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This volume comprises the proceedings of the International Symposium on Zeolites and Microporous Crystals (ZMPC '93). At this meeting progress in the following areas was discussed: crystal chemistry; synthesis; ion exchange and modification; adsorption and diffusion; intercalation and cross-linking; host-guest interaction; catalysis; applications.

This comprehensive manual covers the main aspects of ion exchangers in chemistry, technical chemistry, and chemical engineering. It is a new edition of Dorfner's Ion exchangers--properties and applications (1972) which was the English translation of the German Ionenaustauscher (de Gruyter, Berlin, 1970). This edition is being issued directly in English in order to most effectively communicate with the international scientific and technical community. Applications of ion exchange technology have extended far beyond water treatment, and coverage here includes progress in such industries as sugar refining, purification of pharmaceuticals, hydrometallurgy (where knowledge of the use of ion exchange technology for uranium and copper hydrometallurgy has been upgraded, but the market for uranium and copper has deteriorated), solvent purification, catalysis, agriculture, medicine, and waste treatment. Chapters are self-contained, and a number introduce the field for beginners. Synthetic ion exchange resins are defined and discussed as reactive polymers. Appendices list

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commercial ion exchange materials and their sources of supply and provide computing tables for practical application. Despite de Gruyter's diligent efforts to use acid-free paper, this essential volume is printed on decidedly acidic paper. Annotation copyrighted by Book News, Inc., Portland, OR

Progress in Filtration and Separation contains reference content on fundamentals, core principles, technologies, processes, and applications. It gives detailed coverage of the latest technologies and research, models, applications and standards, practical implementations, case studies, best practice, and process selection. Extensive worked examples are included that cover basic calculations through to process design, including the effects of key variables. Techniques and topics covered include pervaporation, electro dialysis, ion exchange, magnetic (LIMS, HIMS, HGMS), ultrasonic, and more. Solves the needs of university based researchers and R&D engineers in industry for high-level overviews of sub-topics within the solid-liquid separation field Provides insight and understanding of new technologies and methods Combines the expertise of several separations experts

For centuries we have known that fruit is important for health, but we are only just beginning to fully understand why. Bioactives in Fruit: Health Benefits and Functional Foods aims to summarise some of our current knowledge on the bioactive compounds that are associated with the health benefits of specific fruits with a strong emphasis on the validation of health benefits by human intervention trials. Reflecting the current interest in food and health, the book includes strategies to retain and enhance the bioactives in fruit through breeding, growing conditions, fruit storage, processing into ingredients and production of functional foods. To accomplish this task authors with expertise in biology, chemistry, pharmacology, food science, nutrition, medicine, and horticulture have contributed. They come from

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universities, government and industry funded research institutes and biotechnology and food companies in Europe, the United States, Asia and New Zealand to give the book a broad perspective. This book, describing fruit bioactives, their health benefits when consumed as a food and related topics regarding their development into fresh or processed functional foods, will be of use to postgraduate students, researchers, functional food product developers, food regulators and anyone who has curiosity about why fruit is good for you. The information contained within will provide plant breeders with new targets for the development of value-added horticultural products, and will also provide nutritionists and dieticians with a useful resource for developing strategies to assist in preventing or slowing disease onset or severity. Bioactives in Fruit: Health Benefits and Functional Foods is a major resource which will be required reading for anyone working in the fields of health and functional foods.

This volume, Applied Chemistry and Chemical Engineering, Volume 5: Research Methodologies in Modern Chemistry and Applied Science, is designed to fulfill the requirements of scientists and engineers who wish to be able to carry out experimental research in chemistry and applied science using modern methods. Each chapter describes the principle of the respective method, as well as the detailed procedures of experiments with examples of actual applications. Thus, readers will be able to apply the concepts as described in the book to their own experiments. This book traces the progress made in this field and its sub-fields and also highlight some of the key theories and their applications and will be a valuable resource for chemical engineers in Materials Science and others.

Low dimensionality is a multifarious concept which applies to very diversified materials. Thus, examples of low-dimensional systems are structures with one or several layers, single lines

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or patterns of lines, and small clusters isolated or dispersed in solid systems. Such low dimensional features can be produced in a wide variety of materials systems with a broad spectrum of scientific and practical interests. These features, in turn, induce specific properties and, particularly, specific transport properties. In the case of zeolites, low dimensionality appears in the network of small-diameter pores of molecular size, extending in one, two or three dimensions, that these solids exhibit as a characteristic feature and which explains the term of "molecular sieves" currently used to name these materials. Indeed, a large number of industrial processes for separation of gases and liquids, and for catalysis are based upon the use of this low dimensional feature in zeolites. For instance, zeolites constitute the first class of catalysts employed all over the world. Because of the peculiarity and flexibility of their structure (and composition), zeolites can be adapted to suit many specific and diversified applications. For this reason, zeolites are presently the object of a large and fast-growing interest among chemists and chemical engineers.

Zeolites are hydrated aluminosilicate minerals of the family of microporous solids. According to the US Geological Survey, there are about 40 naturally occurring zeolites, forming in sedimentary and volcanic rocks. The most commonly mined forms include clinoptilolite, chabazite and mordenite. There are over 200 synthetic zeolites. For their abundance, natural and synthetic zeolites are widely used in the industry, agriculture, water treatment, wastewater treatment and as dietary supplements to treat diarrhea, autism, cancer and other. This book *Zeolites and Their Applications* deals with several aspects of zeolite morphology, synthesis and applications. The book is divided into three sections and structured into nine chapters. The first section includes the introductory chapter, the second section explains mineralogy,

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morphology and synthesis of zeolites and the third section focuses on the different applications of both natural and synthetic zeolites. So, in this book, the readers will obtain updated information on mineralogy, morphology, synthesis and application of zeolites. Scientists from different scientific fields reported in this book their findings.

Nanomaterials for the Detection and Removal of Wastewater Pollutants assesses the role of nanotechnology and nanomaterials in improving both the detection and removal of inorganic and organic contaminants from wastewater that originates from municipal and industrial plants. The book covers how nanotechnology is being used to remove common contaminants, including dyes, chlorinated solvents, nitrites/nitrates, and emerging contaminants, such as pharmaceuticals, personal care products and pesticides. Sections cover nanofiltration, adsorption and remediation. Nanomaterial immobilization recovery is also addressed, along with the quantification of heat/mass transport limitations, sizing aspects and transport phenomena. Finally, regulatory aspects regarding contaminants and nanoparticles in the environment are covered. This book is an important resource for both materials scientists and environmental scientists looking to see how nanotechnology can play a role in making wastewater a less hazardous part of the global ecosystem. Addresses the role of new nanotechnology-based solutions for the detection and removal of common and emerging contaminants

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Discusses the environmental impact of nanoparticles used in wastewater contaminant detection and removal Explores the major challenges for using nanomaterials to detect and remove contaminants from wastewater

Fundamentals of Adsorption contains 2 plenary lectures and 96 selected papers from the IVth International Conference, Kyoto, May, 1992. The topics cover a wide range of studies from fundamentals to applications: characterization of porous adsorbents, molecular simulation, adsorption isotherms, diffusion in adsorbents, breakthrough detection, chromatography, pressure swing operation, etc. Model studies on adsorption, surface characterization, microporosimetry, molecular simulations of equilibrium and diffusion, computer simulation of adsorption beds, and many theoretical studies are also included. Special attention is given to: bulk gas separation and purification, solvent recovery, bioproduct separation, environmental pollution control, methane storage, adsorption cooling and resources recovery.

Introduction to Zeolite Molecular Sieves, 3rd Edition presents a collection of the most important results and ideas in the field of molecular sieve chemistry and technology, the most important experimental techniques related to the research activities in molecular sieves, and identifies new areas of molecular sieve chemistry. Chapters start at a

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reasonably simple entry level, but also covers the present state-of-the-art in the field. Topics covered include structure, synthesis, characterization, ion exchange, adsorption, diffusion, separations, and natural zeolites. * 6 years since the last edition this book brings together the rapid development within the field of molecular sieve chemistry and applications * Accessible to newcomers to the field, also containing valuable information for experienced researchers * 27 chapters written by renowned scientists in their field, including updates on some 2nd edition chapters

Ion-exchange Technology II: Applications presents an overview of the numerous industrial applications of ion-exchange materials. In particular, this volume focuses on the use of ion-exchange materials in various fields including chemical and biochemical separations, water purification, biomedical science, toxic metal recovery and concentration, waste water treatment, catalysis, alcohol beverage, sugar and milk technologies, pharmaceuticals industry and metallurgical industries. This title is a highly valuable source not only to postgraduate students and researchers but also to industrial R&D specialists in chemistry, chemical, and biochemical technology as well as to engineers and industrialists.

Zeolites have been the focus of intensive activity and growth in applications over the past 25 years in ion exchange, in adsorption and in catalytic process

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technology. Beginning with the synthetic zeolites A, X and Y, continuing into the emerging ZSM series, and including selected natural zeolites, applications span the range from large-scale purification and separation to such major petroleum and petrochemical processes as catalytic cracking and aromatics alkylation. The future promises several new areas of significant use as our energy resource base is expanded. As a result, a NATO Advanced Study Institute on Zeolites was held in Alcabideche, Portugal, May 1-12, 1983. Its purpose was to summarize the state-of-the-art in zeolite science and technology, with particular emphasis on recent developments. This summary is intended to complement presentations of the latest research results at the 1983 International Zeolites Association meeting in Reno, Nevada - USA. Both the fundamentals concepts and industrial applications are addressed in the lectures of the Institute. Individual chapters cover historical development, structure, crystallography and synthesis techniques. Basic principles of adsorption, diffusion, ion exchange and acidity are reviewed. A section on catalysis addresses shape selectivity, transition metals, bifunctional catalysis and "methanol to-gasoline". Included in the section on industrial applications are chapters on reactor and adsorber design, catalytic cracking, xylene and n -paraffins isomerization, as well as ion exchange and

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This book contains information about the technological development of ion exchange in their application for industrial processes. Widely used and well known fields of ion exchange like chromatography and electromembrane technology are described in this book with experimental details. Designing new materials for nanotechnology and nanomaterials as ion exchanger are also explained by experimental proofs. Ion exchange book is suitable not only for postgraduate students but also for researchers in chemistry, biochemistry and chemical technology.

This book presents the applications of ion-exchange materials in the chemical and food industries. It includes topics related to the application of ion exchange chromatography in water softening, purification and separation of chemicals, separation and purification of food products and catalysis. This title is a highly valuable source of knowledge on ion-exchange materials and their applications suitable for postgraduate students and researchers but also to industrial R&D specialists in chemistry, chemical, and biochemical technology. Additionally, this book will provide an in-depth knowledge of ion-exchange column and operations suitable for engineers and industrialists.

Due to increasing demand for potable and irrigation water, water suppliers have to use alternative resources.

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They either have to regenerate wastewater or deal with contaminated surface water. This book brings together the experiences of various experts in preparing of innovative materials that are selective for arsenic and chromium removal, and in

The aim of these volumes is not to cover all phases of ion-exchange theory, which may be found in general texts, nor to cover every application in the literature, or to show an engineer ways on how to become an expert in the field so he could do it all by himself. The main purpose of these books is to show the practical engineer what has been done in various types of applications of ion-exchange processes in pollution control, how to set up laboratory tests, the problems that may be encountered to identify the individuals and organizations who are experts in the various phases of ion exchange, and most importantly, to emphasize the new developments in the polymers with active sites that offer new approaches to wastewater treatment methods.

Environment and Development: Basic Principles, Human Activities, and Environmental Implications focuses on the adverse impact that human activities, developments, and economic growth have on both natural and inhabited environments. The book presents the associated problems, along with solutions that can be used to achieve a harmonic, sustainable development that provides for the co-existence of man and natural life.

Chapters provide detailed information on a range of environments including: atmospheric, aquatic, soil, natural, urban, energy, and extraterrestrial, as well as the relationship between the environment and development.

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In addition, this comprehensive book presents the latest research findings and trends in global environmental policy for each issue. Offers a discussion of the extraterrestrial environment and waste in earth orbit as one of the distinctive topics of the book Addresses global environmental policy issues and policies Presents tabulated data to support the analysis and explain the issues presented Includes case studies covering many topics of current interest Analyzes environmental issues and proposes solutions grounded in recent research findings Discusses the various interpretations of the development concept as well as alternative pathways to sustainable development

Now in its 3rd Edition, Industrial Catalysis offers all relevant information on catalytic processes in industry, including many recent examples. Perfectly suited for self-study, it is the ideal companion for scientists who want to get into the field or refresh existing knowledge. The updated edition covers the full range of industrial aspects, from catalyst development and testing to process examples and catalyst recycling. The book is characterized by its practical relevance, expressed by a selection of over 40 examples of catalytic processes in industry. In addition, new chapters on catalytic processes with renewable materials and polymerization catalysis have been included. Existing chapters have been carefully revised and supported by new subchapters, for example, on metathesis reactions, refinery processes, petrochemistry and new reactor concepts. "I found the book accessible, readable and interesting - both as a refresher and as an introduction to new topics - and a

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convenient first reference on current industrial catalytic practise and processes." Excerpt from a book review for the second edition by P. C. H. Mitchell, Applied Organometallic Chemistry (2007)

Widely used in adsorption, catalysis and ion exchange, the family of molecular sieves such as zeolites has been greatly extended and many advances have recently been achieved in the field of molecular sieves synthesis and related porous materials. Chemistry of Zeolites and Related Porous Materials focuses on the synthetic and structural chemistry of the major types of molecular sieves. It offers a systematic introduction to and an in-depth discussion of microporous, mesoporous, and macroporous materials and also includes metal-organic frameworks. Provides focused coverage of the key aspects of molecular sieves Features two frontier subjects: molecular engineering and host-guest advanced materials Comprehensively covers both theory and application with particular emphasis on industrial uses This book is essential reading for researches in the chemical and materials industries and research institutions. The book is also indispensable for researches and engineers in R&D (for catalysis) divisions of companies in petroleum refining and the petrochemical and fine chemical industries.

The objectives of this program are to study the application of catalysts and the catalysis of liquefaction of low rank coals. Ion exchange and adsorption techniques are being used or modified to incorporate catalytically active metals (Fe, Co, Ni and Mo) in relatively small (100-2000 ppM) quantities into coal

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samples. Relative oil yields are being determined by PETC and Auburn University workers as collaborators to establish the effectiveness of the catalyst incorporation techniques. It is hoped that these techniques will provide highly active forms of the catalyst in low concentrations to minimize the need for metals recovery. A two step preparation of the coal is used to (1) remove material which both limits oil conversion and prepares for the addition of exchangeable catalyst, and (2) add catalytically active material which enhances the conversion of the coal matter to the oil fraction in the processing.

In recent years, the area dealing with the physical chemistry of materials has become an emerging discipline in materials science that emphasizes the study of materials for chemical, sustainable energy, and pollution abatement applications. Written by an active researcher in this field, *Physical Chemistry of Materials: Energy and Environmental Appl*

Zeolites are crystalline inorganic solids that are industrially used for adsorption, ion exchange and catalysis. As catalysts, they have been particularly successful in the hydrocarbon processing industry due to their unique activities and selectivities. Zeolites are mainly used in acid catalyzed reactions, but their catalytic functionality can be diversified through the incorporation of elements that are traditionally not part of their framework. The incorporation of various elements has been studied in recent decades resulting in zeolites with potential to perform different chemistries or improve catalytic performance in existing ones. However, many of these investigations have been conducted under conditions that do not necessarily represent realistic scenarios for industrial

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implementation. The main objective of this dissertation was to study the single and simultaneous framework incorporation of tin, boron, germanium and aluminum in MFI zeolites under synthesis conditions that are more in line with industrial preparations. These include the use of mixtures in alkaline media with high concentration of precursor species. The interest on tin resides on its potential for Lewis acid catalysis, while boron and germanium have potential for modulating acid strength and enhancing catalytic properties respectively. Three specific systems were studied: MFI zeolites with simultaneous incorporation of germanium and aluminum (i.e. Ge-Al-MFI zeolites), MFI zeolites with simultaneous incorporation of germanium and boron (i.e. B-Ge-MFI zeolites), and MFI zeolites with single incorporation of tin (i.e. Sn-MFI zeolites). Systematic synthesis experiments were coupled with extensive analytical characterization in order to assess how element incorporation and zeolite physicochemical properties are affected by synthesis conditions. In addition, the catalytic activity of Sn-MFI zeolites for the hydroxylation of phenol was studied. The general conclusion from this work is that framework incorporation of these elements is highly influenced by pH, mixture composition and the presence of sodium cations. Sodium cations are commonly included in industrial preparations through the use of sodium hydroxide, but they were found to negatively affect framework incorporation due to a tendency to form stable extra-framework impurities with the heteroatoms, especially germanium and tin. pH and mixture composition are particularly influential in controlling germanium and boron incorporation, while the incorporation of tin, its coordination environment and catalytic performance were found to depend on synthesis conditions as well as post-synthesis treatments. The electronic version of this dissertation is accessible from

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<http://hdl.handle.net/1969.1/148180>

Ion-exchange Technology I: Theory and Materials describes the theoretical principles of ion-exchange processes. More specifically, this volume focuses on the synthesis, characterization, and modelling of ion-exchange materials and their associated kinetics and equilibria. This title is a highly valuable source not only to postgraduate students and researchers but also to industrial R&D specialists in chemistry, chemical, and biochemical technology as well as to engineers and industrialists.

Zeolites are attracting a great deal of attention in various fields of science and technology. Many exciting new developments have occurred in their industrial application and these developments have in turn inspired much new significant fundamental research. This proceedings volume, containing 121 contributed papers, an introductory talk, two plenary lectures and nine invited lectures, is valuable not only for the quantity but also for the high quality and originality of the contents. The topics addressed cover all fields of science and technology related to natural and synthetic zeolites, namely: mineralogy, geology, structure, synthesis, ion-exchange and modification, sorption, catalysis, and technical applications (including agricultural uses). The numerous new results and concepts presented and the particularly timely publication of the volume make it a must for all involved with zeolites.

Analytical Chemistry, Volume 38: Ion Exchange in Analytical Chemistry provides a broad survey of the important role that ion exchange can and should play in chemical analysis. This book focuses on the plate-equilibrium theory of chromatography, which is less difficult theoretically than the mass-transfer theory. Organized into 11 chapters, this volume begins with an overview of the earliest recorded application of ion exchange. This text then examines how high temperature

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affects ion-exchange resins. Other chapters consider the exchange of ions between a solid ion-exchanging material and a solution, which is a typically reversible reaction. This book describes as well the relatively simple separations and other applications of ion exchange to analytical chemistry. The final chapter deals with the interesting nature of the metal complexes formed within the exchanger and describe the use of ion-exchange distribution studies to determine the stability and nature of complexes existing in the solution. This book is a valuable resource for analytical chemists.

There has been a lack of authoritative, current information on the structure, investigation and preparation of inorganic sorbents, their numerous applications as well as the adsorption from gaseous and liquid phases on new and chemically modified inorganic solids. This volume deals with the above-mentioned themes and presents 34 up-to-date comprehensive and critical reviews written by well-recognized authorities. The sorbents discussed are primarily mineral ones. Each contribution treats a problem critically by showing its development, presenting documentation on the state-of-the-art and identifying subjects for further research. The book will be of interest to researchers in academic institutes and industrial laboratories engaged in the fields of surface chemistry, inorganic chemistry, adsorption, ion-exchange, catalysis, chromatography and spectroscopy of the surface phenomena, as well as to students attending graduate and postgraduate courses.

Pollution of waters by toxic metals is accelerating worldwide due to industrial and population growth, notably in countries having poor environmental laws, resulting in many diseases such as cancer. Classical remediation techniques are limited. This books reviews new, advanced or improved techniques for metal removal, such as hybrid treatments, nanotechnologies and unconventional adsorbents, e.g. metal-

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organic frameworks. Contaminants include rare earth elements, arsenic, lead, cadmium, chromium, copper and effluents from the electronic, textile, agricultural and pharmaceutical industries.

"Handbook of Natural Zeolites provides a comprehensive and updated summary of all important aspects of natural zeolites science and technology. The e-book contains four sections covering the relevant scientific background, established technologies, recent "

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Adsorption, Ion Exchange and Catalysis is essentially a mixture of environmental science and chemical reactor engineering. More specifically, three important heterogeneous processes, namely, adsorption, ion exchange and catalysis, are analysed, from fundamental kinetics to reactor design with emphasis on their environmental applications. In Chapter 1, the subject of air and water pollution is dealt with. Data about pollutants and emission sources are given and the treatment methods are shortly presented. In Chapter 2, the very basics and historical development of adsorption, ion exchange and catalysis are presented as well as their environmental applications. Chapter 3 is devoted to heterogeneous processes and reactor analysis. All types of reactors are described in depth and reactor modelling, hydraulics and mass/heat transfer phenomena are examined for each type of reactor. Chapters 4 and 5 are dedicated to adsorption & ion exchange and catalysis, respectively. The basic principles are presented including kinetics, equilibrium, mass/heat transfer phenomena as well as the analytical solutions of the reactor models presented in Chapter 3. In the sixth chapter, the subject of scale up is approached. The two Annexes at the end of the book contain physical properties of substances of environmental interest as well as unit

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conversion tables. Finally, nearly all the examples contained are based on real experimental data found in literature with environmental interest. Most of the examples consider all aspects of operation design – kinetics, hydraulics and mass transfer. * Provides basic knowledge of major environmental problems and connects them to chemical engineering
This book is a printed edition of the Special Issue "Wastewater Treatment and Reuse Technologies" that was published in Applied Sciences

There is an increasing challenge for chemical industry and research institutions to find cost-efficient and environmentally sound methods of converting natural resources into fuels chemicals and energy. Catalysts are essential to these processes and the Catalysis Specialist Periodical Report series serves to highlight major developments in this area. This series provides systematic and detailed reviews of topics of interest to scientists and engineers in the catalysis field. The coverage includes all major areas of heterogeneous and homogeneous catalysis and also specific applications of catalysis such as NO_x control kinetics and experimental techniques such as microcalorimetry. Each chapter is compiled by recognised experts within their specialist fields and provides a summary of the current literature. This series will be of interest to all those in academia and industry who need an up-to-date critical analysis and summary of catalysis research and applications. Catalysis will be of interest to anyone working in academia and industry that needs an up-to-date critical analysis and summary of catalysis research and applications. Specialist Periodical Reports provide systematic and detailed review coverage in major areas of chemical research. Compiled by teams of leading experts in their specialist fields, this series is designed to help the chemistry community keep current with the latest developments in their field. Each volume in the series is published either annually or

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biennially and is a superb reference point for researchers.

This book covers a wide variety of topics related to advancements in different stages of mass transfer modelling processes. Its purpose is to create a platform for the exchange of recent observations, experiences, and achievements. It is recommended for those in the chemical, biotechnological, pharmaceutical, and nanotechnology industries as well as for students of natural sciences, technical, environmental and employees in companies which manufacture machines for the above-mentioned industries. This work can also be a useful source for researchers and engineers dealing with mass transfer and related issues. The proceedings of the 11th Zeolite Conference has been published in three volumes, containing 5 plenary lectures and 274 full papers. Part A comprises Synthesis and Characterization (99 papers), Part B Catalysis and Environment (102 papers) and Part C Adsorption and Diffusion, Modifications, Novel Materials and Theory (78 papers). Zeolite science and technology has been and continues to be an area receiving great attention. Increasing interest in the synthesis and the characterization of zeolite and microporous materials is reflected in the large number of contributions. Other areas gaining recognition include novel materials, adsorption, theory and modeling.

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