Semiconductor Material And Device Characterization Solution

Electrical Characterization of Silicon-on-Insulator Materials and DevicesCrucial Issues in Semiconductor Materials and Processing TechnologiesCharacterization of Semiconductor Materials, Volume 1Radiation Effects in Advanced Semiconductor Materials and DevicesSemiconductor NanowiresCharacterisation and Control of Defects in SemiconductorsIII–V Compound SemiconductorsOrganic Semiconductor Material and Device Characterization by Low Frequency Noise and Admittance Spectroscopy of PolymerCharacterization of Semiconductor Heterostructures and NanostructuresCharacterization of Wide Bandgap Power Semiconductor DevicesHeteroepitaxy of SemiconductorsSemiconductor Material and Device CharacterizationWide Bandgap Semiconductor Electronics And DevicesCompound Semiconductor Bulk Materials and CharacterizationsPower Electronics Device Applications of Diamond SemiconductorsPhysics of Semiconductor DevicesOptical Characterization of SemiconductorsExtended Defects in SemiconductorsAnalytical and Diagnostic Techniques for Semiconductor Materials, Devices, and Processes 7Semiconductor MaterialsFundamentals of Silicon Carbide TechnologyHall Effect DevicesGaN-based Materials and DevicesMaterials and Reliability Handbook for Semiconductor Optical and Electron DevicesSemiconductor Devices: Physics and Technology, 3rd EditionSemiconductor Material and Device CharacterizationHandbook of GaN Semiconductor Materials and DevicesSelf-Organized Organic SemiconductorsSpringer Handbook of Electronic and Photonic MaterialsSemiconductor Physical ElectronicsHandbook of Compound SemiconductorsSemiconductor Material and Device CharacterizationFundamentals of Semiconductor Manufacturing and Process ControlCompound SemiconductorsHandbook of Silicon Semiconductor Metrology2D Semiconductor Materials and DevicesRare Earth and Transition Metal Doping of Semiconductor MaterialsSemiconductor Measurements and InstrumentationHeteroepitaxy of SemiconductorsSemiconductor Material and Device Characterization

Electrical Characterization of Silicon-on-Insulator Materials and Devices

Crystal orientation. Crystallographic defects and their observation. Resistivity and carrier-concentration measurements. Lifetime. Mobility, hall, and type measurements. Thickness measurements. Preparation of samples for microscopic examination. Microscopy and photography. The electron microscope and other analytical instruments.

Crucial Issues in Semiconductor Materials and Processing Technologies

The purpose of this book is to provide the reader with a self-contained treatment of fundamen tal 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 transistor, MOS devices, photonic devices, quantum effect devices, 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 mat erials scientists with more device backgrounds, and device engineers with a broader knowledge of fundamental solid state physics.

Characterization of Semiconductor Materials, Volume 1

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

Radiation Effects in Advanced Semiconductor Materials and Devices

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.

Semiconductor Nanowires

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.

Characterisation and Control of Defects in Semiconductors

This book provides an up-to-date review of the experimental and theoretical methods used for studying defects in semiconductors, this book focuses on recent developments driven by the requirements of new materials, including nitrides, oxide semiconductors and 2-D semiconductors.

III–V Compound Semiconductors

This Third Edition updates a landmark text with thelatest findings The Third Edition of the internationally laudedSemiconductor Material and Device Characterization bringsthe text fully up-to-date with the latest developments in the fieldand includes new pedagogical tools to assist readers. Not only doesthe Third Edition set forth all the latest measurementtechniques, but it also examines new interpretations and newapplications of existing techniques. Semiconductor Material and Device Characterizationremains the sole text dedicated to characterization techniques formeasuring semiconductor materials and devices. Coverage includesthe 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 athoroughly revised and updated Third Edition, including: Updated and revised figures and examples reflecting the mostcurrent data and information 260 new references offering access to the latest research anddiscussions in specialized topics New problems and review questions at the end of each chapter totest readers' understanding of the material In addition, readers will find fully updated and revisedsections in each chapter. Plus, two new chapters have been added: Charge-Based and Probe Characterization introduces charge-basedmeasurement and Kelvin probes. This chapter also examinesprobe-based measurements, including scanning capacitance, scanningKelvin force, scanning spreading resistance, and ballistic electronemission microscopy. Reliability and Failure Analysis examines failure times anddistribution functions, and discusses electromigration, hotcarriers, gate oxide integrity, negative bias temperatureinstability, stress-induced leakage current, and electrostaticdischarge. Written by an internationally recognized authority in the field,Semiconductor Material and Device Characterization remainsessential reading for graduate students as well as forprofessionals working in the field of semiconductor devices andmaterials. An Instructor's Manual presenting detailed solutions to all theproblems in the book is available from the Wiley editorialdepartment.

Organic Semiconductor Material and Device Characterization by Low Frequency Noise and Admittance Spectroscopy of Polymer

With the dawn of Gallium Oxide ($Ga2O_3$) and Aluminum Gallium Nitride (AlGaN)

electronics and the commercialization of Gallium Nitride (GaN) and Silicon Carbide (SiC) based devices, the field of wide bandgap materials and electronics has never been more vibrant and exciting than it is now. Wide bandgap semiconductors have had a strong presence in the research and development arena for many years. Recently, the increasing demand for high efficiency power electronics and high speed communication electronics, together with the maturity of the synthesis and fabrication of wide bandgap semicon-ductors, has catapulted wide bandgap electronics and optoelectronics into the mainstream.Wide bandgap semiconductors exhibit excellent material properties, which can potentially enable power device operation at higher efficiency, higher temperatures, voltages, and higher switching speeds than current Si technology. This edited volume will serve as a useful reference for researchers in this field — newcomers and experienced alike.This book discusses a broad range of topics including fundamental transport studies, growth of high-quality films, advanced materials characterization, device modeling, high frequency, high voltage electronic devices and optical devices written by the experts in their respective fields. They also span the whole spectrum of wide bandgap materials including AlGaN, $Ga_2O_3$and diamond.

Characterization of Semiconductor Heterostructures and Nanostructures

Rare Earth and Transition Metal Doping of Semiconductor Material explores traditional semiconductor devices that are based on control of the electron’s electric charge. This book looks at the semiconductor materials used for spintronics applications, in particular focusing on wide band-gap semiconductors doped with transition metals and rare earths. These materials are of particular commercial interest because their spin can be controlled at room temperature, a clear opposition to the most previous research on Gallium Arsenide, which allowed for control of spins at supercold temperatures. Part One of the book explains the theory of magnetism in semiconductors, while Part Two covers the growth of semiconductors for spintronics. Finally, Part Three looks at the characterization and properties of semiconductors for spintronics, with Part Four exploring the devices and the future direction of spintronics. Examines materials which are of commercial interest for producing smaller, faster, and more power-efficient computers and other devices Analyzes the theory behind magnetism in semiconductors and the growth of semiconductors for spintronics Details the properties of semiconductors for spintronics

Characterization of Wide Bandgap Power Semiconductor Devices

Diagnostic characterization techniques for semiconductor materials, devices and device processing are addressed at this symposium. It will cover new techniques as well as advances in routine analytical technology applied to semiconductor process development and manufacture. The hardcover edition includes a CD-ROM of ECS Transactions, Volume 10, Issue 1, Analytical Techniques for Semiconductor Materials and Process Characterization 5 (ALTECH 2007). The PDF edition also includes the ALTECH 2007 papers.

Heteroepitaxy of Semiconductors

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.

Semiconductor Material and Device Characterization

The awaited revision of Semiconductor Devices: Physics and Technology offers more than 50% new or revised material that reflects a multitude of important discoveries and advances in device physics and integrated circuit processing. Offering a basic introduction to physical principles of modern semiconductor devices and their advanced fabrication technology, the third edition presents students with theoretical and practical aspects of every step in device characterizations and fabrication, with an emphasis on integrated circuits. Divided into three parts, this text covers the basic properties of semiconductor materials, emphasizing silicon and gallium arsenide; the physics and characteristics of semiconductor devices bipolar, unipolar special microwave and photonic devices; and the latest processing technologies, from crystal growth to lithographic pattern transfer.

Wide Bandgap Semiconductor Electronics And Devices

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 implication 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.

Compound Semiconductor Bulk Materials and Characterizations

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 back-bone 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.

Power Electronics Device Applications of Diamond Semiconductors

A practical guide to semiconductor manufacturing from processcontrol to yield modeling and experimental design Fundamentals of Semiconductor Manufacturing and Process Controlcovers all issues involved in manufacturing microelectronic devicesand circuits, including fabrication sequences, process control,experimental design, process modeling, yield modeling, and CIM/CAMsystems. Readers are introduced to both the theory and practice ofall basic manufacturing concepts. Following an overview of manufacturing and technology, the textexplores process monitoring methods, including those that focus onproduct wafers and those that focus on the equipment used toproduce wafers. Next, the text sets forth some fundamentals ofstatistics and yield modeling, which set the foundation for adetailed discussion of how statistical process control is used toanalyze quality and improve yields. The discussion of statistical experimental design offers readers apowerful approach for systematically varying controllable processconditions and determining their impact on output parameters thatmeasure quality. The authors

introduce process modeling concepts,including several advanced process control topics such asrun-by-run, supervisory control, and process and equipmentdiagnosis. Critical coverage includes the following: * Combines process control and semiconductor manufacturing * Unique treatment of system and software technology and managementof overall manufacturing systems * Chapters include case studies, sample problems, and suggestedexercises * Instructor support includes electronic copies of the figures andan instructor's manual Graduate-level students and industrial practitioners will benefitfrom the detailed exami?nation of how electronic materials andsupplies are converted into finished integrated circuits andelectronic products in a high-volume manufacturingenvironment. An Instructor's Manual presenting detailed solutions to all theproblems in the book is available from the Wiley editorialdepartment. An Instructor Support FTP site is also available.

Physics of Semiconductor Devices

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.

Optical Characterization of Semiconductors

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.

Extended Defects in Semiconductors

This is the first book to explain, illustrate, and compare the most widely used methods in optics: photoluminescence, infrared spectroscopy, and Raman scattering. Written with non-experts in mind, the book develops the background needed to understand the why and how of each technique, but does not require special knowledge of semiconductors or optics. Each method is illustrated with numerous case studies. Practical information drawn from the authors experience is given to help establish optical facilities, including commercial sources for equipment, and experimental details. For industrial scientists with specific problems in semiconducting materials; for academic scientists who wish to apply their spectroscopic methods to characterization problems; and for students in solid

state physics, materials science and engineering, and semiconductor electronics and photonics, this book provides a unique overview, bringing together these valuable techniques in a coherent wayfor the first time. Discusses and compares infrared, Raman, and photoluminescence methods Enables readers to choose the best method for a given problem Illustrates applications to help non-experts and industrial users, with answers to selected common problems Presents fundamentals with examples from the semiconductor literature without excessive abstract discussion Features equipment lists and discussion of techniques to help establish characterization laboratories

Analytical and Diagnostic Techniques for Semiconductor Materials, Devices, and Processes 7

Materials and Reliability Handbook for Semiconductor Optical and Electron Devices provides comprehensive coverage of reliability procedures and approaches for electron and photonic devices. These include lasers and high speed electronics used in cell phones, satellites, data transmission systems and displays. Lifetime predictions for compound semiconductor devices are notoriously inaccurate due to the absence of standard protocols. Manufacturers have relied on extrapolation back to room temperature of accelerated testing at elevated temperature. This technique fails for scaled, high current density devices. Device failure is driven by electric field or current mechanisms or low activation energy processes that are masked by other mechanisms at high temperature. The Handbook addresses reliability engineering for III-V devices, including materials and electrical characterization, reliability testing, and electronic characterization. These are used to develop new simulation technologies for device operation and reliability, which allow accurate prediction of reliability as well as the design specifically for improved reliability. The Handbook emphasizes physical mechanisms rather than an electrical definition of reliability. Accelerated aging is useful only if the failure mechanism is known. The Handbook also focuses on voltage and current acceleration stress mechanisms.

Semiconductor Materials

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.

Fundamentals of Silicon Carbide Technology

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.

Hall Effect Devices

Based on the authors' years of extensive experience, this is an authoritative overview of Wide Bandgap (WBG) device characterization. It provides essential tools to assist researchers, advanced students and practicing engineers in performing both static and dynamic characterization of WBG devices, particularly those based on using silicon carbide (SiC) and gallium nitride (GaN) power semiconductors. The book presents practical considerations for real applications, and includes examples of applying the described methodology.

GaN-based Materials and Devices

Materials and Reliability Handbook for Semiconductor Optical and Electron Devices

The first book devoted to modern techniques of semiconductor characterization, this comprehensive guide to semiconductor measurement methods is detailed enough for a two-term graduate course. Organized for quick access so that it can be used as a handbook of specific characterization techniques. Processes are characterized through the use of test structures and the main techniques used within the semiconductor industry are thoroughly explained. While the majority of the book is devoted to widely used electrical characterization methods, the more specialized optical, chemical and physical methods are also covered. Contains over 1,300 references.

Semiconductor Devices: Physics and Technology, 3rd Edition

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

Semiconductor Material and Device Characterization

Semiconductor nanowires promise to provide the building blocks for a new generation of nanoscale electronic and optoelectronic devices. Semiconductor Nanowires: Materials, Synthesis, Characterization and Applications covers advanced materials for nanowires, the growth and synthesis of semiconductor nanowires—including methods such as solution growth, MOVPE, MBE, and self-organization. Characterizing the properties of semiconductor nanowires is covered in chapters describing studies using TEM, SPM, and Raman scattering. Applications of semiconductor nanowires are discussed in chapters focusing on solar cells, battery electrodes, sensors, optoelectronics and biology. Explores a selection of advanced materials for semiconductor nanowires Outlines key techniques for the property assessment and characterization of semiconductor nanowires Covers a broad range of applications across a number of fields

Handbook of GaN Semiconductor Materials and Devices

This book focuses on the exciting topic on 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, optic-electronics, nanotechnology and semiconductors. Chapters cover chemistry, physics, processing, and characterization. The applications include photovoltaics, light-emitting diodes (LEDs), and transistors.

Self-Organized Organic Semiconductors

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

Springer Handbook of Electronic and Photonic Materials

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.

Semiconductor Physical Electronics

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 this fast-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 fabrication 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.

Handbook of Compound Semiconductors

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 SOl groups. Many contributing students have since then disappeared from the SOl 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 contri butions 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.

Semiconductor Material and Device Characterization

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.

Fundamentals of Semiconductor Manufacturing and Process Control

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

Compound Semiconductors

Heteroepitaxy has evolved rapidly in recent years. With each new wave of material/substrate combinations, our understanding of how to control crystal growth becomes more refined. Most books on the subject focus on a specific material or material family, narrowly explaining the processes and techniques appropriate for each. Surveying the principles common to all types of semiconductor materials, Heteroepitaxy of Semiconductors: Theory, Growth, and Characterization is the first comprehensive, fundamental introduction to the field. This book reflects our current understanding of nucleation, growth modes, relaxation of strained layers, and dislocation dynamics without emphasizing any particular material. Following an overview of the properties of semiconductors, the author introduces the important heteroepitaxial growth methods and provides a survey of semiconductor crystal surfaces, their structures, and nucleation. With this foundation, the book provides in-depth descriptions of mismatched heteroepitaxy and lattice strain relaxation, various characterization tools used to monitor and evaluate the growth process, and finally, defect engineering approaches. Numerous examples highlight the concepts while extensive micrographs, schematics of experimental setups, and graphs illustrate the discussion. Serving as a solid starting point for this rapidly evolving area, Heteroepitaxy of Semiconductors: Theory, Growth, and Characterization makes the principles of heteroepitaxy easily accessible to anyone preparing to enter the field.

Handbook of Silicon Semiconductor Metrology

Hall Effect Devices: Magnetic Sensors and Characterization of Semiconductors focuses on electron devices whose principle of operation is based on the classical Hall effect, and are used mainly as magnetic sensors and as means for characterizing semiconductors. Examples of these devices include Hall plates, magnetotransistors, and magnetodiodes. The book provides a self-contained description of the galvanomagnetic phenomena and modern device physics of Hall elements and related devices. It discusses the main concepts and physical principles of interface electronics, and carefully selected examples illustrate the arguments and provide a picture of the state of the art. The book also covers advances in the field, in particular the most important developments inspired by the progress in microelectronics. Hall Effect Devices serves as a useful reference for postgraduate engineers and scientists involved in the research and development of magnetic sensors as well as for those who apply the Hall effect as a means of exploring the basic electronic properties of solids or for characterizing semiconductor materials.

2D Semiconductor Materials and Devices

The unique materials properties of GaN-based semiconductors have 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 saturation velocity, high sheet carrier concentration at heterojunction interfaces, high breakdown field, and low thermal impedance of GaN-based films grown over SiC or bulk AlN substrates make nitride-based electronic devices very promising. The chemical inertness of nitrides is another key property.This volume, written by experts on different aspects of nitride technology, addresses the entire spectrum of issues related to nitride materials and devices, and it will be useful for

technologists, scientists, engineers, and graduate students who are working on wide bandgap materials and devices. The book can also be used as a supplementary text for graduate courses on wide bandgap semiconductor technology.

Rare Earth and Transition Metal Doping of Semiconductor Materials

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.

Semiconductor Measurements and Instrumentation

Characterization of semiconductor materials and methods used to characterize them will be described extensively in this new Noyes series. Written by experts in each subject area, the series will present the most up-to-date information available in this rapidly advancing field. Includes chapters on Electrical Characterization, Ion Mass Spectrometry, Photoelectron Spectroscopy, Ion/Solid Interactions and more.

Heteroepitaxy of Semiconductors

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.

Semiconductor Material and Device Characterization

Semiconductor Material and Device Characterization is the only book on the market devoted to the characterization techniques used by the modern semiconductor industry to measure diverse semiconductor materials and devices. It covers the full range of electrical and optical characterization methods while thoroughly treating the more specialized chemical and physical techniques. This newly revamped and expanded Second Edition incorporates the many innovations that have come to dominate the field during the past decade. From scanning probe techniques to the detection of metallic impurities in silicon wafers to the use of microwave reflection to measure contactless resistivity, each chapter presents state-of-the-art tools and techniques, most of which were in their infancy or had not yet been developed when the previous edition first came out. Featured here are: * An entirely new chapter on reliability and probe microscopy * Numerous examples and end-of-chapter problems - new to this edition * Five hundred illustrations revised for this edition * Updated bibliography with over 1,200 references * Easy-to-use text including a real-world mix of units rather than strictly MKS units. This practical new edition is ideal for textbook adoptions at the graduate level and is destined to become an essential reference for research and development teams in the semiconductor industry.