2d Materials And Van Der Waals Heterostructures Arxiv

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2d Inorganic Materials Beyond Graphene - Rao C N R 2017-08-28
Two-dimensional materials have had widespread applications in nanoelectronics, catalysis, gas capture, water purification, energy storage and conversion. Initially based around graphene, research has since moved on to looking at alternatives, including transitions metal dichalcogenides, layered topological insulators, metallic mono-chalcogenides, borocarbonitrides and phosphorene. This book provides a review of research in the field of these materials, including investigation into their defects, analysis on hybrid structures focusing on their properties and synthesis, and characterization and applications of 2D materials beyond graphene. It is designed to be a single-point reference for students, teachers and researchers of chemistry and its related subjects, particularly in the field of nanomaterials. Contents: Transition Metal Dichalcogenides and Other Layered Materials (Manoj K Jana and C N R Rao)Topological Valleytronics (Motohiko Ezawa)Two-Dimensional, Layered Materials as Catalysts for Oxygen Reduction Reaction (Debdyuti Mukherjee and S Sampath)Phosphorene (Arpita Paul and Umesh V Waghmare)2D van der Waals Hybrid: Structures, Properties and Devices (Md Ali Aamir, Tanweer Ahmed, Kimberly Hsieh, Saurav Islam, Paritosh Karnatak, Ranjit Kashid, Phanibhusan Singha Mahapatra, Jayanta Mishra, Tathagata Paul, Avradip Pradhan, Kallol Roy, Anindita Sahoo and Arindam Ghosh)Thermoelectric Energy Conversion in Layered Metal Chalcogenides (Satya N Guin, Ananya Banik and Kanishka Biswas)Plasma Chemical and Physical Vapour Deposition Methods and Diagnostics for 2D Materials (Majed A. Alrefae, Nicholas R Glavin, Andrey A Voevodin and Timothy S Fisher)Metal Contacts to MOS2 (Naveen Kaushik, Sameer Grover, Mandar M Deshmukh and Saurabh Lodha)Strain Dependent Properties of 2D MX2 (M = Mo and W; X = S, Se and Te) (Tribhuwan Pandey, Swastibrata Bhattacharyya and Abhishek K Singh)Point Defects, Grain Boundaries and Planar Faults in 2D h-BN and TMX2 Theory and Simulations (Anjali Singh and Umesh V Waghmare) Readership: Students, teachers and researchers of chemistry and its related subjects, particularly in the field of nanomaterials. Keywords:2D Materials;Borocarbonitrides;Phosphorene;Graphene;Catalysis;Nanomaterials;Gas Capture;Water Purification;Dichalcogenides;Topological Insulators;Mono-chalcogenidesReview:0
Advanced Topics on Crystal Growth - Sukarno Olavo Ferreira 2013
Crystal growth is the key step of a great number of very important applications. The development of new devices and products, from the traditional microelectronic industry to pharmaceutical industry and many others, depends on crystallization processes. The objective of this book is not to cover all areas of crystal growth but just present, as specified in the title, important selected topics, as applied to organic and inorganic systems. All authors have been selected for being key researchers in their field of specialization, working in important universities and research labs around the world. The first section is mainly devoted to biological systems and covers topics like proteins, bone and ice crystallization. The second section brings some applications to inorganic systems and describes more general growth techniques like chemical vapor crystallization and electrodeposition. This book is mostly recommended for students working in the field of crystal growth and for scientists and engineers in the fields of crystalline materials, crystal engineering and the industrial applications of crystallization processes.
Defects in Two-Dimensional Materials - Rafik Addou 2022-03-01
Defects in Two-Dimensional Materials addresses the fundamental physics and chemistry of defects in 2D materials and their effects on physical, electrical and optical properties. The book explores 2D materials such as graphene, hexagonal boron nitride (h-BN) and transition metal dichalcogenides (TMD). This knowledge will enable scientists and engineers to tune 2D materials properties to meet specific application requirements. The book reviews the techniques to characterize 2D material defects and compares the defects present in the various 2D materials (e.g. graphene, h-BN, TMDs, phosphorene, silicene, etc.). As two-dimensional materials research and development is a fast-growing field that could lead to many industrial applications, the primary objective of this book is to review, discuss and present opportunities in controlling defects in these materials to improve device performance in general or use the defects in a controlled way for novel applications. Presents the theory, physics and chemistry of 2D materials Catalogues defects of 2D materials and their impacts on materials properties and performance Reviews methods to characterize, control and engineer defects in 2D materials
2D Metal Carbides and Nitrides (MXenes) - Babak Anasori 2019-10-30
This book describes the rapidly expanding field of two-dimensional (2D) transition metal carbides and nitrides (MXenes). It covers fundamental knowledge on synthesis, structure, and properties of these new materials, and a description of their processing, scale-up and emerging applications. The ways in which the quickly expanding family of MXenes can outperform other novel nanomaterials in a variety of applications, spanning from energy storage and conversion to electronics; from water science to transportation; and in defense and medical applications, are discussed in detail.
2D Materials and Van der Waals Heterostructures - Antonio Di Bartolomeo 2020-06-23
The advent of graphene and, more recently, two-dimensional materials has opened new perspectives in electronics, optoelectronics, energy harvesting, and sensing applications. This book, based on a Special Issue published in Nanomaterials – MDPI covers experimental, simulation, and theoretical research on 2D materials and their van der Waals heterojunctions. The emphasis is the physical properties and the applications of 2D materials in state-of-the-art sensors and electronic or optoelectronic devices.
Graphene - Wonbong Choi 2016-04-19
Since the late 20th century, graphene—a one-atom-thick planar sheet of sp2-bonded carbon atoms densely packed in a honeycomb crystal lattice—has garnered appreciable attention as a potential next-generation electronic material due to its exceptional properties. These properties include high current density, ballistic transport, chemical inertness, high thermal conductivity, optical transmittance, and super hydrophobicity at nanometer scale. In contrast to research on its excellent electronic and optoelectronic properties, research on the syntheses of a single sheet of graphene for industrial applications is in its nascent stages. Graphene: Synthesis and Applications reviews the advancement and future directions of graphene research in the areas of synthesis and properties, and explores applications, such as electronics, heat dissipation, field emission, sensors, composites, and energy.
Fundamentals and Supercapacitor Applications of 2D Materials - Chandra Sekhar Rout 2021-05-04
Fundamentals and Applications of Supercapacitor 2D Materials covers different aspects of supercapacitor 2D materials, including their important properties, synthesis, and recent developments in supercapacitor applications of engineered 2D materials. In addition, theoretical investigations and various types of supercapacitors based on 2D materials such as symmetric, asymmetric, flexible, and micro-supercapacitors are covered. This book is a useful resource for research scientists, engineers, and students in the fields of supercapacitors, 2D nanomaterials, and energy storage devices. Due to their sub-nanometer thickness, 2D

materials have a high packing density, which is suitable for the fabrication of highly-packed energy supplier/storage devices with enhanced energy and power density. The flexibility of 2D materials, and their good mechanical properties and high packing densities, make them suitable for the development of thin, flexible, and wearable devices. Explores recent developments and looks at the importance of 2D materials in energy storage technologies Presents both the theoretical and DFT related studies Discusses the impact on performance of various operating conditions Includes a brief overview of the applications of supercapacitors in various industries, including aerospace, defense, biomedical, environmental, energy, and automotive

Advances in Optoelectronic Materials - Shadia Jamil Ikhmayies 2021

This book focuses on the progress in optoelectronic materials research and technologies, presenting reviews and original works on the theory, fabrication, characterization, and applications of optoelectronic materials. The chapters discuss preparation and properties of several optoelectronic materials, such as ZnO, SnO2, Zn1-XSnXO, BaTiO3, GaAs, GaP, ZnSe, and NaAlSi. The structural, optical, vibrational, and magnetic properties are discussed, in addition to transport and phase transformations.

2D Materials - 2016-06-24

2D Materials contains the latest information on the current frontier of nanotechnology, the thinnest form of materials to ever occur in nature. A little over 10 years ago, this was a completely unknown area, not thought to exist. However, since then, graphene has been isolated and acclaimed, and a whole other class of atomically thin materials, dominated by surface effects and showing completely unexpected and extraordinary properties has been created. This book is ideal for a variety of readers, including those seeking a high-level overview or a very detailed and critical analysis. No nanotechnologist can currently overlook this new class of materials. Presents one of the first detailed books on this subject of nanotechnology Contains contributions from a great line-up of authoritative contributors that bring together theory and experiments Ideal for a variety of readers, including those seeking a high-level overview or a very detailed and critical analysis

Raman Spectroscopy of Two-Dimensional Materials - Ping-Heng Tan 2018-12-30

This book shows the electronic, optical and lattice-vibration properties of the two-dimensional materials which are revealed by the Raman spectroscopy. It consists of eleven chapters covering various Raman spectroscopy techniques (ultralow-frequency, resonant Raman spectroscopy, Raman imaging), different kinds of two-dimensional materials (in-plane isotropy and anisotropy materials, van der Waals heterostructures) and their physical properties (double-resonant theory, surface and interface effect). The topics include the theory origin, experimental phenomenon and advanced techniques in this area. This book is interesting and useful to a wide readership in various fields of condensed matter physics, materials science and engineering.

Semiconductor Superlattices - H T Grahn 1995-04-17

This book surveys semiconductor superlattices, in particular their growth and electronic properties in an applied electric field perpendicular to the layers. The main developments in this field, which were achieved in the last five to seven years, are summarized. The electronic properties include transport through minibands at low electric field strengths, the Wannier–Stark localization and Bloch oscillations at intermediate electric field strengths, resonant tunneling of electrons and holes between different subbands, and the formation of electric field domains for large carrier densities at high electric field strengths. Contents: Growth and Characterization (K Fujiwara)Miniband Transport (A Sibille)Wannier–Stark Localization and Bloch Oscillations (F Agulló-Rueda & J Feldmann)Resonant Tunneling (H Grahn)Electric Field Domains (H Grahn). Readership: Physicists and materials scientists. keywords:Semiconductor Superlattices;Nanostructures;Fabrication;Miniband Transport;Bloch Oscillations;Wannierâ□□Stark Localization;Resonant Tunneling;Electric-Field Domains;Non-Linear Transport;Optical Properties

Photovoltaic and Photoelectrochemical Solar Energy Conversion - F. Cardon 2012-10-01

In recent years there has been an increasing interest in syscems which enable the conversion of solar energy into electri calor chemical energy. Many types of systems have been proposed and studied experimenta11y, the fundamentals of which extend from solid state physics to photo- and electrochemistry. For most of the systems considered excitation of an electron by absorption of a photon is fo1lowed by charge separation at an interface. It follows that the different fields involved (photovo1taics, photo electrochemistry, photogalvanics, etc.) have several essential aspects in common. It was the main purpose with the NATO Advanced Study Insti tute held at Gent, Belgium, from August 25 to September 5, 1980, to bring together research workers specializing in one of these fields in order to enab1e them not only to extend their knowledge into their own field but also to promote the interdisciplinary exchange of ideas. The scope of the A.S.I. has been 1imited to systems which have not or have hardly reached the stage of prac tica1 development. As a consequence, no lectures on economica1 aspects of solar energy conversion have been included. The topics covered in this volume are the fundamentals of recombination in solar ce1ls (P. Landsberg), theoretical and experimental aspects of heterojunctions and semiconductor/metal Schottky barriers (J.J. Loferski, W.H. Bloss and W.G. Townsend), photoelectrochemica1 ce11s (H. Gerischer and A.J. Nozik), pho- v PREFACE vi ga1vanic ce11s (W.J. Albery) and fina11y, surfactant assemb1ies (M. Grätzel).

Synthetic Biodegradable Polymers - Bernhard Rieger 2012-01-21

Salen Metal Complexes as Catalysts for the Synthesis of Polycarbonates from Cyclic Ethers and Carbon Dioxide, by Donald J. Darensbourg.- Material Properties of Poly(Propylene Carbonates), by Gerrit. A. Luinstra and Endres Borchardt.- Poly(3-Hydroxybutyrate) from Carbon Monoxide, by Robert Reichardt and Bernhard Rieger. - Ecoflex® and Ecovio®: Biodegradable, Performance-Enabling Plastics, by K. O. Siegenthaler, A. Künkel, G. Skupin and M. Yamamoto.- Biodegradability of Poly(Vinyl Acetate) and Related Polymers, by Manfred Amann and Oliver Minge.- Recent Developments in Ring-Opening Polymerization of Lactones, by P. Lecomte and C. Jérôme.- Recent Developments in Metal-Catalyzed Ring-Opening Polymerization of Lactides and Glycolides: Preparation of Polylactides, Polyglycolide, and Poly(lactide-co-glycolide), by Saikat Dutta, Wen-Chou Hung, Bor-Hunn Huang and Chu-Chieh Lin.- Bionolle (Polybutylenesuccinate), by Yasushi Ichikawa, Tatsuya Mizukoshi.- Polyurethanes from Renewable Resources, by David A. Babb.-

Integration of 2D Materials for Electronics Applications - Filippo Giannazzo 2019-02-13

This book is a printed edition of the Special Issue "Integration of 2D Materials for Electronics Applications" that was published in Crystals

Graphene Materials - George Kyzas 2017-05-17

Graphene is, basically, a single atomic layer of graphite, an abundant mineral that is an allotrope of carbon that is made up of very tightly bonded carbon atoms organized into a hexagonal lattice. What makes graphene so special is its sp2 hybridization and very thin atomic thickness (of 0.345 Nm). These properties are what enable graphene to break so many records in terms of strength, electricity, and heat conduction (as well as many others). This book gathers valuable information about many advanced applications of graphene (electrical, optical, environmental, cells, capacitors, etc).

Biomedical Innovations to Combat COVID-19 - Sergio Rosales-Mendoza 2021-10-15

Biomedical Innovations to Combat COVID-19 provides an updated overview on the development of vaccines, antiviral drugs and nanomaterials, and diagnostic methods for the fight against COVID-19. Perspectives on such technologies are identified, discussed, and enriched with figures for easy understanding and applicability. Furthermore, it contains basic aspects of virology, immunology, and antiviral drugs that are needed to fully appreciate these innovations. This book is split into four sections: introduction, presenting basic virologic and epidemiological aspects of COVID-19; vaccines against COVID-19, discussing their different types and applications used to develop them; diagnostic approaches for SARS-CoV-2, encompassing advanced sensing and microfluidic-based biosensors; and drug development and delivery, where antivirals based on nanomaterials or drugs are presented. It is a valuable source for virologists, biotechnologists, and members of biomedical field interested in learning more about how novel technologies can be applied to fasten the eradication of the COVID-19 and similar pandemics. Presents updated literature coverage summarizing the most relevant information on COVID-19 Written by experts from diverse scientific domains in order to provide readers with a thorough view on the subject Encompasses tables, figures and information trees especially developed for the book in order to condense and highlight key points for quick reference

Synthesis, Modelling and Characterization of 2D Materials and their Heterostructures - Eui-Hyeok Yang 2020-06-19

Synthesis, Modelling and Characterization of 2D Materials and Their Heterostructures provides a detailed discussion on the multiscale computational approach surrounding atomic, molecular and atomic-informed continuum models. In addition to a detailed theoretical description, this book provides example problems, sample code/script, and a discussion on how theoretical analysis provides insight into optimal experimental design. Furthermore, the book addresses the growth mechanism of these 2D materials, the formation of defects, and different lattice mismatch and interlayer interactions. Sections cover direct band gap, Raman scattering, extraordinary strong light matter interaction, layer dependent photoluminescence, and other physical properties. Explains multiscale computational techniques, from atomic to continuum scale, covering different time and length scales Provides fundamental theoretical insights, example problems, sample code and exercise problems Outlines major characterization and synthesis methods for different types of 2D materials

Electronic Transport in Mesoscopic Systems - Supriyo Datta 1997-05-15

Advances in semiconductor technology have made possible the fabrication of structures whose dimensions are much smaller than the mean free path of an electron. This book gives a thorough account of the theory of electronic transport in such mesoscopic systems. After an initial chapter covering fundamental concepts, the transmission function formalism is presented, and used to describe three key topics in mesoscopic physics: the quantum Hall effect; localisation; and double-barrier tunnelling. Other sections include a discussion of optical analogies to mesoscopic phenomena, and the book concludes with a description of the non-equilibrium Green's function formalism and its relation to the transmission formalism. Complete with problems and solutions, the book will be of great interest to graduate students of mesoscopic physics and nanoelectronic device engineering, as well as to established researchers in these fields.

Two-dimensional Materials - Pramoda Kumar Nayak 2016-08-31

There are only a few discoveries and new technologies in materials science that have the potential to dramatically alter and revolutionize our material world. Discovery of two-dimensional (2D) materials, the thinnest form of materials to ever occur in nature, is one of them. After isolation of graphene from graphite in 2004, a whole other class of atomically thin materials, dominated by surface effects and showing completely unexpected and extraordinary properties, has been created. This book provides a comprehensive view and state-of-the-art knowledge about 2D materials such as graphene, hexagonal boron nitride (h-BN), transition metal dichalcogenides (TMD) and so on. It consists of 11 chapters contributed by a team of experts in this exciting field and provides latest synthesis techniques of 2D materials, characterization and their potential applications in energy conservation, electronics, optoelectronics and biotechnology.

Frontiers of Materials Research - National Academies of Sciences, Engineering, and Medicine 2019-09-12

Modern materials science builds on knowledge from physics, chemistry, biology, mathematics, computer and data science, and engineering sciences to enable us to understand, control, and expand the material world. Although it is anchored in inquiry-based fundamental science, materials research is strongly focused on discovering and producing reliable and economically viable materials, from super alloys to polymer composites, that are used in a vast array of products essential to today's societies and economies. Frontiers of Materials Research: A Decadal Survey is aimed at documenting the status and promising future directions of materials research in the United States in the context of similar efforts worldwide. This third decadal survey in materials research reviews the progress and achievements in materials research and changes in the materials research landscape over the last decade; research opportunities for investment for the period 2020-2030; impacts that materials research has had and is expected to have on emerging technologies, national needs, and science; and challenges the enterprise may face over the next decade.

Nanomechanics in van der Waals Heterostructures - Matthew Holwill 2019-05-04

Micro/nano-mechanical systems are a crucial part of the modern world providing a plethora of sensing and actuation functionalities used in everything from the largest cargo ships to the smallest hand-held electronics; from the most advanced scientific and medical equipment to the simplest household items. Over the past few decades, the processes used to produce these devices have improved, supporting dramatic reductions in size, but there are fundamental limits to this trend that require a new production paradigm. The 2004 discovery of graphene ushered in a new era of condensed matter physics research, that of two-dimensional materials. Being only a few atomic layers thick, this new class of materials exhibit unprecedented mechanical strength and flexibility and can couple to electric, magnetic and optical signals. Additionally, they can be combined to form van der Waals heterostructures in an almost limitless number of ways. They are thus ideal candidates to reduce the size and extend the capabilities of traditional micro/nano-mechanical systems and are poised to redefine the technological sphere. This thesis attempts to develop the framework and protocols required to produce and characterise micro/nano-mechanical devices made from two-dimensional materials. Graphene and its insulating analogue, hexagonal boron nitride, are the most widely studied materials and their heterostructures are used as the test-bed for potential device architectures and capabilities. Interlayer friction, electro-mechanical actuation and surface reconstruction are some of the key phenomena investigated in this work.

2D Materials for Nanophotonics - Young Min Jhon 2020-11-29

2D Materials for Nanophotonics presents a detailed overview of the applications of 2D materials for nanophotonics, covering the photonic properties of a range of 2D materials including graphene, 2D phosphorene and MXenes, and discussing applications in lighting and energy storage. This comprehensive reference is ideal for readers seeking a detailed and critical analysis of how 2D materials are being used for a range of photonic and optical applications. Outlines the major photonic properties in a variety of 2D materials Demonstrates major applications in lighting and energy storage Explores the challenges of using 2D materials in photonics

Semiconductors - Martin I. Pech-Canul 2019-01-17

This book is a practical guide to optical, optoelectronic, and semiconductor materials and provides an overview of the topic from its fundamentals to cutting-edge processing routes to groundbreaking technologies for the most recent applications. The book details the characterization and properties of these materials. Chemical methods of synthesis are emphasized by the authors throughout the publication. Describes new materials and updates to older materials that exhibit optical, optoelectronic and semiconductor behaviors; Covers the structural and mechanical aspects of the optical, optoelectronic and semiconductor materials for meeting mechanical property and safety requirements; Includes discussion of the environmental and sustainability issues regarding optical, optoelectronic, and semiconductor materials, from processing to recycling.

2D Monoelemental Materials (Xenes) and Related Technologies - Zongyu Huang 2022

Monoelemental 2D materials called Xenes have a graphene-like structure, intra-layer covalent bond, and weak van der Waals forces between layers. Materials composed of different groups of elements have different structures and rich properties, making Xenes materials a potential candidate for the next generation of 2D materials. 2D Monoelemental Materials (Xenes) and Related Technologies: Beyond Graphene describes the structure, properties, and applications of Xenes by classification and section. The first section covers the structure and classification of single-element 2D materials, according to the different main groups of monoelemental materials of different components and includes the properties and applications with detailed description. The second section discusses the structure, properties, and applications of advanced 2D Xenes materials, which are composed of heterogeneous structures, produced by defects, and regulated by the field. Features include: Systematically detailed single element materials according to the main groups of the constituent elements Classification of the most effective and widely studied 2D Xenes materials Expounding upon changes in properties and improvements in applications by different regulation mechanisms Discussion of the significance of 2D single-element materials where structural characteristics are closely combined with different preparation methods and the relevant theoretical properties complement each other with practical applications Aimed at researchers and advanced students in materials science and engineering, this book offers a broad view of current knowledge in the emerging and promising field of 2D monoelemental materials.

Smart Nanosystems for Biomedicine, Optoelectronics and Catalysis - Tatyana Shabatina 2020-11-26

Nowadays nanoscience and nanotechnologies provide us with many excellent examples of the unique solutions for the different technical problems and demands of human society. Smart stimuli-responsive nanosystems and nanomaterials are used in many fields such as medicine, biomedical, biotechnology, agriculture, environmental pollution control, cosmetics, optics, health, food, energy, textiles, automotive,

communication technologies, agriculture, and electronics. The book “Smart Nanosystems for Biomedicine, Optoelectronics and Catalysis” describes the modern trends in nanoscience and nanotechnology for creation of smart hybrid nanosystems combining the inorganic nano-objects with organic, biological, and biocompatible materials, which create multifunctional and remotely controlled platforms for diverse technical and biomedical uses. The material includes several review and original research articles devoted to the problems of directed chemical and biological synthesis of such nanosystems, thorough analysis of their physical and chemical properties and prospects of their possible applications. We hope that the presented book will be useful for different nanoscience research groups and PhD and graduate students, to introduce them to the world of hybrid metal-organic and metal-biological nano-objects, and smart self-organizing nanosystems and open new ways of their possible use in different scientific and practical areas.

Two Dimensional Transition Metal Dichalcogenides - Narayanasamy Sabari Arul 2019-07-30

This book presents advanced synthesis techniques adopted to fabricate two-dimensional (2D) transition metal dichalcogenides (TMDs) materials with its enhanced properties towards their utilization in various applications such as, energy storage devices, photovoltaics, electrocatalysis, electronic devices, photocatalysts, sensing and biomedical applications. It provides detailed coverage on everything from the synthesis and properties to the applications and future prospects of research in 2D TMD nanomaterials.

2D Materials for Electronics, Sensors and Devices - Saptarshi Das 2022-09-30

2D Materials for Electronics, Sensors and Devices: Synthesis, Characterization, Fabrication and Application provides an overview of various top-down and bottom-up synthesis techniques, along with stitching, stacking and stoichiometric control methods for different 2D materials and their heterostructures. The book focuses on the widespread applications of various 2D materials in high-performance and low-power sensors, field effect devices, flexible electronics, straintronics, spintronics, brain-inspired electronics, energy harvesting and energy storage devices. This is an important reference for materials scientists and engineers looking to gain a greater understanding on how 2D materials are being used to create a range of low cost, sustainable products and devices. Discusses the major synthesis and preparation methods of a range of emerging 2D electronic materials Provides state-of–the-art information on the most recent advances, including theoretical and experimental studies and new applications Discusses the major challenges of the mass application of 2D materials in industry

The Chemistry of Germanium - E. G. Rochow 2014-05-18

Pergamon Texts in Inorganic Chemistry, Volume 14: The Chemistry of Germanium, Tin, and Lead focuses on the properties, characteristics, transformations, and reactions of lead, germanium, and tin. The book focuses on germanium and compounds of Ge(I) and Ge(II). Discussions focus on germanium(II) compounds of phosphorus and arsenic, germanium(II) imide and nitride, monohalides, analytical determination, biological activity, chemical behavior of germanium, and production and industrial use of germanium. The text then elaborates on organogermanium compounds, complexes of germanium(IV), and tin. Topics include nuclear magnetic resonance, chemical properties of tin metal, isotopes of tin, occurrence and distribution of tin, and fluorogermanates and chlorogermanates. The manuscript takes a look at nuclear magnetic resonance, extraction, industrial and commercial utilization, toxicity, and chemical properties of metallic lead. The publication is a vital source of data for researchers interested in the chemistry of lead, germanium, and tin.

Van der Waals Heterostructures - Yue Zhang 2023-01-04

Van der Waals Heterostructures A comprehensive resource systematically detailing the developments and applications of van der Waals heterostructures and devices Van der Waals Heterostructures is essential reading to understand the developments made in van der Waals heterostructures and devices in all aspects, from basic synthesis to physical analysis and heterostructures assembling to devices applications, including demonstrated applications of van der Waals heterostructure on electronics, optoelectronics, and energy conversion, such as solar energy, hydrogen energy, batteries, catalysts, biotechnology, and more. This book starts from an in-depth introduction of van der Waals interactions in layered materials and the forming of mixed-dimensional heterostructures via van der Waals force. It then comprehensively summarizes the synthetic methods, devices building processes and physical mechanism of 2D van der Waals heterostructures, and devices including 2D-2D electronics, 2D-2D optoelectronics, and mixed dimensional van der Waals heterostructures. In Van der Waals Heterostructures, readers can expect to find specific information on: The current library of 2D semiconductors and the current synthesis and performances of 2D semiconductors Controllable synthesis and assemble van der Waals heterostructures, physics of the van der Waals interface, and multi-field coupling effects 2D-2D electronics, 2D-2D optoelectronics, mixed dimensional van der Waals heterostructures, and van der Waals heterostructure applications on energy conversion Insight into future perspectives of the van der Waals heterostructures and devices with the detailed effective role of 2D materials for integrated electrical and electronic equipment

Materials Development and Processing for Biomedical Applications - Savaş Kaya 2022-04-06

Materials Development and Processing for Biomedical Applications focuses on various methods of manufacturing, surface modifications, and advancements in biomedical applications. This book examines in detail about five different aspects including, materials properties, development, processing, surface coatings, future perspectives and fabrication of advanced biomedical devices. Fundamental aspects are discussed to better understand the processing of various biomedical materials such as metals, ceramics, polymers, composites, etc. A wide range of surface treatments are covered in this book that will be helpful for the readers to understand the importance of surface treatments and their future perspectives. Additional Features Include: Examines various properties of biomedical materials at the beginning in several chapters which will enrich the fundamental knowledge of the readers. Discusses advancements in various fields of biomedical applications. Provides a glimpse of characterization techniques for the evaluation of material properties. Addresses biocompatibility, biocorrosion, and tribocorrosion. This book explores new and novel strategies for the development of materials and their biomedical applications. It will serve as a comprehensive resource for both students and scientists working in materials and biomedical sciences.

2D Materials - Craig E. Banks 2018-06-27

Most reference texts covering two-dimensional materials focus specifically on graphene, when in reality, there are a host of new two-dimensional materials poised to overtake graphene. This book provides an authoritative source of information on twodimensional materials covering a plethora of fields and subjects and outlining all two-dimensional materials in terms of their fundamental understanding, synthesis, and applications.

2D Semiconductor Materials and Devices - Dongzhi Chi 2019-10-19

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

2D Materials for Photonic and Optoelectronic Applications - Qiaoliang Bao 2019-10-19

2D Materials for Photonic and Optoelectronic Applications introduces readers to two-dimensional materials and their properties (optical, electronic, spin and plasmonic), various methods of synthesis, and possible applications, with a strong focus on novel findings and technological challenges. The two-dimensional materials reviewed include hexagonal boron nitride, silicene, germanene, topological insulators, transition metal dichalcogenides, black phosphorous and other novel materials. This book will be ideal for students and researchers in materials science, photonics, electronics, nanotechnology and condensed matter physics and chemistry, providing background for both junior investigators and timely reviews for seasoned researchers. Provides an in-depth look at boron nitride, silicene, germanene, topological insulators, transition metal dichalcogenides, and more Reviews key applications for photonics and optoelectronics, including photodetectors, optical signal processing, light-emitting diodes and photovoltaics Addresses key technological challenges for the realization of optoelectronic applications and comments on future solutions

2D Nanoscale Heterostructured Materials - Satyabrata Jit 2020-05-09

2D Nanoscale Heterostructured Materials: Synthesis, Properties, and Applications assesses the current

status and future prospects for 2D materials other than graphene (e.g., BN nanosheets, MoS2, NbSe2, WS2, etc.) that have already been contemplated for both low-end and high-end technological applications. The book offers an overview of the different synthesis techniques for 2D materials and their heterostructures, with a detailed explanation of the many potential future applications. It provides an informed overview and fundamentals properties related to the 2D Transition metal dichalcogenide materials and their heterostructures. The book helps researchers to understand the progress of this field and points the way to future research in this area. Explores synthesis techniques of newly evolved 2D materials and their heterostructures with controlled properties Offers detailed analysis of the fundamental properties (via various experimental process and simulations techniques) of 2D heterostructures materials Discusses the applications of 2D heterostructured materials in various high-performance devices

Advances in Condensed-Matter and Materials Physics - Jagannathan Thirumalai 2020-05-06

This book, Condensed Matter and Material Physics, incorporates the work of multiple authors to enhance the theoretical as well as experimental knowledge of materials. The investigation of crystalline solids is a growing need in the electronics industry. Micro and nano transistors require an in-depth understanding of semiconductors of different groups. Amorphous materials, on the other hand, as non-equilibrium materials are widely applied in sensors and other medical and industrial applications. Superconducting magnets, composite materials, lasers, and many more applications are integral parts of our daily lives. Superfluids, liquid crystals, and polymers are undergoing active research throughout the world. Hence profound information on the nature and application of various materials is in demand. This book bestows on the reader a deep knowledge of physics behind the concepts, perspectives, characteristic properties, and prospects. The book was constructed using 10 contributions from experts in diversified fields of condensed matter and material physics and its technology from over 15 research institutes across the globe.

Spintronic 2D Materials - Wenqing Liu 2019-06-15

Spintronic 2D Materials: Fundamentals and Applications provides an overview of the fundamental theory of 2D electronic systems that includes a selection of the most intensively investigated 2D materials. The book tells the story of 2D spintronics in a systematic and comprehensive way, providing the growing community of spintronics researchers with a key reference. Part One addresses the fundamental theoretical aspects of 2D materials and spin transport, while Parts Two through Four explore 2D material systems, including graphene, topological insulators, and transition metal dichalcogenides. Each section discusses properties, key issues and recent developments. In addition, the material growth method (from lab to mass production), device fabrication and characterization techniques are included throughout the book. Discusses the fundamentals and applications of spintronics of 2D materials, such as graphene, topological insulators and transition metal dichalcogenides Includes an in-depth look at each materials system, from material growth, device fabrication and characterization techniques Presents the latest solutions on key challenges, such as the spin lifetime of 2D materials, spin-injection efficiency, the potential proximity effects, and much more

Fundamentals and Sensing Applications of 2D Materials - Chandra Sekhar Rout 2019-06-15

Fundamentals and Sensing Applications of 2D Materials provides a comprehensive understanding of a wide range of 2D materials. Examples of fundamental topics include: defect and vacancy engineering, doping and advantages of 2D materials for sensing, 2D materials and composites for sensing, and 2D materials in biosystems. A wide range of applications are addressed, such as gas sensors based on 2D materials, electrochemical glucose sensors, biosensors (enzymatic and non-enzymatic), and printed, stretchable, wearable and flexible biosensors. Due to their sub-nanometer thickness, 2D materials have a high packing density, thus making them suitable for the fabrication of thin film based sensor devices. Benefiting from their unique physical and chemical properties (e.g. strong mechanical strength, high surface area, unparalleled thermal conductivity, remarkable biocompatibility and ease of functionalization), 2D layered nanomaterials have shown great potential in designing high performance sensor devices. Provides a comprehensive overview of 2D materials systems that are relevant to sensing, including transition metal dichalcogenides, metal oxides, graphene and other 2D materials system Includes information on potential applications, such as flexible sensors, biosensors, optical sensors, electrochemical sensors, and more Discusses graphene in terms of the lessons learned from this material for sensing applications and how these lessons can be applied to other 2D materials

Chemical Vapor Transport Reactions - Michael Binnewies 2012-08-31

This comprehensive handbook covers the diverse aspects of chemical vapor transport reactions from basic research to important practical applications. The book begins with an overview of models for chemical vapor transport reactions and then proceeds to treat the specific chemical transport reactions for the elements, halides, oxides, sulfides, selenides, tellurides, pnictides, among others. Aspects of transport from intermetallic phases, the stability of gas particles, thermodynamic data, modeling software and laboratory techniques are also covered. Selected experiments using chemical vapor transport reactions round out the work, making this book a useful reference for researchers and instructors in solid state and inorganic chemistry.

2D Materials - Phaedon Avouris 2017-06-29

Learn about the most recent advances in 2D materials with this comprehensive and accessible text. Providing all the necessary materials science and physics background, leading experts discuss the fundamental properties of a wide range of 2D materials, and their potential applications in electronic, optoelectronic and photonic devices. Several important classes of materials are covered, from more established ones such as graphene, hexagonal boron nitride, and transition metal dichalcogenides, to new and emerging materials such as black phosphorus, silicene, and germanene. Readers will gain an in-depth understanding of the electronic structure and optical, thermal, mechanical, vibrational, spin and plasmonic properties of each material, as well as the different techniques that can be used for their synthesis. Presenting a unified perspective on 2D materials, this is an excellent resource for graduate students, researchers and practitioners working in nanotechnology, nanoelectronics, nanophotonics, condensed matter physics, and chemistry.

Oxide-Based Materials and Structures - Rada Savkina 2020-05-07

Oxide-based materials and structures are becoming increasingly important in a wide range of practical fields including microelectronics, photonics, spintronics, power harvesting, and energy storage in addition to having environmental applications. This book provides readers with a review of the latest research and an overview of cutting-edge patents received in the field. It covers a wide range of materials, techniques, and approaches that will be of interest to both established and early-career scientists in nanoscience and nanotechnology, surface and material science, and bioscience and bioengineering in addition to graduate students in these areas. Features: Contains the latest research and developments in this exciting and emerging field Explores both the fundamentals and applications of the research Covers a wide range of materials, techniques, and approaches