

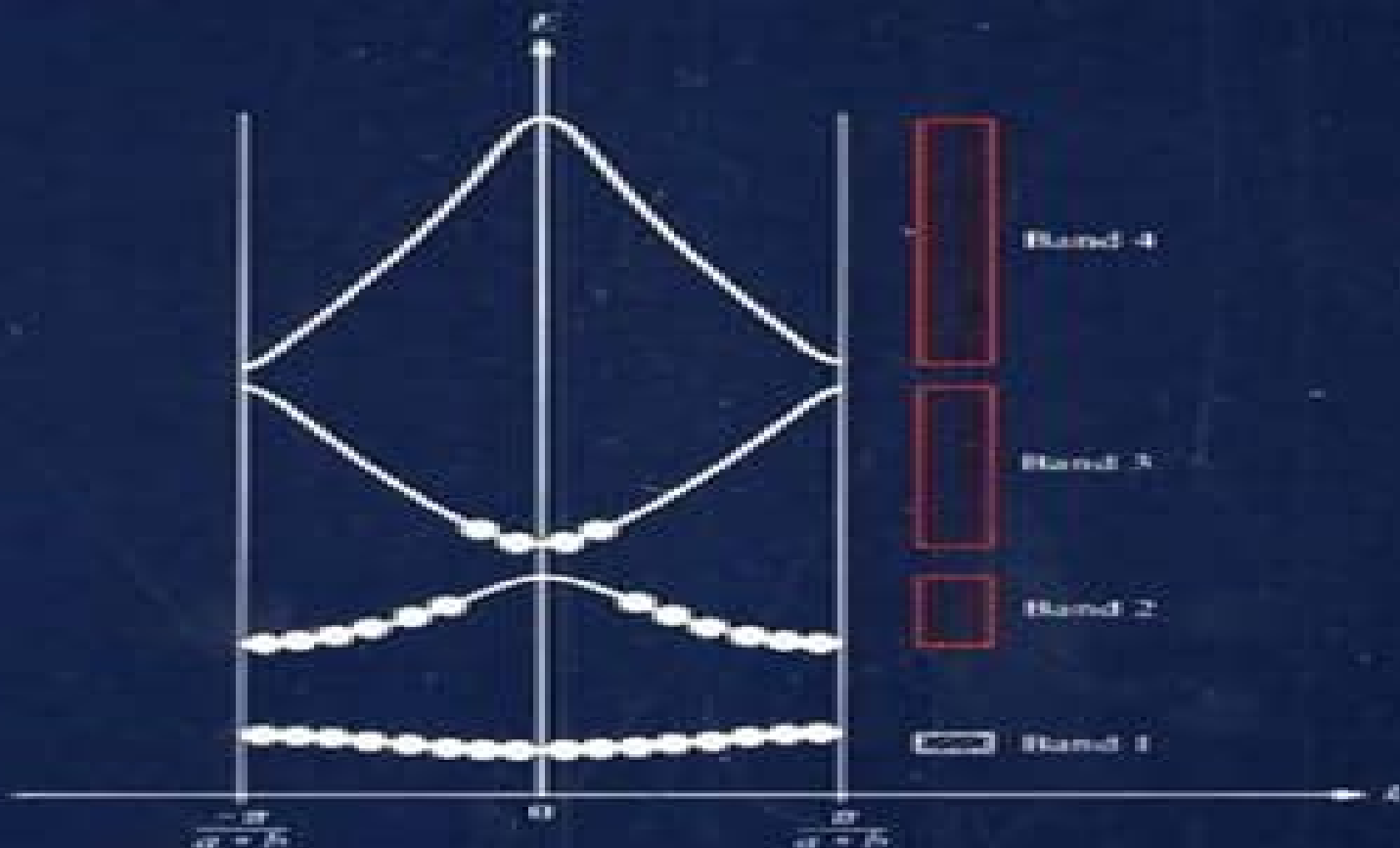
VOLUME VI

MODULAR SERIES ON SOLID STATE DEVICES

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Advanced Semiconductor Fundamentals

Robert F. Pierret



Solid State Devices Vol

Institute of Radio Engineers



Solid State Devices Vol :

Modular Series on Solid State Devices Robert F. Pierret, 1983 *Solid State Devices* , 1975 **Physics Of Semiconductor Devices - Proceedings Of The Fourth International Workshop** S Radhakrishna, S C Jain, 1987-12-01

This volume compiles the papers presented at the conference which cover the various facets of semiconductor research with emphasis on microelectronics VLSI and special aspects related to semiconductor applications There are four sections Microelectronics Materials Photovoltaics and Gallium Arsenide Devices *Nondestructive Evaluation of Semiconductor Materials and Devices* J. Zemel, 2013-11-11 From September 19 29 a NATO Advanced Study Institute on Non destructive Evaluation of Semiconductor Materials and Devices was held at the Villa Tuscolano in Frascati Italy A total of 80 attendees and lecturers participated in the program which covered many of the important topics in this field The subject matter was divided to emphasize the following different types of problems electrical measurements acoustic measurements scanning techniques optical methods backscatter methods x ray observations accelerated life tests It would be difficult to give a full discussion of such an Institute without going through the major points of each speaker Clearly this is the proper task of the eventual readers of these Proceedings Instead it would be preferable to stress some general issues What came through very clearly is that the measurements of the basic scientists in materials and device phenomena are of substantial immediate concern to the device technologies and end users *Hierarchical Device Simulation* Christoph Jungemann, Bernd Meinerzhagen, 2012-12-06 This book summarizes the research of more than a decade Its early motivation dates back to the eighties and to the memorable talks Dr C Moglestue FHG Freiburg gave on his Monte Carlo solutions of the Boltzmann transport equation at the NASECODE conferences in Ireland At that time numerical semiconductor device modeling basically implied the application of the drift diffusion model On the one hand those talks clearly showed the potential of the Monte Carlo model for an accurate description of many important transport issues that cannot adequately be addressed by the drift diffusion approximation On the other hand they also clearly demonstrated that at that time only very few experts were able to extract useful results from a Monte Carlo simulator With this background Monte Carlo research activities were started in 1986 at the University of Aachen RWTH Aachen Germany Different to many other Monte Carlo research groups the Monte Carlo research in Aachen took place in an environment of active drift diffusion and hydrodynamic model development

Compact Models for Integrated Circuit Design Samar K. Saha, 2018-09-03 Compact Models for Integrated Circuit Design Conventional Transistors and Beyond provides a modern treatise on compact models for circuit computer aided design CAD Written by an author with more than 25 years of industry experience in semiconductor processes devices and circuit CAD and more than 10 years of academic experience in teaching compact modeling courses this first of its kind book on compact SPICE models for very large scale integrated VLSI chip design offers a balanced presentation of compact modeling crucial for addressing current modeling challenges and understanding new models for emerging devices Starting

from basic semiconductor physics and covering state of the art device regimes from conventional micron to nanometer this text Presents industry standard models for bipolar junction transistors BJTs metal oxide semiconductor MOS field effect transistors FETs FinFETs and tunnel field effect transistors TFETs along with statistical MOS models Discusses the major issue of process variability which severely impacts device and circuit performance in advanced technologies and requires statistical compact models Promotes further research of the evolution and development of compact models for VLSI circuit design and analysis Supplies fundamental and practical knowledge necessary for efficient integrated circuit IC design using nanoscale devices Includes exercise problems at the end of each chapter and extensive references at the end of the book Compact Models for Integrated Circuit Design Conventional Transistors and Beyond is intended for senior undergraduate and graduate courses in electrical and electronics engineering as well as for researchers and practitioners working in the area of electron devices However even those unfamiliar with semiconductor physics gain a solid grasp of compact modeling concepts from this book

Principles of Power Electronics John G. Kassakian, David J. Perreault, George C.

Vergheze, Martin F. Schlecht, 2023-08-03 Substantially expanded and updated the new edition of this classic textbook provides unrivalled coverage of the fundamentals of power electronics Comprehensive coverage of foundational concepts in circuits magnetics devices dynamic models and control establishes a strong conceptual framework for further study Extensive discussion of contemporary practical considerations enhanced by real world examples prepares readers for design scenarios ranging from low power dc dc converters to multi megawatt ac machine drives New topics include SiC and GaN wide bandgap materials superjunction MOSFET and IGBT devices advanced magnetics design multi level and switched capacitor converters RF converter circuits and EMI Over 300 new and revised end of chapter problems enhance and expand understanding of the material with solutions for instructors Unique in its breadth and depth and providing a range of flexible teaching pathways at multiple levels this is the definitive guide to power electronics for graduate and senior undergraduate students in electrical engineering and practicing electrical engineers

Custom-Specific Integrated Circuits

Hurst, 1985-03-27 In the semiconductor industry cutting basic design time of microelectronics is by far the most cost effective measure for keeping production budgets in line Custom Specific Integrated Circuits thoroughly considers the various methods available to reduce the design time of a microelectronic circuit to fit a specialized requirement This important work explores the principles of both bipolar and MOS technologies and provides in depth coverage of the many avenues which enable system designers to incorporate specific needs into an integrated circuit form Comprehensive and up to date this reference compares and contrasts all the techniques of custom an semicustom design and fabrication including programmable arrays masterslice arrays cell libraries and full custom examines the principles of placement and routing of regular structures presents convenient chapter summaries for quick review of essential material and offers physics fundamentals for basic understanding while concentrating on practical system design Ideal for both the practicing engineer

and graduate level engineering student this outstanding book gives electrical electronic design computer mechanical and control engineers as well as electrical electronic and computer science engineering students the contemporary hands on coverage needed to master Custom Specific Integrated Circuits Book jacket

Radiation Effects in Semiconductors Krzysztof Iniewski, 2018-09-03 Space applications nuclear physics military operations medical imaging and especially electronics modern silicon processing are obvious fields in which radiation damage can have serious consequences i.e. degradation of MOS devices and circuits Zeroing in on vital aspects of this broad and complex topic Radiation Effects in Semiconductors addresses the ever growing need for a clear understanding of radiation effects on semiconductor devices and circuits to combat potential damage it can cause Features a chapter authored by renowned radiation authority Lawrence T Clark on Radiation Hardened by Design SRAM Strategies for TID and SEE Mitigation This book analyzes the radiation problem focusing on the most important aspects required for comprehending the degrading effects observed in semiconductor devices circuits and systems when they are irradiated It explores how radiation interacts with solid materials providing a detailed analysis of three ways this occurs Photoelectric effect Compton effect and creation of electron positron pairs The author explains that the probability of these three effects occurring depends on the energy of the incident photon and the atomic number of the target The book also discusses the effects that photons can have on matter in terms of ionization effects and nuclear displacement Written for post graduate researchers semiconductor engineers and nuclear and space engineers with some electronics background this carefully constructed reference explains how ionizing radiation is creating damage in semiconducting devices and circuits and systems and how that damage can be avoided in areas such as military space missions nuclear applications plasma damage and X ray based techniques It features top notch international experts in industry and academia who address emerging detector technologies circuit design techniques new materials and innovative system approaches

MOS Devices for Low-Voltage and Low-Energy Applications Yasuhisa Omura, Abhijit Mallik, Naoto Matsuo, 2017-02-28 Helps readers understand the physics behind MOS devices for low voltage and low energy applications Based on timely published and unpublished work written by expert authors Discusses various promising MOS devices applicable to low energy environmental and biomedical uses Describes the physical effects quantum tunneling of MOS devices Demonstrates the performance of devices helping readers to choose right devices applicable to an industrial or consumer environment Addresses some Ge based devices and other compound material based devices for high frequency applications and future development of high performance devices Seemingly innocuous everyday devices such as smartphones tablets and services such as on line gaming or internet keyword searches consume vast amounts of energy Even when in standby mode all these devices consume energy The upcoming Internet of Things IoT is expected to deploy 60 billion electronic devices spread out in our homes cars and cities Britain is already consuming up to 16 per cent of all its power through internet use and this rate is doubling every four years According to The UK's Daily Mail May 2015 if usage rates

continue all of Britain's power supply could be consumed by internet use in just 20 years In 2013 U S data centers consumed an estimated 91 billion kilowatt hours of electricity corresponding to the power generated by seventeen 1000 megawatt nuclear power plants Data center electricity consumption is projected to increase to roughly 140 billion kilowatt hours annually by 2020 the equivalent annual output of 50 nuclear power plants Natural Resources Defense Council USA Feb 2015 All these examples stress the urgent need for developing electronic devices that consume as little energy as possible The book MOS Devices for Low Voltage and Low Energy Applications explores the different transistor options that can be utilized to achieve that goal It describes in detail the physics and performance of transistors that can be operated at low voltage and consume little power such as subthreshold operation in bulk transistors fully depleted SOI devices tunnel FETs multigate and gate all around MOSFETs Examples of low energy circuits making use of these devices are given as well The book MOS Devices for Low Voltage and Low Energy Applications is a good reference for graduate students researchers semiconductor and electrical engineers who will design the electronic systems of tomorrow Dr Jean Pierre Colinge Taiwan Semiconductor Manufacturing Company TSMC The authors present a creative way to show how different MOS devices can be used for low voltage and low power applications They start with Bulk MOSFET following with SOI MOSFET FinFET gate all around MOSFET Tunnel FET and others It is presented the physics behind the devices models simulations experimental results and applications This book is interesting for researchers graduate and undergraduate students The low energy field is an important topic for integrated circuits in the future and none can stay out of this Prof Joao A Martino University of Sao Paulo Brazil

Tunneling Field Effect Transistors T. S. Arun Samuel, Young Suh Song, Shubham Tayal, P. Vimala, Shiromani Balmukund Rahi, 2023-06-08 This book will give insight into emerging semiconductor devices from their applications in electronic circuits which form the backbone of electronic equipment It provides desired exposure to the ever growing field of low power electronic devices and their applications in nanoscale devices memory design and biosensing applications Tunneling Field Effect Transistors Design Modeling and Applications brings researchers and engineers from various disciplines of the VLSI domain to together tackle the emerging challenges in the field of nanoelectronics and applications of advanced low power devices The book begins by discussing the challenges of conventional CMOS technology from the perspective of low power applications and it also reviews the basic science and developments of subthreshold swing technology and recent advancements in the field The authors discuss the impact of semiconductor materials and architecture designs on TFET devices and the performance and usage of FET devices in various domains such as nanoelectronics Memory Devices and biosensing applications They also cover a variety of FET devices such as MOSFETs and TFETs with various structures based on the tunneling transport phenomenon The contents of the book have been designed and arranged in such a way that Electrical Engineering students researchers in the field of nanodevices and device circuit codesign as well as industry professionals working in the domain of semiconductor devices will find the material useful and easy to follow

Nanoscale Devices Brajesh Kumar Kaushik, 2018-11-16 The primary aim of this book is to discuss various aspects of nanoscale device design and their applications including transport mechanism modeling and circuit applications Provides a platform for modeling and analysis of state of the art devices in nanoscale regime reviews issues related to optimizing the sub nanometer device performance and addresses simulation aspect and or fabrication process of devices Also includes design problems at the end of each chapter Advanced Ultra Low-Power Semiconductor Devices Shubham Tayal, Abhishek Kumar Upadhyay, Shiromani Balmukund Rahi, Young Suh Song, 2023-11-22 ADVANCED ULTRA LOW POWER SEMICONDUCTOR DEVICES Written and edited by a team of experts in the field this important new volume broadly covers the design and applications of metal oxide semiconductor field effect transistors This outstanding new volume offers a comprehensive overview of cutting edge semiconductor components tailored for ultra low power applications These components pivotal to the foundation of electronic devices play a central role in shaping the landscape of electronics With a focus on emerging low power electronic devices and their application across domains like wireless communication biosensing and circuits this book presents an invaluable resource for understanding this dynamic field Bringing together experts and researchers from various facets of the VLSI domain the book addresses the challenges posed by advanced low power devices This collaborative effort aims to propel engineering innovations and refine the practical implementation of these technologies Specific chapters delve into intricate topics such as Tunnel FET negative capacitance FET device circuits and advanced FETs tailored for diverse circuit applications Beyond device centric discussions the book delves into the design intricacies of low power memory systems the fascinating realm of neuromorphic computing and the pivotal issue of thermal reliability Authors provide a robust foundation in device physics and circuitry while also exploring novel materials and architectures like transistors built on pioneering channel dielectric materials This exploration is driven by the need to achieve both minimal power consumption and ultra fast switching speeds meeting the relentless demands of the semiconductor industry The book s scope encompasses concepts like MOSFET FinFET GAA MOSFET the 5 nm and 7 nm technology nodes NCFET ferroelectric materials subthreshold swing high k materials as well as advanced and emerging materials pivotal for the semiconductor industry s future **Handbook for III-V High Electron Mobility Transistor Technologies** D. Nirmal, J. Ajayan, 2019-05-14 This book focusses on III V high electron mobility transistors HEMTs including basic physics material used fabrications details modeling simulation and other important aspects It initiates by describing principle of operation material systems and material technologies followed by description of the structure I V characteristics modeling of DC and RF parameters of AlGaIn GaN HEMTs The book also provides information about source drain engineering gate engineering and channel engineering techniques used to improve the DC RF and breakdown performance of HEMTs Finally the book also highlights the importance of metal oxide semiconductor high electron mobility transistors MOS HEMT Key Features Combines III As P N HEMTs with reliability and current status in single volume Includes AC DC modelling and sub millimeter

wave devices with reliability analysis Covers all theoretical and experimental aspects of HEMTs Discusses AlGaIn GaN transistors Presents DC RF and breakdown characteristics of HEMTs on various material systems using graphs and plots

Fiftieth Anniversary, 1912-1962 Institute of Radio Engineers, 1962 **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 *Intrinsic Point Defects, Impurities, and Their Diffusion in Silicon* Peter

Pichler, 2012-12-06 Basically all properties of semiconductor devices are influenced by the distribution of point defects in their active areas This book contains the first comprehensive review of the properties of intrinsic point defects acceptor and donor impurities isovalent atoms chalcogens and halogens in silicon as well as of their complexes Special emphasis is placed on compiling the structures energetic properties identified electrical levels and spectroscopic signatures and the diffusion behavior from experimental and theoretical investigations In addition the book discusses the fundamental concepts of silicon and its defects the electron system diffusion thermodynamics and reaction kinetics which form the scientific basis needed for a thorough understanding of the text Therefore the book is able to provide an introduction to newcomers in this field up to a comprehensive reference for experts in process technology solid state physics and simulation of semiconductor processes

MOSFET Modeling for Circuit Analysis and Design Carlos Galup-Montoro, Mario Cherem Schneider, 2007 This is the first book dedicated to the next generation of MOSFET models Addressed to circuit designers with an in depth treatment that appeals to device specialists the book presents a fresh view of compact modeling having completely abandoned the regional modeling approach Both an overview of the basic physics theory required to build compact MOSFET models and a unified treatment of inversion charge and surface potential models are provided The needs of digital analog and RF designers as regards the availability of simple equations for circuit designs are taken into account Compact expressions for hand analysis or for automatic synthesis valid in all operating regions are presented throughout the book All the main expressions for computer simulation used in the new generation compact models are derived Since designers in advanced technologies are increasingly concerned with fluctuations the modeling of fluctuations is strongly emphasized A unified approach for both space matching and time noise fluctuations is introduced Physical Models of Semiconductor Quantum Devices Ying

Fu, Magnus Willander, 2013-11-27 Solid state electronics is undergoing rapid changes driven by heteroepitaxy lithography and new device concepts While ten years ago Si was the material of choice in solid state electronics now GaAs InGaAs AlAs InP Ge etc have all become quite important The advent of semiconductor lasers and integrated optoelectronic circuits has led to a flurry of activities in compound semiconductors Additionally the remarkable advances in the thin film epitaxy have

allowed active semiconductor devices with sub three dimensional properties and built in controlled biaxial strain due to lattice mismatch This book addresses three main areas of interest i electronic and optical properties of low dimensional semiconductor materials ii principal physics of quantum electronic devices iii principal physics of quantum optical devices These areas will provide readers with an intimate knowledge of the new material properties on which novel solid state electronic devices such as quantum diode and small size transistor high electron mobility transistor are based leading to the very front of the development of material and device research The link between basic physics on which the real devices are based and the output from the real devices is closely observed in the book Chapter 1 Elemental and compound semiconductors 1 1 Crystalline nature of solids The intrinsic property of a crystal is that the environment around a given atom or group of atoms is exactly the same as the environment around another atom or similar group of atoms

Physics of Semiconductor Devices J.-P. Colinge, C.A. Colinge, 2007-05-08 Physics of Semiconductor Devices covers both basic classic topics such as energy band theory and the gradual channel model of the MOSFET as well as advanced concepts and devices such as MOSFET short channel effects low dimensional devices and single electron transistors Concepts are introduced to the reader in a simple way often using comparisons to everyday life experiences such as simple fluid mechanics They are then explained in depth and mathematical developments are fully described Physics of Semiconductor Devices contains a list of problems that can be used as homework assignments or can be solved in class to exemplify the theory Many of these problems make use of Matlab and are aimed at illustrating theoretical concepts in a graphical manner

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