Semiconductor Material And Device Characterization Solution Manual

Ultrawide Bandgap Semiconductors, Volume 107 in the Semiconductors and Semimetals series, highlights the latest breakthrough in fundamental science and technology development of ultrawide bandgap (UWBG) semiconductor materials and devices based on gallium oxide, aluminium nitride, boron nitride, and diamond. It includes important topics on the materials growth, characterization, and device applications of UWBG materials, where electronic, photonic, thermal and quantum properties are all thoroughly explored. Contains the latest breakthrough in fundamental science and technology development of ultrawide bandgap (UWBG) semiconductor materials and devices Provides a comprehensive presentation that covers the fundamentals of materials growth and characterization, as well as design and performance characterization of state-of-the-art UWBG materials, structures, and devices Presents an in-depth discussion on electronic, photonic, thermal, and quantum technologies based on UWBG materials

The new edition of the most detailed and comprehensive single-volume reference on major semiconductor devices The Fourth Edition of Physics of Semiconductor Devices remains the standard reference work on the fundamental physics and operational characteristics of all major bipolar, unipolar, special microwave, and optoelectronic devices. This fully updated and expanded edition includes approximately 1,000 references to original research papers and review articles, more than 650 high-quality technical illustrations, and over two dozen tables of material parameters. Divided into five parts, the text first provides a summary of semiconductor properties, covering energy band, carrier concentration, and transport properties. The second part surveys the basic building blocks of semiconductor devices, including p-n junctions, metal-semiconductor contacts, and metal-insulator-semiconductor (MIS) capacitors. Part III examines bipolar transistors, MOSFETs (MOS field-effect transistors), and other field-effect transistors such as JFETs (junction-field-effect-transistors) and MESFETs (metal-semiconductor field-effect transistors). Part IV focuses on negative-resistance and power devices. The book concludes with coverage of photonic devices and sensors, including light-emitting diodes (LEDs), solar cells, and various photodetectors and semiconductor sensors. This classic volume, the standard textbook and reference in the field of semiconductor devices: Provides the practical foundation necessary for understanding the devices currently in use and evaluating the performance and limitations of future devices Offers completely updated and revised information that reflects advances in device concepts, performance, and application Features discussions of topics of contemporary interest, such as applications of photonic devices that convert optical energy to electric energy Includes numerous problem sets, real-world examples, tables, figures, and illustrations; several useful appendices; and a detailed solutions manual Explores new work on leading-edge technologies such as MODFETs, resonant-tunneling diodes, quantum-cascade lasers, single-electron transistors, real-space-transfer devices, and MOS-controlled thyristors Physics of Semiconductor Devices, Fourth Edition is an indispensable resource for design engineers, research scientists, industrial and electronics engineering managers, and graduate students in the field.

The unique materials properties of GaN-based semiconductors has stimulated a great deal of interest in research and development regarding nitride materials growth and optoelectronic and nitride-based electronic devices. High electron mobility, and breakdown field. The high thermal-impedance of GaN-based films grown over SiC or bulk AlN substrates make nitride-based electronic devices very promising.

Semiconductors lie at the heart of some of the most important industries and technologies of the twentieth century. The complexity of silicon integrated circuits is increasing considerably because of the continuous dimensional shrinkage to improve efficiency and functionality. This evolution in design rules poses real challenges for the materials scientists and processing engineers. Materials, defects and processing now have to be understood in their totality. World experts discuss, in this volume, the crucial issues facing lithography, ion implantation and plasma processing, metallization and insulating layer quality, and crystal growth. Particular emphasis is placed upon silicon, but compound semiconductors and photonic materials are also highlighted. The fundamental concepts of phase stability, interfaces and defects play a key role in understanding these crucial issues. These concepts are reviewed in a crucial fashion.

Semiconductor Material and Device Characterization John Wiley & Sons

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. The elucidation of the effects of structurally extended defects on electronic properties of materials is especially important in view of the current advances in electronic device development that involve defect control and engineering at the nanometer level. This book surveys the properties, effects, roles and characterization of extended defects in semiconductors. The basic properties of extended defects (dislocations, stacking faults, grain boundaries, and precipitates) are outlined, and their effect on the electronic properties of semiconductors, their role in semiconductor devices, and techniques for their characterization are discussed. These topics are among the central issues in the investigation and applications of semiconductors and in the operation of semiconductor devices. The authors preface their treatment with an introduction to semiconductor materials and conclude with a chapter on point defect maldistributions. This text is suitable for advanced undergraduate and graduate students in materials science and engineering, and for those studying semiconductor physics.

Learn the basic properties and designs of modern VLSI devices, as well as the factors affecting performance, with this thoroughly updated second edition. The first edition has been widely adopted as a standard textbook in microelectronics in many major US
universities and worldwide. The internationally renowned authors highlight the intricate interdependencies and subtle trade-offs between various practically important device parameters, and provide an in-depth discussion of device scaling and scaling limits of CMOS and bipolar devices. Equations and parameters provided are checked continuously against the reality of silicon data, making the book equally useful in practical transistor design and in the classroom. Every chapter has been updated to include the latest developments, such as MOSFET scale length theory, high-field transport model and SiGe-base bipolar devices. Power Electronics Device Applications of Diamond Semiconductors presents state-of-the-art research on diamond growth, doping, device processing, theoretical modeling and device performance. The book begins with a comprehensive and close examination of diamond crystal growth from the vapor phase for epitaxial diamond and wafer preparation. It looks at single crystal vapor deposition (CVD) growth sectors and defect control, ultra high purity SC-CVD, SC diamond wafer CVD, heteroepitaxy on Ir/MqO and needle-induced large area growth, also discussing the latest doping and semiconductor characterization methods, fundamental material properties and device physics. The book concludes with a discussion of circuits and applications, featuring the switching behavior of diamond devices and applications, high frequency and high temperature operation, and potential applications of diamond semiconductors for high voltage devices. Includes contributions from today’s most respected researchers who present the latest results for diamond growth, doping, device fabrication, theoretical modeling and device performance. Examines why diamond semiconductors could lead to superior power electronics. Discusses the main challenges to device realization and the best opportunities for the next generation of power electronics.

2D Semiconductor Materials and Devices reviews the basic science and state-of-art technology of 2D semiconductor materials and devices. Chapters discuss the basic structure and properties of 2D semiconductor materials, including both elemental (silicene, phosphorene) and compound semiconductors (transition metal dichalcogenide), the current growth and characterization methods of these 2D materials, state-of-the-art devices, and current and potential applications. Reviews a broad range of emerging 2D electronic materials beyond graphene, including silicene, phosphorene and compound semiconductors. Provides an in-depth review of material properties, growth and characterization aspects—topics that could enable applications. Features contributions from the leading experts in the field. This publication is a compilation of papers presented at the Semiconductor Device Reliability Workshop sponsored by the NATO International Scientific Exchange Program. The Workshop was held in Crete, Greece from June 4 to June 9, 1989. The objective of the Workshop was to review and to further explore advances in the field of semiconductor device reliability through invited paper presentations and discussions. The technical emphasis was on quality assurance and reliability of optoelectronic and high speed semiconductor devices. The primary support for the meeting was provided by the Scientific Affairs Division of NATO. We are indebted to NATO for their support and to Dr. Craig Sinclair, who administers this program. The chapters of this book follow the format and order of the sessions of the meeting. Thirty-six papers were presented and discussed during the five-day Workshop. In addition, two panel sessions were held, with audience participation, where the particularly controversial topics of burn-in and reliability modeling and prediction methods were discussed. A brief review of these sessions is presented in this book. This critical volume examines the different methods used for the synthesis of a great number of photocatalysts, including TiO2, ZnO and other modified semiconductors, as well as characterization techniques used for determining the optical, structural and morphological properties of the semiconducting materials. Additionally, the authors discuss photoelectrochemical methods for determining the light activity of the photocatalytic semiconductors by means of measurement of properties such as band gap energy, flat band potential and kinetics of hole and electron transfer. Photocatalytic Semiconductors: Synthesis, Characterization and Environmental Applications provide an overview of the semiconductor materials from first- to third-generation photocatalysts and their applications in wastewater treatment and water disinfection. The book further presents economic and toxicological aspects in the production and application of photocatalytic materials. This book is a practical guide to optical, optoelectronic, and semiconductor materials and provides an overview of the topic from its fundamentals to cutting-edge processing routes to groundbreaking technologies for the most recent applications. The book details the characterization and properties of these materials. Chemical methods of synthesis are emphasized by the authors throughout the publication. Describes new materials and updates to older materials that exhibit optical, optoelectronic and semiconductor behaviors; Covers the structural and mechanical aspects of the optical, optoelectronic and semiconductor materials for meeting mechanical property and safety requirements; Includes discussion of the environmental and sustainability issues regarding optical, optoelectronic, and semiconductor materials, from processing to recycling. This book reviews the recent advances and current technologies used to produce microelectronic and optoelectronic devices from compound semiconductors. It provides a complete overview of the technologies necessary to grow bulk single-crystal substrates, grow hetero- or homoepitaxial films, and process advanced devices such as HBT's, QW diode lasers, etc. Resistivity -- Carrier and doping density -- Contact resistance and Schottky barriers -- Series resistance, channel length and width, and threshold voltage -- Defects -- Oxide and interface trapped charges, oxide thickness -- Carrier lifetimes -- Mobility -- Charge-based and probe characterization -- Optical characterization -- Chemical and physical characterization -- Reliability and failure analysis. The second, updated edition of this essential reference book provides a wealth of detail on a wide range of electronic and photonic materials, starting from fundamentals and building up to advanced topics and applications. Its extensive coverage, with clear illustrations and applications, carefully selected chapter sequencing and logical flow, makes it very different from other electronic materials handbooks. It has been written by professionals in the field and instructors who teach the subject at a university or in corporate laboratories. The Springer Handbook of Electronic and Photonic Materials, second edition, includes practical applications used as examples, details of experimental techniques, useful
tables that summarize equations, and, most importantly, properties of various materials, as well as an extensive glossary. Along with significant updates to the content and the references, the second edition includes a number of new chapters such as those covering novel materials and selected applications. This handbook is a valuable resource for graduate students, researchers and practicing professionals working in the area of electronic, optoelectronic and photonic materials.

A practical guide to semiconductor manufacturing from process control to yield modeling and experimental design Fundamentals of Semiconductor Manufacturing and Process Control offers all issues involved in manufacturing microelectronic devices and circuits, including fabrication sequences, process control, experimental design, process modeling, yield modeling, and CIM/CAM systems. Readers are introduced to both the theory and practice of all basic manufacturing concepts. Following an overview of manufacturing and technology, the text explores process monitoring methods, including those that focus on product wafers and those that focus on the equipment used to produce wafers. Next, the text sets forth some fundamentals of statistics and yield modeling, which set the foundation for a detailed discussion of how statistical process control is used to analyze quality and improve yields. The discussion of statistical experimental design offers readers a powerful approach for systematically varying controllable process conditions and determining their impact on output parameters that measure quality. The authors introduce process modeling concepts, including several advanced process control topics such as run-by-run, supervisory control, and process and equipment diagnosis. Critical coverage includes the following: * Combines process control and semiconductor manufacturing * Unique treatment of system and software technology and management of overall manufacturing systems * Chapters include case studies, sample problems, and suggested exercises * Instructor support includes electronic copies of the figures, and an instructor’s manual. Graduate-level students and industrial practitioners will benefit from the detailed exam?nation of how electronic materials and supplies are converted into finished integrated circuits and semiconductor products in a high-volume manufacturing environment. An Instructor’s Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department. An Instructor Support FTP site is also available.

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 This book addresses material growth, device fabrication, device application, and commercialization of energy-efficient white light-emitting diodes (LEDs), laser diodes, and power electronics devices. It begins with an overview on basics of semiconductor materials, physics, growth and characterization techniques, followed by detailed discussion of advantages, drawbacks, design issues, processing, applications, and key challenges for state of the art GaN-based devices. It includes state-of-the-art material synthesis techniques with an overview on growth technologies for emerging bulk or free standing GaN and AlN substrates and their applications in electronics, detection, sensing, optoelectronics and photonics. Wengang (Wayne) Bi is Distinguished Chair Professor and Associate Dean in the College of Information and Electrical Engineering at Hebei University of Technology in Tianjin, China. Hao-chung (Henry) Kuo is Distinguished Professor and Associate Director of the Photonics Center at National Chiao-Tung University, Hsin-Tsu, Taiwan, China. Pei-Cheng Ku is an associate professor in the Department of Electrical Engineering & Computer Science at the University of Michigan, Ann Arbor, USA. Bo Shen is the Cheung Kong Professor at Peking University in China. At the heart of modern power electronics converters are power semiconductor switching devices. The emergence of wide bandgap (WBG) semiconductor devices, including silicon carbide and gallium nitride, promises power electronics converters with higher efficiency, smaller size, lighter weight, and lower cost than converters using the established silicon-based devices. However, WBG devices pose new challenges for converter design and require more careful characterization, in particular due to their fast switching speed and more stringent need for protection. Characterization of Wide Bandgap Power Semiconductor Devices presents comprehensive methods with examples for the characterization of this important class of power devices. After an introduction, the book covers pulsed static characterization; junction capacitance characterization; fundamentals of dynamic characterization; gate drive for dynamic characterization; layout design and parasitic management; protection design for double pulse test; measurement and data processing for dynamic characterization; cross-talk consideration; impact of three-phase system; and topology considerations. This book focuses on the exciting topic of self-organized organic semiconductors — from materials to device applications. It offers up-to-date and accessible coverage of self-organized semiconductors for organic chemistry, polymer science, liquid crystals, materials science, material engineering, electrical engineering, chemical engineering, optics, optoelectronics, nanotechnology and semiconductors. Chapters cover chemistry, physics, processing, and characterization. The applications include photovoltaics, light-emitting diodes (LEDs), and transistors. This book presents a practical guide to the analysis of materials and includes a thorough description of the underlying theories and instrumental aberrations caused by real experiments. The main emphasis concerns the analysis of thin films and multilayers, primarily semiconductors, although the techniques are very general. Semiconductors can be very perfect composite crystals and therefore their study will lead to the largest volume of information, since X-ray scattering can assess the deviation from perfection. The description is intentionally conceptual so that the reader can grasp the real processes involved. In this way the analysis becomes significantly easier, making the reader aware of misleading artifacts and assisting in the determination of a more complete and reliable analysis. The theory of scattering is very important and is covered in such a way that the assumptions are clear. Greatest emphasis is placed on the dynamical diffraction theory including new developments extending its applicability to reciprocal space mapping and modelling samples with relaxed and distorted interfaces. A practical guide to the measurement of diffraction patterns, including the smearing effects introduced to the measurement, is also
presented. Contents: An Introduction to Semiconductor Materials, An Introduction to X-Ray Scattering, Equipment for Measuring Diffraction Patterns, A Practical Guide to the Evaluation of Structural Parameters, Readership: Postgraduate researchers in crystallography, materials science, semiconductors and physics. Keywords: X-Ray; Diffraction; Scattering; Semiconductors; Rocking Curve; Reciprocal Space; Topography; High Resolution; Thin Films; Reflectometry; Dynamical Theory

This Third Edition updates a landmark text with the latest findings. The Third Edition of the internationally lauded Semiconductor Material and Device Characterization brings the text fully up-to-date with the latest developments in the field and includes new pedagogical tools to assist readers. Not only does the Third Edition set forth all the latest measurement techniques, but it also examines new interpretations and new applications of existing techniques. Semiconductor Material and Device Characterization remains the sole text dedicated to characterizing techniques for semiconductor materials and devices. Coverage includes the full range of electrical and optical characterization methods, including the more specialized chemical and physical techniques. Readers familiar with the previous two editions will discover thoroughly revised and updated Third Edition, including: Updated and revised figures and examples reflecting the most current data and information 260 new references offering access to the latest research and discussions in specialized topics New problems and review questions at the end of each chapter to test readers' understanding of the material In addition, readers will find fully updated and revised sections in each chapter. Plus, two new chapters have been added: Charge-Based and Probe Characterization introduces charge-based measurement and Kelvin probes. This chapter also examines probe-based measurements, including scanning capacitance, scanning Kelvin force, scanning spreading resistance, and ballistic electron emission microscopy. Reliability and Failure Analysis examines failure times and distribution functions, and discusses electromigration, hot carriers, gate oxide integrity, negative bias temperature instability, stress-induced leakage current, and electrostatic discharge. Written by an internationally recognized authority in the field, Semiconductor Material and Device Characterization remains essential reading for graduate students as well as for professionals working in the field of semiconductor devices and materials. An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department.

The purpose of this book is to provide the reader with a self-contained treatment of fundamental solid state and semiconductor device physics. The material presented in the text is based upon the lecture notes of a one-year graduate course sequence taught by this author for many years in the Department of Electrical Engineering of the University of Florida. It is intended as an introductory textbook for graduate students in electrical engineering. However, many students from other disciplines and backgrounds such as chemical engineering, materials science, and physics have also taken this course sequence, and will be interested in the material presented herein. This book may also serve as a general reference for device engineers in the semiconductor industry. The present volume covers a wide variety of topics on basic solid state physics and physical principles of various semiconductor devices. The main subjects covered include crystal structures, lattice dynamics, semiconductor statistics, energy band theory, excess carrier phenomena and recombination mechanisms, carrier transport and scattering mechanisms, optical properties, photoelectric effects, metal-semiconductor devices, the p–n junction diode, bipolar junction transistors, MOSFETs, MOS capacitors, photovoltaic devices, quantum wells, and high-speed III–V semiconductor devices. The text presents a unified and balanced treatment of the physics of semiconductor materials and devices. It is intended to provide physicists and chemists with more device backgrounds, and device engineers with a broader knowledge of fundamental solid state physics.

A comprehensive introduction and up-to-date reference to SiC power semiconductor devices covering topics from material properties to applications Based on a number of breakthroughs in SiC material science and fabrication technology in the 1980s and 1990s, the first SiC Schottky barrier diodes (SBDs) were released as commercial products in 2001. The SiC SBD market has grown significantly since that time, and SBDs are now used in a variety of power systems, particularly switch-mode power supplies and motor controls. SiC power MOSFETs entered commercial production in 2011, providing rugged, high-efficiency switches for high-frequency power systems. In this wide-ranging book, the authors draw on their considerable experience to present both an introduction to SiC materials, devices, and applications and an in-depth reference for scientists and engineers working in such a moving-field. Fundamentals of Silicon Carbide Technology covers basic properties of SiC materials, processing technology, theory and analysis of practical devices, and an overview of the most important systems applications. Specifically included are: A complete discussion of SiC material properties, bulk crystal growth, epitaxial growth, device technology, and characterization techniques. Device physics and operating equations for Schottky diodes, pin diodes, JBS/MPS diodes, JFETs, MOSFETs, BJTs, IGBTs, and thyristors. A survey of power electronics applications, including switch-mode power supplies, motor drives, power converters for electric vehicles, and converters for renewable energy sources. Coverage of special applications, including microwave devices, high-temperature electronics, and rugged sensors. Fully illustrated throughout, the text is written by recognized experts with over 45 years of combined experience in SiC research and development. This book is intended for graduate students and researchers in crystal growth, material science, and semiconductor device technology. The book is also useful for design engineers, application engineers, and product managers in areas such as power supplies, converter and inverter design, electric vehicle technology, high-temperature electronics, sensors, and smart grid technology.

This wide-ranging book summarizes the current knowledge of radiation defects in semiconductors, outlining the shortcomings of present experimental and modelling techniques and giving an outlook on future developments. It also provides information on the application of sensors in nuclear power plants.

In the past ten years, heteroepitaxy has continued to increase in importance with the explosive growth of the electronics industry and the development of a myriad of heteroepitaxial devices for solid state lighting, green energy, displays, communications, and digital computing. Our ever-growing understanding of the basic physics and chemistry underlying heteroepitaxy, especially lattice relaxation and dislocation dynamic, has enabled an ever-increasing emphasis on metamorphic devices. To reflect this focus, two all-new chapters have been included in this new edition. One chapter addresses metamorphic buffer layers, and the other covers metamorphic devices. The remaining seven chapters have been revised extensively with new material on crystal symmetry and relationships, III-nitride materials, lattice relaxation physics and models, in-situ characterization, and reciprocal space maps. 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, AlGaN 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.

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.

Silicon-based microelectronics has steadily improved in various performance-to-cost metrics. But after decades of processor scaling, fundamental limitations and considerable new challenges have emerged. The integration of compound semiconductors is the leading candidate to address many of these issues and to continue the relentless pursuit of more powerful, cost-effective processors. III-V Compound Semiconductors: Integration with Silicon-Based Microelectronics covers recent progress in this area, addressing the two major revolutions occurring in the semiconductor industry: integration of compound semiconductors into Si microelectronics, and their fabrication on large-area Si substrates. The authors present a scientific and technological exploration of GaN, GaAs, and III-V compound semiconductor devices within Si microelectronics, building a fundamental foundation to help readers deal with relevant design and application issues. Explores silicon-based CMOS applications developed within the cutting-edge DARPA program Providing an overview of systems, devices, and their component materials, this book: Describes structure, phase diagrams, and physical and chemical properties of III-V and Si materials, as well as integration challenges Focuses on the key merits of GaN, including its importance in commercializing a new class of power diodes and transistors Analyzes more traditional III-V materials, discussing their merits and drawbacks for device integration with Si microelectronics Elucidates properties of III-V semiconductors and describes approaches to evaluate and characterize their attributes Introduces novel technologies for the measurement and evaluation of material quality and device properties Investigates state-of-the-art optical devices, LEDs, Si photonics, high-speed, high-power III-V materials and devices, III-V solar cell devices, and more Assembling the work of renowned experts, this is a reference for scientists and engineers working at the intersection of Si and compound semiconductor technology. Its comprehensive coverage is valuable for both students and experts in this burgeoning field.

Compound Semiconductor Devices provides a comprehensive insight into today ?s standard technologies, covering the vast range of semiconductor products and their possible applications. The materials covered runs from the basics of conventional semiconductor technology through standard,power and opto semiconductors, to highly complex memories and microcontrollers and the special devices and modules for smartcards, automotive electronics, consumer electronics and telecommunications. Some chapters are devoted to the production of semiconductor components and their use in electronic systems as well as to quality management. The book offers students and users a unique overview of technology, architecture and areas of application of semiconductor products.
The Third Edition of the standard textbook and reference in the field of semiconductor devices. This classic book has set the standard for advanced study and reference in the semiconductor device field. Now completely updated and reorganized to reflect the tremendous advances in device concepts and performance, this Third Edition remains the most detailed and exhaustive single source of information on the most important semiconductor devices. It gives readers immediate access to detailed descriptions of the underlying physics and performance characteristics of all major bipolar, field-effect, microwave, photonic, and sensor devices. Designed for graduate textbook adoptions and reference needs, this new edition includes: A complete update of the latest developments New devices such as three-dimensional MOSFETs, MODFETs, resonant-tunneling diodes, semiconductor sensors, quantum-cascade lasers, single-electron transistors, real-space transfer devices, and more Materials completely reorganized Problem sets at the end of each chapter All figures reproduced at the highest quality Physics of Semiconductor Devices, Third Edition offers engineers, research scientists, faculty, and students a practical basis for understanding the most important devices in use today and for evaluating future device performance and limitations. A Solutions Manual is available from the editorial department. 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.

Containing more than 300 equations and nearly 500 drawings, photographs, and micrographs, this reference surveys key areas such as optical measurements and in-line calibration methods. It describes cleanroom-based measurement technology used during the manufacture of silicon integrated circuits and covers model-based, critical dimension, overlay This book provides an overview of compound semiconductor materials and their technology. After presenting a theoretical background, it describes the relevant material preparation technologies for bulk and thin-layer epitaxial growth. It then briefly discusses the electrical, optical, and structural properties of semiconductors, complemented by a description of the most popular characterization tools, before more complex hetero- and low-dimensional structures are discussed. A special chapter is devoted to GaN and related materials, owing to their huge importance in modern optoelectronic and electronic devices, on the one hand, and their particular properties compared to other compound semiconductors, on the other. In the last part of the book, the physics and functionality of optoelectronic and electronic device structures (LEDs, laser diodes, solar cells, field-effect and heterojunction bipolar transistors) are discussed on the basis of the specific properties of compound semiconductors presented in the preceding chapters of the book. Compound semiconductors form the backbone of all opto-electronic and electronic devices besides the classical Si electronics. Currently the most important field is solid state lighting with highly efficient LEDs emitting visible light. Also laser diodes of all wavelength ranges between mid-infrared and near ultraviolet have been the enabler for a huge number of unprecedented applications like CDs and DVDs for entertainment and data storage, not to speak about the internet, which would be impossible without optical data communications with infrared laser diodes as key elements. This book provides a concise overview over this class of materials, including the most important technological aspects for their fabrication and characterisation, also covering the most relevant devices based on compound semiconductors. It presents therefore an excellent introduction into this subject not only for students, but also for engineers and scientist who intend to put their focus on this field of science.

This book is concerned with compound semiconductor bulk materials and has been written for students, researchers and engineers in material science and device fabrication. It offers them the elementary and intermediate knowledge of compound semiconductor bulk materials necessary for entering this field. In the first part, the book describes the physical properties, crystal growth technologies, principles of crystal growth, various defects in crystals, characterization techniques and applications. In the second and the third parts, the book reviews various compound semiconductor materials, including important industrial materials and the results of recent research.

Silicon on Insulator is more than a technology, more than a job, and more than a venture in microelectronics; it is something different and refreshing in device physics. This book recalls the activity and enthu siasm of our SOI groups. Many contributing students have since then disappeared from the SOI horizon. Some of them believed that SOI was the great love of their scientific lives; others just considered SOI as a fantastic LEGO game for adults. We thank them all for kindly letting us imagine that we were guiding them. This book was very necessary to many people. SOI engineers will certainly be happy; indeed, if the performance of their SOI components is not always outstanding, they can now safely incriminate the relations given in the book rather than their process. Martine, Gunter, and Y. S. Chang can contemplate at last the amount of work they did with the figures. Our SOI accomplices already know how much we borrowed from their expertise and would find it indecent to have their detailed contribu tions listed. Jean-Pierre and Dimitris incited the book, while sharing their experience in the reliability of floating bodies. Our families and friends now realize the SOI capability of dielectrically isolating us for about two years in a BOX. Our kids encouraged us to start writing. Our wives definitely gave us the courage to stop writing. They had a hard time fighting the symptoms of a rapidly developing SOI allergy. A guide to the field of wide bandgap semiconductor technology Wide Bandgap Semiconductors for Power Electronics is a comprehensive and authoritative guide to wide bandgap materials silicon carbide, gallium nitride, diamond and
gallium(III) oxide. With contributions from an international panel of experts, the book offers detailed coverage to the growth of these materials, their characterization, and how they are used in a variety of power electronics devices such as transistors and diodes and in the areas of quantum information and hybrid electric vehicles. The book is filled with the most recent developments in the burgeoning field of wide bandgap semiconductor technology and includes information from cutting-edge semiconductor companies as well as material from leading universities and research institutions. By taking both scholarly and industrial perspectives, the book is designed to be a useful resource for scientists, academics, and corporate researchers and developers. This important book: Presents a review of wide bandgap materials and recent developments Links the high potential of the wide bandgap semiconductor with the technologic implementation capabilities Offers a unique combination academic and industrial perspectives Meets the demand for a resource that addresses wide bandgap materials in a comprehensive manner Written for materials scientists, semiconductor physicists, electrical engineers, Wide Bandgap Semiconductors for Power Electronics provides a state of the art guide to the technology and application of SiC and related wide bandgap materials.

A semiconductor interface is the contact between the semiconductor itself and a metal. The interface is a site of change, and it is imperative to ensure that the semiconducting material is sealed at this point to maintain its reliability. This book examines various aspects of interfaces, showing how they can affect microstructures and devices such as infrared photodetectors (as used in nightsights) and blue diode lasers. It presents various techniques for examining different types of semiconductor material and suggests future potential commercial applications for different semiconductor devices. Written by experts in their fields and focusing on metallic semiconductors (Cadmium Telluride and related compounds), this comprehensive overview of recent developments is an essential reference for those working in the semiconductor industry and provides a concise and comprehensive introduction to those new to the field.

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