

Book Review

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Homogeneous catalysis— understanding the art

Kluwer, Dordrecht, 2004,
407 pp; price £87.00 (UK).
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This book, which is directed at graduate student level and above, and towards established chemists who have migrated to the field of homogeneous catalysis from initial training and/or experience in different disciplines, covers the major aspects of the title subject, with emphasis on research emanating from the van Leeuwen group. The book is divided into 19 chapters, the first three of which include a discussion of fundamental aspects, via sections entitled 'Introduction' (including historical aspects, catalyst characterisation and ligands), 'Elementary steps' and 'Kinetics'. Subsequent chapters provide detailed coverage of the following specific aspects of homogeneous catalysis: hydrogenation, isomerization, methanol carbonylation, hydroformylation, ethene oligomerization, polymerization of propene (but not ethene), alkene hydrocyanation, palladium-catalysed carbonylation and cross-coupling reactions, asymmetric epoxidation, oxidation with dioxigen, alkene metathesis, enantioselective cyclopropanation, hydrosilylation, and finally, C–H bond functionalization.

Understandably, in accordance with the origins of homogeneous catalysis, the focus of the book is on the chemistry and processes associated with the manufacture of bulk chemicals. Nevertheless, in recognition of the more recent switch in emphasis towards applications in fine chemicals manufacture, where the huge superiority of homogeneous over heterogeneous catalysts in terms of both chemoselectivity and regioselectivity is most significant, the authors have, where appropriate, successfully integrated these more recent developments into the text, and, overall, a balanced picture of contemporary homogeneous catalysis has been achieved. Nevertheless, there are some anomalies in the coverage. For example, one of the

classic examples of homogeneous catalysis, the nickel-catalysed hydrocyanation of buta-1,3-diene to adiponitrile, which has been the subject of intensive mechanistic studies primarily by the DuPont group, and from which much fundamental knowledge relating to ligand design first emanated, is deemed to merit a chapter of only nine pages, whereas *propene* polymerization (as the chapter is titled in the contents pages, but *alkene* polymerization as referred to throughout the relevant text) merits close to 40 pages of discussion, notwithstanding the fact that, after activation with methylaluminoxane, such catalysts are arguably not even truly homogeneous. Nevertheless, this particular chapter does represent a very thorough and professional account of the present state of the art with respect to propene polymerization. Although the subject of kinetics rightly merits a separate introductory chapter, thermodynamics (the importance of which cannot be underestimated, not only to graduate students, but also to the many practitioners of catalysis who, over the years, have vainly attempted to discover catalysts for reactions that are thermodynamically unfavourable!) is not given separate treatment and is mentioned, with one exception in the discussion on cobalt-catalysed hydroformylation, essentially only in passing. Finally, one surprising omission from a text of this nature concerns the lack of any reference to the potential impact, or otherwise, of the use of combinatorial and high-throughput testing methods on discovery and development in homogeneous catalysis.

This book has to be compared alongside numerous other contemporary texts on homogeneous catalysis that are also available. The books by Cornils and Hermann are encyclopaedic in both nature and coverage, and represent excellent reference texts. This work, notwithstanding the provision of considerable detail, is certainly more user friendly, and more comparable with the classic *Homogeneous Catalysis* texts of Parshall and Ittel from DuPont, the most recent edition of which was published in 1992. The title of the present work is, in fact, strongly reminiscent of one of the first

texts devoted specifically to homogeneous catalysis, published in 1981, namely that by Chris Masters, and entitled *Homogeneous Transition-metal Catalysis—A Gentle Art*. Even though this is now out of print, it has stood the test of time, and much of its contents are still very relevant today, for those of the appropriate vintage to own a personal copy! I do find it surprising that this earlier text has received no acknowledgement whatsoever in the present work, particularly since both authors had substantive careers at the Shell laboratories in Amsterdam.

Overall, the book is well written and readable, although there are some noticeable variations in style between different chapters, such as might be expected from a multi-author work (see the passing acknowledgements to the originators of the first drafts in the Preface). Few typographical errors are evident, although the misnumbering of tables in the chapter on palladium-catalysed carbonylation may lead to some confusion. The provision, in the Preface, of a glossary of the abbreviations and acronyms used would have been useful. As is common in books of this sort, the index leaves much to be desired. To quote just one example, a casual glance in the index under hydroformylation might suggest that cobalt is the only catalyst for the reaction!

Notwithstanding some of the aforementioned criticisms, overall I consider the book to provide an excellent account of contemporary homogeneous catalysis, adequately filling the gap that is now evident between the respective treatises of Parshall and Ittel and Cornils and Hermann, and as such should provide a useful addition to the burgeoning review literature in the area of homogeneous catalysis. Moreover, the asking price of £87 for a volume of this sort seems reasonable in present-day terms, although I suspect that sales may well be restricted largely to library purchases.

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