Comprehensive Semiconductor Science And Technology 6 Vols

With over 17,000 articles concerning NMR published per year, keeping up to date with the latest developments and applications of this technique can prove time-consuming. Now in its 42nd volume, the Specialist Periodical Report on NMR provides a digest of the current literature, compiled by experts in the field. The current volume devotes several chapters to the aspects and applications of spin-spin couplings, and biochemists will find seperate chapters dedicated to proteins, lipids and carbohydrates. Further chapters discuss the latest developments in nuclear sheilding, imaging and NMR in living systems. For a comprehensive account of the latest developments and research using NMR, look no further than Specialist Periodical Reports - Nuclear Magnetic Resonance. An essential book for NMR lab and university shelf.

This thesis elucidates electron correlation effects in topological matter whose electronic states hold nontrivial topological properties robust against small perturbations. In addition to a comprehensive introduction to topological matter, this thesis provides a new perspective on correlated topological matter. The book comprises three subjects, in which electron correlations in different forms are considered. The first focuses on Coulomb interactions for massless Dirac fermions. Using a perturbative approach, the author reveals emergent Lorentz invariance in a low-energy limit and discusses how to probe the Lorentz invariance experimentally. The second subject aims to show a principle for synthesizing topological insulators with common, light elements. The interplay between the spin–orbit interaction and electron correlation is considered, and Hund's rule and electron filling are consequently found to play a key role for a strong spin–orbit interaction important for topological insulators. The last subject is classification of topological crystalline insulators in the presence of electron correlation. Unlike non-interacting topological insulators, such two- and three-dimensional correlated insulators with mirror symmetry are demonstrated to be characterized, respectively, by the Z4 and Z8 group by using the bosonization technique and a geometrical consideration.

Nanostructured Semiconductors focuses on the development of semiconductor nanocrystals, their technologies and applications, including energy harvesting, solar cells, solid oxide fuel cells, and chemical sensors. Semiconductor oxides are used in electronics, optics, catalysts, sensors, and other functional devices. In their 2D form, the reduction in size confers exceptional properties, useful for creating faster electronics and more efficient catalysts. Since the first edition of the book, there has been significant progress in the development of new functional nanomaterials with unique and sometimes unpredictable quantum-confined properties within the class what it called two-dimensional (2D) semiconductors. These nanocrystals represent extremely thin nano-structures with thickness of just few nano-meters. Since that time, not only were 2D semiconductor oxides further developed, more importantly, 2D metal dichalcogenides, such as MoS2, MoSe2, WS2, WSe2 and others also progressed significantly in their development demonstrating their superior properties compared to their bulk and microstructural counterparts. The book has been expanded to include these advancements. The book begins with the structure and properties of semiconductor nanocrystals (chapter 1), addresses electronic device applications (chapter 2), discusses 2-Dimensional oxides and dichalcogenide semiconductors (chapters 3 through 5), and ends with energy, environment, and bio applications (chapters 6 through 8). Focuses on the development of semiconductor nanocrystals and their technologies and applications, including energy harvesting, solar cells, solid oxide fuel cells and chemical sensors Include other 2D materials, such as dichalcogenides to present a comprehensive resource on the latest advancements in nanostructured semiconductors Reviews the fundamental physics of conductivity and electron arrangement before proceeding to practical applications Contains a unique chapter dedicated to the new atomic layer deposition (ALD) technique which has the ability to develop 2D nanostructures with great precision

The book presents a comprehensive survey of the thermoballistic approach to charge carrier transport in semiconductors. This semi-classical approach, which the authors have developed over the past decade, bridges the gap between the opposing drift-diffusion and ballistic models of carrier transport. While incorporating basic features of the latter two models, the physical concept underlying the thermoballistic approach constitutes a novel, unifying scheme. It is based on the introduction of "ballistic configurations" arising from a random partitioning of the length of a semiconducting sample into ballistic transport intervals. Stochastic averaging of the ballistic carrier currents over the ballistic configurations results in a position-dependent thermoballistic current, which is the key element of the thermoballistic concept and forms the point of departure for the calculation of all relevant transport properties. In the book, the thermoballistic concept and its implementation are developed in great detail and specific examples of interest to current research in semiconductor physics and spintronics are worked out.

This book presents extensive information on the mechanisms of epitaxial growth in III-nitride compounds, drawing on a state-of-the-art computational approach that combines ab initio calculations, empirical interatomic potentials, and Monte Carlo simulations to do so. It discusses important theoretical aspects of surface structures and elemental growth processes during the epitaxial growth of III-nitride compounds. In addition, it discusses advanced fundamental structural and electronic properties, surface structures, fundamental growth processes and novel behavior of thin films in III-nitride semiconductors. As such, it will appeal to all researchers, engineers and graduate students seeking detailed information on crystal growth and its application to III-nitride compounds.

Materials Under Extreme Conditions: Recent Trends and Future Prospects analyzes the chemical transformation and decomposition of materials exposed to extreme conditions, such as high temperature, high pressure, hostile chemical environments, high radiation fields, high vacuum, high magnetic and electric fields, wear and abrasion related to chemical bonding, special crystallographic features, and microstructures. The materials covered in this work encompass oxides, non-oxides, alloys and intermetallics, glasses, and carbon-based materials. The book is written for researchers in academia and industry, and technologists in chemical engineering, materials chemistry, chemistry, and condensed matter physics. Describes and analyzes the chemical transformation and decomposition of a wide range of materials exposed to extreme conditions Brings together information currently scattered across the Internet or incoherently dispersed amongst journals and proceedings Presents chapters on phenomena, materials synthesis, and processing, characterization and properties, and applications Written by established researchers in the field

In this book, Complementary Metal Oxide Semiconductor (CMOS) devices are extensively discussed. The topics encompass the technology advancement in the fabrication process of metal

oxide semiconductor field effect transistors or MOSFETs (which are the fundamental building blocks of CMOS devices) and the applications of transistors in the present and future eras. The book is intended to provide information on the latest technology development of CMOS to researchers, physicists, as well as engineers working in the field of semiconductor transistor manufacturing and design.

Laser Annealing Processes in Semiconductor Technology: Theory, Modeling and Applications in Nanoelectronics synthesizes the scientific and technological advances of laser annealing processes for current and emerging nanotechnologies. The book provides an overview of the laser-matter interactions of materials and recent advances in modeling of laser-related phenomena, with the bulk of the book focusing on current and emerging (beyond-CMOS) applications. Reviewed applications include laser annealing of CMOS, group IV semiconductors, superconducting materials, photonic materials, 2D materials. This comprehensive book is ideal for post-graduate students, new entrants, and experienced researchers in academia, research and development in materials science, physics and engineering. Introduces the fundamentals of laser materials and device fabrication methods, including laser-matter interactions and laser-related phenomena Addresses advances in physical modeling and in predictive simulations of laser annealing processes such as atomistic modeling and TCAD simulations Reviews current and emerging applications of laser annealing processes such as CMOS technology and group IV semiconductors

Single Crystals of Electronic Materials: Growth and Properties is a complete overview of the state-of-the-art growth of bulk semiconductors. It is not only a valuable update on the body of information on crystal growth of well-established electronic materials, such as silicon, III-V, II-VI and IV-VI semiconductors, but also includes chapters on novel semiconductors, such as wide bandgap oxides like ZnO, Ga2, O3, In2, O3, Al2, O3, nitrides (AIN and GaN), and diamond. Each chapter focuses on a specific material, providing a comprehensive overview that includes applications and requirements, thermodynamic properties, schematics of growth methods, and more. Presents the latest research and most comprehensive overview of both standard and novel semiconductors Provides a systematic examination of important electronic materials, including their applications, growth methods, properties, technologies and defect and doping issues Takes a close look at emerging materials, including wide bandgap oxides, nitrides and diamond

50 Years of Materials Science in Singapore describes in vivid detail how a newly independent nation like Singapore developed world-class research capabilities in materials science that helped the country make rapid progress in energy, biomedical and electronics sectors. The economy mirrored this rapid trail of progress, utilizing home-grown technology and the contribution of materials science to the various sectors is undeniable in ensuring the economic growth and stability of Singapore. Contents:Historical Narrative Early Beginnings to Present (Freddy Boey)Composites, Nanocomposites and Hybrid Materials (Chaobin He, Xiao Hu, Zhang Yu and John Wang)Materials for Water Remediation (Membranes) (Sui Zhang, Lin Luo, Zhi Wei Thong and Tai-Shung Chung)Nanostructured Catalytic and Adsorbent Materials for Water Remediation (Zhong Chen and Teik Thye Lim) Solar Energy and Energy Storage Materials and Devices Research in Singapore (D Sabba, J Wang, M Srinivasan, A G Aberle and S Mhaisalkar)50 Years of Biomaterials Research in Singapore (Subbu Venkatraman, Swee Hin Teoh and Ali Miserez)2D Materials (Andrew T S Wee, Kian Ping Loh and Antonio H Castro Neto)Electronic Materials Research in Singapore (Chee Ying Khoo, Pooi See Lee, Sze Ter Lim and Chee Lip Gan)"Singaporean" Materials Science: What Does the Future Hold? (Subbu Venkatraman) Readership: General public, people interested in history of Singapore, people interested in materials science.

Advances in Agronomy continues to be recognized as a leading reference and a first-rate source for the latest research in agronomy. As always, the subjects covered are varied and exemplary of the myriad of subject matter dealt with by this long-running serial Timely and state-of-the-art reviews Distinguished, well recognized authors A venerable and iconic review series Timely publication of submitted reviews Semiconductors are at the heart of modern living. Almost everything we do, be it work, travel, communication, or entertainment, all depend on some feature of semiconductor technology. Comprehensive Semiconductor Science and Technology captures the breadth of this important field, and presents it in a single source to the large audience who study, make, and exploit semiconductors. Previous attempts at this achievement have been abbreviated, and have omitted important topics. Written and Edited by a truly international team of experts, this work delivers an objective yet cohesive global review o.

Under certain conditions electrons in a semiconductor become much hotter than the surrounding crystal lattice. When this happens, Ohm's Law breaks down: current no longer increases linearly with voltage and may even decrease. Hot electrons have long been a challenging problem in condensed matter physics and remain important in semiconductor research. Recent advances in technology have led to semiconductors with submicron dimensions, where electrons can be confined to two (quantum well), one (quantum wire), or zero (quantum dot) dimensions. In these devices small voltages heat electrons rapidly, inducing complex nonlinear behavior; the study of hot electrons is central to their further development. This book is the only comprehensive and up-to-date coverage of hot electrons. Intended for both established researchers and graduate students, it gives a complete account of the historical development of the subject, together with current research and future trends, and covers the physics of hot electrons in bulk and low-dimensional device technology. The contributions are from leading scientists in the field and are grouped broadly into five categories: introduction and overview; hot electron-phonon interactions and ultra-fast phenomena in bulk and two-dimensional structures; hot electrons in quantum wires and dots; hot electron tunneling and transport in superlattices; and novel devices based on hot electron transport.

This book addresses fabrication as well as characterization and modeling of semiconductor nanostructures in the optical regime, with a focus on nonlinear effects. The visible range as well as near and far infrared spectral region will be considered with a view to different envisaged applications. The book covers the current key challenges of the research in the area, including: exploiting new material platforms, fully extending the device operation into the nonlinear regime, adding re-configurability to the envisaged devices and proposing new modeling tools to help in conceiving new functionalities. • Explores several topics in the field of semiconductor nonlinear nanophotonics, including fabrication, characterization and modeling of semiconductor nanostructures in the optical regime, with a focus on nonlinear effects • Describes the research challenges in the field of optical metasurfaces in the nonlinear regime • Reviews the use and achievements of all-dielectric nanoantennas for strengthening the nonlinear optical response • Describes both theoretical and experimental aspects of photonic devices based on semiconductor optical nanoantennas and metasurfaces • Gathers contributions from several leading groups in this research field to provide a thorough and complete overview of the current state of the art in the field of semiconductor nonlinear nanophotonics Costantino De Angelis has been full professor of electromagnetic fields at the University of Brescia since 1998. He is an OSA Fellow and has been responsible for several university research contracts in the last 20 years within Europe, the United States, and Italy. His technical interests are in optical antennas and nanophotonics. He is the author of over 150 peer-reviewed scientific journal articles. Giuseppe Leo has been a full professor in physics at Paris Diderot University since 2004, and in charge of the nonlinear devices group of MPQ Laboratory since 2006. His research areas include nonlinear optics, micro- and nano-photonics, and optoelectronics, with a focus on AlGaAs platform. He has coordinated several research programs and coauthored 100 peer-reviewed journal articles, 200 conference papers, 10 book chapters and also has four patents. Dragomir Neshev is a professor in physics and the leader of the experimental photonics group in the Nonlinear Physics Centre at Australian National University (ANU). His activities span over several branches of

optics, including nonlinear periodic structures, singular optics, plasmonics, and photonic metamaterials. He has coauthored 200 publications in international peer-reviewed scientific journals.
Topological Insulators, volume six in the Contemporary Concepts of Condensed Matter Series, describes the recent revolution in condensed matter physics that occurred in our understanding of crystalline solids. The book chronicles the work done worldwide that led to these discoveries and provides the reader with a comprehensive overview of the field. Starting in 2004, theorists began to explore the effect of topology on the physics of band insulators, a field previously considered well understood. However, the inclusion of topology brings key new elements into this old field. Whereas it was thought that all band insulators are essentially equivalent, the new theory predicts two distinct classes of band insulators in two spatial dimensions and 16 classes in three dimensions. These "topological" insulators exhibit a host of unusual physical properties, including topologically protected gapless surface states and exotic electromagnetic response, previously thought impossible in such systems. Within a short time, this new state of quantum matter, topological insulators, has been discovered experimentally both in 2D thin film structures and in 3D crystals and alloys. It appears that topological insulators are quite common in nature, and there are dozens of confirmed substances that exhibit this behavior. Theoretical and experimental studies of these materials are ongoing with the goal of attaining the fundamental understanding and exploiting them in future practical applications. Usable as a textbook for graduate students and as a reference resource for professionals Includes the most recent discoveries and visions for future technological applications All authors are prominent in the field
Volume IIIA Basic Techniques Handbook of Crystal Growth, 2nd Edition Volume IIIA (Basic Techniques), edited by chemical and biological engineering expert Thomas F. Kuech, presents the underpinning science and technology associated with epitaxial growth as well as highlighting many of the chief and burgeoning areas for epitaxial growth. Volume IIIA focuses on major growth techniques which are used both in the scientific investigation of crystal growth processes and commercial development of advanced epitaxial structures. Techniques based on vacuum deposition, vapor phase epitaxy, and liquid and solid phase epitaxy are presented along with new techniques for the development of three-dimensional nano-and micro-structures. Volume IIIB Materials, Processes, and Technology Handbook of Crystal Growth, 2nd Edition Volume IIIB (Materials, Processes, and Technology), edited by chemical and biological engineering expert Thomas F. Kuech, describes both specific techniques for epitaxial growth as well as an array of materials-specific growth processes. The volume begins by presenting variations on epitaxial growth process where the kinetic processes are used to develop new types of materials at low temperatures. Optical and physical characterizations of epitaxial films are discussed for both in situ and exit to characterization of epitaxial materials. The remainder of the volume presents both the epitaxial growth processes associated with key technology materials as well as unique structures such as monolayer and two dimensional materials. Volume IIIA Basic Techniques Provides an introduction to the chief epitaxial growth processes and the underpinning scientific concepts used to understand and develop new processes. Presents new techniques and technologies for the development of three-dimensional structures such as quantum dots, nano-wires, rods and patterned growth Introduces and utilizes basic concepts of thermodynamics, transport, and a wide cross-section of kinetic processes which form the atomic level text of growth process Volume IIIB Materials, Processes, and Technology Describes atomic level epitaxial deposition and other low temperature growth techniques Presents both the development of thermal and lattice mismatched streams as the techniques used to characterize the structural properties of these materials Presents in-depth discussion of the epitaxial growth techniques associated with silicone silicone-based materials, compound semiconductors, semiconducting nitrides, and refractory materials
This book presents the research and development-related results of the “FIRST” Quantum Information Processing Project, which was conducted from 2010 to 2014 with the support of the Council for Science, Technology and Innovation of the Cabinet Office of the Government of Japan. The project supported 33 research groups and explored five areas: quantum communication, quantum metrology and sensing, coherent computing, quantum simulation, and quantum computing. The book is divided into seven main sections. Parts I through V, which consist of twenty chapters, focus on the system and architectural aspects of quantum information technologies, while Parts VI and VII, which consist of eight chapters, discuss the superconducting quantum circuit, semiconductor spin and molecular spin technologies. Readers will be introduced to new quantum computing schemes such as quantum annealing machines and coherent Ising machines, which have now arisen as alternatives to standard quantum computers and are designed to successfully address NP-hard/NP-complete combinatorial optimization problems, which are ubiquitous and relevant in our modern life. The book offers a balanced mix of theory-based and experimentation-based chapters written by leading researchers. Extensive information is provided on Quantum simulation, which focuses on the implementation of various many-body Hamiltonians in a well-controlled physical system, Quantum key distribution, Quantum repeaters and quantum teleportation, which are indispensable technologies for building quantum networks with various advanced applications and require far more sophisticated experimental techniques to implement.
This book offers a timely and complete overview on chemical vapour deposition (CVD) and its variants for the processing of nanoparticles, nanowires, nanotubes, nanocomposite coatings, thin and thick films, and composites. Chapters discuss key aspects, from processing, material structure and properties to practical use, cost considerations, versatility, and sustainability. The author presents a comprehensive overview of CVD and its potential in producing high performance, cost-effective nanomaterials and thin and thick films. Features Provides an up-to-date introduction to CVD technology for the fabrication of nanomaterials, nanostructured films, and composite coatings Discusses processing, structure, functionalization, properties, and use in clean energy, engineering, and biomedical grand challenges Covers thin and thick films and composites Compares CVD with other processing techniques in terms of structure/properties, cost, versatility, and sustainability Kwang-Leong Choy is the Director of the UCL Centre for Materials Discovery and Professor of Materials Discovery in the Institute for Materials Discovery at the University College London. She earned her D.Phil. from the University of Oxford, and is the recipient of numerous honors including the Hetherington Prize, Oxford Metallurgical Society Award, and Grunfeld Medal and Prize from the Institute of Materials (UK). She is an elected fellow of the Institute of Materials, Minerals and Mining, and the Royal Society of Chemistry.
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 provides the elementary and intermediate knowledge of compound semiconductor bulk materials necessary for entry into this field. The first volume described the physical properties, crystal growth technologies, principles of crystal growth, various defects in crystals, characterization techniques and applications, and reviewed various III-V and II-V compound semiconductor materials. In this second volume, other materials are reviewed, including those that have recently received attention such as GaN, AlN, SiC and ZnO

for optical and electronic devices.
This volume investigates the theory of the effect of static electric fields on one-electron states in. nanocylindrical and nanospherical heterolayers and quantized semiconductor films. Homogeneous external electrostatic field for all these structures has been considered as a "universal" modulating factor. For structures with radial symmetry, a study on the influence of radial static field and the electric field of a charged ring on one-electron states is presented. Chapters focusing on homogeneous field effect on low-dimensional excitonic states in the quantized films and quantum wires - in both wide bandgap and narrowband semiconductors - are also included. Other contents include calculations weak, moderate and strong electric fields, quantum-mechanical approximation and perturbation theory, the quasi-classical approximation (WKB method). Readers will benefit from the varied methodological to the subject which gives them a concrete analytical framework to solve problems related to nanoscale semiconductor design. The reference should prove to be useful to academics and professionals working in semiconductor nanoelectronics research and development.
This issue of ECS Transactions includes 33 papers that were presented at the Second International Conference on Semiconductor Technology for Ultra Large Integrated Circuits and Thin Film Transistors (ULSIC vs. TFT II), held in the Xi¿an Garden Hotel, Xian, China, July 5-10, 2009. This symposium was sponsored by the Engineering Conferences International.
Comprehensive semiconductor science and technology: 6 VolumesComprehensive semiconductor science and technology. 5. Devices and applications
Amorphous solids (including glassy and non-crystalline solids) are ubiquitous since the vast majority of solids naturally occurring in our world are amorphous. Although the field is diverse and complex, this three-volume set covers the vast majority of the important concepts needed to understand these materials and their principal practical applications. One volume discusses the most important subset of amorphous insulators, namely oxide glasses; the other two volumes discuss the most important subsets of amorphous semiconductors, namely tetrahedrally coordinated amorphous semiconductors and amorphous and glassy chalcogenides. Together these three volumes provide a comprehensive set of theoretical concepts and practical information needed to become conversant in the field of amorphous materials. They are suitable for advanced graduate students, postdoctoral research associates, and researchers wishing to change fields or sub-fields.The topics covered in these three volumes include (1) concepts for understanding the structures of amorphous materials, (2) techniques to characterize the structural, electronic, and optical properties of amorphous materials, (3) the roles of defects in affecting the electronic and optical properties of amorphous materials, and (4) the concepts for understanding practical devices and other applications of amorphous materials. Applications discussed in these volumes include transistors, solar cells, displays, bolometers, fibers, non-volatile memories, vidicons, photoresists, and optical disks.
Discussing the many facets of highly integrated semiconductor detector systems, this comprehensive text provides an application-oriented introduction to sensors and electronics.
Silicon, as a single-crystal semiconductor, has sparked a revolution in the field of electronics and touched nearly every field of science and technology. Though available abundantly as silica and in various other forms in nature, silicon is difficult to separate from its chemical compounds because of its reactivity. As a solid, silicon is chemically inert and stable, but growing it as a single crystal creates many technological challenges. Crystal Growth and Evaluation of Silicon for VLSI and ULSI is one of the first books to cover the systematic growth of silicon single crystals and the complete evaluation of silicon, from sand to useful wafers for device fabrication. Written for engineers and researchers working in semiconductor fabrication industries, this practical text: Describes different techniques used to grow silicon single crystals Explains how grown single-crystal ingots become a complete silicon wafer for integrated-circuit fabrication Reviews different methods to evaluate silicon wafers to determine suitability for device applications Analyzes silicon wafers in terms of resistivity and impurity concentration mapping Examines the effect of intentional and unintentional impurities Explores the defects found in regular silicon-crystal lattice Discusses silicon wafer preparation for VLSI and ULSI processing Crystal Growth and Evaluation of Silicon for VLSI and ULSI is an essential reference for different approaches to the selection of the basic silicon-containing compound, separation of silicon as metallurgical-grade pure silicon, subsequent purification, single-crystal growth, and defects and evaluation of the deviations within the grown crystals.
The discovery of the rich topological structures of electronic states in solids has opened up many interesting possibilities. The “twist” of the wavefunctions in momentum space, which is characterized by topological invariants, leads to the robust edge or surface states. The electron fractionalization associated with these topological states brings about the novel physics such as absence of localization, topological magneto-electric effect, and Majorana fermions. Here we describe the principles and some concrete examples of the theoretical design of the topological materials and their functions based on these recent developments.
Chemistry of Nanomaterials: Fundamentals and Applications provides a foundational introduction to this chemistry. Beginning with an introduction to the field of nanoscience and technology, the book goes on to outline a whole range of important effects, interactions and properties. Tools used to assess such properties are discussed, followed by chapters putting this fundamental knowledge in context by providing examples of nanomaterials and their applications in the real world. Drawing on the experience of its expert authors, this book is an accessible introduction to the interactions at play in nanomaterials for both upper-level students and researchers. Highlights the foundational chemical interactions at play in nanomaterials Provides accessible insight for readers across multidisciplinary fields Places nanomaterial chemistry in the context of the broader field of nanoscale research
Heavily doped silicon is required for devices such as PowerMOSFETs. For the devices to be as sufficient as possible it is necessary to lower the electrical resistivity of the silicon substrate as low as possible. Yet, during the growth of heavily n-type doped silicon by the Czochralski method dislocation formation occurs frequently, reducing yield. Thus this work covers the topics intrinsic point defects, electrical activity of dopant atoms, spreading of dislocations and facet growth. Each topic is discussed in regard of their possible impact on the formation of the dislocations. In doing so, the control of facet growth is found to be most crucial to prevent the formation of the dislocations.
This book addresses electrocatalysis based on chalcogenides, particularly in the nanoscale domain. Special attention is paid to the hydrogen evolution reaction (HER) and the oxygen reduction reaction

(ORR). The book provides an introduction to materials synthesis; the basic principles of electrocatalysis; related precious metal versus non-precious metal catalytic center chalcogenides as well as supports; and the role of such supports in stabilizing the catalytic centers. In short: pursuing a bottom-up approach, it covers the properties of this class of electrocatalysts and examines their applications in low-temperature fuel systems such as microfluidic fuel cells for portable devices. Accordingly, it is ideally suited for all professionals and researchers interested in electrochemistry, renewable energy and electrocatalysis, and non-precious metal centers for chemical energy conversion.

Nanostructured Semiconductor Oxides for the Next Generation of Electronics and Functional Devices focuses on the development of semiconductor nanocrystals, their technologies and applications, including energy harvesting, solar cells, solid oxide fuel cells, and chemical sensors. Semiconductor oxides are used in electronics, optics, catalysts, sensors, and other functional devices. In their 2D form, the reduction in size confers exceptional properties, useful for creating faster electronics and more efficient catalysts. After explaining the physics affecting the conductivity and electron arrangement of nanostructured semiconductors, the book addresses the structural and chemical modification of semiconductor nanocrystals during material growth. It then covers their use in nanoscale functional devices, particularly in electronic devices and carbon nanotubes. It explores the impact of 2D nanocrystals, such as graphene, chalcogenides, and oxide nanostructures, on research and technology, leading to a discussion of incorporating graphene and semiconductor nanostructures into composites for use in energy storage. The final three chapters focus on the applications of these functional materials in photovoltaic cells, solid oxide fuel cells, and in environmental sensors including pH, dissolved oxygen, dissolved organic carbon, and dissolved metal ion sensors. Nanostructured Semiconductor Oxides for the Next Generation of Electronics and Functional Devices is a crucial resource for scientists, applied researchers, and production engineers working in the fabrication, design, testing, characterization, and analysis of new semiconductor materials. This book is a valuable reference for those working in the analysis and characterization of new nanomaterials, and for those who develop technologies for practical devices fabrication. Focuses on the development of semiconductor nanocrystals, their technologies and applications, including energy harvesting, solar cells, solid oxide fuel cells, and chemical sensors Reviews fundamental physics of conductivity and electron arrangement before proceeding to practical applications A vital resource for applied researchers and production engineers working with new semiconductor materials

Infrared Detectors and technologies are very important for a wide range of applications, not only for Military but also for various civilian applications. Comparatively fast bolometers can provide large quantities of low cost devices opening up a new era in infrared technologies. This book deals with various aspects of bolometer developments. It covers bolometer material aspects, different types of bolometers, performance limitations, applications and future trends. The chapters in this book will be useful for senior researchers as well as beginning graduate students.

Volume 2 of Novel Superfluids continues the presentation of recent results on superfluids, including novel metallic systems, superfluid liquids, and atomic/molecular gases of bosons and fermions. The phenomenon of superfluidity remains one of the most important topics in physics. Again and again, novel superfluids yield surprising and interesting behaviors. The many classes of metallic superconductors continue to offer challenges. The technicalapplications grow steadily. What the temperature and field limits are remains illusive. Atomic nuclei, neutron stars and the Universe itself all involve various aspects of superfluidity, and the lessons learned have hada broad impact on physics as a whole.

Covers both the fundamentals and the state-of-the-art technology used for MBE Written by expert researchers working on the frontlines of the field, this book covers fundamentals of Molecular Beam Epitaxy (MBE) technology and science, as well as state-of-the-art MBE technology for electronic and optoelectronic device applications. MBE applications to magnetic semiconductor materials are also included for future magnetic and spintronic device applications. Molecular Beam Epitaxy: Materials and Applications for Electronics and Optoelectronics is presented in five parts: Fundamentals of MBE; MBE technology for electronic devices application; MBE for optoelectronic devices; Magnetic semiconductors and spintronics devices; and Challenge of MBE to new materials and new researches. The book offers chapters covering the history of MBE; principles of MBE and fundamental mechanism of MBE growth; migration enhanced epitaxy and its application; quantum dot formation and selective area growth by MBE; MBE of III-nitride semiconductors for electronic devices; MBE for Tunnel-FETs; applications of III-V semiconductor quantum dots in optoelectronic devices; MBE of III-V and III-nitride heterostructures for optoelectronic devices with emission wavelengths from THz to ultraviolet; MBE of III-V semiconductors for mid-infrared photodetectors and solar cells; dilute magnetic semiconductor materials and ferromagnet/semiconductor heterostructures and their application to spintronic devices; applications of bismuth-containing III–V semiconductors in devices; MBE growth and device applications of Ga2O3; Heterovalent semiconductor structures and their device applications; and more. Includes chapters on the fundamentals of MBE Covers new challenging researches in MBE and new technologies Edited by two pioneers in the field of MBE with contributions from well-known MBE authors including three Al Cho MBE Award winners Part of the Materials for Electronic and Optoelectronic Applications series Molecular Beam Epitaxy: Materials and Applications for Electronics and Optoelectronics will appeal to graduate students, researchers in academia and industry, and others interested in the area of epitaxial growth.

Semiconductors are at the heart of modern living. Almost everything we do, be it work, travel, communication, or entertainment, all depend on some feature of semiconductor technology. Comprehensive Semiconductor Science and Technology captures the breadth of this important field, and presents it in a single source to the large audience who study, make, and exploit semiconductors. Previous attempts at this achievement have been abbreviated, and have omitted important topics. Written and Edited by a truly international team of experts, this work delivers an objective yet cohesive global review of the semiconductor world. The work is divided into three sections. The first section is concerned with the fundamental physics of semiconductors, showing how the electronic features and the lattice dynamics change drastically when systems vary from bulk to a low-dimensional structure and further to a nanometer size. Throughout this section there is an emphasis on the full understanding of the underlying physics. The second section deals largely with the transformation of the conceptual framework of solid state physics into devices and systems which require the growth of extremely high purity, nearly defect-free bulk and epitaxial materials. The last section is devoted to exploitation of the knowledge described in the previous sections to highlight the spectrum of devices we see all around us. Provides a comprehensive global picture of the semiconductor world Each of the work's three sections presents a complete description of one aspect of the whole Written and Edited by a truly international team of experts

This multi-contributor handbook discusses Molecular Beam Epitaxy (MBE), an epitaxial deposition technique which involves laying down layers of materials with atomic thicknesses on to substrates. It summarizes MBE research and application in epitaxial growth with close discussion and a ‘how to’ on processing molecular or atomic beams that occur on a surface of a heated crystalline substrate in a vacuum. MBE has expanded in importance over the past thirty years (in terms of unique authors, papers and conferences) from a pure research domain into commercial applications (prototype device structures and more at the advanced research stage). MBE is important because it enables new device phenomena and facilitates the production of multiple layered structures with extremely fine dimensional and compositional control. The techniques can be deployed wherever precise thin-film devices with enhanced and unique properties for computing, optics or photonics are required. This book covers the advances made by MBE both in research and mass production of electronic and optoelectronic devices. It includes new semiconductor materials, new device structures which are commercially available, and

many more which are at the advanced research stage. Condenses fundamental science of MBE into a modern reference, speeding up literature review Discusses new materials, novel applications and new device structures, grounding current commercial applications with modern understanding in industry and research Coverage of MBE as mass production epitaxial technology enhances processing efficiency and throughput for semiconductor industry and nanostructured semiconductor materials research community

In its original form, this widely acclaimed primer on the fundamentals of quantized semiconductor structures was published as an introductory chapter in Raymond Dingle's edited volume (24) of Semiconductors and Semimetals. Having already been praised by reviewers for its excellent coverage, this material is now available in an updated and expanded "student edition." This work promises to become a standard reference in the field. It covers the basics of electronic states as well as the fundamentals of optical interactions and quantum transport in two-dimensional quantized systems. This revised student edition also includes entirely new sections discussing applications and one-dimensional and zero-dimensional systems. Available for the first time in a new, expanded version Provides a concise introduction to the fundamentals and fascinating applications of quantized semiconductor structures

An authoritative and comprehensive guide to the devices and applications of Terahertz technology Terahertz (THz) technology relates to applications that span in frequency from a few hundred GHz to more than 1000 GHz. Fundamentals of Terahertz Devices and Applications offers a comprehensive review of the devices and applications of Terahertz technology. With contributions from a range of experts on the topic, this book contains in a single volume an inclusive review of THz devices for signal generation, detection and treatment. Fundamentals of Terahertz Devices and Applications offers an exploration and addresses key categories and aspects of Terahertz Technology such as: sources, detectors, transmission, electronic considerations and applications, optical (photonic) considerations and applications. Worked examples—based on the contributors' extensive experience— highlight the chapter material presented. The text is designed for use by novices and professionals who want a better understanding of device operation and use, and is suitable for instructional purposes This important book: Offers the most relevant up-to-date research information and insight into the future developments in the technology Addresses a wide-range of categories and aspects of Terahertz technology Includes material to support courses on Terahertz Technology and more Contains illustrative worked examples Written for researchers, students, and professional engineers, Fundamentals of Terahertz Devices and Applications offers an in-depth exploration of the topic that is designed for both novices and professionals and can be adopted for instructional purposes.

In modern research and development, materials manufacturing crystal growth is known as a way to solve a wide range of technological tasks in the fabrication of materials with preset properties. This book allows a reader to gain insight into selected aspects of the field, including growth of bulk inorganic crystals, preparation of thin films, low-dimensional structures, crystallization of proteins, and other organic compounds.

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