2d Materials

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

November 6-7, 2017 Frankfurt, Germany Key Topics : Graphene and 2D Materials based Nanocomposites, Chemistry and Biology studies of Graphene, Graphene Modification and Functionalisation, Synthesis of Graphene and 2D Materials, Graphene nano In Energy and Storage, Graphene Supercapacitors, Graphene and Graphene oxide , Graphene-like 2D materials , Graphene Application Technology, Emerging Trends in the field of Graphene nano, Advances in Graphene Physics, Carbon nano chips and

nanostructures, Graphene Chemistry, Graphite, Graphene & their polymer nano composites, Graphene: Synthesis, Properties & Phenomena, Physics of Graphene, Graphene and Biomaterials for health Care, Nano Medicine & Biotechnology,

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

This book is dedicated to the new two-dimensional one-atomic-layer-thick materials such as graphene, metallic chalcogenides, silicene and other 2D materials. The book describes their main physical properties and applications in nanoelctronics, photonics, sensing and computing. A large part of the book deals with graphene and its amazing physical properties. Another important part of the book deals with semiconductor monolayers such as MoS2 with

impressive applications in photonics, and electronics. Silicene and germanene are the atom-thick counterparts of silicon and germanium with impressive applications in electronics and photonics which are still unexplored. Consideration of two-dimensional electron gas devices conclude the treatment. The physics of 2DEG is explained in detail and the applications in THz and IR region are discussed. Both authors are working currently on these 2D materials developing theory and applications.

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.

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. 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

Information, Sensing and Energy Applications

Two-dimensional Materials

Technology, Formulation and Applications

Intelligent System

2D Materials and Van der Waals Heterostructures

Characterization, Production and Applications

Fundamentals and Sensing Applications of 2D Materials

Properties and Photonic Applications

Synthesis, Characterization and Potential Applications

Major developments in the semiconductor industry are on the horizon through the use of two-dimensional (2D) materials, such as graphene and transition metal dichalcogenides, for integrated circuits (ICs). 2D Materials for Nanoelectronics is the first comprehensive treatment of these materials and their applications in nanoelectronic devices. Comprised of chapters authored by internationally recognised researchers, this book: Discusses the use of graphene for high-frequency analog circuits Explores logic and photonic applications of molybdenum disulfide (MoS2) Addresses novel 2D materials including silicene, germanene, stanene, and phosphorene Considers the use of 2D materials for both field-effect transistors (FETs) and logic circuits Provides background on

the simulation of structural, electronic, and transport properties from first principles 2D Materials for Nanoelectronics presents extensive, state-of-the-art coverage of the fundamental and applied aspects of this exciting field. 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

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

Two-dimensional (2D) materials have attracted a great deal of attention in recent years due to their potential applications in gas/chemical sensors, healthcare monitoring, biomedicine, electronic skin, wearable sensing technology and advanced electronic devices. Graphene is one of today's most popular 2D nanomaterials alongside boron nitrides, molybdenum disulfide, black phosphorus and metal oxide nanosheets, all

of which open up new opportunities for future devices. This book provides insights into models and theoretical backgrounds, important properties, characterizations and applications of 2D materials, including graphene, silicon nitride, aluminum nitride, ZnO thin film, phosphorene and molybdenum disulfide.

This book discusses the functional ink systems of graphene and related two-dimensional (2D) layered materials in the context of their formulation and potential for various applications, including in electronics, optoelectronics, energy, sensing, and composites using conventional graphics and 3D printing technologies. The authors explore the economic landscape of 2D materials and introduce readers to fundamental properties and production technologies. They

also discuss major graphics printing technologies and conventional commercial printing processes that can be used for printing 2D material inks, as well as their specific strengths and weaknesses as manufacturing platforms. Special attention is also paid to scalable production methods for ink formulation, making this an ideal book for students and researchers in academia or industry, who work with functional graphene and other 2D material ink systems and their applications. Explains the state-of-the-art 2D material production technologies that can be manufactured at the industrial scale for functional ink formulation; Provides starting formulation examples of 2D material, functional inks for specific printing methods and their characterization techniques; Reviews existing demonstrations of applications

related to printed 2D materials and provides possible future development directions while highlighting current knowledge gaps; Gives a snapshot and forecast of the commercial market for printed GRMs based on the current state of technologies and existing patents.

This thesis focuses on the transport and magneto-transport properties of graphene p-n-p junctions, such as the pronounced quantum Hall effect, a well-defined plateau–plateau transition point, and scaling behavior. In addition, it demonstrates persistent photoconductivity (PPC) in the monolayer MoS_2 devices, an effect that can be attributed to random localized potential fluctuations in the devices. Further, it studies scaling behavior at zeroth Landau level and high performance of fractional values of quantum

Hall plateaus in these graphene p-n-p devices. Moreover, it demonstrates a unique and efficient means of controlling the PPC effect in monolayer MoS2. This PPC effect may offer novel functionalities for MoS2-based optoelectronic applications in the future.

Intelligent system is an advanced machine that can perceive, learn, and solve the problems with a great accuracy. Technologies with intelligent system are currently available in the market and used in real-world applications, i.e., self-driving cars, Siri, Alexa, Facebook, and so on. To exceed human cognitive capabilities, the important keys rely on the development of sensors and algorithms. Therefore, the insight into artificial intelligence (AI) methods becomes a fundamental building block for design and construction of

intelligent system with particular applications. This book aims to describe the AI systems ranging from the basic knowledge, i.e., algorithm and mathematical models of AI techniques, fundamentals of machine learning, genetic algorithm, and fuzzy logic, to the current state-of-the-art applications, such as smart road and biomedical applications.

2D Materials for Infrared and Terahertz Detectors

Physics and Devices of Atomically Thin Materials

Physics and Applications

2D Materials for Nanoelectronics

Developments, Devices, and Applications

Quantum Confined Excitons in 2-Dimensional Materials

2D Materials for Photonic and Optoelectronic Applications

Properties and Devices

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

This book presents the first established experimental results of an emergent field:

2-dimensional materials as platforms for quantum technologies, specifically through the optics of quantum-confined excitons. It also provides an extensive review of the literature from a number of disciplines that informed the research, and introduces the materials of focus – 2d Transition Metal Dichalcogenides (2d-TMDs) – in detail, discussing electronic and chemical structure, excitonic behaviour and response to strain. This is followed by a brief overview of quantum information technologies, including concepts such as single-photon sources and quantum networks.

The methods chapter addresses quantum optics techniques and 2d-material processing, while the results section shows the development of a method to deterministically create quantum dots (QDs) in the 2d-TMDs, which can trap single-excitons; the fabrication of atomically thin quantum light-emitting diodes to induce all-electrical single-photon emission from the QDs, and lastly, the use of devices to controllably trap single-spins in the QDs –the first step towards their use as optically-addressable matter qubits.

This concise book offers an essential introduction

and reference guide for the many newcomers to the field of physics of elemental 2D materials. Silicene and related materials are currently among the most actively studied materials, especially following the first experimental synthesis on substrates in 2012. Accordingly, this primer introduces and reviews the most crucial developments regarding silicene from both theoretical and experimental perspectives. At the same time the reader is guided through the extensive body of relevant foundational literature. The text starts with a brief history of silicene,

followed by a comparison of the bonding nature in silicon versus carbon atoms. Here, a simple but robust framework is established to help the reader follow the concepts presented throughout the book. The book then presents the atomic and electronic structure of free-standing silicene, followed by an account of the experimental realization of silicene on substrates. This topic is subsequently developed further to discuss various reconstructions that silicene acquires due to interactions with the substrate and how such effects are mirrored in the electronic properties. Next the book examines the

dumbbell structure that is the key to understanding the growth mechanism and atomic structure of multilayer silicene. Last but not least, it addresses similar effects in other elemental 2D materials from group IV (germanene, stanane), group V (phosphorene) and group III (borophene), as well as transition metal dichalcogenides and other compositions, so as to provide a general comparative overview of their electronic properties. Two-dimensional (2D) materials have attracted tremendous interest since the study of graphene in the early 21st century. With their thickness in the

angstrom-to-nanometer range, 2D materials, including graphene, transition metal dichalcogenides, phosphorene, silicene, and other inorganic and organic materials, can be an ideal platform to study fundamental many-body interactions because of reduced screening and can also be further engineered for nanophotonic applications. This book compiles research outcomes of leading groups in the field of 2D materials for nanophotonic physics and devices. It describes research advances of 2D materials for various nanophotonic applications, including

ultrafast lasers, atomically thin optical lenses, and gratings to inelastically manipulate light propagation, their integrations with photonic nanostructures, and light–matter interactions. The book focuses on actual applications, while digging into the physics underneath. It targets advanced undergraduate- and graduate-level students of nanotechnology and researchers in nanotechnology, physics, and chemistry, especially those with an interest in 2D materials.

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. 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 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

Preparation and Properties of 2D Materials
2D Materials
Electrical and Optoelectronic Properties of the Nanodevices Composed of Two-Dimensional Materials
Synthesis, Properties and Applications
Printing of Graphene and Related 2D Materials
Two-dimensional Materials for Photodetector
Graphene and Molybdenum (IV) Disulfide
2d Inorganic Materials Beyond Graphene
Synthesis, Properties, and Applications

This book brings together innovative methodologies and

strategies adopted in the research and developments of Advanced 2D Materials. Well-known worldwide researchers deliberate subjects on (1) Synthesis, characterizations, modeling and properties, (2) State-of-the-art design and (3) innovative uses of 2D materials including: Two-dimensional layered gallium selenide Synthesis of 2D boron nitride nanosheets The effects of substrates on 2-D crystals Electrical conductivity and reflectivity of models of some 2D materials Graphene derivatives in semicrystalline polymer composites Graphene oxide based multifunctional composites Covalent and non-covalent polymer grafting of graphene oxide Graphene-semiconductor hybrid photocatalysts for

solar fuels Graphene based sensors Graphene composites from bench to clinic Photocatalytic ZnO-graphene hybrids Hydroxyapatite-graphene bioceramics in orthopaedic applications

2D and Quasi-2D Composite and Nanocomposite Materials: Theory, Properties and Photonic Applications covers the theory, characterization and computational modeling of 2D composite materials and shows how they are used for the creation of materials for 3D structures The book covers three major themes: Properties of 2D and quasi-2D composites are discussed in the context of homogenization theory. Homogenization results are discussed for spatiotemporal material composites

assembled from materials which are distributed on a micro-scale in space and in time. New types of transport phenomena and localization in random media are addressed, with particular attention to the non-reciprocity of transport coefficients. Plasmonics and magneto-optics are also of particular interest. Magneto-transport and sub-wavelength resolution in electromagnetic and acoustic imaging are further considered. This book is an important resource for materials scientists and engineers working on nanomaterials, photonic composites, and materials theory, modeling and simulations. Outlines major modelling techniques of 2D nanocomposites for photonic applications Explores how the properties of 2D

nanocomposites make them suitable for use for building 3D structures Assesses the challenges of using 2D nanocomposites for designing new devices on a mass scale

Atomic thin two-dimensional (2D) materials are the thinnest forms of materials to ever occur in nature and have the potential to dramatically alter and revolutionize our material world. Some of the unique properties of these materials including wide photoresponse wavelength, passivated surfaces, strong interaction with incident light, and high mobility have created tremendous interest in photodetector application. This book provides a comprehensive state-of-the-art knowledge about

photodetector technology in the range visible to infrared region using various 2D materials including graphene, transition metal dichalcogenides, III-V semiconductor, and so on. It consists of 10 chapters contributed by a team of experts in this exciting field. We believe that this book will provide new opportunities and guidance for the development of next-generation 2D photodetector.
2D Materials for Infrared and Terahertz Detectors provides an overview of the performance of emerging detector materials, while also offering, for the first time, a comparison with traditional materials used in the fabrication of infrared and terahertz detectors. Since the discovery of graphene, its applications to electronic and

optoelectronic devices have been intensively researched. The extraordinary electronic and optical properties allow graphene and other 2D materials to be promising candidates for infrared (IR) and terahertz (THz) photodetectors, and yet it appears that the development of new detectors using these materials is still secondary to those using traditional materials. This book explores this phenomenon, as well as the advantages and disadvantages of using 2D materials. Special attention is directed toward the identification of the most-effective hybrid 2D materials in infrared and terahertz detectors, as well as future trends. Written by one of the world's leading researchers in the field of IR

optoelectronics, this book will be a must-read for researchers and graduate students in photodetectors and related fields. Features • Offers a comprehensive overview of the different types of 2D materials used in fabrication of IR and THz detectors, and includes their advantages/disadvantages • The first book to compare new detectors to a wide family of common, commercially available detectors that use traditional materials.
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.

Emerging 2D Materials and Devices for the Internet of Things: Information, Sensing and Energy Applications summarizes state-of-the-art technologies in applying 2D

layered materials, discusses energy and sensing device applications as essential infrastructure solutions, and explores designs that will make internet-of-things devices faster, more reliable and more accessible for the creation of mass-market products. The book focuses on information, energy and sensing applications, showing how different types of 2D materials are being used to create a new generation of products and devices that harness the capabilities of wireless technology in an eco-efficient, reliable way. This book is an important resource for both materials scientists and engineers, who are designing new wireless products in a variety of industry sectors. Explores how 2D materials are being used to

create faster and more reliable wireless network solutions Discusses how graphene-based nanocomposites are being used for energy harvesting and storage applications Outlines the major challenges for integrating 2D materials in electronic sensing devices 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
Integration of 2D Materials for Electronics Applications
Two-Dimensional Materials in Nanophotonics
Advanced 2D Materials
Proceedings of 2nd World Congress and Expo on Graphene & 2D Materials 2017
2D Semiconductor Materials and Devices
2D Nanoscale Heterostructured Materials
Emerging 2D Materials and Devices for the Internet of Things
Journal of Nanomaterials and Molecular Nanotechnology1433 rd Conference : Volume 6
2D Nanoelectronics

Since the great success of graphene, atomically thin-layered nanomaterials, called two dimensional (2D) materials, have attracted tremendous attention due to their extraordinary physical properties. Specifically, van der Waals heterostructured architectures based on a few 2D materials, named atomic-scale Lego, have been proposed as unprecedented platforms for the implementation of versatile devices with a completely novel function or extremely high-performance, shifting the research paradigm in materials science and engineering. Thus, diverse 2D materials beyond existing bulk materials have

been widely studied for promising electronic, optoelectronic, mechanical, and thermoelectric applications. Especially, this Special Issue included the recent advances in the unique preparation methods such as exfoliation-based synthesis and vacuum-based deposition of diverse 2D materials and also their device applications based on interesting physical properties. Specifically, this Editorial consists of the following two parts: Preparation methods of 2D materials and Properties of 2D materials 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

2D MaterialsProperties and DevicesCambridge University Press

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
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 Ever since the discovery of graphene, two-dimensional layered materials (2DLMs) have

been the central tool of the materials research community. The reason behind their importance is their superlative and unique electronic, optical, physical, chemical and mechanical properties in layered form rather than in bulk form. The 2DLMs have been applied to electronics, catalysis, energy, environment, and biomedical applications. The following topics are discussed in the book's fifteen chapters: • The research status of the 2D metal-organic frameworks and the different techniques used to synthesize them. • 2D black phosphorus (BP) and its practical application in various fields. •

Reviews the synthesis methods of MXenes and provides a detailed discussion of their structural characterization and physical, electrochemical and optical properties, as well as applications in catalysis, energy storage, environmental management, biomedicine, and gas sensing. • The carbon-based materials and their potential applications via the photocatalytic process using visible light irradiation. • 2D materials like graphene, TMDCs, few-layer phosphorene, MXene in layered form and their heterostructures. • The structure and applications of 2D perovskites. • The physical

parameters of pristine layered materials, ZnO, transition metal dichalcogenides, and heterostructures of layered materials are discussed. • The coupling of graphitic carbon nitride with various metal sulfides and oxides to form efficient heterojunction for water purification. • The structural features, synthetic methods, properties, and different applications and properties of 2D zeolites. • The methods for synthesizing 2D hollow nanostructures are featured and their structural aspects and potential in medical and non-medical applications. • The characteristics and structural

aspects of 2D layered double hydroxides (LDHs) and the various synthesis methods and role of LDH in non-medical applications as adsorbent, sensor, catalyst, etc. • The synthesis of graphene-based 2D layered materials synthesized by using top-down and bottom-up approaches where the main emphasis is on the hot-filament thermal chemical vapor deposition (HFTCVD) method. • The different properties of 2D h-BN and borophene and the various methods being used for the synthesis of 2D h-BN, along with their growth mechanism and transfer techniques. • The physical properties and current progress of

various transition metal dichalcogenides (TMDC) based on photoactive materials for photoelectrochemical (PEC) hydrogen evolution reaction. • The state-of-the-art of 2D layered materials and associated devices, such as electronic, biosensing, optoelectronic, and energy storage applications.

2D and Quasi-2D Composite and Nanocomposite Materials

Introduction to the Physics of Silicene and other 2D Materials

Spintronic 2D Materials

Synthesis, Modelling and Characterization of 2D

Materials and their Heterostructures
Fundamentals and Supercapacitor Applications of 2D Materials
2D Materials for Nanophotonics
Layered 2D Materials and Their Allied Applications
Fundamentals and Applications