Characterization Of Porous Solids And Powders Surface Area Pore Size And Density Particle Technology Series By Lowell S Shields Joan E Thomas Martin A Thommes Ma 2006 Hardcover

The Fifth International Symposium on the Characterisation of Porous Solids (COPS-V) was held at Heidelberg, Germany, from May 30 to June 2, 1999. About 220 participants from 25 countries enjoyed a very successful meeting with 32 lectures and 155 poster presentations. The Symposium started with a highly stimulating lecture by Sir John Meurig Thomas, Cambridge, highlighting the recent developments in engineering of new catalysts. The following two full sessions were devoted to theory, modelling and simulation which provide the basis for the interpretation of pore structural data of adsorbents and finely dispersed solids. Sessions 2 and 3 focused on the advances in the synthesis and characterisation of highly ordered inorganic adsorbents and carbons. Sessions 4 and 5 addressed important questions with respect to the characterisation of porous solids by sorption measurement and other related techniques. The intensive three-day programme provided a stimulating forum for the exchange of novel research findings, concepts, techniques and materials which are collected in this volume.

The objectives of the Third IUPAC Symposium on the Characterization of Porous Solids (COPS-III) were (1) to provide the opportunity for specialists to exchange ideas and new information on theoretical principles and methodology and (2) to generate proposals for the comparison and utilization of the many techniques now available for the characterization of porous solids. A successful outcome of the Symposium has been the final report of the IUPAC Subcommittee on Recommendations for the Characterization of Porous Solids, a summary of which is given in these proceedings. The edited papers included in the present volume have been selected from the 155 oral and poster presentations given at this symposium, which attracted 200 participants from 28 different countries. The following topics were discussed: 1. Simulation and modelling of pore structures and pore-filling mechanisms 2. Novel experimental techniques with particular reference to high-resolution techniques 3. Model pore structures and reference materials 4. Porous materials of technological importance. The wide range of materials and techniques described provide a useful and comprehensive reference source for academic and industrial scientists and technologists.

The rapid growth of interest in powders and their surface properties in many diverse industries prompted the writing of this book for those who have the need to make meaningful measurements without the benefit of years of experience. It is intended as an introduction to some of the elementary theory and experimental methods used to study the surface area, porosity and density of powders. It may be found useful by those with little or no training in solid surfaces who have the need to quickly learn the rudiments of surface area, density and pore-size measurements. Syosset, New York S. Lowell May, 1983 J. E. Shields Xl List of symbols Use of symbols for purposes other than those indicated in the following list are so defined in the text. Some symbols not shown in this list are defined in the text. d adsorbate cross-sectional area A area; condensation coefficient; collision frequency C BET constant c concentration D diameter; coefficient of thermal diffusion E adsorption potential f permeability aspect

factor F flow rate; force; feed rate 9 gravitational constant G Gibbs free energy GS free surface energy h heat of immersion per unit area; height H enthalpy Hi heat of immersion Hsv heat of adsorption BET intercept; filament current k thermal conductivity; specific reaction rate K Harkins-Jura constant I length L heat of liquefaction M mass M molecular weight n number of moles N number of molecules; number of particles N Avagadro's number .

Electrochemistry of Porous Materials describes essential theoretical aspects of the electrochemistry of nanostructured materials and primary applications, incorporating the advances in the field in the last ten years including recent theoretical formulations and the incorporation of novel materials. Concentrating on nanostructured micro- and mesoporous materials, the highly anticipated Second Edition offers a more focused and practical analysis of key porous materials considered relatively homogeneous from an electrochemical point of view. The author details the use of electrochemical methods in materials science for characterization and their applications in the fields of analysis, energy production and storage, environmental remediation, and the biomedical arena. Additional features include: Incorporates new theoretical advances in the voltammetry of porous materials and multiphase porous electrochemistry. Includes new developments in sensing, energy production and storage, degradation of pollutants, desalination and drug release. Describes redox processes for different porous materials, assessing their electrochemical applications. Written at an accessible and understandable level for researchers and graduate students working in the field of material chemistry. Selective and streamlined, Electrochemistry of Porous Materials, Second Edition culls a wide range of relevant and practically useful material from the extensive literature on the subject, making it an invaluable reference for readers of all levels of understanding.

Engineers and scientists alike will find this book to be an excellent introduction to the topic of porous materials, in particular the three main groups of porous materials: porous metals, porous ceramics, and polymer foams. Beginning with a general introduction to porous materials, the next six chapters focus on the processing and applications of each of the three main materials groups. The book includes such new processes as gel-casting and freeze-drying for porous ceramics and self-propagating high temperature synthesis (SHS) for porous metals. The applications discussed are relevant to a wide number of fields and industries, including aerospace, energy, transportation, construction, electronics, biomedical and others. The book concludes with a chapter on characterization methods for some basic parameters of porous materials. Porous Materials: Processing and Applications is an excellent resource for academic and industrial researchers in porous materials, as well as for upper-level undergraduate and graduate students in materials science and engineering, physics, chemistry, mechanics, metallurgy, and related specialties. A comprehensive overview of processing and applications of porous materials – provides younger researchers, engineers and students with the best introduction to this class of materials Includes three full chapters on modern applications - one for each of the three main groups of porous materials Introduces readers to several characterization methods for porous materials, including methods for characterizing pore size, thermal conductivity, electrical resistivity and specific surface area

Nanostructured materials with tailored properties are regarded as a fundamental

element in the development of future science and technology. Research is still ongoing into the nanosized construction elements required to create functional solids. The recently developed technique, nanocasting, has great advantage over others in terms of the synthesis of special nanostructured materials by the careful choice of suitable elements and nanoengineering steps. This new book summarizes the recent developments in nanocasting, including the principles of nanocasting, syntheses of novel nanostructured materials, characterization methods, detailed synthetic recipes and further possible development in this area. The book focuses on the synthesis of porous solids from the viewpoint of methodology and introduces the science of nanocasting from fundamental principles to their use in synthesis of various materials. It starts by outlining the principles of nanocasting, requirements to the templates and precursors and the tools needed to probe matter at the nanoscale level. It describes how to synthesize nano structured porous solids with defined characteristics and finally discusses the functionalization and application of porous solids. Special attention is given to new developments in this field and future perspectives. A useful appendix covering the detailed synthetic recipes of various templates including porous silica, porous carbon and colloidal spheres is included which will be invaluable to researchers wanting to follow and reproduce nanocast materials. Topics covered in the book include: * inorganic chemistry * organic chemistry * solution chemistry * sol-gel and interface science * acid-base equilibria * electrochemistry * biochemistry * confined synthesis The book gives readers not only an overview of nanocasting technology, but also sufficient information and knowledge for those wanting to prepare various nanostructured materials without needing to search the available literature.

Today, calorimetry is considered an art (although some consider it a tool) that studies the energy changes that occur during a change of state. This allows physicochemical analysis to study in detail the thermodynamic systems and to evaluate the different variables that establish the characteristics of the system itself. This book illustrates how the reader can use this technique in a wide spectrum of applications.

This book is written in honor of Prof. Francisco Rodriguez-Reinoso, who has made significant contributions in the area of porous materials such as active carbons and graphenes. It details the preparation of porous materials, including carbonaceous, zeolitic, and siliceous materials, MOFs, aerogels, and xerogels, describing the characterization techniques and the interpretation of the results, and highlighting common errors that can occur during the process. This book subsequently presents the use of modeling based on thermodynamics to describe the materials. Lastly, it illustrates a number of current environmental protection applications in the context of both water and air.

The 7th International Symposium on the Characterization of Porous Solids (COPS-VII) was held in the Congress Centre in Aix-en-Provence between the 25th-28th May 2005. The symposium covered recent results of fundamental and applied research on the characterization of porous solids. Papers relating to characterization methods such as gas adsorption and liquid porosimetry, X-ray techniques and microscopic measurements as well as the corresponding molecular modelling methods were given. These characterization methods were shown to be applied to all types of porous solids such as clays, carbons, ordered mesoporous materials, porous glasses, oxides, zeolites and metal organic frameworks. * 36 oral presentations and 166 posters and

around 230 guests from 27 countries. * A large part of this symposium was devoted to the use computational methods to characterise porous solids

This innovative reference collects state-of-the-art procedures for the construction and design of nanoparticles and porous material while suggesting appropriate areas of application. Presenting both synthesis and characterization protocols, Surfaces of Nanoparticles and Porous Materials contains over 3000 references, tables, equations, drawings, and photographs. It examines the thermodynamics and kinetics of adsorption involving organic and inorganic liquids, solids, and gaseous media.. Topics include characterization, transport processes, diffusion, and the adsorption of heavy metals, ions, proteins, and pharmaceutical organics.

The developments in the area of ordered nanoporous solids have moved beyond the traditional catalytic and separation uses and given rise to a wide variety of new applications in different branches of chemistry, physics, material science, etc. The activity in this area is due to the outstanding properties of nanoporous materials that have attracted the attention of researchers from different communities. However, recent achievements in a specific field often remain out of the focus of collaborating communities. This work summarizes the latest developments and prospects in the area of ordered porous solids, including synthetic layered materials (clays), microporous zeolite-type materials, ordered mesoporous solids, metal-organic-framework compounds (MOFs), carbon, etc. All aspects, from synthesis via comprehensive characterization to the advanced applications of ordered porous materials, are presented. The chapters are written by leading experts in their respective fields with an emphasis on recent progress and the state of the art. * Summarizes the latest developments in the field of ordered nanoporous solids * Presents state-of-the-art coverage of applications related to porous solids * Incorporates 28 contributions from experts across the disciplines

Having successfully replaced elements used in traditional, pollution-prone, energy-consuming separation processes, nanoporous materials play an important role in chemical processing. Although their unique structural or surface physicochemical properties can, to an extent, be tailored to meet specific process-related requirements, the task of charac

The Second IUPAC Symposium on the Characterization of Porous Solids (COPS-II) provided the opportunity for detailed discussion and appraisal of the most important techniques currently used for the characterization of porous materials, especially those of technological importance. The 82 selected papers and reviews contained in this volume are mainly concerned with the theoretical and experimental aspects of adsorption, fluid penetration, small-angle scattering and spectroscopic methods with their application in the study of adsorbents, catalysts, constructional materials, etc. Particular attention is given to the characterization of carbons, oxides, zeolites, clays, cement and polymers. The wide range of materials and techniques described in this book provide a useful and comprehensive reference source for academic and industrial scientists and technologists.

The objectives of the Third IUPAC Symposium on the Characterization of Porous Solids (COPS-III) were (1) to provide the opportunity for specialists to exchange ideas and new information on theoretical principles and methodology and (2) to generate proposals for the comparison and utilization of the many techniques now available for the characterization of porous solids. A successful outcome of the Symposium has been the final report of the IUPAC Subcommittee on "Recommendations for the Characterization of Porous Solids", a summary of

which is given in these proceedings. The edited papers included in the present volume have been selected from the 155 oral and poster presentations given at this symposium, which attracted 200 participants from 28 different countries. The following topics were discussed:1. Simulation and modelling of pore structures and pore-filling mechanisms2. Novel experimental techniques with particular reference to high-resolution techniques3. Model pore structures and reference materials4. Porous materials of technological importance. The wide range of materials and techniques described provide a useful and comprehensive reference source for academic and industrial scientists and technologists.--[Source inconnue].

This first book devoted to this hot field of science covers materials with bimodal, trimodal and multimodal pore size, with an emphasis on the successful design, synthesis and characterization of all kinds of hierarchically porous materials using different synthesis strategies. It details formation mechanisms related to different synthesis strategies while also introducing natural phenomena of hierarchy and perspectives of hierarchical science in polymers, physics, engineering, biology and life science. Examples are given to illustrate how to design an optimal hierarchically porous material for specific applications ranging from catalysis and separation to biomedicine, photonics, and energy conversion and storage. With individual chapters written by leading experts, this is the authoritative treatment, serving as an essential reference for researchers and beginners alike.

With the increasing role of porous solids in conventional and newly emerging technologies, there is an urgent need for a deeper understanding of fluid behaviour confined to pore spaces of these materials especially with regard to their transport properties. From its early years, NMR has been recognized as a powerful experimental technique enabling direct access to this information. In the last two decades, the methodological development of different NMR techniques to assess dynamic properties of adsorbed ensembles has been progressed. This book will report on these recent advances and look at new broader applications in engineering and medicine. Having both academic and industrial relevance, this unique reference will be for specialists working in the research areas and for advanced graduate and postgraduate studies who want information on the versatility of diffusion NMR.

The importance of porosity has long been recognized by scientists and engineers. Porous solids are widely encountered in industry and everyday life and their behaviour, e.g. chemical reactivity, adsorptive capacity, and catalytic activity is dependent on their pore structure. A considerable amount of work on porous solids has been undertaken both in academic and in industrial laboratories. However, all this activity is in urgent need of a critical appraisal. To undertake this task, a number of leading experts in the field of adsorption, porosimetry, X-ray and neutron scattering, optical and electron microscopy, calorimetry and fluid permeation, were brought together at the 1987 IUPAC (COPS I) Symposium. This proceedings volume provides an up-to-date overall review of the theoretical foundations for modelling and characterizing porous systems. It deals with most of the techniques in current use as applied to both model systems and porous solids of industrial importance. The reader will find the description and discussion of a number of novel techniques as well as a critical appraisal and comparison of the more established methods. All those concerned with the characterization of porous solids in academic and industrial laboratories will find much to interest them in this volume. It should be on the bookshelf of applied research centres involved in adsorption, catalysis, purification of gases and liquids, pigments, fillers, building materials, etc.

The papers included in this issue of ECS Transactions were originally presented in the symposium ¿Characterization of Porous Materials¿, held during the 213th meeting of The Electrochemical Society, in Phoenix, Arizona from May 18 to 23, 2008.

This book contains 99 of the papers that were presented at the 6th in the series of Symposia on Characterization of Porous Solids held in Alicante, Spain, May

2002. Written by leading international specialists in the subject, the contributions represent an up-to-date and authoritative account of recent developments around the world in the major methods used to characterize porous solids. The book is a useful work of reference for anyone interested in characterizing porous solids, such as MCM-41 mesoporous materials, pillared clays, etc. Papers on pore structure determination using gas adsorption feature strongly, together with papers on small angle scattering methods, mercury porosimetry, microcalorimetry, scanning probe microscopies, and image analysis.

Characterisation of Porous Solids IV provides an up-to-date survey on both theoretical and applied aspects of this important topic in one comprehensive volume. Covering international research, many areas of this multidisciplinary subject are covered in detail, including computer simulation methods applied to porous solids and aspects of model mesoporous solids such as MCM-41. As well as insights into state-of-the-art research, an indication of the likely directions of future developments is also given. While of specific interest to materials scientists, chemists and chemical engineers, Characterisation of Porous Solids IV will also have a wider appeal to scientists and engineers whose work, either directly or indirectly, involves the study or use of porous solids.

The declared objective of this book is to provide an introductory review of the various theoretical and practical aspects of adsorption by powders and porous solids with particular reference to materials of technological importance. The primary aim is to meet the needs of students and non-specialists who are new to surface science or who wish to use the advanced techniques now available for the determination of surface area, pore size and surface characterization. In addition, a critical account is given of recent work on the adsorptive properties of activated carbons, oxides, clays and zeolites. Provides a comprehensive treatment of adsorption at both the gas/solid interface and the liquid/solid interface Includes chapters dealing with experimental methodology and the interpretation of adsorption data obtained with porous oxides, carbons and zeolites Techniques capture the importance of heterogeneous catalysis, chemical engineering and the production of pigments, cements, agrochemicals, and pharmaceuticals

This four-volume handbook gives a state-of-the-art overview of porous materials, from synthesis and characterization and simulation all the way to manufacturing and industrial applications. The editors, coming from academia and industry, are known for their didactic skills as well as their technical expertise. Coordinating the efforts of 37 expert authors in 14 chapters, they construct the story of porous carbons, ceramics, zeolites and polymers from varied viewpoints: surface and colloidal science, materials science, chemical engineering, and energy engineering. Volumes 1 and 2 cover the fundamentals of preparation, characterisation, and simulation of porous materials. Working from the fundamentals all the way to the practicalities of industrial production processes, the subjects include hierarchical materials, in situ and operando characterisation

using NMR, X-Ray scattering and tomography, state-of-the-art molecular simulations of adsorption and diffusion in crystalline nanoporous materials, as well as the emerging areas of bio-artificing and drug delivery. Volume 3 focuses on porous materials in industrial separation applications, including adsorption separation, membrane separation, and osmotic distillation. Finally, and highly relevant to tomorrow's energy challenges, Volume 4 explains the energy engineering aspects of applying porous materials in supercapacitors, fuel cells, batteries, electrolysers and sub-surface energy applications.The text contains many high-quality colourful illustrations and examples, as well as thousands of up-to-date references to peer-reviewed articles, reports and websites for further reading. This comprehensive and well-written handbook is a must-have reference for universities, research groups and companies working with porous materials.Related Link(s)

Characterization of Liquids, Dispersions, Emulsions and Porous Materials Using Ultrasound, Third Edition, presents a scientific background for novel methods of characterizing homogeneous and heterogeneous liquids (dispersions, emulsions, and gels) as well as porous materials. Homogeneous liquids are characterized in rheological terms, whereas particle-size distribution and zeta potential are parameters of heterogeneous liquids. For porous materials, porosity, pore size, and zeta potential are output characteristics. These methods are based on ultrasound, which opens an opportunity for simplifying the sample preparation by eliminating dilution. This in turn, makes measurements faster, easier, precise, suitable for accurate quality control, PAT, and formulation of complex systems. This book provides theoretical background of acoustics, rheology, colloid science, electrochemistry, and other relevant scientific fields, describing principles of existing instrumentation and, in particular, commercially available instruments. Finally, the book features an extensive list of existing applications. Presents a theoretical multi-disciplinary background of several new ultrasound analytical techniques in one place Validates the theoretical basis of several new analytical techniques Compares the efficiency and applications of various ultrasound techniques Lists many ultrasound applications in colloid chemistry Contains an extensive bibliography on this multidisciplinary topic

Characterization of Porous Solids and Powders: Surface Area, Pore Size and DensitySpringer Science & Business Media

The growth of interest in newly developed porous materials has prompted the writing of this book for those who have the need to make meaningful measurements without the benefit of years of experience. One might consider this new book as the 4th edition of "Powder Surface Area and Porosity" (Lowell & Shields), but for this new edition we set out to incorporate recent developments in the understanding of fluids in many types of porous materials, not just powders. Based on this, we felt that it would be prudent to change the title to "Characterization of Porous Solids and Powders: Surface Area, Porosity and Density". This book gives a unique overview of principles associated with the

characterization of solids with regard to their surface area, pore size, pore volume and density. It covers methods based on gas adsorption (both physi and chemisorption), mercury porosimetry and pycnometry. Not only are the theoretical and experimental basics of these techniques presented in detail but also, in light of the tremendous progress made in recent years in materials science and nanotechnology, the most recent developments are described. In particular, the application of classical theories and methods for pore size analysis are contrasted with the most advanced microscopic theories based on statistical mechanics (e.g. Density Functional Theory and Molecular Simulation). The characterization of heterogeneous catalysts is more prominent than in earlier editions; the sections on mercury porosimetry and particularly chemisorption have been updated and greatly expanded.

The first comprehensive textbook on the timely and rapidly developing topic of inorganic porous materials This is the first textbook to completely cover a broad range of inorganic porous materials. It introduces the reader to the development of functional porous inorganic materials, from the synthetic zeolites in the 50's, to today's hybrid materials such as metal-organic frameworks (MOFs), covalent organic frameworks (COFs) and related networks. It also provides the necessary background to understand how porous materials are organized, characterized, and applied in adsorption, catalysis, and many other domains. Additionally, the book explains characterization and application from the materials scientist viewpoint, giving the reader a practical approach on the characterization and application of the respective materials. Introduction to Inorganic Porous Materials begins by describing the basic concepts of porosity and the different types of pores, surfaces, and amorphous versus crystalline materials, before introducing readers to nature's porous materials. It then goes on to cover everything from adsorption and catalysis to amorphous materials such as silica to inorganic carbons and Periodic Mesoporous Organosilicas (PMOs). It discusses the synthesis and applications of MOFs and the broad family of COFs. It concludes with a look at future prospects and emerging trends in the field. The only complete book of its kind to cover the wide variety of inorganic and hybrid porous materials A comprehensive reference and outstanding tool for any course on inorganic porous materials, heterogeneous catalysis, and adsorption Gives students and investigators the opportunity to learn about porous materials, how to characterize them, and understand how they can be applied in different fields Introduction to Inorganic Porous Materials is an excellent book for students and professionals of inorganic chemistry and materials science with an interest in porous materials, functional inorganic materials, heterogeneous catalysis and adsorption, and solid state characterization techniques.

This book gives a unique overview of principles associated with the characterization of solids with regard to their surface area, pore size and density. The book covers methods based on Gas Adsorption (Physi- and Chemisorption), Mercury Porosimetry and Pycnometry. Not only are the theoretical and

experimental basics of these techniques described, but also the most recent developments, particularly in light of the tremendous progress made in recent years in Materials Science and Nanotechnology. The application of classical theories and methods for pore size analysis are discussed in contrast with the most advanced microscopic theories based on statistical mechanics (e.g. Density Functional Theory and Molecular Simulation). The book will appeal both to students and to scientists in industry who are in need of accurate and comprehensive pore and surface area characterization of their materials.

This unique book is the Proceedings of the 8th International Symposium on the Characterisation of Porous Solids, known also as "COPS VIII". The conference is one of a series, held every three years, which covers developments in methods for the characterisation of porous materials, and applications of those methods. The scope of the conference: COPS VIII is concerned with fundamental and applied research on the characterisation of the structure of porous materials, and the relationship between structure and material performance. The scope includes experimental characterisation methods such as X-Ray diffraction, NMR, adsorption, mercury intrusion, and calorimetry; theoretical and simulation methods used to interpret experimental data, such as molecular simulation, classical and statistical mechanical theory, and pore network modelling; and applied research on the impact of measured material properties on performance in applications.