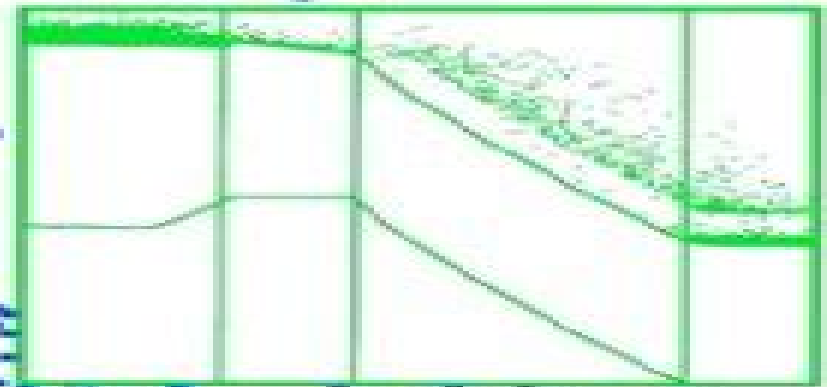


NUMERICAL SIMULATION OF SUBMICRON SEMICONDUCTOR DEVICES



KAZUTAKA TOMIZAWA

Numerical Simulation Of Submicron Semiconductor Devices Artech House Materials Science Library

Edwin Chihchuan Kan



Numerical Simulation Of Submicron Semiconductor Devices Artech House Materials Science Library:

Numerical Simulation of Submicron Semiconductor Devices Kazutaka Tomizawa, 1993-01-01 Describes the basic theory of carrier transport develops numerical algorithms used for transport problems or device simulations and presents real world examples of implementation *Computational Electronics* Dragica Vasileska, Stephen M. Goodnick, 2022-06-01 Computational Electronics is devoted to state of the art numerical techniques and physical models used in the simulation of semiconductor devices from a semi classical perspective Computational electronics as a part of the general Technology Computer Aided Design TCAD field has become increasingly important as the cost of semiconductor manufacturing has grown exponentially with a concurrent need to reduce the time from design to manufacture The motivation for this volume is the need within the modeling and simulation community for a comprehensive text which spans basic drift diffusion modeling through energy balance and hydrodynamic models and finally particle based simulation One unique feature of this book is a specific focus on numerical examples particularly the use of commercially available software in the TCAD community The concept for this book originated from a first year graduate course on computational electronics taught now for several years in the Electrical Engineering Department at Arizona State University Numerous exercises and projects were derived from this course and have been included The prerequisite knowledge is a fundamental understanding of basic semiconductor physics the physical models for various device technologies such as pn diodes bipolar junction transistors and field effect transistors **Introduction to the Physics of Electron Emission** Kevin L. Jensen, 2024-08-19 A practical in depth description of the physics behind electron emission physics and its usage in science and technology Electron emission is both a fundamental phenomenon and an enabling component that lies at the very heart of modern science and technology Written by a recognized authority in the field with expertise in both electron emission physics and electron beam physics An Introduction to Electron Emission provides an in depth look at the physics behind thermal field photo and secondary electron emission mechanisms how that physics affects the beams that result through space charge and emittance growth and explores the physics behind their utilization in an array of applications The book addresses mathematical and numerical methods underlying electron emission describing where the equations originated how they are related and how they may be correctly used to model actual sources for devices using electron beams Writing for the beam physics and solid state communities the author explores applications of electron emission methodology to solid state statistical and quantum mechanical ideas and concepts related to simulations of electron beams to condensed matter solid state and fabrication communities Provides an extensive description of the physics behind four electron emission mechanisms field photo and secondary and how that physics relates to factors such as space charge and emittance that affect electron beams Introduces readers to mathematical and numerical methods their origins and how they may be correctly used to model actual sources for devices using electron beams Demonstrates applications of electron methodology as well as quantum mechanical

concepts related to simulations of electron beams to solid state design and manufacture Designed to function as both a graduate level text and a reference for research professionals Introduction to the Physics of Electron Emission is a valuable learning tool for postgraduates studying quantum mechanics statistical mechanics solid state physics electron transport and beam physics It is also an indispensable resource for academic researchers and professionals who use electron sources model electron emission develop cathode technologies or utilize electron beams

Computational Modeling in Semiconductor Processing M. Meyyappan, 1995 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

Handbook of Nanostructured Materials and Nanotechnology, Five-Volume Set Hari Singh Nalwa, 1999-10-29 Nanostructured materials is one of the hottest and fastest growing areas in today's materials science field along with the related field of solid state physics Nanostructured materials and their based technologies have opened up exciting new possibilities for future applications in a number of areas including aerospace automotive x ray technology batteries sensors color imaging printing computer chips medical implants pharmacy and cosmetics The ability to change properties on the atomic level promises a revolution in many realms of science and technology Thus this book details the high level of activity and significant findings are available for those involved in research and development in the field It also covers industrial findings and corporate support This five volume set summarizes fundamentals of nano science in a comprehensive way The contributors enlisted by the editor are at elite institutions worldwide Key Features Provides comprehensive coverage of the dominant technology of the 21st century Written by 127 authors from 16 countries making this truly international First and only reference to cover all aspects of nanostructured materials and nanotechnology

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InP HBTs B. Jalali, S. J. Pearton, 1995 This work provides a comprehensive overview of current InP HBT technology and its applications Each chapter is written by a world renowned expert on topics including crystal growth processing physics modelling and digital and analog circuits

The British National Bibliography Arthur James Wells, 1994 **Subject Guide to Books in Print**, 1993 **Bulletin signalétique des télécommunications**, 1994-07

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

Simulation of Semiconductor Devices and Processes, Vol. 5 Siegfried Selberherr, Hannes Stippel, Ernst Strasser, 1993 The Physics of Submicron Semiconductor Devices (Nato Asi Series. Series B. Physics, Vol 180) Harold L. Grubin, David K. Ferry, C. Jacoboni, 1988

The papers contained in the volume represent lectures delivered as a 1983 NATO ASI held at Urbino Italy The lecture series was designed to identify the key submicron and ultrasubmicron device physics transport materials and contact issues Nonequilibrium transport quantum transport interfacial and size constraints issues were also highlighted The ASI was supported by NATO and the European Research Office H L Grubin D K Ferry C Jacoboni v CONTENTS MODELLING OF SUBMICRON DEVICES 1 E Constant BOLTZMANN TRANSPORT EQUATION 33 K Hess TRANSPORT AND MATERIAL CONSIDERATIONS FOR SUBMICRON DEVICES 45 H L Grubin EPITAXIAL GROWTH FOR SUB MICRON STRUCTURES 179 C E C Wood INSULATOR SEMICONDUCTOR INTERFACES 195 C W Wilms en THEORY OF THE ELECTRONIC STRUCTURE OF SEMICONDUCTOR SURFACES AND INTERFACES 223 C Calandra DEEP LEVELS AT COMPOUND SEMICONDUCTOR INTERFACES 253 W Monch ENSEMBLE MONTE CARLO TECHNIQUES 289 C Jacoboni NOISE AND DIFFUSION IN SUBMICRON STRUCTURES 323 L Reggiani SUPERLATTICES 361 K Hess SUBMICRON LITHOGRAPHY 373 C D W Wilkinson and S P Beaumont QUANTUM EFFECTS IN DEVICE STRUCTURES DUE TO SUBMICRON CONFINEMENT IN ONE DIMENSION 401 B D McCombe vii viii CONTENTS PHYSICS OF HETEROSTRUCTURES AND HETEROSTRUCTURE DEVICES 445 P J Price CORRELATION EFFECTS IN SHORT TIME NONSTATIONARY TRANSPORT 477 J J Niez DEVICE DEVICE INTERACTIONS 503 D K Ferry QUANTUM TRANSPORT AND THE WIGNER FUNCTION 521 G J Iafrate FAR INFRARED MEASUREMENTS OF VELOCITY OVERSHOOT AND HOT ELECTRON DYNAMICS IN SEMICONDUCTOR DEVICES 577 S J Allen Jr *Numerical Models for the Simulation of Nonstationary Effects in Submicron Semiconductor Devices* Edwin Chihchuan Kan, 1992 Numerical modeling of nonstationary transport effects using partial differential equations derived from the Boltzmann Transport Equation BTE is investigated Augmented drift diffusion ADD models and

improved energy transport ET models for submicron device simulation are constructed and numerically implemented Analytical derivation of the length coefficient for the ADD models is presented for both single and multi valley approximations Results of typical nsp n nsp ballistic diodes for Si and GaAs are presented The extension of the ADD model to two dimensions is then formulated and the implementation problems with the standard box integration method as used in conventional drift diffusion DD models are examined Improved ET models are derived from the zeroth and second moments of the Boltzmann transport equation and from the presumed function form of the even part of the distribution function Energy band nonparabolicity and non Maxwellian distribution effects are included to first order The ET models are amenable to an efficient self consistent discretization with standard techniques taking advantage of the similarity between current and energy flow equations Numerical results for ballistic diodes and MOSFETs are presented Typical spurious velocity overshoot spikes obtained in conventional hydrodynamics simulations of ballistic diodes are virtually eliminated By comparing the formulation of the ET and HD models we find that the spurious spike is caused by the momentum relaxation time approximation and the resulting form of the thermal diffusion terms Calculations based on a two carrier population model at the anode junction further confirm our analysis of the spurious spike

Simulation of semiconductor devices and processes ,1984 Numerical Simulation of Advanced Semiconductor Devices Mike Gault,1994 **The Physics of Submicron Semiconductor Devices** Harold L Grubin,David Ferry,C Jacoboni,2014-01-15 **Numerical Simulation of Advanced Semiconductor Devices** Mike Gault,1994 **Numerical Simulation of Semiconductor Devices** Franco Brezzi,Luisa Donatella Marini,Paola Pietra,1988 **Numerical Simulations of Semiconductor Devices by Streamline-Diffusion Methods** Xunlei Jiang,1995 Abstract Theoretical and practical aspects of the design and implementation of the streamline diffusion SD method for semiconductor device models are explored systematically Emphasis is placed on the hydrodynamic HD model which is computationally more challenging than the drift diffusion DD model but provides some important physical information missing in the DD model We devise a non symmetric SD method for device simulations This numerical method is uniformly used for the HD model including a proposed simplification SHD and the DD model An appropriate SD operator is derived for the general non symmetric convection diffusion system Linear stability analysis shows that our proposed numerical method is stable if the system can be symmetrized Stability arguments and numerical experiments also suggest that the combination of the method of lines and the semidiscrete SD method may not be appropriate for the transient problem a fact which often has been ignored in the literature An efficient method consistent with the SD method used for conservation laws is developed for the potential equation The method produces a more accurate electric field than the conventional Galerkin method Moreover it solves for the potential and electric field in a decoupled manner We apply our numerical method to the diode and MESFET devices Shocks for the diode in one and two space dimensions and the electron depletion near the gate for the MESFET in two space dimensions are simulated Model

comparisons are implemented We observe that the difference in solutions between the HD and DD models is significant The solution discrepancy between the full HD and SHD models is almost negligible in MESFET simulation as in many other engineering applications However an exceptional case is found in our experiments

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