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Thermochemical properties of inorganic substances
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Gas Source Molecular Beam Epitaxy
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Springer Handbook of Crystal Growth
III-nitride Devices and Nanoengineering
Semiconductor Nanostructures for Optoelectronic Devices
Metalorganic Vapor Phase Epitaxy 1992
Springer Handbook of Electronic and Photonic Materials
Gallium Oxide
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Handbook of Crystal Growth

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Handbook of Manufacturing Engineering and Technology Springer Science & Business Media
Light and light based technologies have played an important role in transforming our lives via scientific contributions spanned over thousands of years. In this book we present a vast collection of articles on various aspects of light and its applications in the contemporary world at a popular or semi-popular level. These articles are written by the world authorities in their respective fields. This is therefore a rare volume where the world experts have come together to present the developments in this most important field of science in an almost pedagogical manner. This volume covers five aspects related to light. The first presents two articles, one on the history of the nature of light, and the other on the scientific achievements of Ibn-Haitham (Alhazen), who is broadly considered the father of modern optics. These are then followed by an article on ultrafast phenomena and the invisible world. The third part includes papers on specific sources of light, the discoveries of which have revolutionized optical technologies in our lifetime. They discuss the nature and the characteristics of lasers, Solid-state lighting based on the Light Emitting Diode (LED) technology, and finally modern electron optics and its relationship to the Muslim golden age in science. The book’s fourth part discusses various applications of optics and light in today's world, including biophotonics, art, optical communication, nanotechnology, the eye as an optical instrument, remote sensing, and optics in medicine. In turn, the last part focuses on quantum optics, a modern field that grew out of the interaction of light and matter. Topics addressed include atom optics, slow, stored and stationary light, optical tests of the foundation of physics, quantum mechanical properties of light fields carrying orbital angular momentum, quantum communication, and Wave-Particle dualism in action.
Vertical GaN and SiC Power Devices Springer Science & Business Media
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
Liquid Phase Epitaxy Elsevier
Volume IA Handbook of Crystal Growth, 2nd Edition (Fundamentals: Thermodynamics and Kinetics) Volume IA addresses the present status of crystal growth science, and provides scientific tools for the following volumes: Volume II (Bulk Crystal Growth) and III (Thin Film Growth and Epitaxy).

Volume IA highlights thermodynamics and kinetics. After historical introduction of the crystal growth, phase equilibria, defect thermodynamics, stoichiometry, and shape of crystal and structure of melt are described. Then, the most fundamental and basic aspects of crystal growth are presented, along with the theories of nucleation and growth kinetics. In addition, the simulations of crystal growth by Monte Carlo, ab initio-based approach and colloidal assembly are thoroughly investigated. Volume IB Handbook of Crystal Growth, 2nd Edition (Fundamentals: Transport and Stability) Volume IB discusses pattern formation, a typical problem in crystal growth. In addition, an introduction to morphological stability is given and the phase-field model is explained with comparison to experiments. The field of nanocrystal growth is rapidly expanding and here the growth from vapor is presented as an example. For the advancement of life science, the crystal growth of protein and other biological molecules is indispensable and biological crystallization in nature gives many hints for their crystal growth. Another subject discussed is pharmaceutical crystal growth. To understand the crystal growth, in situ observation is extremely powerful. The observation techniques are demonstrated. Volume IA Explores phase equilibria, defect thermodynamics of Si, stoichiometry of oxides and atomistic structure of melt and alloys Explains basic ideas to understand crystal growth, equilibrium shape of crystal, rough-smooth transition of step and surface, nucleation and growth mechanisms Focuses on simulation of crystal growth by classical Monte Carlo, ab-initio based quantum mechanical approach, kinetic Monte Carlo and phase field model. Controlled colloidal assembly is presented as an experimental model for crystal growth. Volume IIB Describes morphological stability theory and phase-field model and comparison to experiments of dendritic growth Presents nanocrystal growth in vapor as well as protein crystal growth and biological crystallization Interprets mass production of pharmaceutical crystals to be understood as ordinary crystal growth and explains crystallization of chiral molecules Demonstrates in situ observation of crystal growth in vapor, solution and melt on the ground and in space

Proceedings of the 2nd Annual International Conference on Material, Machines and Methods for Sustainable Development (MMMS2020) John Wiley & Sons

Vol 2A: Basic Technologies Handbook of Crystal Growth, 2nd Edition Volume IIA (Basic Technologies) presents basic growth technologies and modern crystal cutting methods. Particularly, the methodical fundamentals and development of technology in the field of bulk crystallization on both industrial and research scales are explored. After an introductory chapter on the formation of minerals, ruling historically the basic crystal formation parameters, advanced basic technologies from melt, solution, and vapour being applied for research and production of the today most important materials, like silicon, semiconductor compounds and oxides are presented in detail. The interdisciplinary and general importance of crystal growth for human live are illustrated. Vol 2B: Growth Mechanisms and Dynamics Handbook of Crystal Growth, 2nd Edition Volume IIB (Growth Mechanisms and Dynamics) deals with characteristic mechanisms and dynamics accompanying each bulk crystal growth method discussed in Volume IIA. Before the atoms or molecules pass over from a position in the fluid medium (gas, melt or solution) to their place in the crystalline face they must be transported in the fluid over macroscopic distances by diffusion, buoyancy-driven convection, surface-tension-driven convection, and forced convection (rotation, acceleration, vibration, magnetic mixing). Further, the heat of fusion and the part carried by the species on their way to the crystal by conductive and convective transport must be dissipated in the solid phase by well-organized thermal conduction and radiation to maintain a stable propagating interface. Additionally, segregation and capillary phenomena play a decisional role for chemical composition and crystal shaping, respectively. Today, the increase of high-quality crystal yield, its size enlargement and reproducibility are imperative conditions to match the strong economy. Volume 2A Presents the status and future of Czochralski and float zone growth of dislocation-free silicon Examines directional solidification of silicon ingots for photovoltaics, vertical gradient freeze of GaAs, CdTe for HF electronics and IR imaging as well as antiferromagnetic compounds and super alloys for turbine blades Focuses on growth of dielectric and conducting oxide crystals for lasers and non-linear optics Topics on hydrothermal, flux and vapour phase growth of III-nitrides, silicon carbide and diamond are explored Volume 2B Explores capillarity control of the crystal shape at the growth from the melt Highlights modeling of heat and mass transport dynamics Discusses control of convective melt processes by magnetic fields and vibration measures Includes imperative information on the segregation phenomenon and validation of compositional homogeneity Examines crystal defect generation mechanisms and their controllability Illustrates proper automation modes for ensuring constant crystal growth process Exhibits fundamentals of solution growth, gel growth of protein crystals, growth of superconductor materials and mass crystallization for food and pharmaceutical industries

Optoelectronic Devices Springer Science & Business Media

Gallium Oxide: Technology, Devices and Applications discusses the wide bandgap semiconductor and its promising applications in power electronics, solar blind UV detectors, and in extreme environment electronics. It also covers the fundamental science of gallium oxide, providing an in-depth look at the most relevant properties of this materials system. High quality bulk Ga2O3 is now commercially available from several sources and n-type epi structures are also coming onto the market. As researchers are focused on creating new complex structures, the book addresses the latest processing and synthesis methods. Chapters are designed to give readers a complete picture of the Ga2O3 field and the area of devices based on Ga2O3, from their theoretical simulation, to fabrication and application. Provides an overview of the advantages of the gallium oxide materials system, the advances in in bulk and epitaxial crystal growth, device design and processing Reviews the most relevant applications, including photodetectors, FETs, FINFETs, MOSFETs, sensors, catalytic applications, and more Addresses materials properties, including structural, mechanical, electrical, optical, surface and contact

III-Nitride Semiconductors: Electrical, Structural and Defects Properties IOP Publishing Limited

Here is one of the first single-author treatments of organometallic vapor-phase epitaxy (OMVPE)--a leading technique for the fabrication of semiconductor materials and devices. Also included are metal-organic molecular-beam epitaxy (MOMBE) and chemical-beam epitaxy (CBE) ultra-high-vacuum deposition techniques using organometallic source molecules. Of interest to researchers, students, and people in the semiconductor industry, this book provides a basic foundation for understanding the technique and the application of OMVPE for the growth of both III-V and II-VI semiconductor materials and the special structures required for device applications. In addition, a comprehensive summary detailing the OMVPE results observed to date in a wide range of III-V and II-VI semiconductors is provided. This includes a comparison of results obtained through the use of other epitaxial techniques such as molecular beam epitaxy (MBE), liquid-phase epitaxy (LPE), and vapor phase epitaxy using halide transport.

Optics in Our Time Springer Science & Business Media

The Springer Reference Work Handbook of Manufacturing Engineering and Technology provides overviews and in-depth and authoritative analyses on the basic and cutting-edge manufacturing technologies and sciences across a broad spectrum of areas. These topics are commonly encountered in industries as well as in academia. Manufacturing engineering curricula across universities are now essential topics covered in major universities worldwide.

Phosphors for Radiation Detectors Springer

Chemical growth methods of electronic materials are the keystone of microelectronic device processing. This book discusses the applications of metalorganic chemistry for the vapor phase deposition of compound semiconductors. Vapor phase methods used for semiconductor deposition and the materials properties that make the organometallic precursors useful in the electronics industry are discussed for a variety of materials. Topics included: * techniques for compound semiconductor growth * metalorganic precursors for III-V MOVPE * metalorganic precursors for II-VI MOVPE * single-source precursors * chemical beam epitaxy * atomic layer epitaxy Several useful appendixes and a critically selected, up-to-date list of references round off this practical handbook for materials scientists, solid-state and organometallic chemists, and engineers.

Organometallic Vapor-Phase Epitaxy Springer Science & Business Media

The first book to present a unified treatment of hybrid source MBE and metalorganic MBE. Since metalorganic MBE permits selective area growth, the latest information on its application to the INP/GaInAs(P) system is presented. This system has been highlighted because it is one of rising importance, vital to optical communications systems, and has great potential for future ultra-highspeed electronics. The use of such analytical methods as high resolution x-ray diffraction, secondary ion mass spectroscopy, several photoluminescence methods, and the use of active devices for materials evaluation is shown in detail.

Technology of Gallium Nitride Crystal Growth Artech House

Phosphors for Radiation Detector Phosphors for Radiation Detectors Discover a comprehensive overview of luminescence phosphors for radiation detection In Phosphors for Radiation Detection, accomplished researchers Takayuki Yanagida and Masanori Koshimizu deliver a state-of-the-art exploration of the use of phosphors in radiation detection. The internationally recognized contributors discuss the fundamental physics and detector functions associated with the technology with a focus on real-world applications. The book discusses all forms of luminescence phosphors for radiation detection used in a variety of fields, including medicine, security, resource exploration, environmental monitoring, and high energy physics. Readers will discover discussions of dosimeter materials, including thermally stimulated luminescent materials, optically stimulated luminescent materials, and radiophotoluminescence materials. The book also covers transparent ceramics and glasses and a broad range of devices used in this area. Phosphors for Radiation Detection also includes: Thorough introductions to ionizing radiation induced luminescence, organic scintillators, and inorganic oxide scintillators Comprehensive explorations of luminescent materials, including discussions of materials synthesis and their use in gamma-ray, neutron, and charged particle detection Practical discussions of semiconductor scintillators, including treatments of organic-inorganic layered perovskite materials for scintillation detectors In-depth examinations of thermally stimulated luminescent materials, including discussions of the dosimetric properties for photons, charged particles, and neutrons Relevant for research physicists, materials scientists, and electrical engineers, Phosphors for Radiation Detection is an also an indispensable resource for postgraduate and senior undergraduate students working in detection physics.

Metalorganic Vapor Phase Epitaxy of III-V Heteroepitaxial Systems Springer

This work is about two-step epitaxial growth using metalorganic vapor-phase epitaxy (MOVPE) for the realization of edge-emitting near-infrared laser diodes. The fabricated gallium arsenide-based devices fall into two categories: high-power lasers (watt range, multimodal) and tunable lasers (milliwatt range, monomodal). Common to both cases is that surface contamination – particularly that due to oxygen – needs to be removed before regrowth. Thus, in-situ etching with carbon tetrabromide (CBr4) is first studied. The experimental results include kinetic data, the effects of different etching conditions as well as substrate characteristics, and the effectiveness in reducing surface contamination. These investigations pave the way to devices based on 2-step epitaxy combined with in-situ etching. Correspondingly, thermally-tuned SG-DBR lasers operating around 975 nm have been successfully realized, obtaining a tuning range of 21 nm. In addition, the possibility of using electronic tuning in similar devices has been explored. High-power broad-area lasers have also been realized, using two-step epitaxy combined with ex-situ and in-situ etching, to create a buried, shallow “mesa” containing the active zone. This approach allows introducing lateral electrical and optical confinement, and – simultaneously – non-absorbing mirrors at the laser facets. Additionally, a different strategy to create a buried current aperture is presented, which is based on ion implantation followed by epitaxial regrowth. This enables to improve device performance and simultaneously introduce non-absorbing mirrors at the facets with correspondingly increased reliability.

Handbook of Crystal Growth Wiley

This book presents selected, peer-reviewed proceedings of the 2nd International Conference on Material, Machines and Methods for Sustainable Development (MMMS2020), held in the city of Nha Trang, Vietnam, from 12 to 15 November, 2020. The purpose of the conference is to explore and ensure an understanding of the critical aspects contributing to sustainable development, especially materials, machines and methods. The contributions published in this book come from authors representing universities, research institutes and industrial companies, and reflect the results of a very broad spectrum of research, from micro- and nanoscale materials design and processing, to mechanical engineering technology in industry. Many of the contributions selected for these proceedings focus on materials modeling, eco-material processes and mechanical manufacturing.

Mercury Cadmium Telluride North Holland

Mercury cadmium telluride (MCT) is the third most well-regarded semiconductor after silicon and gallium arsenide and is the material of choice for use in infrared sensing and imaging. The reason for this is that MCT can be ‘tuned’ to the desired IR wavelength by varying the cadmium concentration. Mercury Cadmium Telluride: Growth, Properties and Applications provides both an introduction for newcomers, and a comprehensive review of this fascinating material. Part One discusses the history and current status of both bulk and epitaxial growth techniques, Part Two is concerned with the wide range of properties of MCT, and Part Three covers the various device types that have been developed using MCT. Each chapter opens with some historical background and theory before presenting current research. Coverage includes: Bulk growth and properties of MCT and CdZnTe for MCT epitaxial growth Liquid phase epitaxy (LPE) growth Metal-organic vapour phase epitaxy (MOVPE) Molecular beam epitaxy (MBE) Alternative substrates Mechanical, thermal and optical properties of MCT Defects, diffusion, doping and annealing Dry device processing

Photoconductive and photovoltaic detectors Avalanche photodiode detectors Room-temperature IR detectors
CVD of Compound Semiconductors Springer Nature
Modern Inorganic Synthetic Chemistry, Second Edition captures, in five distinct sections, the latest advancements in inorganic synthetic chemistry, providing materials chemists, chemical engineers, and materials scientists with a valuable reference source to help them advance their research efforts and achieve breakthroughs. Section one includes six chapters centering on synthetic chemistry under specific conditions, such as high-temperature, low-temperature and cryogenic, hydrothermal and solvothermal, high-pressure, photochemical and fusion conditions. Section two focuses on the synthesis and related chemistry problems of highly distinct categories of inorganic compounds, including superheavy elements, coordination compounds and coordination polymers, cluster compounds, organometallic compounds, inorganic polymers, and nonstoichiometric compounds. Section three elaborates on the synthetic chemistry of five important classes of inorganic functional materials, namely, ordered porous materials, carbon materials, advanced ceramic materials, host-guest materials, and hierarchically structured materials. Section four consists of four chapters where the synthesis of functional inorganic aggregates is discussed, giving special attention to the growth of single crystals, assembly of nanomaterials, and preparation of amorphous materials and membranes. The new edition's biggest highlight is Section five where the frontier in inorganic synthetic chemistry is reviewed by focusing on biomimetic synthesis and rationally designed synthesis. Focuses on the chemistry of inorganic synthesis, assembly, and organization of wide-ranging inorganic systems Covers all major methodologies of inorganic synthesis Provides state-of-the-art synthetic methods Includes real examples in the organization of complex inorganic functional materials Contains more than 4000 references that are all highly reflective of the latest advancement in inorganic synthetic chemistry Presents a comprehensive coverage of the key issues involved in modern inorganic synthetic chemistry as written by experts in the field
Rare Earth and Transition Metal Doping of Semiconductor Materials Elsevier
Epitaxial Silicon Technology is a single-volume, in-depth review of all the silicon epitaxial growth techniques. This technology is being extended to the growth of epitaxial layers on insulating substrates by means of a variety of lateral seeding approaches. This book is divided into five chapters, and the opening chapter describes the growth of silicon layers by vapor-phase epitaxy, considering both atmospheric and low-pressure growth. The second chapter discusses molecular-beam epitaxial growth of silicon, providing a unique ability to grow very thin layers with precisely controlled doping characteristics. The third chapter introduces the silicon liquid-phase epitaxy, in which the growth of silicon layers arose from a need to decrease the growth temperature and to suppress autodoping. The fourth chapter addresses the growth of silicon on sapphire for improving the radiation hardness of CMOS integrated circuits. The fifth chapter deals with the advances in the application of silicon epitaxial growth. This chapter also discusses the formation of epitaxial layers of silicon on insulators, such as silicon dioxide, which do not provide a natural single crystal surface for growth. Each chapter begins with a discussion on the fundamental transport mechanisms and the kinetics governing the growth rate, followed by a description of the electrical properties that can be achieved in the layers and the restrictions imposed by the growth technique upon the control over its electrical characteristics. Each chapter concludes with a discussion on the applications of the particular growth technique. This reference material will be useful for process technologists and engineers who may need to apply epitaxial growth for device fabrication.
Modern Inorganic Synthetic Chemistry Springer
This unique new resource provides a comparative introduction to vertical Gallium Nitride (GaN) and Silicon Carbide (SiC) power devices using real commercial device data, computer, and physical models. This book uses commercial examples from recent years and presents the design features of various GaN and SiC power components and devices. Vertical verses lateral power semiconductor devices are explored, including those based on wide bandgap materials. The abstract concepts of solid state physics as they relate to solid state devices are explained with particular emphasis on power solid state devices. Details about the effects of photon recycling are presented, including an explanation of the phenomenon of the family tree of photon-recycling. This book offers in-depth coverage of bulk crystal growth of GaN, including hydride vapor-phase epitaxial (HVPE) growth, high-pressure nitrogen solution growth, sodium-flux growth, ammonothermal growth, and sublimation growth of SiC. The fabrication process, including ion implantation, diffusion, oxidation, metallization, and passivation is explained. The book provides details about metal-semiconductor contact, unipolar power diodes, and metal-insulator-semiconductor (MIS) capacitors. Bipolar power diodes, power switching devices, and edge terminations are also covered in this resource.
Properties of Advanced Semiconductor Materials Springer Nature
This book provides comprehensive coverage of the new wide-bandgap semiconductor gallium oxide (Ga2O3). Ga2O3 has been attracting much attention due to its excellent materials properties. It features an extremely large bandgap of greater than 4.5 eV and availability of large-size, high-quality native substrates produced from melt-grown bulk single crystals. Ga2O3 is thus a rising star among ultra-wide-bandgap semiconductors and represents a key emerging research field for the worldwide semiconductor community. Expert chapters cover physical properties, synthesis, and state-of-the-art applications, including materials properties, growth techniques of melt-grown bulk single crystals and epitaxial thin films, and many types of devices. The book is an essential resource for academic and industry readers who have an interest in, or plan to start, a new R&D project related to Ga2O3.
15th European Workshop on Metalorganic Vapour Phase Epitaxy (EWMOVPE XV) John Wiley & Sons
Systematically discusses the growth method, material properties, and applications for key semiconductor materials MOVPE is a chemical vapor deposition technique that produces single or polycrystalline thin films. As one of the key epitaxial growth technologies, it produces layers that form the basis of many optoelectronic components including mobile phone components (GaAs), semiconductor lasers and LEDs (III-Vs, nitrides), optical communications (oxides), infrared detectors, photovoltaics (II-IV materials), etc. Featuring contributions by an international group of academics and industrialists, this book looks at the fundamentals of MOVPE and the key areas of equipment/safety, precursor chemicals, and growth monitoring. It covers the most important materials from III-V and II-VI compounds to quantum dots and nanowires, including sulfides and selenides and oxides/ceramics. Sections in every chapter of Metalorganic Vapor Phase Epitaxy (MOVPE): Growth, Materials Properties and Applications cover the growth of the particular materials system, the properties of the resultant material, and its applications. The book offers information on arsenides, phosphides, and antimonides; nitrides; lattice-mismatched growth; CdTe, MCT (mercury cadmium telluride); ZnO and related materials; equipment and safety; and more. It also offers a chapter that looks at the future of the technique. Covers, in order, the growth method, material properties, and applications for each material Includes chapters on the fundamentals of MOVPE and the key areas of equipment/safety, precursor chemicals, and growth monitoring Looks at important materials such as III-V and II-VI compounds, quantum dots, and nanowires Provides topical and wide-ranging coverage from well-known authors in the field Part of the Materials for Electronic and Optoelectronic Applications series Metalorganic Vapor Phase Epitaxy (MOVPE): Growth, Materials Properties and Applications is an excellent book for graduate students, researchers in academia and industry, as well as specialist courses at undergraduate/postgraduate level in the area of epitaxial growth (MOVPE/ MOCVD/ MBE).
III-Nitride Semiconductor Optoelectronics Elsevier
Research advances in III-nitride semiconductor materials and device have led to an exponential increase in activity directed towards electronic and optoelectronic applications. There is also great scientific interest in this class of materials because they appear to form the first semiconductor system in which extended defects do not severely affect the optical properties of devices. The volume consists of chapters written by a number of leading researchers in nitride materials and device technology with the emphasis on the dopants incorporations, impurities identifications, defects engineering, defects characterization, ion implantation, irradiation-induced defects, residual stress, structural defects and phonon confinement. This unique volume provides a comprehensive review and introduction of defects and structural properties of GaN and related compounds for newcomers to the field and stimulus to further advances for experienced researchers. Given the current level of interest and research activity directed towards nitride materials and devices, the publication of the volume is particularly timely. Early pioneering work by Pankove and co-workers in the 1970s yielded a metal-insulator-semiconductor GaN light-emitting diode (LED), but the difficulty of producing p-type GaN precluded much further effort. The current level of activity in nitride semiconductors was inspired largely by the results of Akasaki and co-workers and of Nakamura and co-workers in the late 1980s and early 1990s in the development of p-type doping in GaN and the demonstration of nitride-based LEDs at visible wavelengths. These advances were followed by the successful fabrication and commercialization of nitride blue laser diodes by Nakamura et al at Nichia. The chapters contained in this volume constitutes a mere sampling of the broad range of research on nitride semiconductor materials and defect issues currently being pursued in academic, government, and industrial laboratories worldwide.
GaN and Related Materials John Wiley & Sons
Devices, nanoscale science and technologies based on GaN and related materials, have achieved great developments in recent years. New GaN-based devices such as UV detectors, fast p-HEMT and microwave devices are developed far more superior than other semiconductor materials-based devices.Written by renowned experts, the review chapters in this book cover the most important topics and achievements in recent years, discuss progress made by different groups, and suggest future directions. Each chapter also describes the basis of theory and experiment.This book is an invaluable resource for device design and processing engineers, material growers and evaluators, postgraduates and scientists as well as newcomers in the GaN field.