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This volume continues the tradition formed in Nanotechnology in Catalysis 1 and 2. As with those books, this one is based upon an ACS symposium. Some of the most illustrious names in heterogeneous catalysis are among the contributors. The book covers: Design, synthesis, and control of catalysts at nanoscale; understanding of catalytic reaction at nanometer scale; characterization of nanomaterials as catalysts; nanoparticle metal or metal oxides catalysts; nanomaterials as catalyst supports; new catalytic applications of nanomaterials.

Catalysis is a central topic in chemical transformation and energy conversion. Thanks to the spectacular achievements of colloidal chemistry and the synthesis of nanomaterials over the last two decades, there have also been significant advances in nanoparticle catalysis. Catalysis on different metal nanostructures with well-

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defined structures and composition has been extensively studied. Metal nanocrystals synthesized with colloidal chemistry exhibit different catalytic performances in contrast to metal nanoparticles prepared with impregnation or deposition precipitation. Additionally, theoretical approaches in predicting catalysis performance and understanding catalytic mechanism on these metal nanocatalysts have made significant progress. Metal Nanoparticles for Catalysis is a comprehensive text on catalysis on Nanoparticles, looking at both their synthesis and applications. Chapter topics include nanoreactor catalysis; Pd nanoparticles in C-C coupling reactions; metal salt-based gold nanocatalysts; theoretical insights into metal nanocatalysts; and nanoparticle mediated clock reaction. This book bridges the gap between nanomaterials synthesis and characterization, and catalysis. As such, this text will be a valuable resource for postgraduate students and researchers in these exciting fields.

This book offers an overview of the recent studies and advances in environmental catalysis by nanomaterials, considering both the fundamental and the technological aspects. It offers contributions in different areas of environmental catalysis, including the catalytic and photocatalytic abatement of environmentally hazardous effluents from stationary or mobile sources, the valorization of waste and the

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production of sustainable energy. In other words, this monograph provides an overview of modern environmental and energy related applications with a particular emphasis to nano-sized catalytic materials. Recent concepts, experimental data and advanced theories are reported in this book to give evidence of the environmental and sustainable applications that can be found in the highly interdisciplinary field of catalysis. Illustrates how environmental catalysis is a promising opportunity for a sustainable development Covers the seminal and most recent studies concerning the environmental catalysis by nanostructured catalysts Presents an overview of both the fundamental and the technological aspects of environmental catalysis .

Discover an essential overview of recent advances and trends in nanoparticle catalysis Catalysis in the presence of metal nanoparticles is an important and rapidly developing research field at the frontier of homogeneous and heterogeneous catalysis. In *Nanoparticles in Catalysis*, accomplished chemists and authors Karine Philippot and Alain Roucoux deliver a comprehensive guide to the key aspects of nanoparticle catalysis, ranging from synthesis, activation methodology, characterization, and theoretical modeling, to application in important catalytic reactions, like hydrogen production

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and biomass conversion. The book offers readers a review of modern and efficient tools for the synthesis of nanoparticles in solution or onto supports. It emphasizes the application of metal nanoparticles in important catalytic reactions and includes chapters on activation methodology and supported nanoclusters. Written by an international team of leading voices in the field, *Nanoparticles in Catalysis* is an indispensable resource for researchers and professionals in academia and industry alike. Readers will also benefit from the inclusion of:

- A thorough introduction to *New Trends in the Design of Metal Nanoparticles and Derived Nanomaterials for Catalysis*
- An exploration of *Dynamic Catalysis and the Interface Between Molecular and Heterogeneous Catalysts*
- A practical discussion of *Metal Nanoparticles in Water: A Relevant Toolbox for Green Catalysis*
- A concise treatment of the opportunities and challenges of *CO<sub>2</sub> Hydrogenation to Oxygenated Chemicals Over Supported Nanoparticle Catalysts*

Perfect for catalytic, organic, inorganic, and physical chemists, *Nanoparticles in Catalysis* will also earn a place in the libraries of chemists working with organometallics and materials scientists seeking a one-stop resource with expert knowledge on the synthesis and characterization of nanoparticle catalysis.

Nanoparticles exhibit a range of different properties when compared to

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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.

This book offers an overview of the recent studies and advances in environmental catalysis by nanomaterials, considering both the fundamental and the technological aspects. It offers contributions in

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different areas of environmental catalysis, including the catalytic and photocatalytic abatement of environmentally hazardous effluents from stationary or mobile sources, the valorization of waste and the production of sustainable energy. In other words, this monograph provides an overview of modern environmental and energy related applications with a particular emphasis to nano-sized catalytic materials. Recent concepts, experimental data and advanced theories are reported in this book to give evidence of the environmental and sustainable applications that can be found in the highly interdisciplinary field of catalysis.

Nanocatalysis has emerged as a field at the interface between homogeneous and heterogeneous catalysis and offers unique solutions to the demanding requirements for catalyst improvement. Heterogeneous catalysis represents one of the oldest commercial applications of nanoscience and nanoparticles of metals, semiconductors, oxides, and other compounds have been widely used for important chemical reactions. The main focus of this field is the development of well-defined catalysts, which may include both metal nanoparticles and a nanomaterial as the support. These nanocatalysts should display the benefits of both homogenous and heterogeneous catalysts, such as high efficiency and selectivity, stability and easy recovery/recycling. The

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concept of nanocatalysis is outlined in this book and, in particular, it provides a comprehensive overview of the science of colloidal nanoparticles. A broad range of topics, from the fundamentals to applications in catalysis, are covered, without excluding micelles, nanoparticles in ionic liquids, dendrimers, nanotubes, and nanooxides, as well as modeling, and the characterization of nanocatalysts, making it an indispensable reference for both researchers at universities and professionals in industry.

Exhibiting both homogeneous and heterogeneous catalytic properties, nanocatalysts allow for rapid and selective chemical transformations, with the benefits of excellent product yield and ease of catalyst separation and recovery. This book reviews the catalytic performance and the synthesis and characterization of nanocatalysts, examining the current state of the art and pointing the way towards new avenues of research. Moreover, the authors discuss new and emerging applications of nanocatalysts and nanocatalysis, from pharmaceuticals to fine chemicals to renewable energy to biotransformations. Nanocatalysis features contributions from leading research groups around the world. These contributions reflect a thorough review of the current literature as well as the authors' first-hand experience designing and

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synthesizing nanocatalysts and developing new applications for them. The book's nineteen chapters offer a broad perspective, covering:

- Nanocatalysis for carbon-carbon and carbon-heteroatom coupling reactions
- Nanocatalysis for various organic transformations in fine chemical synthesis
- Nanocatalysis for oxidation, hydrogenation, and other related reactions
- Nanomaterial-based photocatalysis and biocatalysis
- Nanocatalysts to produce non-conventional energy such as hydrogen and biofuels
- Nanocatalysts and nano-biocatalysts in the chemical industry

Readers will also learn about the latest spectroscopic and microscopy tools used in advanced characterization methods that shed new light on nanocatalysts and nanocatalysis. Moreover, the authors offer expert advice to help readers develop strategies to improve catalytic performance. Summarizing and reviewing all the most important advances in nanocatalysis over the last two decades, this book explains the many advantages of nanocatalysts over conventional homogeneous and heterogeneous catalysts, providing the information and guidance needed for designing green, sustainable catalytic processes.

This text focuses on the synthesis, properties and applications of nanostructures and nanomaterials, particularly inorganic nanomaterials. It provides coverage of the fundamentals and processing

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techniques with regard to synthesis, properties, characterization and applications of nanostructures and nanomaterials.

This issue contains 17 peer-reviewed (invited and contributed) papers covering various aspects and the latest developments related to processing, modeling and manufacturing technologies of nanoscaled materials including inorganic-organic nanocomposites, nanowire-based sensors, new generation photovoltaic cells, self-assembly of nanostructures, functional nanostructures for cell tracking and heterostructures. Each manuscript was peer-reviewed using The American Ceramic Society review process.

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