simon Li Kevin M. Kramer M. Meyyappan Siegfried Selberherr Siegfried Selberherr Kazutaka Tomizawa Jaroslaw Dabrowski Ton J. Mouthaan Dimitris Tsoukalas J.S. Yuan International Conference on Simulation of Semiconductor Devices and Processes (5, 1993, Wien) Roy Leventhal*

the invention of semiconductor devices is a fairly recent one considering classical time scales in human life the bipolar transistor was announced in 1947 and the mos transistor in a practically usable manner was demonstrated in 1960 from these beginnings the semiconductor device field has grown rapidly the first integrated circuits which contained just a few devices became commercially available in the early 1960s immediately thereafter an evolution has taken place so that today less than 25 years later the manufacture of integrated circuits with over 400 000 devices per single chip is possible coincident with the growth in semiconductor device development the literature concerning semiconductor device and technology issues has literally exploded in the last decade about 50 000 papers have been published on these subjects the advent of so called very large scale integration vlsi has certainly revealed the need for a better understanding of basic device behavior the miniaturization of the single transistor which is the major prerequisite for vlsi nearly led to a breakdown of the classical models of semiconductor devices

sisdep 95 provides an international forum for the presentation of state of the art research and development results in the area of numerical process and device simulation continuously shrinking device dimensions the use of new materials and advanced processing steps in the manufacturing of semiconductor devices require new and improved software the trend towards increasing complexity in structures and process technology demands advanced models describing all basic effects and sophisticated two and three dimensional tools for almost arbitrarily designed geometries the book contains the latest results obtained by scientists from more than 20 countries on process simulation and modeling simulation of process equipment device modeling and simulation of novel devices

power semiconductors and sensors on device simulation and parameter extraction for circuit models practical application of simulation numerical methods and software

the design and optimization of electronic systems often requires appraisal an of the electrical noise generated by active devices and at a technological level the ability to properly design active elements in order to minimize when possible their noise examples of critical applications are of course receiver front ends in rf and optoelectronic transmission systems but also front end stages in sensors and in a completely different context nonlinear circuits such as oscillators mixers and frequency multipliers the rapid de velopment of silicon rf applications has recently fostered the interest toward low noise silicon devices for the lower microwave band such as low noise mos transistors at the same time the rf and microwave ranges are be coming increasingly important in fast optical communication systems thus high frequency noise modeling and simulation of both silicon and compound semiconductor based bipolar and field effect transistors can be considered as an important and timely topic this does not exclude of course low frequency noise which is relevant also in the rf and microwave ranges when ever it is up converted within a nonlinear system either autonomous as an oscillator or non autonomous as a mixer or frequency multiplier the aim of the present book is to provide a thorough introduction to the physics based numerical modeling of semiconductor devices operating both in small signal and in large signal conditions in the latter instance only the non autonomous case was considered and thus the present treatment does not directly extend to oscillators

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

this volume presents the application of the monte carlo method to the simulation of semiconductor devices reviewing the physics of transport in semiconductors followed by an introduction to the physics of semiconductor devices

particle simulation of semiconductor devices is a rather new field which has started to catch the interest of the world s scientific community it represents a time continuous solution of boltzmann s transport equation or its quantum mechanical equivalent and the field equation without encountering the usual numerical problems associated with the direct solution the technique is based on first physical principles by following in detail the transport histories of indi vidual particles and gives a profound insight into the physics of semiconductor devices the method can be applied to devices of any geometrical complexity and material composition it yields an accurate description of the device which is not limited by the assumptions made behind the alternative drift diffusion and hydrodynamic models which represent approximate solutions to the transport equation while the development of the particle modelling technique has been hampered in the past by the cost of computer time today this should not be held against using a method which gives a profound physical insight into individual devices and can be used to predict the properties of devices not yet manufactured employed in this way it can save the developer much time and large sums of money both important considerations for the laboratory which wants to keep abreast of the field of device research applying it to al ready existing electronic components may lead to novel ideas for their improvement the monte carlo particle simulation technique is applicable to microelectronic components of any arbitrary shape and complexity

technology computer aided design or tcad is critical to today s semiconductor technology and anybody working in this industry needs to know something about tcad this book is about how to use computer software to manufacture and test virtually semiconductor devices in 3d it brings to life the topic of semiconductor device physics with a hands on tutorial approach that de emphasizes abstract physics and equations and emphasizes real practice and extensive illustrations coverage includes a comprehensive library of devices representing the state of the art technology such as superjunction ldmos gan led devices etc

cd rom contains win32 version of sgframework and the simulations contains in the book

this book provides you with in depth coverage of the models governing equations and numerical techniques suitable for process simulation so you can give your designs the competitive edge you will understand the basic principles of transport phenomena gas phase and surface reactions in electronics material processing and learn practical numerical techniques used in process simulations

the sisdep 93 conference proceedings present outstanding research and development results in the area of numerical process and device simulation the miniaturization of today s semiconductor devices the usage of new materials and advanced process steps in the development of new semiconductor 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 understanding of physical effects these proceedings support the simulation community and the process and device engineers who need reliable numerical simulation tools for characterization prediction and development this book covers the following topics process simulation and equipment modeling device modeling and simulation of complex structures device simulation and parameter extraction for circuit models integration of process device and circuit simulation practical applications of simulation algorithms and software

describes the basic theory of carrier transport develops numerical algorithms used for transport problems or device simulations and presents real world examples of implementation

predictive simulation of semiconductor processing enables researchers and developers to extend the scaling range of semiconductor devices beyond the parameter range of empirical research it requires a thorough understanding of the basic mechanisms employed in device fabrication such as diffusion ion implantation epitaxy defect formation and annealing and contamination this book presents an in depth discussion of our current understanding of key processes and identifies areas that require further work in order to achieve the goal of a comprehensive predictive process simulation tool

offers an innovative and accessible new approach to the teaching of the fundamentals of semiconductor components by exploiting simulation to explain

the mechanisms behind current in semiconductor structures simulation is a popular tool used by engineers and scientists in device and process research and the accompanying two dimensional process and device simulation software microtec enables students to make their own devices and allows the recreation of real performance under varying parameters there is also an accompanying ftp site containing icecream software integrated circuits and electronics group computerized remedial education and mastering which improves understanding of the physics involved and covers semiconductor physics junction diodes silicon bipolar and mos transistors and photonic devices like leds and lasers features include microtec diskette containing a two dimensional process and device simulator on which the many simulation exercises mentioned in the text can be performed thereby facilitating learning through experimentation computer aided education software accessible vita ftp featuring question and answer games which enables students to enhance their understanding of the physics involved and allows lecturers to set assignments broad coverage spanning the common devices pn junctions metal semiconductor junctions photocells lasers bipolar transistors and mos transistors discussion of fundamental concepts and technological principles offering the student a valuable grounding in semiconductor physics examination of the implications of recent research on small dimensions reliability problems and breakdown mechanisms semiconductor devices explained offers a comprehensive new approach to teaching the fundamentals of semiconductor components based on the use of the accompanying process and device simulation software simulation is a popular tool used by engineers and scientists in device and process research it supports the understanding of basic phenomena by linking the theory to hands on applications and real world problems with semiconductor devices throughout the text students are encouraged to augment their understanding by undertaking simulations and creating their own devices the icecream programme integrated circuits and electronics group computerized remedial education and mastering question and answer game leads students through the concepts of common devices and makes learning fun there is also a self test element in which a data bank generates questions on the fundamentals of semiconductor junctions enabling students to assess their progress larger projects suitable for use as examination assignments are also incorporated the test package is freely available to lecturers from the author on request the remedial component of icecream is available from the wiley ftp site microtec comes on a disk in the back of the book

this volume contains the proceedings of the international conference on

simulation of semiconductor devices and processes sispad 01 held on september 5 7 2001 in athens the conference provided an open forum for the presentation of the latest results and trends in process and device simulation the trend towards shrinking device dimensions and increasing complexity in process technology demands the continuous development of advanced models describing basic physical phenomena involved new simulation tools are developed to complete the hierarchy in the technology computer aided design simulation chain between microscopic and macroscopic approaches the conference program featured 8 invited papers 60 papers for oral presentation and 34 papers for poster presentation selected from a total of 165 abstracts from 30 countries around the world these papers disclose new and interesting concepts for simulating processes and devices

the advent of the microelectronics technology has made ever increasing numbers of small devices on a same chip the rapid emergence of ultra large scaled integrated ulsi technology has moved device dimension into the sub quarter micron regime and put more than 10 million transistors on a single chip while traditional closed form analytical models furnish useful intuition into how semiconductor devices behave they no longer provide consistently accurate results for all modes of operation of these very small devices the reason is that in such devices various physical mechanisms affect the device performance in a complex manner and the conventional assumptions i e one dimensional treatment low level injection quasi static approximation etc em ployed in developing analytical models become questionable thus the use of numerical device simulation becomes important in device modeling researchers and engineers will rely even more on device simulation for device design and analysis in the future this book provides comprehensive coverage of device simulation and analysis for various modem semiconductor devices it will serve as a reference for researchers engineers and students who require in depth up to date information and understanding of semiconductor device physics and characteristics the materials of the book are limited to conventional and mainstream semiconductor devices photonic devices such as light emitting and laser diodes are not included nor does the book cover device modeling device fabrication and circuit applications

semiconductor modeling for simulating signal power and electromagnetic integrity assists engineers both recent graduates and working product designers in designing high speed circuits the authors apply circuit theory circuit simulation tools and practical experience to help the engineer understand semiconductor modeling as applied to high speed digital designs the emphasis is

on semiconductor modeling with pcb transmission line effects equipment enclosure effects and other modeling issues discussed as needed the text addresses many practical considerations including process variation model accuracy validation and verification signal integrity and design flow readers will benefit from its survey of modeling for semiconductors packages and interconnects along with usable advice on how to get complex high speed prototypes to work on the first try highlights include presents a very complete and well balanced treatment of modeling of semiconductors packages and interconnects facilitates reader comprehension of the whole field of high speed modeling including digital and rf circuits combines practical modeling techniques with the latest eda tools for simulation and successful high speed digital design facilitates resolution of practical every day problems presents modeling from its historical roots to current state of the art facilitates keeping abreast of the latest modeling developments as they continue to unfold

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