

Fundamental and Applied Catalysis

Catalyst Characterization

Physical Techniques for Solid Materials

**Edited by Boris Imelik
and Jacques C. Vedrine**

Catalyst Characterization Physical Techniques For Solid Materials

Michel Che, Jacques C. Vedrine



Catalyst Characterization Physical Techniques For Solid Materials:

Catalyst Characterization Boris Imelik, Jacques C. Vedrine, 2013-06-29 to the Fundamental and Applied Catalysis Series
Catalysis is important academically and industrially. It plays an essential role in the manufacture of a wide range of products from gasoline and plastics to fertilizers and herbicides which would otherwise be unobtainable or prohibitively expensive. There are few chemical or oil based material items in modern society that do not depend in some way on a catalytic stage in their manufacture. Apart from manufacturing processes, catalysis is finding other important and ever increasing uses for example successful applications of catalysis in the control of pollution and its use in environmental control are certain to increase in the future. The commercial importance of catalysis and the diverse intellectual challenges of catalytic phenomena have stimulated study by a broad spectrum of scientists including chemists, physicists, chemical engineers and material scientists. Increasing research activity over the years has brought deeper levels of understanding and these have been associated with a continually growing amount of published material. As recently as sixty years ago Rideal and Taylor could still treat the subject comprehensively in a single volume but by the 1950s Emmett required six volumes and no conventional multivolume text could now cover the whole of catalysis in any depth.

Catalyst Characterization Boris Imelik, Jacques C. Vedrine, 2013-05-09 to the Fundamental and Applied Catalysis Series
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Characterization of Solid Materials and Heterogeneous Catalysts Michel Che, Jacques C. Vedrine, 2012-04-16
This two volume book provides an overview of physical techniques used to characterize the structure of solid materials on the one hand and to investigate the reactivity of their surface on the other. Therefore this book is a must have for anyone working in fields related to surface reactivity. Among the latter and because of its most important industrial impact, catalysis has been used as the directing thread of the book. After the preface and a general introduction to physical techniques by M Che and J C Vedrine, two overviews on physical techniques are presented by G Ertl and Sir J M Thomas for investigating model catalysts.

and porous catalysts respectively The book is organized into four parts Molecular Local Spectroscopies Macroscopic Techniques Characterization of the Fluid Phase Gas and or Liquid and Advanced Characterization Each chapter focuses upon the following important themes overview of the technique most important parameters to interpret the experimental data practical details applications of the technique particularly during chemical processes with its advantages and disadvantages conclusions

Characterization of Solid Materials and Heterogeneous Catalysts, 2 Volume Set Michel Che, Jacques C. Vedrigne, 2012-05-14 This two volume book provides an overview of physical techniques used to characterize the structure of solid materials on the one hand and to investigate the reactivity of their surface on the other Therefore this book is a must have for anyone working in fields related to surface reactivity Among the latter and because of its most important industrial impact catalysis has been used as the directing thread of the book After the preface and a general introduction to physical techniques by M Che and J C Vedrigne two overviews on physical techniques are presented by G Ertl and Sir J M Thomas for investigating model catalysts and porous catalysts respectively The book is organized into four parts Molecular Local Spectroscopies Macroscopic Techniques Characterization of the Fluid Phase Gas and or Liquid and Advanced Characterization Each chapter focuses upon the following important themes overview of the technique most important parameters to interpret the experimental data practical details applications of the technique particularly during chemical processes with its advantages and disadvantages conclusions

Catalyst Characterization Science Marvin L. Deviney, John L. Gland, American Chemical Society. Division of Petroleum Chemistry, 1985 Highlights the rapid evolution of the surface science of catalysts Focuses on multi technique strategies for studying catalytic reactions and catalytic materials Discusses new developments in electron microscopy laser induced desorption magnetic methods and new vibrational characterization techniques

Surface and Nanomolecular Catalysis Ryan Richards, 2006-05-25 Using new instrumentation and experimental techniques that allow scientists to observe chemical reactions and molecular properties at the nanoscale the authors of Surface and Nanomolecular Catalysis reveal new insights into the surface chemistry of catalysts and the reaction mechanisms that actually occur at a molecular level during catalysis

Heterogeneous Catalysis in Organic Transformations Varun Rawat, Anirban Das, Chandra Mohan Srivastava, 2022-04-06 As the broad challenges around energy and the environment have become the focus of much research scientists and experts have dedicated their efforts to developing more active and selective catalytic systems for key chemical transformations For many decades environmentally viable protocols for the synthesis of fine chemicals have been the crux of academic and industrial research Heterogeneous Catalysis in Organic Transformations serves as an overview of this work providing a complete description of role of heterogeneous catalysis in organic transformations and offering a review of the current and near future technologies and applications Discusses the fundamentals of catalysis and compares the advantages and disadvantages of different types of catalyst systems Examines oxide nanoparticles and noble metal nanoparticles Consider organometallic compounds solid supported

catalysts and mesoporous materials Describes recent advances in metal based heterogeneous catalysts and new reactions with possible mechanistic pathways Providing a comprehensive review of heterogeneous catalysis from the basics through recent advances this book will be of keen interest to undergraduates graduates and researchers in chemistry chemical engineering and associated fields *Catalysis* B. Viswanathan, 2002 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 Fluid Catalytic Cracking V M.L. Occelli, P. O'Connor, 2001-04-27 Catalyst production for the transformation of crudes into gasoline and other fuel products is a billion dollar year business and fluid cracking catalysts FCCs represent almost half of the refinery catalyst market During the cracking reactions the FCC surface is contaminated by metals Ni V Fe Cu Na and by coke deposition As a result the catalyst activity and product selectivity is reduced to unacceptable levels thus forcing refiners to replace part of the recirculating equilibrium FCC inventory with fresh FCC to compensate for losses in catalyst performance About 1 100 tons day of FCC are used worldwide in over 200 fluid cracking catalyst units FCCUs It is for these reasons that refiners interest in FCC research has remained high through the years almost independantly of crude oil prices However recent oil company mergers and the dissolution of research laboratories have drastically decreased the number of researchers involved in petroleum refining research projects as a result the emphasis of research has shifted from new materials to process improvements and this trend is clearly reflected in the type of papers contained in this volume Modern spectroscopic techniques continue to be essential in the understanding of catalyst performance and several chapters in the book describe the use of ^{27}Al ^{29}Si and ^{13}C NMR to study variation in FCC acidity during aging and coke deposition In addition several chapters have been dedicated to the modeling of FCC deactivation and to the understanding of contact times

on FCC performance Refiners efforts to conform with environmental regulations are reflected in chapters dealing with sulfur removal metals contaminants and olefin generation Metal Oxides in Heterogeneous Catalysis Jacques C.

Vedrine,2018-01-11 Metal Oxides in Heterogeneous Catalysis is an overview of the past present and future of heterogeneous catalysis using metal oxides catalysts The book presents the historical theoretical and practical aspects of metal oxide based heterogeneous catalysis Metal Oxides in Heterogeneous Catalysis deals with fundamental information on heterogeneous catalysis including reaction mechanisms and kinetics approaches There is also a focus on the classification of metal oxides used as catalysts preparation methods and touches on zeolites mesoporous materials and Metal organic frameworks MOFs in catalysis It will touch on acid or base type reactions selective partial and total oxidation reactions and enzymatic type reactions The book also touches heavily on the biomass applications of metal oxide catalysts and environmentally related depollution reactions such as COVs elimination DeNOx and DeSOx Finally the book also deals with future trends and prospects in metal oxide based heterogeneous catalysis Presents case studies in each chapter that provide a focus on the industrial applications Includes fundamentals key theories and practical applications of metal oxide based heterogeneous catalysis in one comprehensive resource Edited and contributed by leading experts who provide perspectives on synthesis characterization and applications *Advanced Solid Catalysts for Renewable Energy Production* González-Cortés,

Sergio,Imbert, Freddy Emilio,2018-01-19 In recent years the replacement of non renewable crude oil by renewable sources has been addressed particularly in developed countries Its main driving force has been the increasing demand and limited reserves of fossil fuels the greenhouse gas effect and the need of securing energy supplies *Advanced Solid Catalysts for Renewable Energy Production* provides emerging research on renewable energy production catalysts and environmental effects of increased productivity While highlighting the challenges for future generations to develop in the sustainable energy age readers will learn the importance of new approaches not only for synthesizing more active and selective nano catalysts but also for designing innovative catalytic processes that can eventually meet the growing energy efficiency demand and overcome the environmental issues This book is an important resource for academicians university researchers technology developers and graduate level students *Molecular Spectroscopy of Oxide Catalyst Surfaces* Anatoli Davydov,2003-06-27

As in the study of transition metal complexes in solution molecular spectroscopic methods principally the infrared ultraviolet visible and electron spin resonance spectroscopies have played key roles in establishing the concepts of coordination chemistry occurring at the surfaces of solids This book describes the development of the principals of coordination chemistry of oxide surfaces using analyses of data obtained by these methods The nature properties concentration of the surface adsorption centers and their influence on the character of interaction with different molecules are investigated The book commences with an account of the basic theoretical principles and experimental techniques of the various spectroscopy methods with special attention devoted to in situ measurements where the oxide or catalyst sample is in contact with the

adsorbate or the reactant A detailed account is presented of the methods for characterizing the oxidation state and degree of coordination of surface cations and oxygen anions by the adsorption of probe molecules The complexation of many inorganic organometallic and organic molecules with different oxide systems is critically examined and a classification of formed surface compounds based on the interaction with definite type of adsorption centers is given Possible mechanisms of numerous catalytic reactions including the transformation of organic molecules over acidic catalysts via the carboionic mechanism are discussed using the spectroscopic identifications of reaction intermediates A comprehensive analysis of the literature on the interpretation of the spectra of surface compounds on oxides is presented This highly illustrated and extensively referenced volume is intended for specialists working in the fields of surface physical chemistry surface and materials sciences and adsorption phenomena and is essential reading for those involved in the heterogeneous catalysis by transition metal oxides

Heterogeneous Catalytic Materials Guido Busca, 2014-05-23 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

In-situ Characterization of Heterogeneous Catalysts José A. Rodríguez, Jonathan C. Hanson, Peter J. Chupas, 2013-04-17 Helps researchers develop new catalysts for sustainable fuel and chemical production Reviewing the latest developments in the field this book explores the in situ characterization of heterogeneous catalysts enabling readers to take full advantage of the sophisticated techniques used to study heterogeneous catalysts and reaction mechanisms In using these techniques readers can learn to improve the selectivity and the performance of catalysts and how to prepare catalysts as efficiently as possible with minimum waste In situ Characterization of Heterogeneous Catalysts features contributions from leading experts in the field of catalysis It begins with an introduction to the fundamentals and then covers Characterization of electronic and structural properties of catalysts using X ray absorption fine structure spectroscopy Techniques for structural characterization based on X ray diffraction neutron scattering and pair distribution function analysis Microscopy and morphological studies Techniques for studying the

interaction of adsorbates with catalyst surfaces including infrared spectroscopy Raman spectroscopy EPR and moderate pressure XPS Integration of techniques that provide information on the structural properties of catalysts with techniques that facilitate the study of surface reactions Throughout the book detailed examples illustrate how techniques for studying catalysts and reaction mechanisms can be applied to solve a broad range of problems in heterogeneous catalysis Detailed figures help readers better understand how and why the techniques discussed in the book work At the end of each chapter an extensive set of references leads to the primary literature in the field By explaining step by step modern techniques for the in situ characterization of heterogeneous catalysts this book enables chemical scientists and engineers to better understand catalyst behavior and design new catalysts for green sustainable fuel and chemical production

Catalyst Characterization Science Marvin L. Deviney, John L. Gland, Highlights the rapid evolution of the surface science of catalysts Focuses on multi-technique strategies for studying catalytic reactions and catalytic materials Discusses new developments in electron microscopy laser induced desorption magnetic methods and new vibrational characterization techniques

Russian Journal of Physical Chemistry, 2001 International Workshop on Dynamics in Confinement B. Frick, R. Zorn, Herma G. Büttner, 2000 *Spectroscopy in Catalysis* J. W. Niemantsverdriet, 2007-07-23 This book is a uniquely helpful guide to many of the major and some minor techniques used to investigate the structures of solid catalysts and model systems and is written from the perspective of a prolific researcher in the field The writing is enjoyable to read the illustrations are clear and the reader is guided efficiently to key technical references for further details Journal of the American Chemical Society Superbly organized and of great pedagogic value Spectroscopy in Catalysis describes the most important modern analytical techniques used to investigate

Characterization of Catalytic Materials Israel E. Wachs, 2010 Heterogeneous catalysis has undergone a revolutionary change in the past two decades due to the development of sophisticated characterization methods that provide fundamental information about the catalyst bulk structures surfaces and their properties For the first time these characterization methods have allowed researchers to see the surfaces of catalytic materials their bulk structures crystalline as well as amorphous phases the influence of the process conditions on the catalytic material as well as the effect of different synthesis methods This new information has tremendously advanced our understanding of catalytic materials and their properties These characterization methods have become our eyes and are indispensable in the development of new catalytic materials It is hard to conceive of a modern heterogeneous catalysis activity be it research or manufacturing without the aid of these new characterization techniques

Handbook of Porous Solids Ferdi Schüth, K. S. W. Sing, Jens Weitkamp, 2002

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