



# FEA SIMULATION OF SEMICONDUCTOR DEVICES

# Analysis And Simulation Of Semiconductor Devices

**Albrecht Möschwitz**



## **Analysis And Simulation Of Semiconductor Devices:**

Analysis and Simulation of Semiconductor Devices S. Selberherr, 2012-12-06 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

**Analysis and Simulation of Semiconductor Devices** Siegfried Selberherr, 1984 *Analysis and Simulation of Semiconductor Devices* S. Selberherr, 2011-12-30 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 *Analysis and Simulation of Semiconductor Devices*

S Selberherr, 1984-07-01 **Simulation of Semiconductor Devices and Processes, Vol. 5**

Siegfried Selberherr, Hannes Stippel, Ernst Strasser, 1993 **Simulation of Semiconductor Devices and Processes**

Siegfried Selberherr, Hannes Stippel, Ernst Strasser, 2012-12-06 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 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, the Conference on Simulation of Semiconductor Devices and Processes brings together the simulation community and the process and device engineers who need reliable numerical simulation tools for characterization, prediction, and development.

*Semiconductor Device Modelling* Christopher M. Snowden, 2012-12-06 Semiconductor device modelling has developed in recent years from being solely the domain of device physicists to span broader technological disciplines involved in device and electronic circuit design and development. The rapid emergence of very high speed, high density integrated circuit technology and the drive towards high speed communications has meant that extremely small scale device structures are used in contemporary designs. The characterisation and analysis of these devices can no longer be satisfied by electrical measurements alone. Traditional equivalent circuit models and closed form analytical models cannot always provide consistently accurate results for all modes of operation of these very small devices. Furthermore, the highly competitive nature of the semiconductor industry has led to the need to minimise development costs and lead time associated with introducing new designs. This has meant that there has been a greater demand for models capable of increasing our understanding of how these devices operate and capable of predicting accurate quantitative results. The desire to move towards computer-aided design and expert systems has reinforced the need for models capable of representing device operation under DC, small signal, large signal, and high frequency operation. It is also desirable to relate the physical structure of the device to the electrical performance. This demand for better models has led to the introduction of improved equivalent circuit models and a upsurge in interest in using physical models.

**Semiconductor Device Physics and Simulation** J.S. Yuan, Juin-Jei Liou, 2013-06-12 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. employed 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 modern 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 The Stationary Semiconductor Device Equations P.A. Markowich,2013-03-09 In the last two decades semiconductor device simulation has become a research area which thrives on a cooperation of physicists electrical engineers and mathematicians In this book the static semiconductor device problem is presented and analysed from an applied mathematician's point of view I shall derive the device equations as obtained for the first time by Van Roosbroeck in 1950 from physical principles present a mathematical analysis discuss their numerical solution by discretisation techniques and report on selected device simulation runs To me personally the most fascinating aspect of mathematical device analysis is that an interplay of abstract mathematics perturbation theory numerical analysis and device physics is prompting the design and development of new technology I very much hope to convey to the reader the importance of applied mathematics for technological progress Each chapter of this book is designed to be as self-contained as possible however the mathematical analysis of the device problem requires tools which cannot be presented completely here Those readers who are not interested in the mathematical methodology and rigor can extract the desired information by simply ignoring details and proofs of theorems Also at the beginning of each chapter I refer to textbooks which introduce the interested reader to the required mathematical concepts

**Analysis and Simulation of Heterostructure Devices** Vassil Palankovski,Rudiger Quay,2003-12-18 Semiconductor heterostructure devices such as Heterojunction Bipolar Transistors HBTs and High Electron Mobility Transistors HEMTs are among the fastest and most advanced high frequency devices The topic of this book is the physical modeling of modern submicron heterostructure devices In particular a detailed discussion of models and parameters for compound semiconductors is presented Based on the comprehensive modeling more than 25 simulation examples for several different types of Si Ge based GaAs based InP based and GaN based HEMTs and HBTs are shown in comparison with experimental data from state of the art devices Device specific optimization potentials are discussed systematically This book is of interest for device and circuit designers in semiconductor development and industry It is strongly recommended for advanced undergraduate and graduate students for researchers in the field of electrical engineering and solid state physics for TCAD users and developers and for researchers who are looking for practical application of their scientific work Introduction to Semiconductor Device Modelling Christopher M. Snowden,1998 This book deals mainly with physical device models which are developed from the carrier transport physics and device geometry considerations The text concentrates on silicon and gallium arsenide devices and includes models of silicon bipolar junction transistors junction field effect transistors JFETs MESFETs silicon and GaAs MESFETs transferred electron devices pn junction diodes and Schottky varactor diodes The

modelling techniques of more recent devices such as the heterojunction bipolar transistors HBT and the high electron mobility transistors are discussed This book contains details of models for both equilibrium and non equilibrium transport conditions The modelling Technique of Small scale devices is discussed and techniques applicable to submicron dimensioned devices are included A section on modern quantum transport analysis techniques is included Details of essential numerical schemes are given and a variety of device models are used to illustrate the application of these techniques in various fields

**Semiconductor Devices, Circuits, and Systems** Albrecht Möschtitzer,1991 Modern electronics is about implementing hardware functions in semiconductor chips and about the software that runs these semi conductor circuits Very large scale integration VLSI of electronic circuits and systems needs interdisciplinary work by device physicists process developers circuit designers design automation specialists and computer architects This book covers all these topics from semiconductor devices to systems in a compact manner The text outlines the latest advances in semiconductor devices for VLSI circuits but also includes simple and easy to use analytical models as well as results of device simulation The circuits part gives an overview of basic bi polar and field effect transistor gates and is mainly devoted to CMOS standard cells and functional blocks macrocells The systems part outlines the top down design style of digital systems mainly processors and memories using functional blocks described in the previous circuit part Finally some problems of testing and details of physical layout of chips are considered As background to this text introductory courses such as Electron Physics Electronic Devices and Circuits or Computer Engineering would be helpful

**Introduction to Device Modeling and Circuit Simulation** Tor A. Fjeldly,Trond Ytterdal,Michael S. Shur,1998 This book is a useful reference for practicing electrical engineers as well as a textbook for a junior senior or graduate level course in electrical engineering The authors combine two subjects device modeling and circuit simulation by providing a large number of well prepared examples of circuit simulations immediately following the description of many device models

**Analysis of Two-dimensional Steady-state and Transient Simulations of Semiconductor Devices** Ognjen Jovan Nastov,1991 **Mathematical Modelling and Simulation of Electrical Circuits and Semiconductor Devices** Randolph E. Bank,1994 Progress in today s high technology industries is strongly associated with the development of new mathematical tools A typical illustration of this partnership is the mathematical modelling and numerical simulation of electric circuits and semiconductor devices At the second Oberwolfach conference devoted to this important and timely field scientists from around the world mainly applied mathematicians and electrical engineers from industry and universities presented their new results Their contributions forming the body of this work cover electric circuit simulation device simulation and process simulation Discussions on experiences with standard software packages and improvements of such packages are included In the semiconductor area special lectures were given on new modelling approaches numerical techniques and existence and uniqueness results In this connection mention is made for example of mixed finite element methods an extension of the Baliga Patankar technique for a

three dimensional simulation and the connection between semiconductor equations and the Boltzmann equations

Microscale Heat Transfer Tim A. Ameel, Robert O. Warrington, 1994      **Nitride Semiconductor Devices** Joachim Piprek, 2007-04-09 This is the first book to be published on physical principles mathematical models and practical simulation of GaN based devices Gallium nitride and its related compounds enable the fabrication of highly efficient light emitting diodes and lasers for a broad spectrum of wavelengths ranging from red through yellow and green to blue and ultraviolet Since the breakthrough demonstration of blue laser diodes by Shuji Nakamura in 1995 this field has experienced tremendous growth worldwide Various applications can be seen in our everyday life from green traffic lights to full color outdoor displays to high definition DVD players In recent years nitride device modeling and simulation has gained importance and advanced software tools are emerging Similar developments occurred in the past with other semiconductors such as silicon where computer simulation is now an integral part of device development and fabrication This book presents a review of modern device concepts and models written by leading researchers in the field It is intended for scientists and device engineers who are interested in employing computer simulation for nitride device design and analysis      **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      Three-Dimensional Simulation of Semiconductor Devices Roland Kircher, Wolfgang Bergner, 2013-03-09      **IEEE Circuits & Devices** , 1991

## Unveiling the Magic of Words: A Overview of "**Analysis And Simulation Of Semiconductor Devices**"

In a world defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their power to kindle emotions, provoke contemplation, and ignite transformative change is really awe-inspiring. Enter the realm of "**Analysis And Simulation Of Semiconductor Devices**," a mesmerizing literary masterpiece penned with a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve into the book's central themes, examine its distinctive writing style, and assess its profound affect on the souls of its readers.

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