

## BOOK REVIEWS

**Heterogeneous Catalysis in Industrial Practice, Second Edition.** BY CHARLES N. SATTERFIELD. McGraw-Hill, New York, 1991.

Like the first edition, this comprehensive, authoritative, and pragmatic overview of applied heterogeneous catalysis is a truly valuable book for chemical engineers and chemists working with solid catalysts in laboratory, pilot-plant, or commercial installations. It can also provide useful practical information to those working on more fundamental aspects of catalysis.

The scope is very similar to that of the first edition, but a good part of the material has been updated and now provides more chemical insight into the underlying phenomena. Throughout the book, Professor Satterfield remains consistent with the revised title: Only concepts and techniques having had a proven impact on industrial catalysis are discussed. The book, after all, does not seek to educate students but rather to serve as a reference book and as a starting point for professionals. It is therefore appropriate that the interesting problem collection of the first edition has now been deleted.

Is the second edition a must for those having direct access to the first edition? Yes, in my opinion, although the extent of revision varies significantly from one chapter to the next. Thus, Chapters 1 to 5 and 11 have changed very little (basic concepts, adsorption, kinetic models, catalyst preparation, physical characterization, experimental methods). This is obviously not due to the lack of research progress in these areas during the last decade, but rather due to the filtering of this progress through the stringent criterion of industrial impact.

Chapter 6 (supported catalysts) has been revised to provide a brief overview of SMSI and spillover effects and to discuss, albeit briefly, the relevance of UHV studies to industrial catalysis. Most of the revision was made in Chapter 7 (zeolites) and Chapter 8 (catalytic oxidation, with more emphasis now on automotive exhaust catalysis). Less material has changed in Chapters 9 (petroleum processing) and 10 (synthesis gas reactions), but this again reflects the limited industrial process changes in these areas over the past decade. Chapter 11 provides some useful guidelines for obtaining diffusional-free kinetic data, but it does require a decent reaction engineering background.

The book is a valuable source of information on applied heterogeneous catalysis. It is a must for professionals, both practitioners and researchers.

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**Catalytic Chemistry.** BY BRUCE C. GATES. Wiley, New York, 1992. xxi + 458 pp.

An author who undertakes the task of writing a book about catalysis is immediately faced with two fundamental problems which relate to the enormous scope of the subject and to the complexity of the material in detail: that is, how to define and limit the area to be covered, and how to structure the material in a manner that has reasonable internal logic. A traditional solution to this problem, which is often used, is to separate heterogeneous from homogeneous catalysis, and then to approach heterogeneous catalysis via adsorption at solid surfaces, and homogeneous catalysis via organometallic chemistry or some appropriate aspect of solution chemistry. An advantage of this approach is that it readily allows the formal development of heterogeneous catalytic kinetics at an early stage in the overall treatment, but it has the disadvantage that it tends to focus attention on classical catalytic archetypes rather than recognizing the great diversity of modern catalysts as materials. On the other hand, this diversity of catalytic materials can, of itself, lead to undue fragmentation of treatment unless strenuous efforts are made to oppose this.

The author of the present book, Professor Bruce C. Gates, will be very well known to all practitioners of catalytic science, particularly as a coauthor of an earlier standard, and highly respected reference book, "Chemistry of Catalytic Processes." The present book, "Catalytic Chemistry," is in no sense another version of, or even a successor to, "Chemistry of Catalytic Process." As is made clear in the Introduction, and as will be immediately evident at first inspection, "Catalytic Chemistry" is unashamedly a teaching book. This is in no way to imply that it concentrates on elementary material: on the contrary, it contains an enormous amount of detailed catalytic chemistry, much at a level of considerable sophistication. While its original, primary purpose may be as a teaching book, it will undoubtedly find wide use as a reference work in catalytic fundamentals.

The author has opted to structure this book basically in terms of catalytic material types, and thus catalytic processes and mechanisms appear in the text where they are appropriate to the particular catalyst type. Furthermore, apart from the short Introduction, the chapter sequence begins with catalysis in solution and ends with catalysis on surfaces. Although this more or less inverts the sequence with which many readers might be familiar, in practice it works remarkably well, and moves generally in the direction of increasing mechanistic complexity. From a pedagogic viewpoint, it has a lot to recommend it.

The book opens with a short Introduction (Chapter 1), which provides a working background to catalysis as a phenomenon, and introduces the reader to some of the elementary concepts involved in catalytic kinetics (but without reference to adsorption isotherms). Chapter 2, Catalysis in Solutions, deals with Acid-Base Catalysis, Electron Transfer Catalysis (Redox reactions), Organometallic Catalysis, Catalysis by Macromolecules (but not including enzymes which are discussed separately), Phase Transfer Catalysis, and Catalysis by Micelles, and the chapter concludes with a fairly brief, introductory discussion on the influence of diffusion, and some important factors in catalytic process engineering. Chapter 3, Catalysis by Enzymes, is really but a brief introduction (37 pp.) to what is now a subject of enormous scope and complexity. It is, however, unreasonable to be critical. We should all thank the author that this chapter is included at all. The days must surely be just about over when a catalytic scientist might consider himself/herself well educated with the customary knowledge of this subject that only extends to a recognition of the name. Chapter 4, Catalysis by Polymers, deals with solid polymers which function as catalysts either by surface functionalization or by a role as a support. This chapter includes a useful introduction to intraparticle mass transport effects. Chapter 5, Catalysis in Molecular-Scale Cavities, is mainly a discussion of catalysis by zeolites (and zeolite analogues) and, in addition to a good discussion of some of the important reactions in zeolites, the chapter includes shape-selective catalysis with respect to both reaction chemistry and catalyst deacti-

vation. The book concludes with Chapter 6, Catalysis on Surfaces, and this covers the topics of Surface Structures, Adsorption, and Surface Catalysis (functionalized surfaces, metal surfaces, metal oxide surfaces, supported metals, mixed metal oxides, metal sulfides).

With regard to the structure of the book, this reviewer has to admit to a personal preference which would have seen basic catalytic kinetics—including discussions of mass and heat transport effects—collected into a separate chapter. However, one can readily appreciate why, from a pedagogic point of view, the author has opted to distribute this material so that it can more easily be related to actual reactions under discussion. The decision is, perhaps, a finely balanced one.

An outstanding feature of the book is the liberal use of specific practical examples which show how individual problems (by no means necessarily numerical) are solved. Furthermore, there is a compilation of selected references for further reading at the end of each chapter, together with further problems for students to struggle with. Promotional literature indicates that a Solution Manual for all problems is available from the publisher.

Each reader will undoubtedly have an individual's view about the weight assigned by the author to particular topics. All in all, this reviewer came to the conclusion that the author has produced a well-balanced, acceptably structured, and very clearly written account of a difficult subject. We, and particularly future students, stand in his debt. A book at about this level, and with these objectives, has been long overdue, and the author is to be congratulated for having risen so ably to the challenge.

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