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Catalyst Immobilization

TANIYA MOHAMMED

Heterogeneous Catalysts Springer This book describes the design, synthesis, characterization and applications of porous organic frameworks (POFs). Special emphasis is placed on the utilization of porous materials for CO2 capture and CH4 and H2 storage, which have promising potential for addressing the issues of environmental degradation and climate change. It also includes two chapters introducing the properties of POFs and defining the principles of synthesis, as well as a chapter dealing with post-modified POFs. This book is intended for those readers who are interested in porous materials and their applications. Guangshan Zhu is a professor at the College of Chemistry, Jilin University, China.

Metal-Organic Framework Materials MDPI Presents state-of-the-art knowledge of heterogeneous catalysts including new applications in energy and environmental fields This book focuses on emerging techniques in heterogeneous catalysis, from new methodology for catalysts design and synthesis, surface studies and operando spectroscopies, ab initio techniques, to critical catalytic systems as relevant to energy and the environment. It provides the vision of addressing the foreseeable knowledge gap unfilled by classical knowledge in the field. Heterogeneous Catalysts: Advanced Design, Characterization and Applications begins with an overview on the evolution in catalysts synthesis and introduces readers to facets engineering on catalysts; electrochemical synthesis of nanostructured catalytic thin films; and bandgap engineering of semiconductor photocatalysts. Next, it examines how we are gaining a more precise understanding of catalytic events and materials under working conditions. It covers bridging pressure gap in surface catalytic studies; tomography in catalysts design; and resolving catalyst performance at nanoscale via fluorescence microscopy. Quantum approaches to predicting molecular reactions on catalytic surfaces follows that, along with chapters on Density Functional Theory in heterogeneous catalysis; first principles simulation of electrified interfaces in electrochemistry; and high-throughput computational design of novel catalytic materials. The book also discusses embracing the energy and environmental challenges of the 21st century through heterogeneous catalysis and much more. Presents recent developments in heterogeneous catalysis with emphasis on new fundamentals and emerging techniques Offers a comprehensive look at the important aspects of heterogeneous catalysis Provides an applications-oriented, bottoms-up approach to a high-interest subject that plays a vital role in industry and is widely applied in areas related to energy and environment Heterogeneous Catalysts: Advanced Design, Characterization and Applications is an important book for catalytic chemists, materials scientists, surface chemists, physical chemists, inorganic chemists, chemical engineers, and other professionals working in the

chemical industry.

Molecule-Based Materials Elsevier
This unique compendium describes research progress on metal-organic framework (MOF) membranes for different relevant industrial gas separations. Specifically, the book focuses mainly on gas separations which are important in flue gas treatment, natural gas purification, hydrogen purification, and nuclear reprocessing. The advantages of using MOFs in mixed matrix membranes are discussed. Some of the pressing challenges in the field, and strategies to potentially overcome them are also distinctly outlined.This volume is a useful reference materials for professionals, academics, researchers and postgraduate students in chemical engineering and materials engineering.

Metal-Organic Frameworks Elsevier
Because of their nanoporous structures and ultra-high surface areas Metal-Organic Framework Composites (MOFs) are very interesting materials. The book focusses on the following applications: gas capture and storage, especially molecular hydrogen storage; performance enhancement of Li-ion batteries; gas separation, nano-filtration, ionic sieving, water treatment, and catalysis; sustainable renewable energy resources, electrochemical capacitors, including supercapacitors, asymmetric supercapacitors and hybrid supercapacitors; biomedical disciplines including drug delivery, theranostics; biological detection and imaging; nanoparticle photosensitizers for photodynamic therapy (PDT) and photothermal therapy (PTT). Keywords: MOF Materials, Hydrogen Storage, Renewable Energy Applications, Lithium Batteries, MOF-Quantum Dots, Clean Energy, Nanoporous MOFs, Supercapacitors, Therapeutic Applications, Biosensing, Bioimaging, Phototherapy of Cancer, Gas Separation, Nano-filtration, Ionic Sieving, Water Treatment, Drug Delivery, Theranostics; Nanoparticle Photosensitizers, Photodynamic Therapy (PDT), Photothermal Therapy (PTT).

Metal-Organic Frameworks Springer
With an unprecedented population boom and rapid industrial development, environmental pollution has become a severe problem for the ecosystem and public health. Classical techniques for sensing and determining environmental contaminants often require complex pretreatments, expensive equipment, and longer testing times. Therefore, new, and state-of-the-art sensing technologies possessing the advantages of excellent sensitivity, rapid detection, ease of use, and suitability for in situ, real-time, and continuous monitoring of environmental pollutants, are highly desirable. Metal-Organic Frameworks-based Hybrid Materials for Environmental Sensing and Monitoring covers the current-state-of-the-art hybrid nanomaterials based on metal-organic frameworks for electrochemical monitoring purposes. Accomplished authors cover various synthetic routes, methods, and theories behind enhancing the electrochemical properties and applications of metal-organic frameworks-based hybrid nanomaterials for electrochemical sensing of environmental pollutants under one roof. This book is essential reading for all academic and industrial researchers working in the fields of materials science and nanotechnology.

Functional Metal-Organic Frameworks Elsevier
This thesis systematically introduces readers to a new metal-organic

framework approach to fabricating nanostructured materials for electrochemical applications. Based on the metal-organic framework (MOF) approach, it also demonstrates the latest ideas on how to create optimal MOF and MOF-derived nanomaterials for electrochemical reactions under controlled conditions. The thesis offers a valuable resource for researchers who want to understand electrochemical reactions at nanoscale and optimize materials from rational design to achieve enhanced electrochemical performance. It also serves as a useful reference guide to fundamental research on advanced electrochemical energy storage materials and the synthesis of nanostructured materials.

The Chemistry of Metal-Organic Frameworks Springer Science & Business Media

Metal-organic frameworks represent a new class of materials that may solve the hydrogen storage problem associated with hydrogen-fueled vehicles. In this first definitive guide to metal-organic framework chemistry, author L. MacGillivray addresses state-of-art developments in this promising technology for alternative fuels. Providing professors, graduate and undergraduate students, structural chemists, physical chemists, and chemical engineers with a historical perspective, as well as the most up-to-date developments by leading experts, Metal-Organic Frameworks examines structure, symmetry, supramolecular chemistry, surface engineering, metal-organometallic frameworks, properties, and reactions.

Metal-Organic Frameworks for Chemical Reactions Wiley

Metal Oxides in Supercapacitors addresses the fundamentals of metal oxide-based supercapacitors and provides an overview of recent advancements in this area. Metal oxides attract most of the materials scientists use due to their excellent physico-chemical properties and stability in electrochemical systems. This justification for the usage of metal oxides as electrode materials in supercapacitors is their potential to attain high capacitance at low cost. After providing the principles, the heart of the book discusses recent advances, including: binary metal oxides-based supercapacitors, nanotechnology, ternary metal oxides, polyoxometalates and hybrids. Moreover, the factors affecting the charge storage mechanism of metal oxides are explored in detail. The electrolytes, which are the soul of supercapacitors and a mostly ignored character of investigations, are also exposed in depth, as is the fabrication and design of supercapacitors and their merits and demerits. Lastly, the market status of supercapacitors and a discussion pointing out the future scope and directions of next generation metal oxides based supercapacitors is explored, making this a comprehensive book on the latest, cutting-edge research in the field. - Explores the most recent advances made in metal oxides in supercapacitors - Discusses cutting-edge nanotechnology for supercapacitors - Includes fundamental properties of metal oxides in supercapacitors that can be used to guide and promote technology development - Contains contributions from leading international scientists active in supercapacitor research and manufacturing

Metal-Organic Frameworks John Wiley & Sons

This book examines the latest research and discovery in the use of MOFs in

catalysis, highlighting the extent to which these materials have been embraced by the community.

Porous Organic Frameworks IGI Global

Metal–organic frameworks are among the most promising novel materials. The concept of MOFs was first introduced in 1990. They were actually initially used in catalysis, gas separation, membranes, electrochemical sensors. Later on, they were introduced as SPE sorbents for PAHs (Polycyclic Aromatic Hydrocarbons) in environmental water samples, then the range expanded to the field of analytical chemistry, both in chromatographic separation and sample preparation, with great success in, e.g., SPE and SPME (Solid Phase Mico-extraction). Since then, the number of analytical applications implementing MOFs as sorbents in sorptive sample preparation approaches is increasing. This is reinforced by the fact that, at least theoretically, an infinite number of structures can be designed and synthesized, thus making tuneability one of the most unique characteristics of MOF materials. Moreover, they have been designed in various shapes, such as columns, fibers, and films, so that they can meet more analytical challenges with improved analytical features.Their exceptional properties attracted the interest of analytical chemists who have taken advantage of the unique structures and properties and have already introduced them in several sample pretreatment techniques, such as solid phase extraction, dispersive SPE, magnetic solid phase extraction, solid phase microextraction, stir bar sorptive extraction, etc.

Introduction to Reticular Chemistry Materials Research Forum LLC

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.

Engineering Solutions for CO2 Conversion CRC Press

A comprehensive guide that offers a review of the current technologies that tackle CO2 emissions The race to reduce CO2 emissions continues to be an urgent global challenge. "Engineering Solutions for CO2 Conversion" offers a thorough guide to the most current technologies designed to mitigate CO2 emissions ranging from CO2 capture to CO2 utilization approaches. With contributions from an international panel representing a wide range of expertise, this book contains a multidisciplinary toolkit that covers the myriad aspects of CO2 conversion strategies. Comprehensive in scope, it explores the chemical, physical, engineering and economical facets of CO2 conversion. "Engineering Solutions for CO2 Conversion" explores a broad range of topics including linking CFD and process simulations, membranes technologies for efficient CO2 capture-conversion, biogas sweetening technologies, plasma-assisted conversion of CO2, and much more. This important resource: * Addresses a pressing concern of global environmental damage, caused by the greenhouse gases emissions from fossil fuels * Contains a review of the most current developments on the various aspects of CO2 capture and utilization strategies * Incldues information on chemical, physical, engineering and economical facets of CO2 capture and utilization * Offers in-depth insight into materials design, processing characterization, and computer modeling with respect to CO2 capture and conversion Written for catalytic chemists, electrochemists, process engineers, chemical engineers, chemists in industry, photochemists, environmental chemists, theoretical chemists, environmental officers, "Engineering Solutions for CO2 Conversion" provides the most current and expert information on the many aspects and challenges of CO2 conversion.

Fabrication of Metal–Organic Framework Derived Nanomaterials and Their Electrochemical Applications CRC Press

Metal-Organic Framework Nanocomposites: From Design to Application assembles the latest advances in MOF nanocomposites, emphasizing their design, characterization, manufacturing, and application and offering a wide-ranging view of these materials with exceptional physical and chemical properties. FEATURES Discusses various types of

MOF materials, such as polyaniline MOF nanocomposites, magnetic MOF nanocomposites, and carbon nanotube-based MOF nanocomposites Includes chapters on the usage of these materials in pollutant removal, electrochemical devices, photocatalysts, biomedical applications, and other applications Covers different aspects of composite fabrication from energy storage and catalysts, including preparation, design, and characterization techniques Emphasizes the latest technology in the field of manufacturing and design Aimed at researchers, academics, and advanced students in materials science and engineering, this book offers a comprehensive overview and analysis of these extraordinary materials.

Co-crystals Wiley

Owing to the extensive interest in construction of functional metal organic frameworks (FMOFs), this book discusses the roles of functional groups on the structure and application of metal organic frameworks (MOFs). The contents of the book are classified based on the structural and chemical properties of organic functions, in order to make readers able to compare the different effects of each function on the structure and application of the MOFs. In each chapter, the chemical properties of applied functional groups are gathered to give deeper insight into the roles of organic functions in the structure and application of MOFs. In the function-application properties, the authors discuss how a functional group can dominate the host-guest chemistry of the MOFs and how this host-guest chemistry can expand the effectiveness and efficiency of the material in different fields of applications. Finally, function-structure properties are discussed. In function-application properties, it is discussed how a functional group can affect the topology, porosity, flexibility and stability of the framework. The features of this subject are novel and are presented for the first time.

Metal-Organic Framework Royal Society of Chemistry

This book describes the fundamental concepts, the latest developments and the outlook of the field of nanozymes (i.e., the catalytic nanomaterials with enzymatic characteristics). As one of today's most exciting fields, nanozyme research lies at the interface of chemistry, biology, materials science and nanotechnology. Each of the book's six chapters explores advances in nanozymes. Following an introduction to the rise of nanozymes research in the course of research on natural enzymes and artificial enzymes in Chapter 1, Chapters 2 through 5 discuss different nanomaterials used to mimic various natural enzymes, from carbon-based and metal-based nanomaterials to metal oxide-based nanomaterials and other nanomaterials. In each of these chapters, the nanomaterials' enzyme mimetic activities, catalytic mechanisms and key applications are covered. In closing, Chapter 6 addresses the current challenges and outlines further directions for nanozymes. Presenting extensive information on nanozymes and supplemented with a wealth of color illustrations and tables, the book offers an ideal guide for readers from disparate areas, including analytical chemistry, materials science, nanoscience and nanotechnology, biomedical and clinical engineering, environmental science and engineering, green chemistry, and novel catalysis.

Metal-Organic Frameworks John Wiley & Sons

Metal-Organic Frameworks (MOFs) are

crystalline compounds consisting of rigid organic molecules held together and organized by metal ions or clusters. Special interests in these materials arise from the fact that many are highly porous and can be used for storage of small molecules, for example H2 or CO2. Consequently, the materials are ideal candidates for a wide range of applications including gas storage, separation technologies and catalysis. Potential applications include the storage of hydrogen for fuel-cell cars, and the removal and storage of carbon dioxide in sustainable technical processes. MOFs offer the inorganic chemist and materials scientist a wide range of new synthetic possibilities and open the doors to new and exciting basic research. Metal-Organic Frameworks Materials provides a solid basis for the understanding of MOFs and insights into new inorganic materials structures and properties. The volume also reflects progress that has been made in recent years, presenting a wide range of new applications including state-of-the art developments in the promising technology for alternative fuels. The comprehensive volume investigates structures, symmetry, supramolecular chemistry, surface engineering, recognition, properties, and reactions. The content from this book will be added online to the Encyclopedia of Inorganic and Bioinorganic Chemistry: http://www.wileyonlinelibrary.com/ref/eibc

Metal-Organic Frameworks Royal Society of Chemistry

Providing vital knowledge on the design and synthesis of specific metal-organic framework (MOF) classes as well as their properties, this ready reference summarizes the state of the art in chemistry. Divided into four parts, the first begins with a basic introduction to typical cluster units or coordination geometries and provides examples of recent and advanced MOF structures and applications typical for the respective class. Part II covers recent progress in linker chemistries, while special MOF classes and morphology design are described in Part III. The fourth part deals with advanced characterization techniques, such as NMR, in situ studies, and modelling. A final unique feature is the inclusion of data sheets of commercially available MOFs in the appendix, enabling experts and newcomers to the field to select the appropriate MOF for a desired application. A must-have reference for chemists, materials scientists, and engineers in academia and industry working in the field of catalysis, gas and water purification, energy storage, separation, and sensors.

Metal-Organic Framework Composites BoD – Books on Demand

The properties of a material depend not only on the specific atoms and molecules it contains, but also on the arrangement of these in space. Many of these three-dimensional arrangements are described as "3D-nets" or "3D-networks". Molecule-Based Materials: The Structural Network Approach is about the synthesis, description, nomenclature and analysis of such nets and the relation of the nets to the physical properties of the materials. It introduces the mathematics, and includes a short guide to programs useful for retrieving, analysing and naming nets. Complete with illustrations and examples of coordination polymer and hydrogen bonded nets, this unique easy-to-read book examines all aspects of 3D nets and will undeniably prove itself valuable to newcomers, well-seasoned students

and researchers working in crystallography, inorganic or organic chemistry.* Covers all aspects of molecule-based 3D nets, complete with 3D illustrations * Contains summary tables of all nets* Easy reading eliminates the need for background knowledge in crystallography or mathematics

Zeolites and Metal-organic Frameworks World Scientific

Metal–organic frameworks (MOFs) are porous crystalline polymers constructed by metal sites and organic building blocks. Since the discovery of MOFs in the 1990s, they have received tremendous research attention for various applications due to their high surface area, controllable morphology, tunable chemical properties, and multifunctionalities, including MOFs as precursors and self-sacrificing templates for synthesizing metal oxides, heteroatom-doped carbons, metal-atoms encapsulated carbons, and others. Thus, awareness and knowledge about MOFs and their derived nanomaterials with conceptual understanding are essential for the advanced material community. This breakthrough new volume aims to explore down-to-earth applications in fields such as biomedical, environmental, energy, and electronics. This book provides an overview of the structural and fundamental properties, synthesis strategies, and versatile applications of MOFs and their derived nanomaterials. It gives an updated and comprehensive account of the research in the field of MOFs and their derived nanomaterials. Whether as a reference for industry professionals and nanotechnologists or for use in the classroom for graduate and postgraduate students, faculty members, and research and development specialists working in the area of inorganic chemistry, materials science, and chemical engineering, this is a must-have for any library.

Applications of Metal-Organic Frameworks and Their Derived Materials John Wiley & Sons

Flexible metal–organic frameworks (MOFs) are a unique class of porous materials that feature stimuli-responsive flexible structures and dynamic structural transformation behaviours. Exhibiting structural changes in response to physical or chemical stimuli creates related functions that can be developed for practical applications. The specific components and architectures of flexible MOFs are key to their unique properties, so understanding their chemistry is of critical importance for more targeted construction and functional research. This book provides an accessible overview of the historical background of the chemistry of flexible MOFs and their features; in particular, design and synthesis, dynamic structure analysis, flexibility, function and theoretical treatment, and interpretation of the mechanisms as well as their applications. It gives readers a fundamental understanding of this chemistry and will be of great help to young researchers, as well as those already familiar with conventional porous materials in creating new materials.

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