Applied Organometallic Chemistry (1989) 199–201

Book reviews

Catalysis: Science and Technology. Volume 8

J R Anderson and M Boudart (eds)
Springer-Verlag, Berlin, 1987
262 pages, DM 148,-

This is the eighth volume in a series of reviews which has already encompasssed many aspects of catalytic chemistry. The purpose of the series is to collect authoritative and definitive chapters on the main areas of contemporary pure and applied catalysis and is of special interest to workers concerned with the latter area. The present volume contains five further comprehensive reviews covering the historical development of catalytic oxidation processes (G Chinchen, P Davies and R J Sampson), catalytic metathesis of alkenes (J C Mol and J A Moulijn), physicochemical aspects of mass and heat transfer in heterogeneous catalysis (J J Carberry), small scale laboratory reactors (K C Pratt) and EPR methods in heterogeneous catalysis (J J Lunsford). Of these the chapter on catalytic metathesis of alkenes is likely to be of most interest to those readers concerned with applications of organometallic chemistry. The authors are all acknowledged experts in their respective fields and this is reflected in the breadth, detail and quality of all the articles.

The first chapter addresses a subject which is of central importance to a substantial part of large scale chemical industry, namely catalytic oxidation processes. This very readable account contains a useful introduction to the background to catalytic oxidation technology, the historical development of which is then exemplified by reference to processes for the production of sulphuric acid, nitric acid and maleic anhydride. This effectively complements a chapter by G K Boreskov on more fundamental aspects of the catalytic activation of dioxygen in an earlier volume of the series. Alkenes are important intermediates in many processes in the organic chemicals industry and methods for their interconversion can assume considerable importance when alkene availability does not match market requirements. One such process is the catalytic metathesis of alkenes which is covered in Chapter 2 with some emphasis on fundamental principles, mechanistic insights obtained from homogeneous catalysis studies and potential novel applications. Metathesis is currently assuming greater significance in terms of the ring opening polymerisation of cycloalkenes and the chapter is therefore particularly timely. The third chapter contains an important contribution on physicochemical aspects of mass and heat transfer in heterogeneous catalysis, the understanding of which is of prime importance to the use of catalysts on the production scale. Chapter 4 provides a very useful critical overview of the most common small scale laboratory activity. The various reactor configurations are described, together with their advantages and disadvantages, construction principles and practical advice. The final chapter contains a very readable account of the use of EPR methods in heterogeneous catalysis. Following an introduction to EPR, its applications to eleven types of catalytic reactions is describes and evidence is given for the role of paramagnetic oxygen ions, mainly O^-, in such diverse reactions as H_2-D_2 exchange, the oxidation of carbon monoxide and the partial oxidation of methane to methanol.

Overall, therefore, this book contains a mixed but thoroughly useful set of reviews and the price, considering the quality and usefulness of the book is quite reasonable. However, in order to secure complete coverage of the field the whole series must be purchased and I expect that this will limit sales to libraries and organisations with significant catalytic interests.

R WHYMAN
ICI Chemicals & Polymers Ltd
Runcorn, UK

Principles of Organometallic Chemistry (Second Edition)

P Powell
Chapman and Hall, London, 1988. 414 pages. £30 hardback; £13.95 paperback. ISBN 0 412 27580 5; 0 412 27590 2

The first edition of Principles of Organometallic Chemistry was published in 1968 and was co-authored by G.E. Coates, M.L.H. Green, K. Wade and the sole-author of the Second Edition, P. Powell. The First Edition proved to be a valuable and well-used book; it really had no serious rival as a general text for undergraduates. Twenty years on, the Second Edition will have to compete with other recently published texts, including A.W. Parkins and R.C. Poller's "Introduction to Organometallic Chemisty", MacMillan (1986) and I. Haiduc and J.J. Zuckerman's "Basic Organometallic Chemistry", de Gruyter (1985). That there is now a good choice of basic texts appropriate for undergraduates reflects the current importance and interest in organometallic chemistry. The tremendous increase in knowledge gained over the past twenty or so years makes the task of producing a text of manageable size a very daunting and a highly selective one. The selectivity in the choice of material covered clearly allows great scope for any reviewer to be critical. This reviewer, however, generally likes the choice of material in Powell's

work (and to be absolutely fair also that chosen by Parkin and Poller); which one is taken as a recommended text is clearly a matter of personal choice.

Powell's book contains thirteen chapters. The first chapter is concerned with general concepts and is followed by three on main group (typical) elements (in *ca.* 130 pages total), seven on transition elements (*ca.* 330 pages total), one on clusters (*ca.* 20 pages) and the last on lanthanides and actinides (5 pages). The main-group chapters are on (i) methods of formation of metal-carbon bonds, (ii) organometallic compounds of the first three groups and (iii) organometallic compounds of Groups IV and V. The approach adopted for transition metal derivatives is essentially based on the electron number of the principal ligand in the complexes and so chapters deal, for example, with alkyl, alkylidene, alkene and alkyne complexes; allyl and diene complexes; five electron ligands; and arenes. Throughout the book, emphasis is placed on structures, bonding, preparation and reactions. Examples of the uses of organometallic compounds in organic synthesis is limited to the more simpler products.

The author also wished to bring out the importance of organometallic chemistry to industry. Throughout the book are various mentions of industrial processes/chemicals. One chapter is also devoted to the mechanisms of homogenous transition metal processes.

At the end of the chapters are key references and a limited number of problems taken (with permission) from various British University examination papers. As an extra, the answers are available in a booklet from the Publishers.

All in all, this is a very useful addition to the available texts and is reasonably priced.

J L WARDELL
Department of Chemistry
University of Aberdeen

Transformation or Organometallics into Common and Exotic Materials: Design and Activation

R M Laine

Martinus Nijhof, Dordrecht, Boston, Lancaster, 1988
306 pp. Price $96.00 (US); £53 (UK); 175.00 Dfl
ISBN 9 024 73661 7

This book contains the proceedings of a NATO Advanced Research Workshop held in September 1986. It is concerned with the design, synthesis and selective conversion of organometallic (or metal organic) precursors to high purity, high strength or temperature-stable materials. The book clearly intends to help establish the scientific principles required for successful applied research in the materials chemistry area. The book contains reviews from most of the participants at the workshop and it is divided into four parts. The first, entitled Framework Sciences, is an attempt to outline the background for the other (more applied) papers. It includes papers on metal clusters, organometallic polymers, gas phase pyrolysis of organometallics and the microstructures of hard metals. Clearly, a background chapter is needed in a work of this nature, but I found the coverage to be somewhat uneven, ranging from quite in-depth discussions to rather more sketchy outlines. For background studies in this area, other sources will give a broader and more comprehensive treatment.

The work becomes much more useful in the three chapters covering (respectively) preceramic polymers, chemical vapour deposition and sol-gel processing and overall make the book a valuable contribution to the field. In these chapters, the book addresses itself directly and practically towards an assessment of the potential use of chemical synthesis as means of preparing materials for advanced technology applications.

The section on materials for electronics is mainly concerned with chemical vapour deposition of conductors, semiconducting materials, or insulating films. This section describes chemical vapour deposition of Fe-Co organometallic clusters (Czekaj-Korn and Geoffroy), metal-silicons (Aylett), boron-nitride (Schleich, Lai and Lam), Group III-V species (Haigh; Maury) and Ruthenocene (Ezzaouia and Gorochov). The chapter by Aylett is particularly useful in that it does what its title claims, tells us 'how to make metal silicide thin films from molecular silicon metal compounds — and how not to'. It is done succinctly and briefly but references are provided.

The chapters on preceramic polymers look at various aspects of materials chemistry for the preparation of bulk non-oxide ceramics. Most work in this areas has been in the (SiC)n and the (SiN)n area. The chapter by Wynne discusses boron nitride precursors; Noltes considers various organosilicons as precursors to (SiC)n for electronic and ceramic applications; Harrod's chapter looks at metallocenes of Ti and Zr as catalysts for the coupling of organosilanes. Bacque, Pillot, Birot and Dunogues discuss the preparation of new polycarbosilane model polymers. Finally in this section Seyferth discusses silicon containing ceramics generally and then describes the preparation of a novel polysilazane, its conversion to ceramic products and their use in improving polysilanes.

The final section is concerned with sol-gel processing. This is concerned with structural control of materials to improve performance in ceramics, glass and composites, essentially by increasing the regularity of molecular order in the polymeric materials, i.e. structural improvement at the microstructural level ($>10{,}000$ Å). Ulrich terms this as ultrastructural processing and defines it as molecular manipulation and control of uniquely homogeneous structures. The system and concepts are illustrated with references to mullite ($3Al_2O_3.2SiO_2$), a high temperature structural material. Work with alkoxides is then described in a chapter by Dislich, with transition metal oxides by Livage, thin film work by Brinker and the preparatio of finely dispersed powders from organometallics by Matijevic and Gheradi.

The work as a whole represents a most useful collection of information in this rapidly growing field, although some