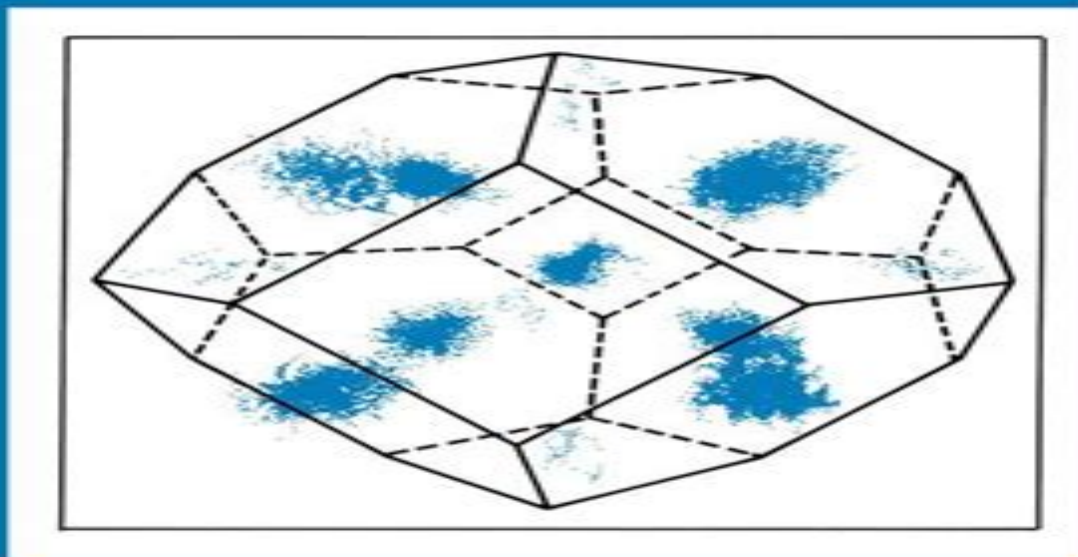


Monte Carlo Simulation of Semiconductor Devices



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The Monte Carlo Method for Semiconductor Device Simulation Carlo Jacoboni, Paolo Lugli, 1989-10-30 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 **The Monte Carlo**

Method for Semiconductor Device Simulation Carlo Jacoboni, Paolo Lugli, 2012-12-06 The application of the Monte Carlo method to the simulation of semiconductor devices is presented A review of the physics of transport in semiconductors is given followed by an introduction to the physics of semiconductor devices The Monte Carlo algorithm is discussed in great details and specific applications to the modelling of semiconductor devices are given A comparison with traditional simulators is also presented **Hierarchical Device Simulation** Christoph Jungemann, Bernd Meinerzhagen, 2003-06-05

This monograph is the first on physics based simulations of novel strained Si and SiGe devices It provides an in depth description of the full band monte carlo method for SiGe and discusses the common theoretical background of the drift diffusion hydrodynamic and Monte Carlo models and their synergy Monte Carlo Device Simulation Karl Hess, 2012-10-11 Monte Carlo simulation is now a well established method for studying semiconductor devices and is particularly well suited to highlighting physical mechanisms and exploring material properties Not surprisingly the more completely the material properties are built into the simulation up to and including the use of a full band structure the more powerful is the method Indeed it is now becoming increasingly clear that phenomena such as reliability related hot electron effects in MOSFETs cannot be understood satisfactorily without using full band Monte Carlo The IBM simulator DAMOCLES therefore represents a landmark of great significance DAMOCLES sums up the total of Monte Carlo device modeling experience of the past and reaches with its capabilities and opportunities into the distant future This book therefore begins with a description of the IBM simulator The second chapter gives an advanced introduction to the physical basis for Monte Carlo simulations and an outlook on why complex effects such as collisional broadening and intracollisional field effects can be important and how they can be included in the simulations References to more basic intro the book The third chapter ductory material can be found throughout describes a typical relationship of Monte Carlo simulations to experimental data and indicates a major difficulty the vast number of deformation potentials required to simulate transport throughout the entire Brillouin zone The fourth chapter addresses possible further extensions of the Monte Carlo approach and subtleties of the electron electron interaction **A Variance-reduced Electrothermal Monte Carlo Method for Semiconductor Device Simulation**

Orazio Muscato, Vincenza Di Stefano, Wolfgang Wagner, 2012 Monte Carlo Simulation of Semiconductor Devices C. Moglestue, 2013-04-17 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 individual 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 already 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

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

Advanced Physical Models for Silicon Device Simulation Andreas Schenk, 2012-12-06

Device simulation has two main purposes to understand and depict the physical processes in the interior of a device and to make reliable predictions of the behavior of an anticipated new device generation Towards these goals the quality of the physical models is decisive The introductory chapter of this book contains a critical review on models for silicon device simulators which rely on moments of the Boltzmann equation With reference to fundamental experimental and theoretical work an extensive collection of widely used models is discussed in terms of physical accuracy and application results This review shows that the quality and efficiency of the physical models which have been developed for the purpose of numerical simulation over the last three decades is sufficient for many applications Nevertheless the basic understanding of the microscopic processes as well as the uniqueness and accuracy of the models are still unsatisfactory Hence the following chapters of the book deal with the derivation of physics based models from a microscopic level also using new approaches of tailored quantum mechanics Each model is compared with experimental data and applied to a number of simulation examples The problems when starting from first

principles and making the models suitable for a device simulator will also be demonstrated We will show that demands for rapid computation and numerical robustness require a compromise between physical soundness and analytical simplicity and that the attainable accuracy is limited by the complexity of the problems Computational Aspects of VLSI Design with an Emphasis on Semiconductor Device Simulation Randolph E. Bank, 1990-02-15 Numerical simulation is rapidly becoming an important part of the VLSI design process allowing the engineer to test evaluate and optimize various aspects of chip design without resorting to the costly and time consuming process of fabricating prototypes This procedure not only accelerates the design process but also improves the end product since it is economically feasible to numerically simulate many more options than might otherwise be considered With the enhanced computing power of today's computers more sophisticated models are now being developed This volume contains the proceedings of the AMS SIAM Summer Seminar on Computational Aspects of VLSI Design held at the Institute for Mathematics and Its Applications at the University of Minnesota in the spring of 1987 The seminar featured presentations by some of the top experts working in this area Their contributions to this volume form an excellent overview of the mathematical and computational problems arising in this area **Computational Electronics** Karl Hess, J.P. Leburton, U. Ravaioli, 2013-03-14 Large computational resources are of ever increasing importance for the simulation of semiconductor processes devices and integrated circuits The Workshop on Computational Electronics was intended to be a forum for the discussion of the state of the art of device simulation Three major research areas were covered conventional simulations based on the drift diffusion and the hydrodynamic models Monte Carlo methods and other techniques for the solution of the Boltzmann transport equation and computational approaches to quantum transport which are relevant to novel devices based on quantum interference and resonant tunneling phenomena Our goal was to bring together researchers from various disciplines that contribute to the advancement of device simulation These include Computer Science Electrical Engineering Applied Physics and Applied Mathematics The success of this multidisciplinary formula was proven by numerous interactions which took place at the Workshop and during the following three day Short Course on Computational Electronics The format of the course including a number of tutorial lectures and the large attendance of graduate students stimulated many discussions and has proven to us once more the importance of cross fertilization between the different disciplines Intrinsic Point Defects, Impurities, and Their Diffusion in Silicon Peter Pichler, 2004-06-02 This book contains the first comprehensive review of intrinsic point defects impurities and their complexes in silicon Besides compiling the structures energetic properties identified electrical levels and spectroscopic signatures and the diffusion behaviour from investigations it gives a comprehensive introduction into the relevant fundamental concepts **Handbook of Integrated Circuit Industry** Yangyuan Wang, Min-Hwa Chi, Jesse Jen-Chung Lou, Chun-Zhang Chen, 2023-11-27 Written by hundreds of experts who have made contributions to both enterprise and academics research these excellent reference books provide all necessary knowledge of the whole industrial chain of

integrated circuits and cover topics related to the technology evolution trends fabrication applications new materials equipment economy investment and industrial developments of integrated circuits Especially the coverage is broad in scope and deep enough for all kind of readers being interested in integrated circuit industry Remarkable data collection update marketing evaluation enough working knowledge of integrated circuit fabrication clear and accessible category of integrated circuit products and good equipment insight explanation etc can make general readers build up a clear overview about the whole integrated circuit industry This encyclopedia is designed as a reference book for scientists and engineers actively involved in integrated circuit research and development field In addition this book provides enough guide lines and knowledges to benefit enterprisers being interested in integrated circuit industry Compound Semiconductor Device Modelling Christopher M. Snowden, Robert E. Miles, 2012-12-06 Compound semiconductor devices form the foundation of solid state microwave and optoelectronic technologies used in many modern communication systems In common with their low frequency counterparts these devices are often represented using equivalent circuit models but it is often necessary to resort to physical models in order to gain insight into the detailed operation of compound semiconductor devices Many of the earliest physical models were indeed developed to understand the unusual phenomena which occur at high frequencies Such was the case with the Gunn and IMPATI diodes which led to an increased interest in using numerical simulation methods Contemporary devices often have feature sizes so small that they no longer operate within the familiar traditional framework and hot electron or even quantum mechanical models are required The need for accurate and efficient models suitable for computer aided design has increased with the demand for a wider range of integrated devices for operation at microwave millimetre and optical frequencies The apparent complexity of equivalent circuit and physics based models distinguishes high frequency devices from their low frequency counterparts Over the past twenty years a wide range of modelling techniques have emerged suitable for describing the operation of compound semiconductor devices This book brings together for the first time the most popular techniques in everyday use by engineers and scientists The book specifically addresses the requirements and techniques suitable for modelling GaAs InP ternary and quaternary semiconductor devices found in modern technology *Nano-Electronic Devices* Dragica Vasileska, Stephen M. Goodnick, 2011-06-10 This book surveys the advanced simulation methods needed for proper modeling of state of the art nanoscale devices It systematically describes theoretical approaches and the numerical solutions that are used in explaining the operation of both power devices as well as nano scale devices It clearly explains for what types of devices a particular method is suitable which is the most critical point that a researcher faces and has to decide upon when modeling semiconductor devices The Drift Diffusion Equation and Its Applications in MOSFET Modeling Wilfried Hänsch, 2012-12-06 To be perfect does not mean that there is nothing to add but rather there is nothing to take away Antoine de Saint Exupery The drift diffusion approximation has served for more than two decades as the cornerstone for the numerical simulation of semiconductor devices However the tremendous speed in the

development of the semiconductor industry demands numerical simulation tools that are efficient and provide reliable results. This makes the development of a simulation tool an interdisciplinary task in which physics, numerical algorithms, and device technology merge. For the sake of an efficient code, there are trade-offs between the different influencing factors. The numerical performance of a program that is highly flexible in device types and the geometries it covers certainly cannot compare with a program that is optimized for one type of device only. Very often the device is sufficiently described by a two-dimensional geometry. This is the case in a MOSFET, for example, if the gate length is small compared with the gate width. In these cases, the geometry reduces to the specification of a two-dimensional device. Here again, the simplest geometries, which are planar or at least rectangular surfaces, will give the most efficient numerical codes. The device engineer has to decide whether this reduced description of the real device is still suitable for his purposes.

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

Theory and Simulation Methods for Electronic and Phononic Transport in Thermoelectric Materials Neophytos Neophytou, 2020-03-16
This book introduces readers to the state-of-the-art theoretical and simulation techniques for determining transport in complex band-structure materials and nanostructured geometry, linking the techniques developed by the electronic transport community to the materials science community. Starting from the semi-classical Boltzmann Transport Equation method for complex band-structure materials, then moving on to Monte Carlo and fully quantum mechanical models for nanostructured materials, the book addresses the theory and computational complexities of each method, as well as their advantages and capabilities. Presented in language that is accessible to junior computational scientists while including enough detail and depth with regards to numerical implementation to tackle modern research problems, it offers a valuable resource for computational scientists and postgraduate researchers whose work involves the theory and simulation of electro-thermal transport in advanced materials.

Topics in High Field Transport in Semiconductors Kevin F. Brennan, P. Paul Ruden, 2001-07-31
This book examines some of the charge carrier transport issues encountered in the field of modern semiconductor devices and novel materials. Theoretical approaches to the understanding and modeling of the relevant physical phenomena seen in devices that have

very small spatial dimensions and that operate under high electric field strength are described in papers written by leading experts and pioneers in this field In addition the book examines the transport physics encountered in novel materials such as wide band gap semiconductors GaN SiC etc as well as organic semiconductors Topics in High Field Transport in Semiconductors provides a comprehensive overview that will be beneficial to newcomers as well as engineers and researchers engaged in this exciting field

Applications of Silicon-Germanium Heterostructure Devices C.K

Maiti,G.A Armstrong,2001-07-20 The first book to deal with the design and optimization of transistors made from strained layers Applications of Silicon Germanium Heterostructure Devices combines three distinct topics technology device design and simulation and applications in a comprehensive way Important aspects of the book include key technology issues for the growth of st

Monte Carlo Method For Semiconductor Device Simulation The: Bestsellers in 2023 The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous engrossing novels captivating the hearts of readers worldwide. Lets delve into the realm of top-selling books, exploring the fascinating narratives that have enthralled audiences this year. Monte Carlo Method For Semiconductor Device Simulation The : Colleen Hoover's "It Ends with Us" This touching tale of love, loss, and resilience has gripped readers with its raw and emotional exploration of domestic abuse. Hoover expertly weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. Uncover the Best : Taylor Jenkins Reid's "The Seven Husbands of Evelyn Hugo" This spellbinding historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reid's compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens' "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens crafts a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting. These bestselling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of compelling stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a brilliant and suspenseful novel that will keep you guessing until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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