

# HANDBOOK OF ZEOLITE SCIENCE AND TECHNOLOGY

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# Preface

Zeolite science and technology continues to make rapid advances across several fronts, including synthesis, characterization, and novel applications. Although traditionally rooted in inorganic solid-state chemistry, modern zeolite science and technology cuts a wide swath through many fields, including organic and physical chemistry, reaction and fluid engineering, spectroscopy, and condensed matter physics, to name a few. On top of this, zeolite science and technology has its own complex and often inconsistent nomenclature. In 1974, the late Donald W. Breck wrote the book *Zeolite Molecular Sieves: Structure, Chemistry, and Use*, which demonstrated in one monograph the breadth of zeolite science and technology, and to this day is considered *the* textbook on zeolites. Although many excellent books and review articles have been written on the subject since then, there remains the need for single publications that provide comprehensive coverage, fundamental principles, and in-depth views of the current status of zeolite science and technology. This *Handbook of Zeolite Science and Technology* is our attempt to fill this void. We feel that the contents of this book will offer value to both the novice and the expert.

Zeolite-based catalysis remains one of the driving forces for the development of the field. As there are several excellent monographs in this area, however, we have decided to focus only on basic mechanistic aspects of catalysis, from both theoretical and experimental points of view. We also emphasize less traditional aspects of zeolites, including host–guest chemistry and novel applications, which will almost certainly contribute to developments in electronics, communications, medicine, and environmental science.

The book is divided into five parts. In Part I, [Chapter 1](#) offers a brief description of zeolites—their synthesis, characterization, and applications. Part II contains four chapters that focus on synthesis and structural aspects. Zeolite synthesis is an extremely broad area of research. [Chapter 2](#) focuses primarily on one framework: MFI (ZSM-5 and silicalite), probably the most extensively studied zeolite. [Chapter 3](#) deals with basic aspects of structural analysis. [Chapters 4](#) and [5](#) examine crystal growth from a theoretical, first-principle perspective, as well as from correlating experimental data with microscopic models of synthesis.

Part III deals with characterization of zeolites. Magnetic resonance spectroscopies are discussed in [Chapters 6](#) and [7](#), followed by electron microscopy in [Chapter 8](#). [Chapters 9](#) and [10](#) focus on adsorption and diffusion of molecules in zeolites—areas of considerable

importance in both condensed matter physics and practical applications of zeolites. [Chapter 11](#) covers vibrational spectroscopies.

Part IV deals with host–guest chemistry in zeolites. There is considerable interest in light-initiated chemical transformations of molecules in zeolites, and advances in this relatively new field are summarized in [Chapters 12](#) and [13](#). Also of recent vintage is the development of electrochemistry of molecules in zeolites, as discussed in [Chapter 14](#). [Chapter 15](#) focuses on chemical transformations in zeolites, which is central to zeolite catalysis, and explains recent trends in modeling reactivity within zeolites.

Part V, the largest part of the *Handbook*, covers applications. [Chapter 16](#) covers the important catalytic reaction of methanol conversion and details the latest mechanistic developments. [Chapter 17](#) discusses zeolitic membranes, now beginning to find important industrial applications. [Chapter 18](#) explores electronic materials based on zeolites, which are expected to play an important role in the next generation of electronic devices. [Chapters 19](#) and [20](#) discuss environmental applications of zeolites, primarily in emission control. [Chapters 21](#) and [22](#) outline the principles and practices of two important application areas: ion exchange and gas separation. [Chapter 23](#) explores the modeling of zeolite applications from an engineering perspective. [Chapter 24](#) demonstrates the potential medical applications of zeolites, some of which are just being realized.

In addition to facilitating cross-fertilization among different subfields of zeolite science and technology, we hope that this book welcomes the next generation of researchers into the field, to tackle problems in a remarkably exciting and fruitful subject.

We would like to take this opportunity to thank all the contributors to this *Handbook*—we hope they will be pleased to see that our collective venture is much greater than the sum of its parts. This is also an opportunity to thank the editors at Marcel Dekker, Inc.: Anita Lekhwani, who first saw the light, and Joe Stubenrauch and Karen Kwak for a most professional finish. We also thank our spouses (Sarah Auerbach, Joseph Gregar, and Lakshmi Dutta) for their support. Finally, though this book has been a labor of love for all concerned and its publication is a joyous event, we are saddened that Larry Kevan, a strong supporter of the project and a contributor to this volume, is no longer with us. Larry was an exceptional zeolite chemist and a very good friend—we miss him and dedicate this book to his memory.

*Scott M. Auerbach  
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Prabir K. Dutta*

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