

The Physics of Instabilities in Solid State Electron Devices

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The Physics of Instabilities in Solid State Electron Devices Harold L. Grubin, V.V. Mitin, E. Schöll, M.P. Shaw, 2013-11-11

The past three decades have been a period where useful current and voltage instabilities in solids have progressed from exciting research problems to a wide variety of commercially available devices. Materials and electronics research has led to devices such as the tunnel Esaki diode, transferred electron Gunn diode, avalanche diodes, real space transfer devices and the like. These structures have proven to be very important in the generation, amplification, switching and processing of microwave signals up to frequencies exceeding 100 GHz. In this treatise we focus on a detailed theoretical understanding of devices of the kind that can be made unstable against circuit oscillations, large amplitude switching events and in some cases internal rearrangement of the electric field or current density distribution. The book is aimed at the semiconductor device physicist, engineer and graduate student. A knowledge of solid state physics on an elementary or introductory level is assumed. Furthermore, we have geared the book to device engineers and physicists desirous of obtaining an understanding substantially deeper than that associated with a small signal equivalent circuit approach. We focus on both analytical and numerical treatment of specific device problems concerning ourselves with the mechanism that determines the constitutive relation governing the device, the boundary conditions, contact effects and the effect of the local circuit environment.

The Physics of Instabilities in Solid State Electron Devices Harold L. Grubin, V. V. Mitin, E. Schöll, 2014-01-15 **Nonlinear**

Dynamics in Solids Harry Thomas, 2012-12-06. This volume contains the notes of lectures given at the school on Nonlinear Dynamics in Solids held at the Physikzentrum Bad Honnef 2-6 October 1989 under the patronage of the Deutsche Physikalische Gesellschaft. Nonlinear dynamics has become a highly active research area owing to many interesting developments during the last three decades in the theoretical analysis of dynamical processes in both Hamiltonian and dissipative systems. Research has been focused on a variety of problems such as the characteristics of regular and chaotic motion in Hamiltonian dynamics, the problem of quantum chaos, the formation and properties of solitary spatio-temporal structures, the occurrence of strange attractors in dissipative systems and the bifurcation scenarios leading to complex time behaviour. Until recently, predictions of the theory have been tested predominantly on instabilities in hydrodynamic systems where many interesting experiments have provided valuable input and have led to a fruitful interaction between experiment and theory. Fluid systems are certainly good candidates for performing clean experiments free from disturbing influences with fluids compared to solids it is simpler to prepare good samples, the relevant length and time scales are in easily accessible ranges and it is possible to do measurements inside the fluid because it can be filled in after the construction of the apparatus. Further, the theory describing the macroscopic dynamics of fluids is well established and contains only very few parameters, all of which have well known values.

Basic Properties of Semiconductors P.T. Landsberg, 2016-04-19. Since Volume 1 was published in 1982, the centres of interest in the basic physics of semiconductors have shifted. Volume 1

was called Band Theory and Transport Properties in the first edition but the subject has broadened to such an extent that Basic Properties is now a more suitable title Seven chapters have been rewritten by the original authors However twelve chapters are essentially new with the bulk of this work being devoted to important current topics which give this volume an almost encyclopaedic form The first three chapters discuss various aspects of modern band theory and the next two analyze impurities in semiconductors Then follow chapters on semiconductor statistics and on surfaces interfaces and band offsets as they occur in heterojunctions Chapters 8 to 19 report on newer topics though a survey of transport properties of carriers is also included Among these are transport of hot electrons and thermoelectric effects including here and elsewhere properties of low dimensional and mesoscopic structures The electron hole liquid the quantum Hall effect localisation ballistic transport coherence in superlattices current ideas on tunnelling and on quantum confinement and scattering processes are also covered

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

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

Theory of Transport Properties of Semiconductor Nanostructures Eckehard Schöll,2013-11-27 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

Springer Handbook of Electronic and Photonic Materials Safa Kasap,Peter Capper,2007-08-01 Electronic materials is a truly interdisciplinary subject that encompasses a number of traditional disciplines such as materials science electrical engineering chemical engineering mechanical

engineering physics and chemistry This unique handbook provides broad coverage of a wide range of electronic and photonic materials starting from fundamentals and building up to advanced topics and applications Its wide coverage with clear illustrations and applications and its chapter sequencing and logical flow make this a very useful and useable handbook Each chapter has been prepared either by expert researchers or instructors who have been teaching the subject at a university or in corporate laboratories Unlike other handbooks that concentrate on a narrow field and have chapters that start at an advanced level the present handbook starts at a senior undergraduate level and builds up the subject matter in easy steps and in a logical flow Wherever possible the sections are logically sequenced to allow those who need a quick overview of a particular topic immediate access to it Additional valuable features include the practical applications used as examples details on experimental techniques useful tables that summarize equations and most importantly properties of various materials Each chapter is full of clear color illustrations that convey the concepts and make the subject matter enjoyable to read and understand An extensive glossary aids readers from adjacent fields The Handbook constitutes an essential reference for today's electrical engineers materials scientists and physicists

Quantum Heterostructures Vladimir Vasil'evich Mitin, Viacheslav Kochelap, Michael A. Strosio, 1999-07-13 Quantum Heterostructures provides a detailed description of the key physical and engineering principles of quantum semiconductor heterostructures Blending important concepts from physics materials science and electrical engineering it also explains clearly the behavior and operating features of modern microelectronic and optoelectronic devices The authors begin by outlining the trends that have driven development in this field most importantly the need for high performance devices in computer information and communications technologies They then describe the basics of quantum nanoelectronics including various transport mechanisms In the latter part of the book they cover novel microelectronic devices and optical devices based on quantum heterostructures The book contains many homework problems and is suitable as a textbook for undergraduate and graduate courses in electrical engineering physics or materials science It will also be of great interest to those involved in research or development in microelectronic or optoelectronic devices

Optoelectronics P. Predeep, 2011-10-05 Optoelectronics Devices and Applications is the second part of an edited anthology on the multifaced areas of optoelectronics by a selected group of authors including promising novices to experts in the field Photonics and optoelectronics are making an impact multiple times as the semiconductor revolution made on the quality of our life In telecommunication entertainment devices computational techniques clean energy harvesting medical instrumentation materials and device characterization and scores of other areas of R

Current Trends in Applied Mathematics Miguel Angel Herrero, Enrique Zuazua, 1996

Encyclopedia of Nonlinear Science Alwyn Scott, 2006-05-17 In 438 alphabetically arranged essays this work provides a useful overview of the core mathematical background for nonlinear science as well as its applications to key problems in ecology and biological systems chemical reaction diffusion problems geophysics economics electrical and mechanical

oscillations in engineering systems lasers and nonlinear optics fluid mechanics and turbulence and condensed matter physics among others

Dynamical Systems René Lozi, Safwan El Assad, Mohammed-Salah Abdelouahab, 2025-06-23 This book offers a captivating exploration of the intersection between mathematics chaos theory and dynamical systems through the personal journeys of twelve renowned mathematicians and physicists from China Europe Russia and the USA The first section of the book provides an intimate look into the formative experiences and early steps of these scientists In these life stories the names of other famous mathematicians arise crisscrossing all the stories in unexpected ways The second part of the book explores the practical applications of chaotic attractors in various fields These include chaos based encryption in cryptography sensor and actuator placement in Chua circuits for control systems and chaotic dynamics in remote sensing for crop modeling It also highlights the role of chaos theory in the development of memristors following Leon Chua's 1971 discovery leading to advances in nonlinear dynamics hyperchaos and memristor based systems The chapters further examine how chaos theory addresses modern challenges such as modeling COVID 19 spread using SEIR models and optimizing mobile network design demonstrating the wide reaching impact of chaotic systems in real world applications This book will be of great value to students and researchers in mathematics physics engineering and related disciplines seeking to deepen their understanding of chaotic dynamical systems and their applications This book includes a revised introduction and a new chapter The remaining chapters were originally published in Journal of Difference Equations and Applications

Collective Dynamics of Nonlinear and Disordered Systems Günter Radons, Wolfram Just, Peter Häussler, 2005-01-12 Phase transitions in disordered systems and related dynamical phenomena are a topic of intrinsically high interest in theoretical and experimental physics This book presents a unified view adopting concepts from each of the disjoint fields of disordered systems and nonlinear dynamics Special attention is paid to the glass transition from both experimental and theoretical viewpoints to modern concepts of pattern formation and to the application of the concepts of dynamical systems for understanding equilibrium and nonequilibrium properties of fluids and solids The content is accessible to graduate students but will also be of benefit to specialists since the presentation extends as far as the topics of ongoing research work

Hot Carriers in Semiconductors Karl Hess, J.P. Leburton, U. Ravaioli, 2012-12-06 This volume contains invited and contributed papers of the Ninth International Conference on Hot Carriers in Semiconductors HCIS 9 held July 3-4 August 4-5 1995 in Chicago Illinois In all the conference featured 15 invited oral presentations 60 contributed oral presentations and 105 poster presentations and an international contingent of 170 scientists As in recent conferences the main themes of the conference were related to nonlinear transport in semiconductor heterojunctions and included Bloch oscillations laser diode structures and femtosecond spectroscopy Interesting questions related to nonlinear transport size quantization and intersubband scattering were addressed that are relevant to the new quantum cascade laser Many lectures were geared toward quantum wires and dots and toward nanostructures and mesoscopic systems in general It is expected that such research will open new

horizons to nonlinear transport studies An attempt was made by the program committee to increase the number of presentations related directly to devices The richness of nonlocal hot electron effects that were discussed as a result in our opinion suggests that future conferences should further encourage reports on such device research On behalf of the Program and International Advisory Committees we thank the participants who made the conference a successful and pleasant experience and the support of the Army Research Office the Office of Naval Research and the Beckman Institute of the University of Illinois at Urbana Champaign We are also indebted to Mrs Sara Starkey and Mrs Autosolitons B.S. Kerner,V.V. Osipov,2013-06-29 This monograph is devoted to an entirely new branch of nonlinear physics solitary intrinsic states or autosolitons which form in a broad class of physical chemical and biological dissipative systems Autosolitons are often observed as highly nonequilibrium regions in slightly nonequilibrium systems in many ways resembling ball lightning which occurs in the atmosphere We develop a new approach to problems of self organization and turbulence treating these phenomena as a result of spontaneous formation and subsequent evolution of autosolitons Scenarios of self organization involve sophisticated interactions between autosolitons whereas turbulence is regarded as a pattern of autosolitons which appear and disappear at random in different parts of the system This monograph is the first attempt to provide a comprehensive summary of the theory of autosolitons as developed by the authors over the years of research The monograph is comprised of three more or less autonomous parts Part I deals with the physical nature and experimental studies of autosolitons and self organization in various physical systems semiconductor and gas plasma heated gas mixture semiconductor structures composite superconductors optical and magnetic media systems with uniformly generated combustion matter distributed gas discharge and electronic systems We discuss feasibility of autosolitons in the form of highly nonequilibrium regions in slightly nonequilibrium gases and semiconductors hot and cold regions in semiconductor and gas plasmas static pulsating and traveling combustion fronts **Scientific and Technical Aerospace Reports** ,1993

New Insulators Devices and Radiation Effects ,1999-02-11 Silicon technology today forms the basis of a world wide multi billion dollar component industry The reason for this expansion can be found not only in the physical properties of silicon but also in the unique properties of the silicon silicon dioxide interface However silicon devices are still subject to undesired electrical phenomena called instabilities These are due mostly to the imperfect nature of the insulators used to the not so perfect silicon insulator interface and to the generation of defects and ionization phenomena caused by radiation The problem of instabilities is addressed in this volume the third of this book series Vol 3 updates and supplements the material presented in the previous two volumes and devotes five chapters to the problems of radiation matter and radiation device interactions The volume will aid circuit manufacturers and circuit users alike to relate unstable electrical parameters and characteristics to the presence of physical defects and impurities or to the radiation environment which caused them

Basic Properties of Semiconductors Peter Theodore Landsberg,1992 Hardbound Since Volume 1 was published in

1982 the centres of interest in the basic physics of semiconductors have shifted Volume 1 was called Band Theory and Transport Properties in the first edition but the subject has broadened to such an extent that Basic Properties is now a more suitable title Seven chapters have been rewritten by the original authors However twelve chapters are essentially new with the bulk of this work being devoted to important current topics which give this volume an almost encyclopaedic form The first three chapters discuss various aspects of modern band theory and the next two analyze impurities in semiconductors Then follow chapters on semiconductor statistics and on surfaces interfaces and band offsets as they occur in heterojunctions Chapters 8 to 19 report on newer topics though a survey of transport properties of carriers is also included Among these are transport of hot electrons and Low-Frequency Noise in Advanced MOS Devices Martin Haartman, Mikael Östling, 2007-08-23 Low Frequency Noise in Advanced CMOS Devices begins with an introduction to noise describing the fundamental noise sources and basic circuit analysis The characterization of low frequency noise is discussed in detail and useful practical advice is given The various theoretical and compact low frequency $1/f$ noise models in MOS transistors are treated extensively providing an in depth understanding of the low frequency noise mechanisms and the potential sources of the noise in MOS transistors Advanced CMOS technology including nanometer scaled devices strained Si SiGe SOI high k gate dielectrics multiple gates and metal gates are discussed from a low frequency noise point of view Some of the most recent publications and conference presentations are included in order to give the very latest view on the topics The book ends with an introduction to noise in analog RF circuits and describes how the low frequency noise can affect these circuits

Reviewing **Physics Of Instabilities In Solid State Electron Devices**: 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 actually astonishing. Within the pages of "**Physics Of Instabilities In Solid State Electron Devices**," 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 into the book's central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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