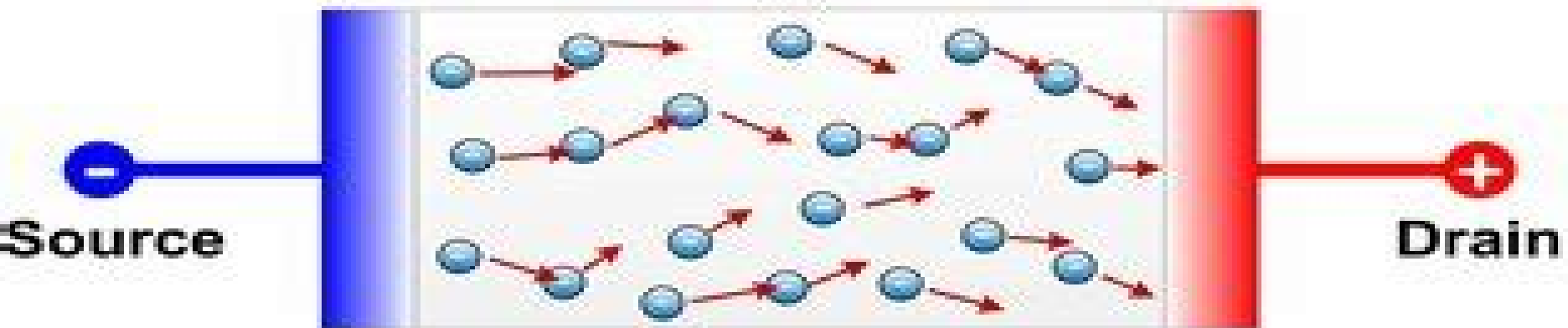
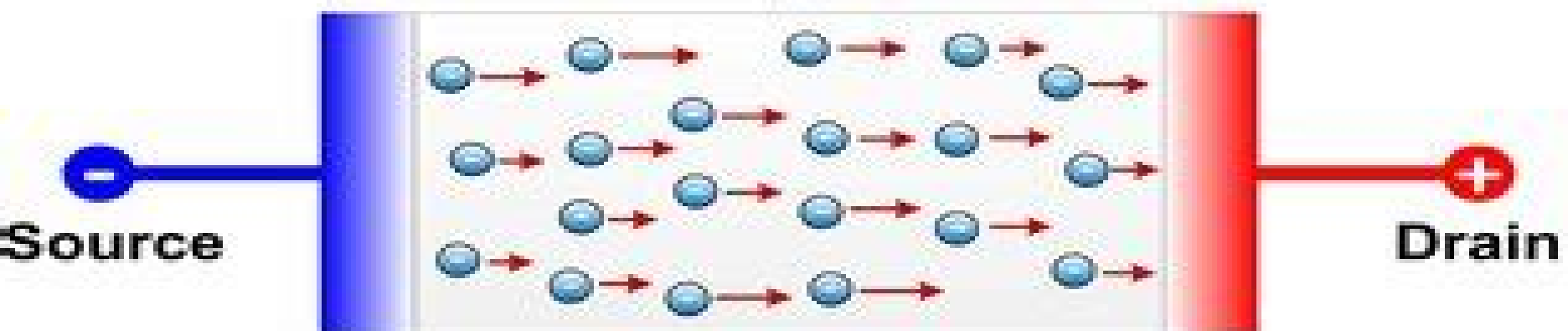




(a)



(b)



(c)

# Semiconductor Transport

**Eckehard Schöll**

A red circular graphic with a gradient, appearing as a stylized arrow or a partial circle, located to the right of the author's name.

## **Semiconductor Transport:**

**Semiconductor Transport** David K. Ferry, 2000 The information revolution would have been radically different or impossible without the use of the materials known generically as semiconductors The properties of these materials particularly the potential for doping with impurities to create transistors and diodes and controlling the local potential by gates are essential for microelectronics Semiconductor Transport is an introductory text on electron transport in semiconductor materials and is written for advanced undergraduates and graduate students The book provides a thorough treatment of modern approaches to the transport properties of semiconductors and their calculation It also introduces those aspects of solid state physics which are vitally important for understanding transport in them Provided by publisher

**Transport Equations for Semiconductors** Ansgar Jüngel, 2009-03-17 This volume presents a systematic and mathematically accurate description and derivation of transport equations in solid state physics in particular semiconductor devices

**Theory of Transport Properties of Semiconductor Nanostructures** Eckehard Schöll, 1997-12-31 Recent advances in the fabrication of semiconductors have created almost unlimited possibilities to design structures on a nanometre scale with extraordinary electronic and optoelectronic properties The theoretical understanding of electrical transport in such nanostructures is of utmost importance for future device applications This represents a challenging issue of today's basic research since it requires advanced theoretical techniques to cope with the quantum limit of charge transport ultrafast carrier dynamics and strongly nonlinear high field effects This book which appears in the electronic materials series presents an overview of the theoretical background and recent developments in the theory of electrical transport in semiconductor nanostructures It contains 11 chapters which are written by experts in their fields Starting with a tutorial introduction to the subject in Chapter 1 it proceeds to present different approaches to transport theory The semiclassical Boltzmann transport equation is in the centre of the next three chapters Hydrodynamic moment equations Chapter 2 Monte Carlo techniques Chapter 3 and the cellular automaton approach Chapter 4 are introduced and illustrated with applications to nanometre structures and device simulation A full quantum transport theory covering the Kubo formalism and nonequilibrium Green's functions Chapter 5 as well as the density matrix theory Chapter 6 is then presented

**Physics and Modeling of Tera- and Nano-devices** Maxim Ryzhii, Victor Ryzhii, 2008 Physics and Modeling of Tera and Nano Devices is a compilation of papers by well respected researchers working in the field of physics and modeling of novel electronic and optoelectronic devices The topics covered include devices based on carbon nanotubes generation and detection of terahertz radiation in semiconductor structures including terahertz plasma oscillations and instabilities terahertz photomixing in semiconductor heterostructures spin and microwave induced phenomena in low dimensional systems and various computational aspects of device modeling Researchers as well as graduate and postgraduate students working in this field will benefit from reading this book

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**High-Frequency Bipolar Transistors** Michael Reisch, 2012-12-06 This book provides a rather comprehensive presentation of the physics and modeling of high frequency bipolar transistors with particular emphasis given to silicon based devices I hope it will be found useful by those who do as well as by those who intend to work in the field as it compiles and extends material presented in numerous publications in a coherent fashion I ve worked on this project for years and did my best to avoid errors De spite all efforts it is possible that something has been overlooked during copy editing and proof reading If you find a mistake please let me know Michael Reisch Kempton December 2002 Notation It is intended here to use the most widely employed notation in cases where the standard textbook notation is different from the SPICE notation the latter is used In order to make formulas more readable model parameters represented in SPICE by a series of capital letters are written here as one capital letter with the rest in the form of a subscript e g XCJC is used here instead of the XCJC used in the SPICE input Concerning the use of lower case and capital letters the following rules are applied Time dependent large signal quantities are represented by lower case letters The variables  $t$ ,  $v$  and  $p$  therefore denote time dependent current voltage and power values

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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

Physical and Chemical Aspects of Organic Electronics Christof Wöll, 2009-04-22 Organic molecules are currently being investigated with regard to their application as active components in semiconductor devices Whereas devices containing organic molecules for the generation of light organic light emitting diodes OLED have already reached the market they e g display information on mobile phones transistors where organic molecules are used to actively control currents and voltages are still in the development stage In this book the principle problems related to using organic materials as semiconductors and to construct functioning devices will be addressed A particular emphasis will be put on the difference between inorganic semiconductors such as Si Ge and GaAs and organic semiconductors OSC The special properties of such soft matter require particular approaches for processing characterization and device implementation which are quite different from the approach used for conventional semiconductors Microelectronics Technology and Devices, SBMICRO 2004 Edval J. P. Santos, Renato P. Ribas, 2004 Granular Nanoelectronics David K. Ferry, John R. Barker, Carlo Jacoboni, 2013-12-14 The technological means now exists for approaching the fundamentallimiting scales of solid state electronics in which a single carrier can in principle represent a single bit in an information flow In this light the prospect of chemically or biologically engineered molecular scale structures which might support information processing functions has enticed workers for many

years The one common factor in all suggested molecular switches ranging from the experimentally feasible proton tunneling structure to natural systems such as the micro tubule is that each proposed structure deals with individual information carrying entities Whereas this future molecular electronics faces enormous technical challenges the same limit is already appearing in existing semiconducting quantum wires and small tunneling structures both superconducting and normal meta devices in which the motion of a single charge through the tunneling barrier can produce a sufficient voltage change to cut off further tunneling current We may compare the above situation with today's Si microelectronics where each bit is encoded as a very large number not necessarily fixed of electrons within a charge pulse The associated reservoirs and sinks of charge carriers may be profitably tapped and manipulated to provide macro currents which can be readily amplified or curtailed On the other hand modern semiconductor ULSI has progressed by adopting a linear scaling principle to the down sizing of individual semiconductor devices

**Methods and Materials in Microelectronic Technology** Joachim

Bargon, 2013-03-09 The papers collected in this volume were presented at the International Symposium on Methods and Materials in Microelectronic Technology This symposium was sponsored by IBM Germany and it was held September 29 October 1 1982 in Bad Neuenahr West Germany The progress of semiconductor and microelectronic technology has become so rapid and the field so sophisticated that it is imperative to exchange the latest insight gained as frequently as it can be accomplished In addition it is peculiar for this field that the bulk of the investigations are carried out at industrial research and development laboratories which makes some of the results less readily accessible Because of these circumstances the academic community which among other things is supposed to communicate the progress in this field to students of different disciplines finds it rather difficult to stay properly informed It was the intent of this IBM sponsored symposium to bring together key scientists from academic institutions primarily from Europe with principal investigators of the industrial scene Accordingly this symposium exposed technologists to scientists and vice versa Scientific advances often lead directly to technological innovations In turn new technologies are often arrived at empirically and because of that are initially poorly understood Scientific inquiry then attempts to probe these processes and phenomena in order to achieve a better understanding Thus science and technology are intricately interconnected and it is important that technical exchange between technologists and scientists is facilitated since the problems are typically interdisciplinary in nature

Scientific and Technical Aerospace Reports, 1992

*Nonlinear Spatio-Temporal Dynamics and Chaos in Semiconductors* Eckehard Schöll, 2001-02-22 This book brings together concepts from semiconductor physics nonlinear dynamics and chaos to examine semiconductor transport phenomena

**Spin Electronics** David D. Awschalom, Robert A. Buhrman, James M.

Daughton, Stephan von Molnár, Michael L. Roukes, 2013-06-29 The history of scientific research and technological development is replete with examples of breakthroughs that have advanced the frontiers of knowledge but seldom does it record events that constitute paradigm shifts in broad areas of intellectual pursuit One notable exception however is that of

spin electronics also called spintronics magnetoelectronics or magnetronics wherein information is carried by electron spin in addition to or in place of electron charge It is now well established in scientific and engineering communities that Moore's Law having been an excellent predictor of integrated circuit density and computer performance since the 1970s now faces great challenges as the scale of electronic devices has been reduced to the level where quantum effects become significant factors in device operation Electron spin is one such effect that offers the opportunity to continue the gains predicted by Moore's Law by taking advantage of the confluence of magnetics and semiconductor electronics in the newly emerging discipline of spin electronics From a fundamental viewpoint spin polarization transport in a material occurs when there is an imbalance of spin populations at the Fermi energy In ferromagnetic metals this imbalance results from a shift in the energy states available to spin up and spin down electrons In practical applications a ferromagnetic metal may be used as a source of spin polarized electrons to be injected into a semiconductor a superconductor or a normal metal or to tunnel through an insulating barrier

**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

**Narrow-gap II-VI Compounds for Optoelectronic and Electromagnetic Applications** Peter Capper, 1997-10-31 The field of narrow gap II VI materials is dominated by the compound mercury cadmium telluride MCT or  $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$  By varying the x value material can be made to cover all the important infrared IR ranges of interest It is probably true to say that MCT is the third most studied semiconductor after silicon and gallium arsenide As current epitaxial layers of MCT are mainly grown on bulk CdTe family substrates these materials are included in this book although strictly of course they are not narrow gap This book is intended for readers who are either new to the field or are experienced workers in the field who need a comprehensive and up to date view of this rapidly expanding area To satisfy the needs of the first group each chapter discusses the principles underlying each topic and some of the historical background before bringing the reader the most recent information available For those currently in the field the book can be used as a collection of useful data as a guide to the literature and as an overview of topics covering the wide range of work areas

**Nonequilibrium Phase Transitions in Semiconductors** Eckehard Schöll, 2012-12-06 Semiconductors can exhibit electrical instabilities like current runaway threshold switching current filamentation or oscillations when they are driven far from thermodynamic equilibrium This book presents a coherent



theoretical description of such cooperative phenomena induced by generation and recombination processes of charge carriers in semiconductors **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 Coupled Multiscale Simulation and Optimization in Nanoelectronics Michael Günther, 2015-06-15

Designing complex integrated circuits relies heavily on mathematical methods and calls for suitable simulation and optimization tools The current design approach involves simulations and optimizations in different physical domains device circuit thermal electromagnetic and in a range of electrical engineering disciplines logic timing power crosstalk signal integrity system functionality COMSON was a Marie Curie Research Training Network created to meet these new scientific and training challenges by a developing new descriptive models that take these mutual dependencies into account b combining these models with existing circuit descriptions in new simulation strategies and c developing new optimization techniques that will accommodate new designs The book presents the main project results in the fields of PDAE modeling and simulation model order reduction techniques and optimization based on merging the know how of three major European semiconductor companies with the combined expertise of university groups specialized in developing suitable mathematical models numerical schemes and e learning facilities In addition a common Demonstrator Platform for testing mathematical methods and approaches was created to assess whether they are capable of addressing the industry s problems and to educate young researchers by providing hands on experience with state of the art problems

## Reviewing **Semiconductor Transport**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is truly astonishing. Within the pages of "**Semiconductor Transport**," an enthralling opus penned by a very acclaimed wordsmith, readers attempt an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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