

Simon Li · Yue Fu

3D TCAD Simulation for Semiconductor Processes, Devices and Optoelectronics

 Springer

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Joachim Piprek



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3D TCAD Simulation for Semiconductor Processes, Devices and Optoelectronics Simon Li, Suihua Li, 2011-10-01
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. *Handbook of Optoelectronic Device Modeling and Simulation* Joachim Piprek, 2017-10-10
Optoelectronic devices are now ubiquitous in our daily lives from light emitting diodes LEDs in many household appliances to solar cells for energy. This handbook shows how we can probe the underlying and highly complex physical processes using modern mathematical models and numerical simulation for optoelectronic device design analysis and performance optimization. It reflects the wide availability of powerful computers and advanced commercial software which have opened the door for non-specialists to perform sophisticated modeling and simulation tasks. The chapters comprise the know-how of more than a hundred experts from all over the world. The handbook is an ideal starting point for beginners but also gives experienced researchers the opportunity to renew and broaden their knowledge in this expanding field. **Advanced Field-Effect Transistors** Dharmendra Singh Yadav, Shiromani Balmukund Rahi, Sukeshni Tirkey, 2023-12-22
Advanced Field Effect Transistors Theory and Applications offers a fresh perspective on the design and analysis of advanced field effect transistor FET devices and their applications. The text emphasizes both fundamental and new paradigms that are essential for upcoming advancement in the field of transistors beyond complementary metal oxide semiconductors CMOS. This book uses lucid intuitive language to gradually increase the comprehension of readers about the key concepts of FETs including their theory and applications. In order to improve readers learning opportunities Advanced Field Effect Transistors Theory and Applications presents a wide range of crucial topics: Design and challenges in tunneling FETs. Various modeling approaches for FETs. Study of organic thin film transistors. Biosensing applications of FETs. Implementation of memory and logic gates with FETs. The advent of low power semiconductor devices and related implications for upcoming technology nodes provide valuable insight into low power devices and their applicability in wireless biosensing and circuit aspects. As a result researchers are constantly looking for new semiconductor devices to meet consumer demand. This book gives more details about all aspects of the low power technology including ongoing and prospective circumstances with fundamentals of FET devices as well as sophisticated low power applications. **CMOSET 2012 VLSI Circuits Devices and Technologies Track Presentation Slides** CMOS Emerging Technologies Research, **Computer Aided Design Of Micro- And Nanoelectronic Devices** Chinmay Kumar Maiti, 2016-10-27
Micro and nanoelectronic devices are the prime movers for

electronics which is essential for the current information age This unique monograph identifies the key stages of advanced device design and integration in semiconductor manufacturing It brings into one resource a comprehensive device design using simulation The book presents state of the art semiconductor device design using the latest TCAD tools Professionals researchers academics and graduate students in electrical electronic engineering and microelectronics will benefit from this reference text

Differentiated Layout Styles for MOSFETs Salvador Pinillos Gimenez,Egon Henrique Salerno Galembeck,2023-05-05 This book describes in detail the semiconductor physics and the effects of the high temperatures and ionizing radiations in the electrical behavior of the Metal Oxide Semiconductor Field Effect Transistors MOSFETs implemented with the first and second generations of the differentiated layout styles The authors demonstrate a variety of innovative layout styles for MOSFETs enabling readers to design analog and RF MOSFETs that operate in a high temperature wide range and an ionizing radiation environment with high electrical performance and reduced die area

Parasitic Substrate Coupling in High Voltage Integrated Circuits Pietro Buccella,Camillo Stefanucci,Maher Kayal,Jean-Michel Sallese,2018-03-14 This book introduces a new approach to model and predict substrate parasitic failures in integrated circuits with standard circuit design tools The injection of majority and minority carriers in the substrate is a recurring problem in smart power ICs containing high voltage high current switching devices besides sensitive control protection and signal processing circuits The injection of parasitic charges leads to the activation of substrate bipolar transistors This book explores how these events can be evaluated for a wide range of circuit topologies To this purpose new generalized devices implemented in Verilog A are used to model the substrate with standard circuit simulators This approach was able to predict for the first time the activation of a latch up in real circuits through post layout SPICE simulation analysis Discusses substrate modeling and circuit level simulation of parasitic bipolar device coupling effects in integrated circuits Includes circuit back annotation of the parasitic lateral n p n and vertical p n p bipolar transistors in the substrate Uses Spice for simulation and characterization of parasitic bipolar transistors latch up of the parasitic p n p n structure and electrostatic discharge ESD protection devices Offers design guidelines to reduce couplings by adding specific protections

Introducing Technology Computer-Aided Design (TCAD) Chinmay K. Maiti,2017-03-16 This might be the first book that deals mostly with the 3D technology computer aided design TCAD simulations of major state of the art stress and strain engineered advanced semiconductor devices MOSFETs BJTs HBTs nonclassical MOS devices finFETs silicon germanium hetero FETs solar cells power devices and memory devices The book focuses on how to set up 3D TCAD simulation tools from mask layout to process and device simulation including design for manufacturing DFM and from device modeling to SPICE parameter extraction The book also offers an innovative and new approach to teaching the fundamentals of semiconductor process and device design using advanced TCAD simulations of various semiconductor structures The simulation examples chosen are from the most popular devices in use today and provide useful technology and device physics insights To extend

the role of TCAD in today's advanced technology era process compact modeling and DFM issues have been included for design technology interface generation Unique in approach this book provides an integrated view of silicon technology and beyond with emphasis on TCAD simulations It is the first book to provide a web based online laboratory for semiconductor device characterization and SPICE parameter extraction It describes not only the manufacturing practice associated with the technologies used but also the underlying scientific basis for those technologies Written from an engineering standpoint this book provides the process design and simulation background needed to understand new and future technology development process modeling and design of nanoscale transistors The book also advances the understanding and knowledge of modern IC design via TCAD improves the quality in micro and nanoelectronics R D and supports the training of semiconductor specialists It is intended as a textbook or reference for graduate students in the field of semiconductor fabrication and as a reference for engineers involved in VLSI technology development who have to solve device and process problems CAD specialists will also find this book useful since it discusses the organization of the simulation system in addition to presenting many case studies where the user applies TCAD tools in different situations

Simulation of Semiconductor Devices and Processes Heiner Ryssel, Peter Pichler, 2012-12-06 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

Simulation of Semiconductor Devices and Processes, Vol. 5 Siegfried Selberherr, Hannes Stippel, Ernst Strasser, 1993 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

Simulation of Semiconductor Devices and Processes, Vol. 6 Heiner Ryssel, Peter Pichler, 1995 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

Simulation of Semiconductor Processes and Devices 2007 Tibor Grasser, 2007-09-18 This volume contains the proceedings of the 12th International Conference on Simulation of Semiconductor Processes and Devices SISPAD 2007 held September 2007 in Vienna Austria It provides a global forum for the presentation and discussion of recent advances and developments in the theoretical description physical modeling and numerical simulation and analysis of semiconductor fabrication processes device operation and system performance

Simulation of Semiconductor Devices and Processes Heiner Ryssel, Peter Pichler, 1995 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

Recent Topics on Modeling of Semiconductor Processes, Devices, and Circuits Rasit Onur Topaloglu, Peng Li, 2011 The last couple of years have been very busy for the semiconductor industry and researchers The rapid speed of production channel length reduction has brought lithographic challenges to semiconductor modeling These include stress optimization transisto

Simulation of Semiconductor Processes and Devices, 2002 **Simulation of Semiconductor Processes and Devices 2001** Dimitris Tsoukalas, 2001-08-21 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.

TCAD Simulation Framework for the Study of TSV-device Interaction Krishnamurthy Yeleswarapu, 2013. With the reduction in transistor dimensions to a few tens of nanometers as a result of aggressive scaling, interconnect delay has now become one of the major bottlenecks to chip performance. Secondly, interconnect power and area have both become a significant part of the total chip power and area respectively. These concerns have led to an effort to find a solution that would reduce interconnect delay and leakage while also reducing the area they occupy in a chip so that either the chip area could be reduced or more functionality could be incorporated within a certain area. 3D integration, i.e., stacking of various sub systems of a chip on top of each other, enables chip makers to achieve higher packaging efficiencies, thereby reducing system cost while also reducing delay and thus increasing the available bandwidth. Through Silicon Vias (TSVs) have emerged as the key interconnect technology for 3D ICs as they enable significant reduction in delay and leakage compared to wire bonded dies while also occupying less area in a package. They also enable stacking of sub systems which differ in functionality and stacking of multiple dies. Also, unlike wire bond dies, need not be bandwidth limited by the number of wire bonds that can be made between two levels in a stack. While TSVs offer many advantages, one of the concerns when implementing a 3D system using TSVs is the mechanisms of interaction between a TSV and a device in its vicinity. Another concern is with regards to the interaction between the TSV and its surrounding material. The purpose of this thesis is to develop a TCAD framework for process and device co simulation of a TSV transistor system to study the various mechanisms of interaction between them as well as between the TSV and substrate. The utility of this tool has been demonstrated by studying two mechanisms of interaction: the effect of TSV induced stress and the effect of TSV device electrical coupling on the electrical performance of bulk NMOS and PMOS transistors. The results from 3D TCAD simulations suggest that designers can scale the keep out zone (KOZ) around TSVs more aggressively, allowing for more efficient utilization of silicon area without a drastic performance penalty.

Simulation of Semiconductor Devices and Processes K. Board, 1986

Technology Computer Aided Design for Si, SiGe and GaAs Integrated Circuits G.A. Armstrong, C.K. Maiti, 2007-11-30. The first book to deal with a broad spectrum of process and device design and modeling issues related to semiconductor devices, bridging the gap between device modelling and process design using TCAD. Presents a comprehensive perspective of emerging fields and covers topics ranging from materials to fabrication, devices modelling and applications. Aimed at research and development engineers and scientists involved in microelectronics technology and device design via Technology CAD and TCAD engineers and

developers

Simulation of Semiconductor Devices and Processes, Vol. 3 Giorgio Baccarani, Massimo Rudan, 1988

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