



RSC Catalysis Series

# Atomically-Precise Methods for Synthesis of Solid Catalysts

Edited by Sophie Hermans and Thierry Visart de Bocarmé



# Atomically Precise Methods For Synthesis Of Solid Catalysts Rsc Catalysis Series

**Joshua Gorimbo,Xinying Liu,Yali  
Yao,Diane Hildebrandt**



### **Atomically Precise Methods For Synthesis Of Solid Catalysts Rsc Catalysis Series:**

Atomically-Precise Methods for Synthesis of Solid Catalysts Sophie Hermans,Thierry Visart de Bocarme,2014-10-31

There is much interest in preparing catalysts with specific structures for a desired catalytic activity Although there has been a great amount of research into correlating particles sizes and microstructure to catalytic activity knowledge about practical catalysts still remain ill defined The current challenge is now to understand atomic control Atomically Precise Methods for Synthesis of Solid Catalysts provides an overview of recent developments in heterogeneous catalysts preparation which aim at controlling the microstructure of such catalysts at the atomic scale Each chapter provides a different synthetic approach to achieve atomic scale control along techniques to characterize the atomically precise solids Topics covered include bimetallic supported catalysts from single source precursors zeolite supported molecular metal complex catalyst surface organometallic chemistry atomic layer deposition and electron microscopy of catalysts Edited by active researchers in the area the book aims to bridge the gap between surface science and heterogeneous catalysis The book is suitable for graduate students as well as researchers in academia in industry from various disciplines including engineering inorganic organometallic chemistry surface science and physical chemistry interested in catalyst design *Atomically-Precise Methods for Synthesis of Solid Catalysts* Sophie Hermans,Thierry Visart de Bocarme,2015 With techniques bridging the gap between surface science and heterogeneous catalysis the book presents a tool kit for anyone wishing to prepare and define solid catalysts

Nanostructured Carbon Materials for Catalysis Philippe Serp,Bruno Machado,2015-03-02 We heartily recommend this book to all readers who wish to gain a better understanding of nanostructured carbon materials surface properties and used in catalysis An Hui Lu ChemCatChem There is great interest in using nanostructured carbon materials in catalysis either as supports for immobilizing active species or as metal free catalysts due to their unique structural thermal chemical electronic and mechanical properties and tailorable surface chemistry This book looks at the structure and properties of different doped and undoped nanocarbons including graphene fullerenes nanodiamonds carbon nanotubes and nanofibers their synthesis and modification to produce catalysts Special attention is paid to adsorption as it impacts the application of these materials in various industrially relevant catalytic reactions discussed herein in addition to photocatalysis and electrocatalysis Written by leading experts in the area this is the first book to provide a comprehensive view of the subject for the catalysis community

**Enantioselective Nickel-catalysed Transformations** Hélène Pellissier,2016-03-21 Due to the lower costs of nickel catalysts and the high abundance of nickel complexes enantioselective nickel mediated transformations have received a continuous and growing attention in recent years This book demonstrates the diversity of chemistry catalysed by chiral nickel catalysts Discussing several different enantioselective transformations this book presents the impressive range of uses that have been found for novel and already known nickel chiral catalysts from basic organic transformations to completely novel methodologies including fascinating one pot domino and multicomponent reactions This much needed book is ideal for

researchers and industrialists in organic chemistry synthesis and medicinal chemistry      **N-Heterocyclic Carbenes** Silvia Diez-Gonzalez, 2016-11-04 In less than 20 years N heterocyclic carbenes NHCs have become well established ancillary ligands for the preparation of transition metal based catalysts This is mainly due to the fact that NHCs tend to bind strongly to metal centres avoiding the need of excess ligand in catalytic reactions Also NHC metal complexes are often insensitive to air and moisture and have proven remarkably resistant to oxidation This book showcases the wide variety of applications of NHCs in different chemistry fields beyond being simple phosphine mimics This second edition has been updated throughout and now includes a new chapter on NHC main group element complexes It covers the synthesis of NHC ligands and their corresponding metal complexes as well as their bonding and stereoelectronic properties and applications in catalysis This is complemented by related topics such as organocatalysis and biologically active complexes Written for organic and inorganic chemists this book is ideal for postgraduates researchers and industrialists      *Heterocycles from Double-Functionalized Arenes* Xiao-Feng Wu, Matthias Beller, 2015-02-02 The efficient synthesis of heterocycles has become one of the main branches in organic chemistry due to their use in the synthesis of natural products and pharmaceuticals Current synthetic strategies based on C H activation methodologies are met with many problems like harsh reaction conditions and low reaction efficiency Double functionalized chemicals offer a perfect alternative for the synthesis of heterocycles *Heterocycles from Double Functionalized Arenes* starts with a short discussion on the importance of heterocycles and a brief introduction on the preparation of double functionalized arenes Specific chapters then look at five membered heterocycles synthesis six membered heterocycles synthesis and macroheterocycles synthesis This is the first book dedicated to the topic of transition metal catalyzed coupling reactions of double functionalized arenes in heterocycle synthesis and can be used as a handbook for senior researchers and as an introduction for organic chemistry students      *Asymmetric Functionalization of C-H Bonds* Shu-Li You, 2015-08-13 Asymmetric C H direct functionalization reactions are one of the most active and fascinating areas of research in organic chemistry due to their significance in the construction of molecular complexity without pre activation and the step economy and atom economy features in potential synthetic application Distinguishing the reactivity among numerous C H bonds in one single molecule represents one of the most challenging issues in organic synthesis and requires precise reaction design As such this field is now receiving increasing attention from researchers This book provides the first comprehensive review of this field summarizing the origin mechanism scope and applications of the asymmetric C H bond functionalization reaction It covers organocatalytic reactions and transition metal catalyzed reactions as well as asymmetric C H functionalization reactions not described in other books Written by a leading expert in this field the book is ideal for postgraduates and researchers working in organic synthesis catalysis and organometallic chemistry      *Dienamine Catalysis for Organic Synthesis* Kengadarane Anebuselvy, Dhevalapally B Ramachary, Indresh Kumar, 2018-03-02 In the past decade a new era in asymmetric catalysis has been realised by the discovery of L proline induced chiral enamines from carbonyls

Inspired by this researchers have developed many other primary catalytic species in situ more recently secondary catalytic species such as amins have been identified for use in asymmetric synthesis High yielding asymmetric synthesis of bioactive and natural products through mild catalysis is an efficient approach in reaction engineering In the early days synthetic chemists mainly focused on the synthesis of complex molecules with less attention on the reaction efficiency and eco friendly conditions Recent investigations have been directed towards the development of atom economy eco friendly and enantioselective synthesis for more targeted and efficient synthesis Building on the momentum of this rapidly expanding research area Dienamine Catalysis for Organic Synthesis will provide a comprehensive introduction from the preformed species in situ generation and onto their applications in the synthesis of bioactive molecules and natural products

### **Nanoparticle Design and Characterization for Catalytic Applications in Sustainable Chemistry** Rafael

Luque, Pepijn Prinsen, 2019-05-10 Nanoparticles exhibit a range of different properties when compared to bulk materials Their high surface area to volume ratio makes them particularly attractive for use as catalysts and recent years have seen an explosion of research in this area The ability to fine tune the size and structure of nanoparticles means that it is possible to design catalytic materials for improved activity or specificity As catalysis is one of the key technologies for more sustainable production of both chemicals and energy the past few years have seen increasing numbers of nanomaterials reported for these applications Depending on the application a number of different catalyst synthesis and optimization protocols can be used This book provides comprehensive links between the design and fabrication method for nanoparticles and their catalytic performance activity selectivity and stability in various applications Presenting an introduction to the concept of catalyst design and recent developments in the preparation and characterisation of nanomaterials followed by several chapters on the design of catalysts for specific applications this book is a valuable resource for researchers working on catalytic reactions industrial processes and nanomaterial applications *Chemicals and Fuels from Biomass via Fischer-Tropsch Synthesis*

Joshua Gorimbo, Xinying Liu, Yali Yao, Diane Hildebrandt, 2022-11-18 In an effort to reduce dependency on fossil fuel resources biomass could essentially be converted into chemicals using high capacity processes The Fischer Tropsch Synthesis FTS pathway has been chosen as the focus of this book as it is a mature area and unlike other pathways such as pyrolysis FTS is a potential way of producing fuel hydrocarbons with no sulfur no nitrogen and no heavy metals contamination making it a good choice Integrating technological development and business development rationales to highlight the key technological developments that are necessary to industrialize biofuels on a global scale this book focusses on the key challenges that still hinder the effective biomass use and the realization of zero fossil fuel use Traditional biomass to hydrocarbons pathways are covered showcasing how they are tailored to yield a specific group of chemicals with the aim of reducing downstream processes New developments are considered including process synthesis catalysts and reactors etc Providing an up to date overview of the production of specialty chemicals and fuels from biomass via the Fischer Tropsch Synthesis pathway this title

makes an excellent addition to the libraries of academics and practitioners working in catalysis and chemical engineering

**Advances in Microwave-assisted Heterogeneous Catalysis** Jianli Hu, Benjaram M Reddy, 2023-11-03 Historically the field of heterogeneous catalysis has focused on the design and optimisation of the catalytic materials. However, as these optimisations start to reach diminishing returns, attention has turned to non-conventional means for improving reaction conditions, such as the use of ultrasound, plasma, electromagnetic heating, and microwave heating. Microwave-assisted catalysis has been demonstrated to be useful in a wide range of applications, including ammonia synthesis, desulfurization, and production of chemicals from biomass. *Advances in Microwave-assisted Heterogeneous Catalysis* begins with the basics of microwave heating and the role of microwaves in heterogeneous catalysis. It goes on to cover the mechanisms of microwave-specific reaction rate enhancement, microwave-assisted synthesis of porous, nonporous, and supported metal catalysts, microwave-augmented reactor technology, and microwave-induced catalysis. The application of microwave-assisted heterogeneous catalysis in various fields of energy conversion, environmental remediation, and bulk and specialty chemicals synthesis are also discussed, making this a great reference for anyone involved in catalysis research. **Asymmetric**

**Autocatalysis** Kenso Soai, Tsuneomi Kawasaki, Arimasa Matsumoto, 2022-10-28 Asymmetric autocatalysis is a reaction in which a chiral compound acts as a chiral catalyst for its own production. The process is a catalytic automultiplication of the chiral compound, leading to an end product with a high enantiomeric excess. It has advantages over non-autocatalytic reactions because the amount of catalyst increases and no loss or deterioration of the catalyst is observed. Additionally, because the catalyst and product have the same structure, the separation of product from the catalyst is not necessary. *Asymmetric Autocatalysis* provides a comprehensive introduction to the topic of autocatalysis and an in-depth review of the current state of the research. Edited by a team including Professor Kenso Soai, who first described these types of reaction, and written by experts from around the world, this book is a great resource for anyone with an interest in organic synthesis, catalysis, and chirality.

**Advances in Photocatalysis, Electrocatalysis and Photoelectrocatalysis for Hydrogen Production** R Geetha Balakrishna, R Shwetharani, Theerthagiri Jayaraman, 2024-12-20 Hydrogen has a lot of promise as an alternative to various carbon-containing fuels, as burning it releases only water, which does not contribute to climate change. However, the standard method of producing hydrogen uses methane as the source, releases carbon dioxide, and requires high temperatures and pressures, meaning it cannot be considered a sustainable process. Photocatalysis, electrocatalysis, and the combining of the two in photoelectrocatalysis offer pathways to producing hydrogen from different starting materials and with lower energy costs, which will be essential to making sustainable hydrogen fuel a reality. *Advances in Photocatalysis, Electrocatalysis and Photoelectrocatalysis for Hydrogen Production* brings together the latest developments in applying these types of catalysis to producing hydrogen. This book is an important resource for anyone working in photo and electrocatalysis or with an interest in routes for green hydrogen.

Computational Catalysis Aravind Asthagiri, Michael Janik, 2024-12-20

First principles based modelling of catalysts is a growing field and the past decade has seen the range of applications for it increase. Improvements in computing power and developments in the areas of machine learning have made many exciting advances possible. The new edition of Computational Catalysis provides an update on the contents of the previous edition whilst introducing new chapters on kinetic Monte Carlo modelling, solvent effects, machine learning for catalyst modelling and design, and modelling complex heterogeneous structures. Written to be accessible to anyone with a familiarity with quantum mechanical methods, this book is a valuable resource for both early career researchers and graduate students.

*Catalysis with Earth-abundant Elements* Uwe Schneider, Stephen Thomas, 2020-10-28 Catalysis remains a key technology in a huge number of industrial processes in the 21st century. The catalytic properties of precious metals such as platinum and palladium are well understood. However, these metals are expensive and their supply is limited. Earth abundant elements such as iron and nickel, as the name suggests, have a plentiful supply and are much cheaper to use, but research on their use in catalysis has historically lagged behind. As researchers and companies increasingly look for ways to reduce costs and improve the sustainability of their processes, there has been a renewed interest in these earth abundant elements. This book presents a detailed overview of current research on the catalytic uses of the most Earth abundant elements. Highlighting the top ten most Earth abundant elements and their various roles in modern synthetic chemistry: s block metals Na, K, Mg, Ca; first row transition metals Ti, Mn, Fe; and p block elements Al, Si, P. The significant stoichiometric use of these elements and their use as acid base dual and/or redox catalysts will be discussed. It will be of use to industrial and academic researchers as well as graduate students with an interest in catalysis and sustainability.

Multi-functional Electrocatalysts Viswanathan S Saji, Vijayamohanan K Pillai, 2024-08-28 Multi functional electrocatalysts are highly unique in that they display features that include the presence of multiple active sites that can simultaneously catalyse two or more different electrochemical reactions. They are particularly crucial for solving several pressing challenges and consequently are a priority in developing contemporary sustainable energy conversion and storage systems such as fuel cells, metal air batteries and electrolyzers for green hydrogen production. This book will serve as a valuable reference for graduate students, researchers and industrial practitioners working on electrochemical energy storage and conversion, electrocatalysis, materials chemistry and green hydrogen technologies.

Organocatalytic Dynamic Kinetic Resolution Hélène Pellissier, 2022-05-06 In a classical kinetic resolution, two enantiomers of a racemate are transformed into chiral products at different rates with a maximum theoretical yield of 50%. However, the need to reduce costs and waste in synthesis have led to efforts to develop novel resolution procedures proceeding beyond this 50% limited yield. This has led to the evolution of classical kinetic resolution into dynamic kinetic resolution (DKR), allowing a quantitative yield of one of the enantiomers. DKR combines the resolution step of kinetic resolution with an in situ racemization of the chirally labile substrate. It is only in the last two decades that chiral green organocatalysts have been demonstrated to be capable of promoting DKRs, considerably expanding the synthetic scope of the

powerful concept of DKR Collecting all the developments in the field of DKR this book shows that a wide variety of organocatalysts allow excellent levels of stereocontrol and yields in many types of transformations It is a great resource for academics and industrialists interested in green enantioselective catalytic reactions *Catalysis* James J Spivey, Yi-Fan Han, Dushyant Shekhawat, 2019-02-13 Catalysts are required for a variety of applications and researchers are increasingly challenged to find cost effective and environmentally benign catalysts to use This volume looks at modern approaches to catalysis and reviews the extensive literature including direct methane conversion nanocomposite catalysts for transformation of biofuels into syngas and hydrogen and catalytic wet air oxidation technology for industrial wastewater treatment Appealing broadly to researchers in academia and industry it will be of great benefit to any researcher wanting a succinct reference on developments in this area now and looking to the future **Noncovalent Interactions in Catalysis** Kamran T Mahmudov, Maximilian N Kopylovich, M Fatima C Guedes da Silva, Armando J L Pombeiro, 2019-03-04 This book provides an overview of the role of different types of noncovalent interactions in both homogeneous and heterogeneous catalysis **Encyclopedia of Interfacial Chemistry**, 2018-03-29 Encyclopedia of Interfacial Chemistry Surface Science and Electrochemistry Seven Volume Set summarizes current fundamental knowledge of interfacial chemistry bringing readers the latest developments in the field As the chemical and physical properties and processes at solid and liquid interfaces are the scientific basis of so many technologies which enhance our lives and create new opportunities its important to highlight how these technologies enable the design and optimization of functional materials for heterogeneous and electro catalysts in food production pollution control energy conversion and storage medical applications requiring biocompatibility drug delivery and more This book provides an interdisciplinary view that lies at the intersection of these fields Presents fundamental knowledge of interfacial chemistry surface science and electrochemistry and provides cutting edge research from academics and practitioners across various fields and global regions



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