

## Introduction To Surface Chemistry Catalysis

A treatment of the important aspects of physical chemistry on metal surfaces, including selective oxidation, desulfurization, cyclization, metal-organic chemical vapor deposition, alkane activation and hydrogen dissociation dynamics. Case studies focus on on the chemistry of selected systems, rather than the techniques, to convey the excitement of recent developments.

Catalysis, Green Chemistry and Sustainable Energy: New Technologies for Novel Business Opportunities offers new possibilities for businesses who want to address the current global transition period to adopt low carbon and sustainable energy production. This comprehensive source provides an integrated view of new possibilities within catalysis and green chemistry in an economic context, showing how these potential new technologies may become useful to business. Fundamentals and specific examples are included to guide the transformation of idea to innovation and business. Offering an overview of the new possibilities for creating business in catalysis, energy and green chemistry, this book is a beneficial tool for students, researchers and academics in chemical and biochemical engineering. Discusses new developments in catalysis, energy and green chemistry from the perspective of converting ideas to innovation and business Presents case histories, preparation of business plans, patent protection and IP rights, creation of start-ups, research funds and successful written proposals Offers an interdisciplinary approach combining science and business The features of this book which will be of special interest to academic organic chemists are the introduction (Chapter 1), which presents a short course on the concepts and language of heterogeneous catalysis, covers organic reaction mechanisms of hydrogenation (Chapter 2), hydrogenolysis (Chapter 4), and oxidation (Chapter 6), a presents problems and solutions specific for running heterogeneous catalytic organic reactions in solution. These materials can supplement advanced chemistry courses. Most synthetic organic chemists use a variety of "protecting groups" which they attach to functional groups (reactive groups of atoms) while some reaction is being conducted on another part of the molecule. These protecting groups prevent reactions and are removed later by a heterogeneous catalytic method called hydrogenolysis. One unique feature of this book, not found in other books on catalysis, is an exhaustive chapter (Chapter 4) on hydrogenolysis, which is dredged from the recent synthetic literature published by modern organic chemists. Academic organic chemists should find this chapter extremely useful and may wish to adopt the book as a supplement for advanced organic chemistry courses designed for seniors and for graduate students. It will also be useful for professors and their research groups engaged in synthetic organic chemistry. Many academic organic chemists are not aware of recent advances in heterogeneous enantioselective catalysis (Chapter 3) or in selective low temperature, liquid phase heterogeneous catalytic oxidations by hydrogen peroxide (Chapter 6). These specialty topics are timely and may be new to academic organic chemists and can be used to supplement their advanced courses. Several features of this book will also be of special interest to industrial chemists who are unfamiliar with heterogeneous catalysis. Many good organic chemists are hire by industry. They synthesize a new compound using standard organic synthetic techniques but are informed by their supervisor that they must convert some of their synthetic steps into heterogeneous catalytic steps. They may not have been exposed to heterogeneous catalysis and have few places to turn. This book offers them a crash course in heterogeneous catalysis as well as many examples of reactions and conditions with which they can start their search. Those industrial organic chemists already familiar with heterogeneous catalysis will find this book useful as a reference to many examples in the recent literature. They will find recent surface science discoveries correlated with heterogeneous catalysis or organic reactions and mechanistic suggestions designed to stimulate innovative nontraditional thinking about organic reactions on surfaces. Written by organic chemists for organic chemists Introduces heterogeneous catalysis concepts and language Presents a comprehensive compilation of protecting group removal procedures Covers liquid-phase hydrogenations, hydrogenolysis, and oxidations Addresses heterogeneous methods for producing pure enantiomers of chiral products Examines the emerging field of heterogenized homogeneous catalysts Mixes practical applications with mechanistic interpretations

Heterogeneous catalysis provides the backbone of the world's chemical and oil industries. The innate complexity of practical catalytic systems suggests that useful progress should be achievable by investigating key aspects of catalysis by experimental studies on idealised model systems. Thin films and supported clusters are two promising types of model system that can be used for this purpose, since they mimic important aspects of the properties of practical dispersed catalysts. Similarly, appropriate theoretical studies of chemisorption and surface reaction clusters or extended slab systems can provide valuable information on the factors that underlie bonding and catalytic activity. This volume describes such experimental and theoretical approaches to the surface chemistry and catalytic behaviour of metals, metal oxides and metal/metal oxide systems. An introduction to the principles and main themes of heterogeneous catalysis is followed by detailed accounts of the application of modern experimental and theoretical techniques to fundamental problems. The application of advanced experimental methods is complemented by a full description of theoretical procedures, including Hartree-Fock, density functional and similar techniques. The relative merits of the various approaches are considered and directions for future progress are indicated.

Fundamental Concepts in Heterogeneous Catalysis

Foundations of Catalysis and Nanoscience

Surface Reactions

Characterization and Chemical Modification of the Silica Surface

Current Trends of Surface Science and Catalysis

Graduate textbook and sourcebook on surface and thin film processes, with links to the World Wide Web.

Surface Properties of Electronic Materials is the fifth volume of the series, The Chemical Physics of Solid Surfaces and Heterogeneous Catalysis. This volume indicates the present state of some basic properties of semiconductor surfaces. Chapter one summarizes the general problems in electronic materials and the areas affected by the surface science methods. The next two chapters illustrate the existing perception of the electronic and structural properties of elemental and compound semiconductor surfaces. This volume also deals with the properties of adsorption of semiconductors relating to both relevant gas phase species and metals. Chapters four to six of this volume explore compound semiconductors and elemental semiconductors. The remaining chapters of this volume explore the adsorption of metals on elemental semiconductors; aspects of growth kinetics and dynamics involved in molecular beam epitaxy; molecular beam epitaxy of silicon; insulators; and metastable phases. The last chapter covers the surface chemistry of dry etching processes.

It has become a tradition that every four years, the Université Catholique de Louvain and the Katholieke Universiteit Leuven jointly organize a symposium devoted to the scientific bases for the preparation of heterogeneous catalysts. These meetings bring together researchers from academia and industry and offer a forum for discussions on the chemistry involved in the preparation of industrial heterogeneous catalysts. This volume containing the Proceedings of the 8th International Symposium on Scientific Bases for the Preparation of Heterogeneous Catalysts consists of papers summarizing most of the 139 oral communications and posters selected by the international scientific committee, composed of 27 experts in the field of catalyst preparation, holding an industrial or academia appointment. The contributions focus on the aspects of catalyst preparation. The main topics are: new approaches in catalyst preparation; advanced preparations of nanoporous and mesoporous catalysts; catalysts preparation for special performances and purposes; catalysts for environmental purposes; and molecular catalysis. Emphasis is put on the role that catalysis can play as an essential element of sustainable development.

Graphene Surfaces: Particles and Catalysis focuses on the surface chemistry and modification of graphene and its derivatives from a theoretical and electrochemical point-of-view. It provides a comprehensive overview of their electronic structure, synthesis, properties and general applications in catalysis science, including their relevance in alcohols and their derivatives oxidation, oxygen reduction, hydrogen evolution, energy storage, corrosion protection and supercapacitors. The book also covers emerging research on graphene chemistry and its impact. Chemical engineers, materials scientists, electrochemists and engineers will find information that will answer their most pressing questions on the surface aspects of graphene and its effect on catalysis. Serves as a time-saving reference for researchers, graduated students and chemical engineers Equips the reader with catalysis knowledge for practical applications Discusses the physical and electrochemical properties of graphene Provides the most important applications of graphene in electrochemical systems Highlights both experimental and theoretical aspects of graphene

Science, Technology and Applications

Solid State Chemistry, Surface Chemistry and Catalytic Behaviour

From an Ancient Technology to a High-Tech Material

Scientific Bases for the Preparation of Heterogeneous Catalysts

Heterogeneous Catalysis in Organic Chemistry

Oxide surface materials are widely used in many applications, in particular where chemically modified oxide surfaces are involved. Indeed, in disciplines such as separation, catalysis, bioengineering, electronics, ceramics, etc., modified oxide surfaces are very important. In all cases, the knowledge of their chemical and surface characteristics is of great importance for the understanding and eventual improvement of their performances. This book reviews the latest techniques and procedures in the characterization and chemical modification of the silica surface, presenting a unified and state-of-the-art approach to the relevant analysis techniques and modification procedures, covering 1000 references integrated into one clear concept.

Surface chemistry is an essential and developing area of physical chemistry and one that has become increasingly interdisciplinary. The Second Edition of Surface Science: Foundations of Catalysis and Nanoscience has been fully revised and updated to reflect all the latest developments in the field and now includes an extensive discussion about nanoparticle growth and the quantum confinement effects in nanoscale systems. Two new chapters have been added and discuss The Liquid/Solid Interface and Non-Thermal Reactions, and Photon and Electron Stimulated Chemistry and Atom Manipulation. There are now many more worked examples included throughout to help students develop their problem-solving skills.

Providing an integrated approach to the various aspects of catalysis, this textbook is ideal for graduate students from catalysis, engineering, and organic synthesis.

Now updated- the current state of development of modern surface science Since the publication of the first edition of this book, molecular surface chemistry and catalysis science have developed rapidly and expanded into fields where atomic scale and molecular information were previously not available. This revised edition of Introduction to Surface Chemistry and Catalysis reflects this increase of information in virtually every chapter. It emphasizes the modern concepts of surface chemistry and catalysis uncovered by breakthroughs in molecular-level studies of surfaces over the past three decades while serving as a reference source for data and concepts related to properties of surfaces and interfaces. The book opens with a brief history of the evolution of surface chemistry and reviews the nature of various surfaces and interfaces encountered in everyday life. New research in two crucial areas-nanomaterials and polymer and biopolymer interfaces-is emphasized, while important applications in tribology and catalysis, producing chemicals and fuels with high turnover and selectivity, are addressed. The basic concepts surrounding various properties of surfaces such as structure, thermodynamics, dynamics, electrical properties, and surface chemical bonds are presented. The techniques of atomic and molecular scale studies of surfaces are listed with references to up-to-date review papers. For advanced readers, this book covers recent developments in in-situ surface analysis such as high- pressure scanning tunneling microscopy, ambient pressure X-ray photoelectron spectroscopy, and sum frequency generation vibrational spectroscopy (SFG). Tables listing surface structures and data summarizing the kinetics of catalytic reactions over metal surfaces are also included. New to this edition: A discussion of new physical and chemical properties of nanoparticles Ways to utilize new surface science techniques to study properties of polymers, reaction intermediates, and mobility of atoms and molecules at surfaces Molecular-level studies on the origin of the selectivity for several catalytic reactions A microscopic understanding of mechanical properties of surfaces Updated tables of experimental data A new chapter on "soft" surfaces, polymers, and biointerfaces Introduction to Surface Chemistry and Catalysis serves as a textbook for undergraduate and graduate students taking advanced courses in physics, chemistry, engineering, and materials science, as well as researchers in surface science, catalysis science, and their applications.

Principles of Colloid and Surface Chemistry

An Introduction to Chemisorption and Catalysis by Metals

An Introduction to Surface Chemistry

Surface Chemistry and Catalysis

Graphene Surfaces

Students contemplating careers in chemistry, whether in research, practice, or academia, obviously need a solid grounding in proper research methodology, reasoning, and analysis. However, there are few resources available that efficiently and effectively introduce these concepts and techniques and inspire students to undertake advanced research, particularly in the area of catalysis. Catalysis: Principles and Applications evolved out of a special, resoundingly successful short course for graduate students interested in catalysis. It covers nearly the entire gamut of the subject, from its fundamentals to its modern, applied aspects. The chapters were contributed by catalysis specialists from leading academic institutions, national laboratories and industrial R&D labs. Because they are based on the authors' lecture notes, each chapter is highly accessible and for the most part self-contained. Topics include various spectroscopic methods, biocatalysis, x-ray and thermal analysis, photocatalysis, and recent developments, such as solid acid catalysts, fine chemical synthesis, and computer-aided catalyst design. The book also contains discussions on a variety of modern applications, including environmental pollution control, petroleum refining, fuel cells, and monomolecular films. Logically presented, well-illustrated, and thoroughly referenced, Catalysis: Principles and Applications offers an outstanding basis for courses in catalysis. It not only imparts the fundamentals, synthesis, characterization, and applications of catalysis, but does so in a way that will motivate students to pursue more advanced studies and ultimately careers in the field.

In the past 12 years since its publication, Concepts of Modern Catalysis and Kinetics has become a standard textbook for graduate students at universities worldwide. Emphasizing fundamentals from thermodynamics, physical chemistry, spectroscopy, solid state chemistry and quantum chemistry, it introduces catalysis from a molecular perspective, and stresses how it is interwoven with the field of reaction kinetics. The authors go on to explain how the world of reacting molecules is connected to the real world of industry, by discussing the various scales (nano - micro - macro) that play a role in catalysis. Reflecting the modern-day focus on energy supplies, this third edition devotes attention to such processes as gas-to-liquids, coal-to-liquids, biomass conversion and hydrogen production. From reviews of the prior editions: "Overall, this is a valuable book that I will use in teaching undergraduates and postgraduates." (Angewandte Chemie - I. E.) "...this excellent book is highly recommended to students at technical universities, but also entrants in chemical industry. Furthermore, this informative handbook is also a must for all professionals in the community." (AFS) "I am impressed by the coverage of the book and it is a valuable addition to the catalysis literature and I highly recommend purchase" (Energy Sources)

In 2001 Wyn Roberts celebrated both his 70th birthday and 50 years of working in surface science, to use the term "surface science" in its broadest meaning. This book aims to mark the anniversary with a contribution of lasting value, something more than the usual festschrift issue of a relevant journal. The book is divided into three sections: Surface Science, Model Catalysts and Catalysis, topics in which Wyn has always had interests. The authors for each chapter were chosen from some of the many eminent scientists who have worked with Wyn in various ways and are all internationally acknowledged as leaders in their field. The authors have produced authoritative reviews of their own specialties which together result in a book with an unrivalled combination of breadth and depth exploring the most recent developments in surface chemistry and catalysis.

Expanding the identical first presentation and Baker Lectures at Cornell University, Reactions at Solid Surfaces comprises an authoritative, self-contained, book-length introduction to surface reactions for both professional chemists and students alike. Outlining our present understanding of the fundamental processes underlying reactions at solid surfaces, the book provides the reader with a complete view of how chemistry works at surfaces, and how to understand and probe the dynamics of surface reactions. Comparing traditional surface probes with more modern ones, and bringing together various disciplines in a cohesive manner, Gerhard Ertl's Reactions at Solid Surfaces serves well as a primary text for graduate students in introductory surface science or chemistry, as well as a self-teaching resource for professionals in surface science, chemical engineering, or nanoscience.

Modeling and Simulation of Heterogeneous Catalytic Reactions

Principles and Applications

Introduction to Surface Chemistry and Catalysis, Second Edition

Catalysis, Green Chemistry and Sustainable Energy

An Introduction

This text presents a unified approach to the wide range of interactions and events which may follow the impact of gas molecules with a metal surface. The scope extends from the physical interactions which lead only to energy exchanges, through physical adsorption, to a discussion of various catalytic processes. Through specific examples, students of adsorption and catalysis are shown how to conduct and interpret experiments. These examples illustrate both the close conceptual and experimental links between adsorption and catalysis, and explore the experimental techniques most often encountered. The work concludes with a detailed case study of the catalytic oxidation of carbon monoxide on palladium and platinum, an important process in the control of automobile exhaust emissions.

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-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.

Introduces major catalytic processes including products from the petroleum, chemical, environmental and alternative energy industries Provides an easy to read description of the fundamentals of catalysis and some of the major catalytic industrial processes used today Offers a rationale for process designs based on kinetics and thermodynamics Alternative energy topics include the hydrogen economy, fuels cells, bio catalytic (enzymes) production of ethanol fuel from corn and biodiesel from vegetable oils Problem sets of included with answers available to faculty who use the book Review: "In less than 300 pages, it serves as an excellent introduction to these subjects whether for advanced students or those seeking to learn more about these subjects on their own time...Particularly useful are the succinct summaries throughout the book...excellent detail in the table of contents, a detailed index, key references at the end of each chapter, and challenging classroom questions..." (GlobalCatalysis.com, May 2016)

Written by one of the world's leading experts on the topic, this advanced textbook is the perfect introduction for newcomers to this exciting field. Concise and clear, the text focuses on such key aspects as kinetics, reaction mechanism and surface reactivity, concentrating on the essentials. The author also covers various catalytic systems, catalysis by design, and activation-deactivation. A website with supplementary material offers additional figures, original material and references.

Chemical Bonding at Surfaces and Interfaces

Catalysis

Adsorption and Catalysis on Transition Metals and Their Oxides

Principles and Practice of Heterogeneous Catalysis

Advances and Applications

Reaction Kinetics and the Development and Operation of Catalytic Processes is a trendsetter. The Keynote Lectures have been authored by top scientists and cover a broad range of topics like fundamental aspects of surface chemistry, in particular dynamics and spillover, the modeling of reaction mechanisms, with special focus on the importance of transient experimentation and the application of kinetics in reactor design. Fundamental and applied kinetic studies are well represented. More than half of these deal with transient kinetics, a new trend made possible by recent sophisticated experimental equipment and the awareness that transient experimentation provides more information and insight into the microphenomena occurring on the catalyst surface than steady state techniques. The trend is not limited to purely kinetic studies since the great majority of the papers dealing with reactors also focus on transients and even deliberate transient operation. It is to be expected that this trend will continue and amplify as the community becomes more aware of the predictive potential of fundamental kinetics when combined with detailed realistic modeling of the reactor operation.

Heterogeneous Catalytic Materials discusses experimental methods and the latest developments in three areas of research: heterogeneous catalysis; surface chemistry; and the chemistry of catalysts. Catalytic materials are those solids that allow the chemical reaction to occur efficiently and cost-effectively. This book provides you with all necessary information to synthesize, characterize, and relate the properties of a catalyst to its behavior, enabling you to select the appropriate catalyst for the process and reactor system. Oxides (used both as catalysts and as supports for catalysts), mixed and complex oxides and salts, halides, sulfides, carbides, and unsupported and supported metals are all considered. The book encompasses applications in industrial chemistry, refinery, petrochemistry, biomass conversion, energy production, and environmental protection technologies. Provides a systematic and clear approach of the synthesis, solid state chemistry and surface chemistry of all solid state catalysts Covers widely used instrumental techniques for catalyst characterization, such as x-ray photoelectron spectroscopy, scanning electron microscopy, and more Includes characterization methods and lists all catalytic behavior of the solid state catalysts Discusses new developments in nanocatalysts and their advantages over conventional catalysts

The chemistry of nanomaterials has developed considerably in the past two decades, and concepts that have emerged from these developments are now well established. The surface modification of nanoparticles is a subject of intense research interest given its importance for many applications across a number of disciplines. This comprehensive guide is the first to be devoted to the surface chemistry of inorganic nanocrystals. Following an introduction to the physical chemistry of surfaces, chapters cover topics such as the surface modification of nanoparticles, water compatible, polymer-based, and inorganic nanocomposites, as well as relevant applications in catalysis, biotechnology and nanomedicine. Highlighting recent advances, Surface Chemistry of Colloidal Nanocrystals provides an integrated approach to chemical aspects related to the surface of nanocrystals. Written by prestigious scientists, this will be a useful resource for students and researchers working in surface science, nanoscience and materials science as well as those interested in the applications of the nanomaterials in areas such as health science, biology, and environmental engineering.

This long-awaited second edition of the successful introduction to the fundamentals of heterogeneous catalysis is now completely revised and updated. Written by internationally acclaimed experts, this textbook includes fundamentals of adsorption, characterizing catalysts and their surfaces, the significance of pore structure and surface area, solid-state and surface chemistry, poisoning, promotion, deactivation and selectivity of catalysts, as well as catalytic process engineering. A final section provides a number of examples and case histories. With its color and numerous graphics plus references to help readers to easily find further reading, this is a pivotal work for an understanding of the principles involved.

Introduction to Catalysis and Industrial Catalytic Processes

Reaction Kinetics and the Development and Operation of Catalytic Processes

Introduction to Surface Physical Chemistry

Metal Nanoparticles for Catalysis

Surface Science

This book is based on a graduate course and suitable as a primer for any newcomer to the field, this book is a detailed introductionto the experimental and computational methods that are used tostudy how solid surfaces act as catalysts. Features include: First comprehensive description of modern theory ofheterogeneous catalysis Basis for understanding and designing experiments in the field Allows reader to understand catalytic design principles Introduction to important elements of energy transformationtechnology Test driven at Stanford University over several semesters

Molecular surface science has made enormous progress in the past 30 years. The development can be characterized by a revolution in fundamental knowledge obtained from simple model systems and by an explosion in the number of experimental techniques. The last 10 years has seen an equally rapid development of quantum mechanical modeling of surface processes using Density Functional Theory (DFT). Chemical Bonding at Surfaces and Interfaces focuses on phenomena and concepts rather than on experimental or theoretical techniques. The aim is to provide the common basis for describing the interaction of atoms and molecules with surfaces and this to be used very broadly in science and technology. The book begins with an overview of structural information on surface adsorbates and discusses the structure of a number of important chemisorption systems. Chapter 2 describes in detail the chemical bond between atoms or molecules and a metal surface in the observed surface structures. A detailed description of experimental information on the dynamics of bond-formation and bond-breaking at surfaces make up Chapter 3. Followed by an in-depth analysis of aspects of heterogeneous catalysis based on the d-band model. In Chapter 5 adsorption and chemistry on the enormously important Si and Ge semiconductor surfaces are covered. In the remaining two Chapters the book moves on from solid-gas interfaces and looks at solid-liquid interface processes. In the final chapter an overview is given of the environmentally important chemical processes occurring on mineral and oxide surfaces in contact with water and electrolytes. Gives examples of how modern theoretical DFT techniques can be used to design heterogeneous catalysts This book suits the rapid introduction of methods and concepts from surface science into a broad range of scientific disciplines where the interaction between a solid and the surrounding gas or liquid phase is an essential component Shows how insight into chemical bonding at surfaces can be applied to a range of scientific problems in heterogeneous catalysis, electrochemistry, environmental science and semiconductor processing Provides both the fundamental perspective and an overview of chemical bonding in terms of structure, electronic structure and dynamics of bond rearrangements at surfaces

This is the first comprehensive book covering all aspects of the use of carbonaceous materials in heterogeneous catalysis. It covers the preparation and characterization of carbon supports and carbon-supported catalysts; carbon surface chemistry in catalysis; the description of catalytic, photo-catalytic, or electro-catalytic reactions, including the development of new carbon materials such as carbon xerogels, aerogels, or carbon nanotubes; and new carbon-based materials in catalytic or adsorption processes. This is a premier reference for carbon, inorganic, and physical chemists, materials scientists and engineers, chemical engineers, and others.

Horizons in Sustainable Industrial Chemistry and Catalysis, Volume 178, presents a comprehensive picture of recent developments in terms of sustainable industrial processes and the catalytic needs and opportunities to develop these novel routes. Each chapter includes an introduction and state-of-the-art in the field, along with a series of specific aspects and examples. The book identifies new opportunities for research that will help us transition to low carbon and sustainable energy and chemical production. Users will find an integrated view of the new possibilities in this area that unleashes new possibilities in energy and chemistry. Combines an analysis of each scenario, the state-of-the-art, and specific examples to help users better understand needs, opportunities, gaps and challenges Offers an integrated view of new catalytic technologies that are needed for future use Presents an interdisciplinary approach that combines broad expertise Brings together experts in the area of sustainable industrial chemistry

Reactions at Solid Surfaces

The Chemical Physics of Solid Surfaces and Heterogeneous Catalysis

Particles and Catalysis

Heterogeneous Catalytic Materials

Contemporary Catalysis

This unique book covers the latest surface science studies on model catalysts, including single crystals, non-colloidal nanocatalysts, and nanoparticles in various forms with the control of size, shape and composition. This book addresses the issue of bridging " materials and pressure gaps " and also discusses the important issue of metal-oxide interface and hot electron flows in heterogeneous catalysis. The current development of in-situ surface techniques that is relevant to bridging " pressure gaps " is also highlighted.

Exciting results are still emerging from the many research groups working in this fertile area and the book is an excellent stimulus to researchers at the start of the 21st century."--BOOK JACKET

Heterogeneous Catalysis: Fundamentals, Engineering and Characterizations provides a comprehensive introduction to the theory of heterogeneous catalysis, including thermodynamic and kinetic aspects, adsorption mechanisms, catalytic reactors and catalyst characterization, with an introduction to sustainable catalysis."Representing a reference source for students and researchers working in this rapidly advancing field, the text reflects the many facets of the discipline, linking fundamental concepts with their applications. Beginning with a step-by-step look at the thermodynamics and energetics of catalysis, from basic concepts to the more complex aspects, the book goes on to cover reaction engineering and modeling, ending with sustainable catalysis and?characterization techniques typically used for solid catalysts. Including presentation slides to support research and learning as well as aid quick understanding of the key concepts, this book will be of interest to postgraduate students and researchers working in chemical engineering, chemistry and materials science as well as industrial researchers.

Includes an accompanying presentation slides aid for easy understanding of key concepts Covers the modeling of catalytic reactors and sustainable catalysis Includes adsorption/desorption thermodynamics and kinetics Details characterization techniques for the assessment of textural, structural, morphological, optical and chemical properties of the catalysts

This book is a printed edition of the Special Issue "Surface Chemistry and Catalysis" that was published in Catalysts

Introduction to Surface and Thin Film Processes

Introduction to Surface Chemistry and Catalysis

Horizons in Sustainable Industrial Chemistry and Catalysis

Towards an Understanding of Microscopic Processes in Catalysis

Concepts of Modern Catalysis and Kinetics

The Nobel Prize in Chemistry 2007 awarded to Gerhard Ertl for his groundbreaking studies in surface chemistry highlighted the importance of heterogeneous catalysis not only for modern chemical industry but also for environmental protection. Heterogeneous catalysis is seen as one of the key technologies which could solve the challenges associated with the increasing diversification of raw materials and energy sources. It is the decisive step in most chemical industry processes, a major method of reducing pollutant emissions from mobile sources and is present in fuel cells to produce electricity. The increasing power of computers over the last decades has led to modeling and numerical simulation becoming valuable tools in heterogeneous catalysis. This book covers many aspects, from the state-of-the-art in modeling and simulations of heterogeneous catalytic reactions on a molecular level to heterogeneous catalytic reactions from an engineering perspective. This first book on the topic conveys expert knowledge from surface science to both chemists and engineers interested in heterogeneous catalysis. The well-known and international authors comprehensively present many aspects of the wide bridge between surface science and catalytic technologies, including DFT calculations, reaction dynamics on surfaces, Monte Carlo simulations, heterogeneous reaction rates, reactions in porous media, electro-catalytic reactions, technical reactors, and perspectives of chemical and automobile industry on modeling heterogeneous catalysis. The result is a one-stop reference for theoretical and physical chemists, catalysis researchers, materials scientists, chemical engineers, and chemists in industry who would like to broaden their horizon and get a substantial overview on the different aspects of modeling and simulation of heterogeneous catalytic reactions.

Catalysis literature can be difficult to read if there is not a sufficient understanding of the underlying connections between the chemical, materials and engineering aspects of catalysis. As a result, many students lack the depth of knowledge to effectively understand the topic. Introduction to Heterogeneous Catalysis solves this issue by presenting not only the basic concepts of catalysis but also, right from the beginning, integrating the chemical, materials and engineering aspects of catalysis in examples taken directly from industry. Aimed at master's and PhD students with a limited background in chemistry, this book provides a thorough introduction to the principles behind catalysis that will enable readers to understand the concepts and analyse the literature necessary for its study.

High-surface-area materials have recently attracted significant interest due to potential applications in various fields such as electrochemistry and catalysis, gas-phase catalysis, optics, sensors and actuators, energy harvesting and storage. In contrast to classical materials the properties of high-surface-area materials are no longer determined by their bulk, but by their nanoscale architecture. Nanoporous gold (np-Au) represents the fascinating class of mesoporous metals that have been intensively investigated in recent years. The current interest and the increasing number of scientific publications show that np-Au by itself is an outstanding nano-material that justifies a book devoted to all aspects of its properties and applications. The resulting publication is a discussion of this unique nano-material and is an accessible and comprehensive introduction to the field. The book provides a broad, multi-disciplinary platform to learn more about the properties of nanoporous gold from an inter-disciplinary perspective. It starts with an introduction and overview of state-of-the-art applications and techniques characterizing this material and its applications. It then covers the progress in research within the last years. The chapters are in-depth overviews written by the world's leading scientists in the particular field. Each chapter covers one technique or application so that the reader can easily target their favoured topic and will get the latest and state-of-the-art information in the field.

This book deals with adsorption and catalysis on the surface of transition elements and their compounds, many of which are in teresting because of their particular electronic structure. The authors have worked through a vast body of experimental evi dence on the structure and properties of surfaces of transition metals and relevant oxides. Consideration is given mostly to simple (as opposed to mixed) oxides of transition elements, to common metals and to the adsorption of simple gases. A great deal of attention is paid to the nature of active surface sites responsible for chemisorption and catalytic transformations. The description relies mainly on the simplified ligand-field theory, which, however, proves quite satisfactory for predicting the adsorptive and catalytic activity of species. In many cases simple systems were explored with the aid of novel techniques, and it is only for such systems that the mechanism of the ele mentary act of adsorption and catalysis can be given adequate treatment. The present monograph has emerged from our earlier work in Russian, which appeared in the Khimiya Publishing House (Mos cow) in 1981. This English edition has, however, been revised completely to broaden its scope and to include more recent a chievements. For fruitful discussions the authors are grateful to A. A.

Fundamentals, Engineering and Characterizations (with accompanying presentation slides and instructor's manual)

Surface Chemistry of Colloidal Nanocrystals

Chemisorption and Reactivity on Supported Clusters and Thin Films:

Introduction to Heterogeneous Catalysis

New Technologies for Novel Business Opportunities