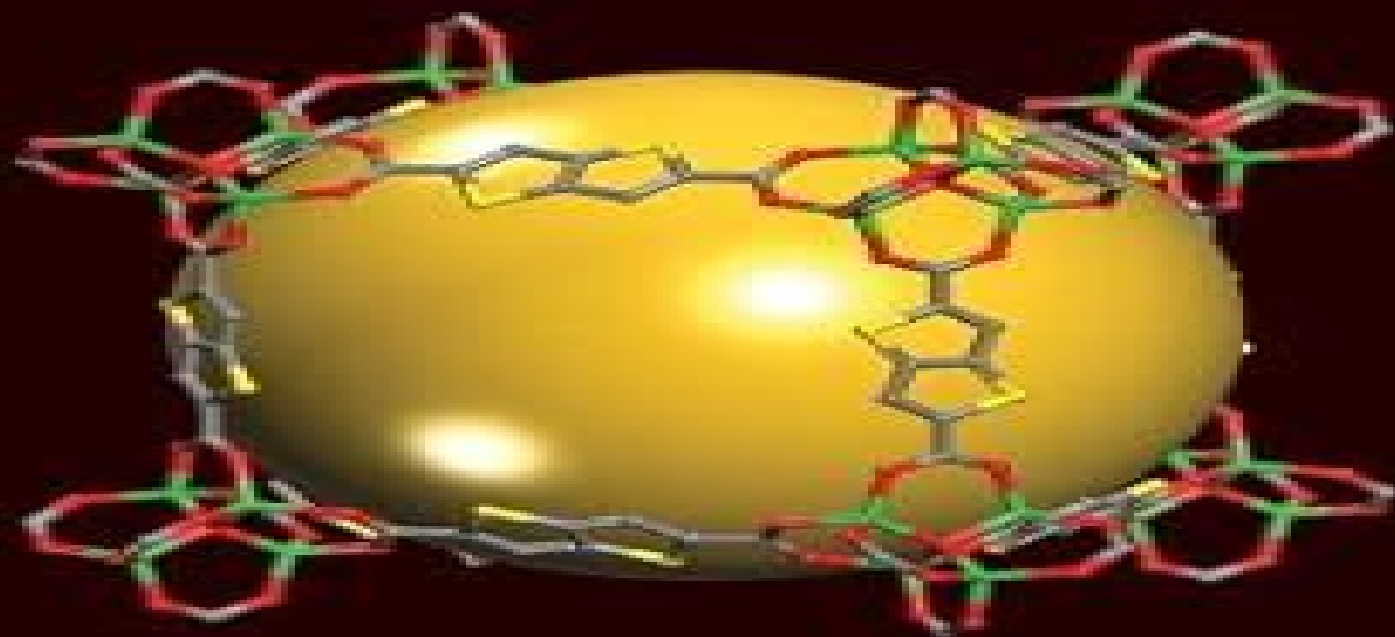


Metal-Organic Frameworks

Design and Application

Edited by Leonard R. MacGillivray



Metal Organic Frameworks Design And Application

Hafezeh Nabipour, Sohrab Rohani



Metal Organic Frameworks Design And Application:

Metal-Organic Frameworks Leonard R. MacGillivray, 2010-12-17 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 Framework Nanocomposites Anish Khan, Mohammad Jawaid, Abdullah Mohammed Ahmed Asiri, Wei Ni, Mohammed Muzibur Rahman, 2020-11-24 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 **Metal-Organic Framework** Xian-He Bu, Michael J. Zaworotko, Zhenjie Zhang, 2020-05-28 The series Topics in Current Chemistry Collections presents critical reviews from the journal Topics in Current Chemistry organized in topical volumes The scope of coverage is all areas of chemical science including the interfaces with related disciplines such as biology medicine and materials science The goal of each thematic volume is to give the non specialist reader whether in academia or industry a comprehensive insight into an area where new research is emerging which is of interest to a larger scientific audience Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed The coverage is not intended to be an exhaustive summary of the field or include large quantities of data but should rather be conceptual concentrating on the methodological thinking that will allow the non specialist reader to understand the information presented Contributions also offer an outlook on potential future developments in the field *Metal Organic Framework Derived Materials* Gomathi Nageswaran, 2024 Metal organic frameworks MOF based materials are used for functional applications due to their large surface area high porosity tunable structure controllable morphology and surface functionality This book explores MOF

derived materials focusing on their structural features synthesis methods unique properties and versatile applications including underlying chemistry It covers research developments in the field for design of novel carbon materials and metal based materials from MOF and their composites including specific applications The book provides a comprehensive idea regarding the fundamental chemistry of Metal Organic Framework MOF derived materials and covers all the aspects of MOF derived materials with focus on derived carbon metal species and composite materials It includes application of MOF derived materials specifically for environmental and energy and conveys a sense of relation between structure property and application of MOF derived materials It also explores developments in the different types of MOF derived materials This book is aimed at senior undergraduate graduate students and researchers in materials science chemical engineering and chemistry

Metal Organic Frameworks Bhawana Jain,Dakeshwar Kumar Verma,Ajaya Kumar Singh,Jai Singh,2024-04-26 Metal Organic Frameworks Fundamentals to Advanced offers a substantial and complete treatment of published results The book includes a summary of current research along with an in depth explanation of Metal organic frameworks MOFs and applications in this versatile area Metal organic frameworks MOFs are structured frameworks made up of metal ions and organic molecules These materials are similar to sponges and can absorb retain and remove molecules from their pores As a result metal organic frameworks MOFs are the most rapidly evolving substances in chemistry with the highest surface areas due to their well ordered pore structure The exciting and vast surface area allows for more chemical reactions and molecule adsorption hence this new resource provides the newest updates on the topics covered Covers the synthetic advantages and versatile applications of metal organic frameworks MOFs due to their organic inorganic hybrid nature and unique porous structure Includes energy applications such as batteries fuel storage fuel cells hydrogen evaluation reactions and super capacitors Features information on using MOFs as a replacement to conventional engineering materials as they are lightweight less costly environmentally friendly and sustainable

The Chemistry of Metal-Organic Frameworks, 2 Volume Set Stefan Kaskel,2016-09-13 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 Frameworks with Heterogeneous Structures Ali Morsali,Kayhaneh Berijani,2021-09-20 METAL ORGANIC FRAMEWORKS

WITH HETEROGENEOUS STRUCTURES A unique book that sheds light on Metal Organic Frameworks complex systems that often display behaviors that surprise and cannot be easily described In this book MOF based heterostructures technology with key characteristics is completely analyzed and the current state of the art is discussed The authors focus on the complex heterostructures promoted by MOFs with advantage of their recent new advances for various applications with particular emphasis on their design As an extension of the design and synthesis the shaping technology of heterostructure MOFs is also of great significance to the future practical applications in industry adsorption desorption gas storage catalysis conductivity optical activity of this class of complex porous materials As this unique book covers all of the aspects of complexity in MOFs with heterogeneous structures it serves as an essential reference to the concepts of introducing complexity to designing the future new platforms of materials with advanced and superior properties This important compact book provides the reader with The principal aspects of heterogeneity that produce complexity in MOFs their effects in the structure chemistry performance and applications The effects of complexities on the structure of metal organic frameworks The roles of complexities on metal organic frameworks applications Explanation of synthesis strategies of the complex heterostructure MOFs Audience This book will be beneficial for chemists materials engineers advanced postgraduate and graduate students researchers and specialists who are working in the area of materials design and their chemistry porous crystalline materials coordination polymers hybrid and functional materials as well as industry professionals such as those working on selective catalysis and adsorption separation optics gas capture processes of biological and pharmaceutical

Metal-Organic Frameworks David Farrusseng, 2011-09-19 An international and interdisciplinary team of leading experts from both academia and industry report on the wide range of hot applications for MOFs discussing both the advantages and limits of the material The resulting overview covers everything from catalysis H₂ and CH₄ storage and gas purification to drug delivery and sensors From the Contents Design of Porous Coordination Polymers Metal Organic Frameworks Past Present and Future Design of Functional Metal Organic Frameworks by Post Synthetic Modification Thermodynamic Methods for Prediction of Gas Separation in Flexible Frameworks Separation and purification of gases by MOFs Opportunities for MOFs in CO₂ capture from flue gases natural gas and syngas by adsorption Manufacture of MOF thin films on structured supports for separation and catalysis Research status of Metal Organic Frameworks for on board cryo adsorptive hydrogen storage applications Separation of xylene isomers Metal Organic Frameworks as Catalysts for Organic Reactions Biomedical applications of Metal Organic Frameworks Metal Organic Frameworks for Biomedical Imaging Luminescent Metal Organic Frameworks Deposition of thin films for sensor applications Industrial MOF Synthesis MOF shaping and immobilisation A must have for every scientist in the field

Metal-Organic Framework Derived Materials Gomathi Nageswaran, Varsha M V, Arun Kumar Rajasekaran, M Shashank Rao, 2024-12-13 Metal organic frameworks MOF based materials are used for functional applications due to their large surface area high porosity tunable structure controllable morphology and surface

functionality This book explores MOF derived materials focusing on their structural features synthesis methods unique properties and versatile applications including underlying chemistry It covers research developments in the field for design of novel carbon materials and metal based materials from MOF and their composites including specific applications Features Provides a comprehensive idea regarding the fundamental chemistry of MOF derived materials Covers all the aspects of MOF derived materials with focus on derived carbon metal species and composite materials Includes application of MOF derived materials specifically for environmental and energy Conveys a sense of relation between structure property and application of MOF derived materials Explores developments in the different types of MOF derived materials This book is aimed at senior undergraduate graduate students and researchers in materials science chemical engineering and chemistry *Porous Organic Frameworks* Guangshan Zhu,Hao Ren,2014-11-28 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

Emerging Applications and Implementations of Metal-Organic Frameworks Elsaed, Shima Mohamed,Zaki, Elsayed,Abdel-Azim, Abdel-Azim,2021-03-18 Metal organic frameworks MOFs are some of the most discussed materials of the last decade Their extraordinary porosity and functionality from metals and organic linkers make them one of the most promising materials for a vast array of applications The easy tunability of their pore size and shape from the micro to meso scale by changing the connectivity of the inorganic moiety and the nature of the organic linkers makes these materials special Moreover by combining with other suitable materials the properties of MOFs can be improved further for enhanced functionality stability ease of preparation and selectivity of operation *Emerging Applications and Implementations of Metal Organic Frameworks* combines the latest empirical research findings with relevant theoretical frameworks in this area in order to improve the reader s understanding of MOFs and their different applications in areas that include drug delivery heavy metal removal from water and gas storage The design and synthesis of MOFs are also investigated along with the preparation of composites of MOFs While covering applications that include water defluoridation rechargeable batteries and pharmaceutically adapted drug delivery systems the book s target audience is comprised of professionals researchers academicians and students working in the field of physical and polymer chemistry physics engineering science and environmental science **The Chemistry of Metal-organic Frameworks** Stefan Kaskel,2016 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

Applications of Metal-Organic Framework Composites Hafezeh Nabipour, Sohrab Rohani, 2025-06-16 Applications of Metal Organic Framework Composites Exploring the Versatility of MOFs systematically describes the state of the art knowledge and fundamentals of metal organic frameworks synthesis structure and functionalization The book discusses the unique mechanical optical magnetic ferroelectric and electronic behaviors of metal organic frameworks covering various emerging applications across different fields including environmental pollutant removal biomedical applications water desalination packaging supercapacitor and energy storage EMI shielding catalysis gas separation chemical sensing fire retardancy water splitting antibacterial applications and battery technology All applications have been efficiently discussed in specific chapters and in each case the processing of metal organic frameworks composites has also been addressed The book enables readers to keep up with the latest advancements in the field and provides an overview of the current state of the art research Covers the synthesis characterization and functionalization of metal organic framework composites featuring detailed experimental protocols and examples Promotes a critical assessment of the challenges and limitations associated with metal organic framework composites as well as strategies for addressing these issues and optimizing their performance Offers guidance on the most promising directions for future research and development as well as practical information on the processing of metal organic framework composites for various applications

Flexible Metal-Organic Frameworks Susumu Kitagawa, 2024-03-25 This book provides an accessible overview of the historical background of the chemistry of flexible metal organic frameworks MOFs and their features

Metal-Organic Framework Derived Materials Gomathi Nageswaran, Arun Kumar Rajasekaran, Varsha M. V, M. Shashank Rao, 2024 This book explores MOF derived materials focusing on their structural features synthesis methods unique properties and versatile applications including underlying chemistry It covers research developments in field for design of novel carbon materials and metal based materials from MOF and their composites including specific applications

Metal-Organic Frameworks for Biomedical Applications Masoud Mozafari, 2020-03-03 Metal Organic Frameworks for Biomedical Applications is a comprehensive authoritative reference that offers a substantial and complete treatment of published results that have yet to be critically reviewed It offers a summary of current research and provides in depth understanding of the role of metal organic frameworks in biomedical engineering The title consists of twenty two chapters

presented by leading international researchers in the field Chapters are arranged by target application in biomedical engineering allowing medical and pharmaceutical specialists to translate current materials and engineering science on metal organic frameworks into their work *From Design to Application* Jinfeng Zhang, 2018 Metal organic frameworks MOFs are a series of porous materials made of wellorganized inorganic metal nodes linked via organic ligands linkers MOFs have gained particular attention due to their applications in gas adsorption and separation selective sorption of harmful chemicals catalysis energy sensing bioscience and electronics The thesis will focus on two different aspects of MOFs Briefly in the first portion of the thesis a less toxic solvent than N N dimethylformamide DMF can be used to make MOFs will be demonstrated In the latter portion of the thesis my efforts to incorporate organic moieties into MOFs for sulfur dioxide sequestration will be described With regard to the use of less toxic solvents it should be noted that with notable exceptions e g mechanochemical water based and electrochemical the synthesis of MOFs is often carried out at elevated temperature using DMF or N N-diethylformamide DEF as the solvent However the industrial scale synthesis of MOFs from DMF DEF may generate significant amounts of DMF waste which can exhibit reprotoxicity and end of life issues associated with the formation of NO_x upon incineration With the introduction of the Registration Evaluation and Authorization of Chemicals REACH legislation in the European Union there is a growing trend towards safer production and use of chemicals by industry As such it is crucial to develop green sustainable methods of synthesizing MOFs Dihydrolevoglucosenone Cyrene a green bioderived solvent from waste cellulose was applied to the synthesis of MOFs The MOF HKUST 1 exhibited a larger Brunauer Emmett Teller BET surface area than HKUST 1 synthesized with DMF Four additional archetypal MOFs were also synthesized to verify the universal application of Cyrene in the synthesis of MOFs However their BET surface areas were lower than DMF made MOFs It was observed that an aldol condensation product of two Cyrene molecules in addition to Cyrene trapped within the pores were responsible for the lower than expected surface areas The use of Cyrene has led to a series of design principles that eliminate the need for problematic solvents such as DMF and can be applied to the synthesis of a wide range of MOFs With regard to sulfur dioxide sequestration it should be noted that sulfur dioxide a colorless gas belonging to SO_x family yields detrimental effects via inhalation or absorption Since MOFs are ideal sorbents for toxic gases in Chapter 3 I will continue along the theme of reprotoxicity and end of life issues by designing MOFs which have the potential to chemically react with sulfur dioxide Unlike the de novo synthetic pathways in the Chapter 2 the Chapter 3 will demonstrate how solvent assisted linker exchange SALE and solvent assisted linker incorporation SALI can be used to make MOFs with the ideal functionalities for sulfur dioxide sequestration In Chapter 3 the main focus of the work was to introduce the butadiene functional groups into different MOFs namely UiO 66 UiO 66 MA muconic acid functionalized UiO 66 MOF 808 MOF 808 BS butadiene sulfone functionalized MOF 808 and MOF 808 BD butadiene functionalized MOF 808 the SALI method was vitalized to determine if the butadiene group could undergo a cheletropic reaction in the presence of sulfur dioxide inside the MOF All MOFs were

exposed to a constant flow of sulfur dioxide the UiO 66 MA was observed to take up three times more sulfur dioxide than the unfunctionalized parent UiO 66 For the MOF 808 series surprisingly the unfunctionalized MOF 808 was able to absorb more than two times the sulfur dioxide than MOF 808 BD and five times higher than MOF 808 BS respectively This suggests that the terminal waters and hydroxide groups are responsible for the enhanced uptake Despite the improved uptake of sulfur dioxide in UiO 66 MA and MOF 808 nuclear magnetic resonance NMR and infrared IR data indicate that no chemical change occurred to the butadiene functionalized group which suggests that a cheletropic reaction did not occur

Metal-Organic Framework Composites Anish Khan, 2019-07-20 Composites based on Metal organic frameworks MOFs have exceptional physical and chemical properties and offer a great number of advanced applications in such fields as energy storage energy conversion by catalysis sensors for environmental applications environment safety and industrial wastewater treatments They also have interesting medical applications such as encapsulation of enzymes The present book covers design synthesis and preparation of various MOFs as well as the resulting product characteristics homogenous morphology small size dispersion high thermal stability and desired surface area

Metal-Organic Frameworks for Chemical Reactions Anish Khan, Francis Verpoort, Abdullah M. Asiri, Md Enamul Hoque, Anwar L. Bilgrami, Mohammad Azam, Kadiyala Chandra Babu Naidu, 2021-01-19 Metal Organic Frameworks for Chemical Reactions From Organic Transformations to Energy Applications brings together the latest information on MOFs materials covering recent technology in the field of manufacturing and design The book covers different aspects of reactions from energy storage and catalysts including preparation design and characterization techniques of MOFs material and applications This comprehensive resource is ideal for researchers and advanced students studying metal organic frameworks in academia and industry Metal organic frameworks MOFs are nanoporous polymers made up of inorganic metal focuses connected by natural ligands These entities have become a hot area of research because of their exceptional physical and chemical properties that make them useful in different fields including medicine energy and the environment Since combination conditions strongly affect the properties of these compounds it is especially important to choose an appropriate synthetic technique that produces a product with homogenous morphology small size dispersion and high thermal stability Covers the synthetic advantages and versatile applications of metal organic frameworks MOFs due to their organic inorganic hybrid nature and unique porous structure Includes energy applications such as batteries fuel storage fuel cells hydrogen evaluation reactions and super capacitors Features information on using MOFs as a replacement to conventional engineering materials because they are lightweight less costly environmentally friendly and sustainable

Metal Organic Frameworks for Energy and Environmental Applications Hongyi Gao, Xiaowei Zhang, 2025-11-25 Metal Organic Frameworks for Energy and Environmental Applications presents a comprehensive overview on the application of metal organic frameworks MOFs to energy and environmental areas MOFs are a promising class of materials due to their tunable structures high surface area and versatile functionalities and are

capturing the attention of the global scientific community due to their intersection with environmental concerns Chapters summarize recent research on MOFS and synthesis strategies for catalysis including photocatalysis electrocatalysis and thermal catalysis and how MOFs offer enhanced performance selectivity and efficiency Additionally the vital role MOFs play in energy storage environmental purification including degradation of harmful agents and resource utilization is explored The book also presents new research on machine learning and data mining including how researchers can leverage datasets and algorithms to discover new high performance MOFs Metal Organic Frameworks for Energy and Environmental Applications will be a valuable reference for those studying and working in the field of MOFs as they apply to energy environmental technologies catalysis and materials science Presents a broad understanding of the diverse applications of MOFs in energy and environment related areas Summarizes recent research on MOFs including synthesis strategies for catalysis energy storage environmental purification etc Introduces machine learning and data mining as techniques to discover high performance MOFs

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