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Book Review

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Concepts of modern catalysis and kinetics

Wiley–VCH, 2003,
469 pp; price £50.
ISBN 3-527-30574-2 (hardcover)

This book is a thorough and comprehensive introduction to the science and application of heterogeneous catalysis, particularly when applied to gas-phase processes.

The book consists of 10 chapters, which are logically organized to take the reader through an introduction to catalysis and its industrial importance, through two chapters detailing the key features of kinetics and reaction rate theory as tools for the understanding and intelligent application of catalysts in an efficient manner. These chapters provide a detailed mathematical description of the major factors relevant to several of the key industrial processes, such as ammonia synthesis. The various key stages of adsorption, the reactions of the adsorbed species, and subsequent desorption are all covered in significant detail. Collision theory, transition state theory and related concepts are explained and illustrated, and conflicting approaches are sensibly evaluated.

Chapter 4 then details the characterization of catalysts, with Chapter 5 being dedicated to a description of solid catalysts, with sections relating to supports, and to methods of loading active sites. Good, concise descriptions of the major surface characterization techniques are given, along with their use in building up a picture of a catalytic site and the surrounding surface. The requirements of a successful catalyst are also discussed, putting into context the efforts expended in designing genuinely effective catalysts.

Chapters 6 and 7 lead logically to a study of the details of surface reactivity and the kinetics of reactions on surfaces. This builds on Chapters 2 and 3 and begins to develop pictures of real catalysts, using the theoretical framework discussed earlier.

The last three chapters deal with applications of the catalysts. Much is made of the importance of a thorough understanding and application of the science described in previous chapters, coupled with an (often less detailed) description of the role of reactor design and chemical engineering in the successful application of the catalysts in a series of well chosen examples. Chapter 8 considers key processes such as steam reforming, partial oxidation of methane, syngas processes and water-gas shift reaction. Fischer–Tropsch and ammonia synthesis are discussed, as are fuel cells and the hydrogen economy. The catalysts involved and the processes themselves have often been treated earlier, allowing the reader to put together the surface science and kinetics with the final process itself. Chapter 9 relates to oil refining and the uses of some of the products of oil refining, such as polymerization. Chapter 10 finishes off with some of the most recent work in the area of environmental catalysis, with a substantial piece on three-way catalysis, as well as other topics such as clean up of power-plant waste.

The book has a useful series of questions and exercises that can be used to reinforce the concepts described in the book. An appendix contains conversion factors, and the index is appropriately designed. The illustrations are generally of a good standard and are clear and informative.

Overall, the book is well thought out and balanced. It will serve as a useful resource for students and those putting together courses in gas-phase heterogeneous catalysis and surface science. My only concern is that the title of the book might lead a potential reader to assume that the whole breadth of catalysis is covered and, therefore, may expect to see chapters on homogeneous catalysis, enzyme catalysis, and indeed liquid-phase heterogeneous catalysis, as well as other catalytic two-phase systems (e.g. PTC). A more specific title would have avoided this possible confusion. Otherwise, this is a very useful book for those interested in this area.

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