Catalysis for Fine Chemical Synthesis – Catalysis by Polyoxometalates 2. By I. V. Kopzhevnikov; Wiley: Chichester; **2002**; hardback, 216 pp, €123.80; ISBN 0-471-62381-4

Catalysis by Polyoxometalates is the second volume of a new series of texts covering catalytic methodologies. This particular text presents a survey of recent developments in both homogeneous and heterogeneous polyoxometalate catalysis. There is an emphasis on acid catalysis and selective oxidation. The author seeks to encourage the use of polyoxometalates and provide greater understanding of the versatility and scope of transformations they afford. The book is concisely written, appropriately illustrated and contains a bibliography to each chapter, with references to all important works and review articles.

Aimed primarily at academic and industrial synthetic chemists, the book provides a gentle introduction to the field. The first chapter distinguishes the major types of polyoxometalates and briefly discusses nomenclature and historical background before introducing their application to catalysis.

Chapter 2 outlines the physiochemical properties of polyoxometalates essential to their understanding. It details the well known structures, thermal stability, solubility and also contains an extensive discussion of their acidic and redox properties.

Chapter 3 supplies detailed procedures gleaned from the literature for the preparation of the most frequently employed catalysts. A general overview of the common methods employed and a section on the preparation of solid supported catalysts is provided. All procedures have been tested and validated. These sections provide a solid foundation and basis for tackling the meat of the text which is contained within the next two chapters.

Chapter 4 (56 pages) describes the uses of heteropoly acid catalysts and begins by providing a general overview of the different types of transformations that can be achieved. It discusses the mechanistic aspects of catalysis for both homogeneous and heterogeneous systems. The chapter is arranged such that homogenous, biphasic and heterogeneous catalysis are dealt with separately rather than by specific transformation. This has the distinct advantage of showing the present scope and limitations of each class. Within these sections, specific reactions are detailed including the hydration of alkenes, esterification reactions, condensations, Friedel–Crafts acylations, Beckmann rearrangements and polymerisations to name but a few. Heterogeneous catalysis forms the larger part of the chapter, consistent with its prevalence and concludes with a short section on the deactivation and regeneration of solid supported catalysts.

Chapter 5 (50 pages) discusses the catalysts for selective oxidation and separates liquid- and gas-phase oxidation into two main sections. Liquid-phase catalysis forms the bulk of the chapter which, in contrast to chapter 4, is arranged according to oxidant (dioxygen, hydrogen peroxide and organic peroxides) with subsections for homogeneous, biphasic and heterogeneous catalysis. Examples of the oxidation of alkanes to alcohols/aldehydes, phenols to quinones, epoxidations, oxidative phenolic couplings and many more highly selective reactions are given. The section on gas-phase oxidation contains an overview of the more commonly used catalysts and is then arranged by reaction, detailing well known processes including the oxidation of methacrolein to methacrylic acid, ethylene to acetic acid and the Wacker oxidation.

Chapter 6 concerns the application of polyoxometalates to hydrogenation, carbonylation and mentions new applications in the area of poly-anion stabilised clusters and catalyst precursors.

Chapter 7 details the commercial applications of heteropoly compounds in Large scale industrial processes. While some of these reactions have already been described in chapter five, this section looks further at the scale and production processes involved.

Finally chapter 8 concludes with applications to areas other than catalysis. These include analytical techniques, separations, coatings, polymers, electrochemistry and medicine.

In conclusion, this textbook provides an excellent overview of catalysis by polyoxometalates. The book is well laid out and the sections are easy to navigate using the contents. The main sections of the book are well written and detailed with few typographical errors. The author admits that because of the enormity of the field, which spans several disciplines, it was not possible to describe every relevant work in detail. Nonetheless he has done an excellent job with the important chapters. Conversely, the final 3 chapters, totalling only 28 pages in all, seem scant in comparison yet compensate the reader with enough further reading. This text is highly recommended to all those concerned with heteropoly acid catalysis and to anyone wishing to utilise these types of catalyst in their research.

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