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Book reviews

Catalytic Activation and Functionalisation of Light Alkanes: Advances and Challenges

E. G. Derouane, J. Haber, F. Lemos, F. Ramôa Ribeiro and M. Guisnet (eds)

Kluwer Academic Publishers, Dordrecht, 1998
x + 492 pages, £145
ISBN 0-7923-4960-1

A major challenge for the chemicals industry is the development of energy-efficient means of selectively functionalizing methane and other lower alkanes. That challenge is principally focused on the development of new catalyst systems. At present, the attractively low cost of the lower alkanes is more than offset by their relative lack of chemical reactivity, so that when conditions can be discovered for their chemical transformation, either conversion rates have to be uneconomically low, or the desired products, e.g. methanol from methane, are themselves destroyed under the chosen conditions. Almost 400 pages of this book comprise a record of the principal lectures at a NATO Advanced Study Institute held in Southern Portugal in the summer of 1997, which was devoted to the many approaches which have been explored for the understanding and development of catalysts for reactions of C_1–C_4 alkanes. This is followed by some 60 pages of selected short communications; the book is completed by a brief report on an accompanying Workshop, a principal finding of which was that there should be greater integration of the diverse approaches to catalyst development, especially with regard to potential applications.

Among the many investigative approaches addressed in the main section are biomimetic activation, organometallic and heteropolyacid-salt activation, and activation by superacids. For all of these, the possible utilization of zeolite supports is extensively analysed. Theoretical approaches which are presented include the computer simulation of catalyst active sites in zeolites.

The book is generally well presented, and, for those active in the field, for whom it is likely to be a valuable source book, its rapid production (January 1998) will be welcomed. However, closer inspection reveals that uniformity between (and even within) chapters, as well as general accuracy, have to some extent suffered. Although the frequency of minor textual errors occasionally becomes distracting [especially the more humorous ones, such as reference to the agnostic (*sic*) effect], only rarely did I find that they leave the intended meaning unclear. A greater distraction was the subject index, which comes close to being of the type that would have been better omitted altogether (for example, neither ‘Fischer–Tropsch’ nor the more recently developed and somewhat controversial ‘Gif’ reactions are indexed, although both are discussed in more than one chapter; in contrast, there are no fewer than 31 entries under the peculiarly uninformative heading ‘alkane’).

Essentially all chapters are copiously referenced, often covering the literature well into 1997, but the book’s ‘author index’ is simply an alphabetical listing of contributors. One personal hobby horse: I regret the use, by some contributors, of reference listings which include titles of research papers. This style, common, for example, in the life sciences, has generally been the exception in chemistry publishing and should, I believe, be discouraged; to my mind it adds little more than the means for a publisher to sell more paper.

Despite these criticisms, and the relatively high cost, this book is itself an important contribution towards the integration of different approaches to catalysis, as advocated in the Workshop report, and is sure to find its way on to the shelves of many laboratories in which catalysis research is being pursued or considered.

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Metal Sites in Proteins and Models: Redox Centres
Structure and Bonding, Volume 90

H. A. O. Hill, P. J. Sadler and A. J. Thomson (eds)

Springer, Heidelberg, 1998
209 pages. £76
ISBN 3-540-62888-6

What a delight to see three volumes of *Structure and Bonding* (88–90) devoted to topics in the area of ‘metal sites in proteins and models’. Even better to find three world-leading biological inorganic chemists as the editors guiding this special series. Surely this must be a recipe for success. In my opinion, it is — but not quite in the way I expected. Although this review is primarily concerned with Volume 90, I feel I must put it in the

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context of the whole series. What I had expected when hearing about the series was a standard collection of reviews on the usual bio-inorganic favourites, e.g. iron–sulphur proteins, copper proteins, cytochromes etc. Instead, the series is an exciting, eclectic (in places even eccentric), mix of articles often covering less well-known systems such as the biochemistry of tungsten. This makes each of the three volumes refreshingly different. I am sure this must have been the intention of the editors and it is interesting that, apart from a few notable exceptions, most contributions come from European laboratories (for the Eurosceptic readers I include the UK in this).

So, this is a good series overall — but what about Volume 90? Well, this volume has the sub-title *Redox Centres* — a label which is not particularly useful for this collection of six articles. It kicks off with a review of the manganese site in the photosynthetic oxygen-evolving complex. The structural characterization of this complex is described in detail with the emphasis on results from X-ray absorption spectroscopy and electron paramagnetic resonance. However, as we discover, the precise structure of the oxygen-evolving complex still tantalizes us with its elusiveness. So, 'plenty of scope for future work' is the take-home-message from this article.

We then move on to a rather odd review which focuses on blue copper proteins and blue copper oxidases, with the first X-ray structure of a vanadium-containing enzyme bolted onto the end. The vanadium enzyme in question is chloroperoxidase (from *Curvularia inaequalis*, a fungus), which oxidizes halides to hypohalous acids. Although this enzyme is indeed of great interest it has little, or nothing, to do with the bulk of the review on copper-containing proteins. Still, these little eccentricities are what makes this series so nice. The main part of the review is a workmanlike description of the current state-of-play in the area of the small blue copper proteins and some multi-copper oxidases.

The next article presents a particularly well-illustrated, in-depth, description of the xanthine oxidase family of molybdoenzymes. The X-ray structure of aldehyde oxidoreductase from *Desulfovibrio gigas* (the first structure of such a molybdo-oxotransferase) is used as a model to aid the interpretation of the huge amount of research data available for xanthine oxidase and related molybdo-enzymes. Such structural insights have allowed major advancements in our understanding of these intriguing enzymes.

From molybdenum, we move to nickel and iron in the form of the [NiFe] hydrogenases. The structural and functional properties of these enzymes are described in another well-illustrated review. Anyone interested in biological electron transfer will find the possible electron-transfer route, from the Fe/Ni centre through three iron–sulphur clusters to the surface of the protein, particularly beautiful. The article certainly does justice to these fascinating enzymes which catalyse the reversible two-electron oxidation of hydrogen, a reaction which is at once both simple and complex.

The next review revisits an old favourite — iron–sulphur proteins — but with a new twist since this article focuses on how coordination sphere and protein environment control the functional properties of iron–sulphur clusters. The review contains a wealth of reduction potential data from a large number of iron–sulphur proteins. The variation of these reduction potentials is analysed in the context of the protein environment. In the case of the high-potential iron proteins (HiPIPs), for example, there is a rather nice correlation between the unit charge of the protein and the reduction potential, suggesting that the electrostatic nature of the protein is the main determinant of $E°$ in these proteins. This is only one of many other interesting insights into iron–sulphur proteins in what will prove a useful article to researchers in the field.

The volume ends with a review of the bio-inorganic chemistry of tungtsen. Much of the chemistry and just about all of the biology of tungsten are surveyed in this interesting report. It engenders a feeling of excitement over the prospects for future research into the biology of tungsten: how is tungsten acquired, transported, stored and incorporated into enzymes? Finally, for the wine connoisseur, we are informed that a bottle of wine accounts for one-tenth of our daily requirement of molybdenum and that there is about the same amount of tungsten also present. An amusing way to end the series and a great excuse to drink more.

I conclude by recommending this and the other two volumes of this stimulating series to all of you who want to look at biological inorganic chemistry from a slightly different perspective than usual.

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Transition Metal Oxides: Structure, Properties and Synthesis of Ceramic Oxides

C. N. R. Rao and B. Raveau

2nd edn. Wiley–VCH, New York and Weinheim, 1998
xi + 373 pages. £80
ISBN 0-471-18971-5

This is an up-dated and extended version of a very well-received book first published in 1995. The distinguished authors, Professor Rao from the Indian Institute of Science at Bangalore and Professor Raveau from the French Centre des Matriaux at Caen, note that the intense world-wide study of transition-metal oxides, their rapidly increasing range of applications and some important developments in the last few years combine to make a new version necessary.

The first and longest section (224 pages) gives a detailed survey of structural types. Although it begins with binary compounds, it soon enters the much more difficult realm of tertiary, quaternary and even quinary