

Techniques of Physics: 14

**THE ELECTRICAL  
CHARACTERIZATION  
OF SEMICONDUCTORS:  
MAJORITY CARRIERS  
AND ELECTRON STATES**

P. Blood and J. W. Orton

# The Electrical Characterization Of Semiconductors Majority Carriers And Electron States

**Dieter Bimberg, Marius  
Grundmann, Nikolai N. Ledentsov**



## **The Electrical Characterization Of Semiconductors Majority Carriers And Electron States:**

*The Electrical Characterization of Semiconductors* Peter Blood, John Wilfred Orton, 1992 Describes the physical principles behind experimental techniques used for measuring the electrical properties of semiconductors The principles involved are illustrated by reference to selected examples drawn from the world of semiconductor materials *Handbook of Thin Films, Five-Volume Set* Hari Singh Nalwa, 2001-10-29 This five volume handbook focuses on processing techniques characterization methods and physical properties of thin films thin layers of insulating conducting or semiconductor material The editor has composed five separate thematic volumes on thin films of metals semimetals glasses ceramics alloys organics diamonds graphites porous materials noncrystalline solids supramolecules polymers copolymers biopolymers composites blends activated carbons intermetallics chalcogenides dyes pigments nanostructured materials biomaterials inorganic polymer composites organoceramics metallocenes disordered systems liquid crystals quasicrystals and layered structures Thin films is a field of the utmost importance in today's materials science electrical engineering and applied solid state physics with both research and industrial applications in microelectronics computer manufacturing and physical devices Advanced high performance computers high definition TV digital camcorders sensitive broadband imaging systems flat panel displays robotic systems and medical electronics and diagnostics are but a few examples of miniaturized device technologies that depend the utilization of thin film materials The Handbook of Thin Films Materials is a comprehensive reference focusing on processing techniques characterization methods and physical properties of these thin film materials **Electrical**

**Characterization of Organic Electronic Materials and Devices** Professor Peter Stallinga, 2009-10-08 Think like an electron Organic electronic materials have many applications and potential in low cost electronics such as electronic barcodes and in light emitting devices due to their easily tailored properties While the chemical aspects and characterization have been widely studied characterization of the electrical properties has been neglected and classic textbook modeling has been applied This is most striking in the analysis of thin film transistors TFTs using thick bulk transistor MOS FET descriptions At first glance the TFTs appear to behave as regular MOS FETs However upon closer examination it is clear that TFTs are unique and merit their own model Understanding and interpreting measurements of organic devices which are often seen as black box measurements is critical to developing better devices and this therefore has to be done with care Electrical Characterization of Organic Electronic Materials and Devices Gives new insights into the electronic properties and measurement techniques for low mobility electronic devices Characterizes the thin film transistor using its own model Links the phenomena seen in different device structures and different measurement techniques Presents clearly both how to perform electrical measurements of organic and low mobility materials and how to extract important information from these measurements Provides a much needed theoretical foundation for organic electronics **Electrical characterization of**

**transition metals in silicon:** Leopold Scheffler, 2015-04-28 Silizium ist ein wichtiger Rohstoff unserer modernen Welt

Mikroelektronik Sensorik und Photovoltaik sind drei wichtige Anwendungsgebiete die aus unserem t glichen Leben heute nicht mehr wegzudenken sind Entscheidend f r all diese Anwendungen ist das Verst ndnis der elektrischen Eigenschaften des Materials welche durch Defekte und Verunreinigungen beeinflusst werden Die bergangsmetalle sind eine wichtige Klasse von Verunreinigungen im Silizium da sie die elektrischen Eigenschaften stark beeinflussen Auch ist bekannt dass Wasserstoff welcher in vielen Prozessen in Silizium eindringen kann mit vielen Defekten reagiert In der vorliegenden Dissertation wird die Wechselwirkung von Wasserstoff mit den Metallen Titan Kobalt und Nickel mit Hilfe der kapazitiven Messmethoden DLTS und MCTS untersucht Verschiedene elektrisch aktive Metall Wasserstoff Komplexe k nnen nachgewiesen werden Auch eine Passivierung der Metalle durch Wasserstoff wird beobachtet Neben den Reaktionen mit den Metallen wird auch eine Wechselwirkung des Wasserstoffs mit im Silizium vorhandenem Kohlenstoff untersucht F r eine Einordnung der Ergebnisse werden diese mit dem aus der Literatur bekannten Verhalten benachbarter Elemente verglichen

**Characterization of Semiconductor Heterostructures and Nanostructures** Giovanni Agostini, Carlo Lamberti, 2011-08-11 In the last couple of decades high performance electronic and optoelectronic devices based on semiconductor heterostructures have been required to obtain increasingly strict and well defined performances needing a detailed control at the atomic level of the structural composition of the buried interfaces This goal has been achieved by an improvement of the epitaxial growth techniques and by the parallel use of increasingly sophisticated characterization techniques and of refined theoretical models based on ab initio approaches This book deals with description of both characterization techniques and theoretical models needed to understand and predict the structural and electronic properties of semiconductor heterostructures and nanostructures Comprehensive collection of the most powerful characterization techniques for semiconductor heterostructures and nanostructures Most of the chapters are authored by scientists that are among the top 10 worldwide in publication ranking of the specific field Each chapter starts with a didactic introduction on the technique The second part of each chapter deals with a selection of top examples highlighting the power of the specific technique to analyze the properties of semiconductors

**The Physics of Semiconductors** Marius Grundmann, 2015-12-24 The 3rd edition of this successful textbook contains ample material for a comprehensive upper level undergraduate or beginning graduate course guiding readers to the point where they can choose a special topic and begin supervised research The textbook provides a balance between essential aspects of solid state and semiconductor physics on the one hand and the principles of various semiconductor devices and their applications in electronic and photonic devices on the other It highlights many practical aspects of semiconductors such as alloys strain heterostructures nanostructures that are necessary in modern semiconductor research but typically omitted in textbooks Coverage also includes additional advanced topics such as Bragg mirrors resonators polarized and magnetic semiconductors nanowires quantum dots multi junction solar cells thin film transistors carbon based nanostructures and transparent conductive oxides The text derives explicit formulas for many results to

support better understanding of the topics The Physics of Semiconductors requires little or no prior knowledge of solid state physics and evolved from a highly regarded two semester course In the third edition several topics are extended and treated in more depth including surfaces disordered materials amorphous semiconductors polarons thermopower and noise More than 1800 references guide the reader to historic and current literature including original and review papers and books

**The Story of Semiconductors** John W. Orton, 2008-12-11 The book provides an overview of the fascinating spectrum of semiconductor physics devices and applications presented from a historical perspective It covers the development of the subject from its inception in the early nineteenth century to the recent millennium Written in a lively informal style it emphasizes the interaction between pure scientific push and commercial pull on the one hand and between basic physics materials and devices on the other It also sets the various device developments in the context of systems requirements and explains how such developments met wide ranging consumer demands It is written so as to appeal to students at all levels in physics electrical engineering and materials science to teachers lecturers and professionals working in the field as well as to a non specialist scientific readership

**Extraction of Semiconductor Diode Parameters** Richard Ocaya, 2024-06-03 This book presents a comprehensive treatise on the extraction of semiconductor diode parameters using various methods Its focus is on metal semiconductor metal insulator semiconductor and p n junction diodes covering a wide range of metals and semiconductors including elemental compound organic and nanostructured materials By bringing together these methods in one place this book provides a much needed standardized point of reference for the field The methods used for device characterization have spread widely but not yet critically compared and contrasted This book aims to bridge this gap by offering a comparative review of the methods and providing the most accurate information on current developments The result is a valuable resource for researchers and practitioners who seek to optimize their use of semiconductor diodes in their work With its thorough coverage and critical analysis this book fills a large void in the field of semiconductor device characterization It is an essential reference for anyone interested in the extraction of semiconductor diode parameters using a variety of methods

*CVD Diamond for Electronic Devices and Sensors* Ricardo S. Sussmann, 2009-01-09 Synthetic diamond is diamond produced by using chemical or physical processes Like naturally occurring diamond it is composed of a three dimensional carbon crystal Due to its extreme physical properties synthetic diamond is used in many industrial applications such as drill bits and scratch proof coatings and has the potential to be used in many new application areas A brand new title from the respected Wiley Materials for Electronic and Optoelectronic Applications series this title is the most up to date resource for diamond specialists Beginning with an introduction to the properties of diamond defects impurities and the growth of CVD diamond with its imminent commercial impact the remainder of the book comprises six sections introduction radiation sensors active electronic devices biosensors MEMs and electrochemistry Subsequent chapters cover the diverse areas in which diamond applications are having an impact including electronics sensors and actuators and

medicine      *Quantum Dot Heterostructures* Dieter Bimberg, Marius Grundmann, Nikolai N. Ledentsov, 1999-03-17 Quantum Dot Heterostructures Dieter Bimberg Marius Grundmann and Nikolai N Ledentsov Institute of Solid State Physics Technische Universit t Berlin Germany Quantum dots are nanometer size semiconductor structures and represent one of the most rapidly developing areas of current semiconductor research as increases in the speed and decreases in the size of semiconductor devices become more important They present the utmost challenge to semiconductor technology making possible fascinating novel devices This important new reference book focuses on the key phenomena and principles Chapter 1 provides a brief account of the history of quantum dots whilst the second chapter surveys the various fabrication techniques used in the past two decades and introduces the concept of self organized growth This topic is expanded in the following chapter which presents a broad review of self organization phenomena at surfaces of crystals Experimental results on growth of quantum dot structures in many different systems and on their structural characterization are presented in Chapter 4 Basic properties of the dots relate to their geometric structure and chemical composition Numerical modeling of the electronic and optical properties of real dots is presented in Chapter 5 together with general theoretical considerations on carrier capture relaxation recombination and properties of quantum dot lasers Chapters 6 and 7 summarize experimental results on electronic optical and electrical properties The book concludes by disoussing highly topical results on quantum dot based photonic devices mainly quantum dot lasers Quantum Dot Heterostructures is written by some of the key researchers who have contributed significantly to the development of the field and have pioneered both the theoretical understanding of quantum dot related phenomena and quantum dot lasers It is of great interest to graduate and postgraduate students and to researchers in semiconductor physics and technology and optoelectronics      Proceedings of the Fifth International Symposium on Long Wavelength Infrared Detectors and Arrays: Physics and Applications Sheng S. Li, H. C. Liu, M. Z. Tidrow, 1997      Capacitance Spectroscopy of Semiconductors Jian V. Li, Giorgio Ferrari, 2018-07-06 Capacitance spectroscopy refers to techniques for characterizing the electrical properties of semiconductor materials junctions and interfaces all from the dependence of device capacitance on frequency time temperature and electric potential This book includes 15 chapters written by world recognized leading experts in the field academia national institutions and industry divided into four sections Physics Instrumentation Applications and Emerging Techniques The first section establishes the fundamental framework relating capacitance and its allied concepts of conductance admittance and impedance to the electrical and optical properties of semiconductors The second section reviews the electronic principles of capacitance measurements used by commercial products as well as custom apparatus The third section details the implementation in various scientific fields and industries such as photovoltaics and electronic and optoelectronic devices The last section presents the latest advances in capacitance based electrical characterization aimed at reaching nanometer scale resolution

**Advanced Characterization Techniques for Thin Film Solar Cells** Daniel Abou-Ras, Thomas Kirchartz, Uwe

Rau,2016-07-13 The book focuses on advanced characterization methods for thin film solar cells that have proven their relevance both for academic and corporate photovoltaic research and development After an introduction to thin film photovoltaics highly experienced experts report on device and materials characterization methods such as electroluminescence analysis capacitance spectroscopy and various microscopy methods In the final part of the book simulation techniques are presented which are used for ab initio calculations of relevant semiconductors and for device simulations in 1D 2D and 3D Building on a proven concept this new edition also covers thermography transient optoelectronic methods and absorption and photocurrent spectroscopy *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 Semiconductor Materials B.G.

Yacobi,2006-04-18 The technological progress is closely related to the developments of various materials and tools made of those materials Even the different ages have been defined in relation to the materials used Some of the major attributes of the present day age i e the electronic materials age are such common tools as computers and fiber optic telecommunication systems in which semiconductor materials provide vital components for various mic electronic and optoelectronic devices in applications such as computing memory storage and communication The field of semiconductors encompasses a variety of disciplines This book is not intended to provide a comprehensive description of a wide range of semiconductor properties or of a continually increasing number of the semiconductor device applications Rather the main purpose of this book is to provide an introductory perspective on the basic principles of semiconductor materials and their applications that are described in a relatively concise format in a single volume Thus this book should especially be suitable as an introductory

text for a single course on semiconductor materials that may be taken by both undergraduate and graduate engineering students This book should also be useful as a concise reference on semiconductor materials for researchers working in a wide variety of fields in physical and engineering sciences

**Handbook of Solid-State Lighting and LEDs** Zhe Chuan Feng, 2017-06-12 This handbook addresses the development of energy efficient environmentally friendly solid state light sources in particular semiconductor light emitting diodes LEDs and other solid state lighting devices It reflects the vast growth of this field and impacts in diverse industries from lighting to communications biotechnology imaging and medicine The chapters include coverage of nanoscale processing fabrication of LEDs light diodes photodetectors and nanodevices characterization techniques application and recent advances Readers will obtain an understanding of the key properties of solid state lighting and LED devices an overview of current technologies and appreciation for the challenges remaining The handbook will be useful to material growers and evaluators device design and processing engineers newcomers students and professionals in the field

**Gallium Nitride and Related Materials** Isik C. Kizilyalli, Jung Han, James S. Speck, Eric P. Carlson, 2025-04-22 This book presents progress in device processing and materials characterization of the wide bandgap semiconductor gallium nitride GaN and related materials for power electronics applications The content of the book is based on the output of multiple well defined and actively managed programs from the U S Department of Energy s Advanced Research Projects Agency Energy ARPA E The material is organized into eight parts with a total of 28 chapters contributed from invited experts that were part of the ARPA E programs along with chapters from a few select experts from around the world who are actively engaged in GaN and related WBG semiconductor research and development The book includes an overview of GaN power electronic devices and systems and a comprehensive review of the key vertical device processing challenges Part I detailed descriptions of bulk GaN substrate technology Part II discussions of the challenges in GaN epitaxial growth and processing Part III an in depth examination of approaches and challenges in GaN selective area p type doping with an eye towards mechanistic understanding Part IV an overview of innovative material characterization techniques developed to understand the device processing challenges Part V an analysis of the fundamental materials properties of GaN in relation to its use in power electronics Part VI a discussion of related earlier stage nitride wide bandgap materials development and application in power electronics and other applications Part VII and concludes with a forward looking discussion of the areas that still need research and development to push the limits of power electronics to utilize wide bandgap semiconductors along with potential high impact application areas Part VIII This book is intended to be an essential reference for anyone working in either basic research or advanced development of vertical architecture GaN power electronics and technologies It is anticipated this book will become a go to reference for any scientist and engineer working in any nitride semiconductor material seeking an updated coverage of the state of the art processing and characterization techniques that will push GaN know how to new materials and device frontiers

**III-V Nitride Semiconductors** Edward



T. Yu, 2022-10-30 The concepts in this book will provide a comprehensive overview of the current state for a broad range of nitride semiconductor devices as well as a detailed introduction to selected materials and processing issues of general relevance for these applications This compilation is very timely given the level of interest and the current stage of research in nitride semiconductor materials and device applications This volume consists of chapters written by a number of leading researchers in nitride materials and device technology addressing Ohmic and Schottky contacts AlGaInN multiple quantum well laser diodes nitride vertical cavity emitting lasers and ultraviolet photodetectors This unique volume provides a comprehensive review and introduction to application and devices based on GaN and related compounds for newcomers to the field and stimulus to further advances for experienced researchers

**Proceedings of the Symposium on Crystalline Defects and Contamination, Their Impact and Control in Device Manufacturing II** Bernd O. Kolbesen (Chemiker.), 1997

**Handbook of Nitride Semiconductors and Devices, Materials Properties, Physics and Growth** Hadis Morkoç, 2009-07-30 The three volumes of this handbook treat the fundamentals technology and nanotechnology of nitride semiconductors with an extraordinary clarity and depth They present all the necessary basics of semiconductor and device physics and engineering together with an extensive reference section Volume 1 deals with the properties and growth of GaN The deposition methods considered are hydride VPE organometallic CVD MBE and liquid high pressure growth Additionally extended defects and their electrical nature point defects and doping are reviewed

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