

Book reviews

The Organometallic Chemistry of the Transition Metals

Robert H Crabtree

John Wiley and Sons, New York, 1992

440 pages. £16.50/\$29.70. ISBN 0471 57388 4

This book is the paperback version of a hardback text published in 1988. The book comprises 16 Chapters: Introduction; General properties of organometallic complexes; The metal–carbon and metal–hydrogen bonds; Ligand substitution reactions; Complexes of pi-bound ligands; Oxidative addition and reductive elimination; Insertion and elimination: Nucleophilic and electrophilic addition; Homogeneous catalysis; Characterization of organometallic compounds; Carbenes, metathesis and polymerization; The activation of small molecules; Clusters and the metal–metal bond; Applications to organic synthesis; Oxidation and high-oxidation state complexes; Bioorganometallic chemistry. Each chapter is relatively self-contained and includes a set of problems and answers and some appropriate references.

The book is intended for senior undergraduate and graduate courses in North America and would be appropriate for second- and third-year undergraduate courses in the UK as well as for an introduction to postgraduate work.

The book is based on a course of lectures given by Professor Crabtree at Yale University and appears to be a transcription of the author's lecture notes. The personalized style, e.g. 'We will now . . .' makes the book very much more readable than most other more formal textbooks and this is a point in the book's favour. However, although basic lecture courses and introductory books can retain much of the same format and content from year to year, science moves on at an ever-increasing pace. It is disappointing, therefore, that Professor Crabtree and the publishers did not take account of this point when launching the paperback version. This book, which is published in 1992, is limited to references from 1985/1986!

In the opinion of this reviewer, and bearing in mind the limitations of student budgets, the original text should have been published in 1988 in a paperback rather than a hardback version; however, given that a paperback version was anticipated some years later, a second edition, especially for the paperback version, covering review articles and journal articles up to 1991/1992, should have been produced. For an introductory book such as this, only a modest amount of work would have been needed but it would have made all the difference giving a book that has relevance for teaching

for 1992–1996; one may compare, similarly, the relevance of the original text for 1988–1992 with the relevance of this paperback, which is dated and really cannot be recommended.

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Organic Synthesis via Organometallics

Karl Dötz and Reinhard Hoffmann (eds)

Vieweg, 1992

332 pages. £37.50.

ISBN 3528 08947 4

This book, which is a compilation of contributions presented at a symposium in Marburg in 1990 aimed at increasing the dialogue between inorganic and organic chemists in this common area, reinforces this aim and as such is a very welcome addition to the chemical literature. It comprises 17 chapters.

Three chapters are devoted to polymerization reactions. Grubbs describes the preparation of polymers of predetermined structure through organometallic intermediates, using living ring-opening metathesis polymerizations as examples. Keim *et al.* report the use of homogeneous palladium catalysts containing chiral bidentate phosphine ligands to achieve the enantioselective telomerization of 1,3-dienes with formaldehyde, β -diketones, β -ketoesters and nitroalkanes. Brintzinger describes the development of chiral ansa-metallocene derivatives for α -olefin polymerization.

Two chapters discuss different ways to activate benzylic positions towards substitution by attachment to organometallic fragments. Fischer describes benzyldiene complexes of $(CO)_5M$ ($M = Cr, W$) as C_1 (actually C_2) sources to effect, for example, the conversion of olefins to cyclopropanes, or thioketones to thi-iranes. Astruc *et al.* describe the use of cationic iron moieties to activate aromatic compounds towards catalytic and stoichiometric benzylic substitution reactions.

The applications of cyclohexadiene and cyclohexadienyl complexes to organic synthesis form the basis of three chapters. Knölker reports the trapping of cyclohexadienyl iron tricarbonyl cations with electron-rich arenes followed by oxidative cyclization as a useful methodology for the synthesis of some carbazole alkaloids. Stephenson *et al.* describe the trapping of cyclohexadienyl iron tricarbonyl cations by electron-rich olefins and arenes and by stabilized carbanions and alkylcuprates with particular emphasis on the control of the regioselectivity. Eilbracht *et al.* show that cyclohexadienes, via the Lewis-acid-promoted carbonylation of their iron tricarbonyl complexes, may be elaborated

regio- and stereo-selectively to seven-membered ring products including bicyclo[3.2.1]octenediones.

Five chapters are devoted to mechanistic and exploratory chemistry. Kochi provides detailed arguments to illustrate the utility of the electron donor-acceptor concept as a unifying mechanism for organometallic reactions. Walther *et al.* discuss the use of nickel bipyridyl complexes to introduce carbon dioxide into organic molecules. For example, 1,3-dienes are converted to the corresponding pent-3-enoic acids, a reaction which has applications in the elaboration of steroid side chains. Casey *et al.* report a series of novel and interesting reactions of organorhenium compounds including olefin, allyl and carbene fragments attached to the cyclopentadienyl rhenium dicarbonyl fragment. Okuda *et al.* discuss the tethering of olefin and cyclopentadienyl ligands to generate new chiral complexes of cobalt. Schurig *et al.* describe the use of nonracemic molybdenum oxodiperoxo reagents to effect the asymmetric synthesis of oxiranes from prochiral olefins and for their kinetic resolution.

Finally four chapters are devoted to asymmetric carbon-carbon bond-forming processes, with particular reference to stereoselective additions to aldehydes. Hoppe and Zschage describe the development of chiral metallated carbamates and strategies for their use in asymmetric synthesis. Hofner *et al.* report the development of a novel class of carbohydrate-derived cyclopentadienyl dialkoxy titanium chiral auxiliaries for attachment to allyl groups and enolates and their use in highly enantioselective allylations and aldol reactions respectively. Bolm reports the synthesis of a C_2 -symmetric homochiral bipyridyl-containing diol which is used directly to catalyse the enantioselective addition of diethylzinc to benzaldehyde and, via its nickel complex, to catalyse the asymmetric conjugate addition of diethylzinc to enones. Noyori *et al.* describe the use of chiral amino alcohols as catalysts to promote the highly enantioselective addition of diethylzinc to aldehydes. The origins of the chirality-amplifying phenomenon operating in these systems is elucidated.

Each and every chapter provides an interesting overview of specific areas of organometallic chemistry. For this reason the book should be on the shelves of every library used by organic and organometallic chemists. The rapid pace at which this subject is evolving means, however, that this collection of individualistic views of the state-of-the-art of particular areas is unlikely to find a place in personal collections. The authors have prepared their chapters in camera-ready form: each therefore has its own particular style, and this combines with the rather curious order in which some of the chapters have been placed to make the book as a whole seem rather disjointed. Perhaps the editors could have done more to control this. Nonetheless I enjoyed reading the book and commend it highly to others interested in organic synthesis via organometallics.

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Transition Metal Organometallics for Organic Synthesis

F J McQuillin, D G Parker and G R Stephenson
Cambridge University Press, Cambridge, 1992
£100 in hardback, \$200
ISBN 0 521 33353 9

This work is a continuation by Drs Parker (ICI, Wilton, UK) and Stephenson (University of East Anglia) of the established text of Parker and the late Professor Francis McQuillin of the University of Newcastle upon Tyne. As such, the present 1992 version has built upon solid and valuable foundations. As the present authors state, they have continued the original McQuillin concept which existed to provide examples giving insight into new synthetic methods using organometallics. The literature is surveyed up to 1988 and extensive literature citations are provided for each of the 15 chapters. Unusually these are all grouped together (but separated by chapter) at the end of the work. However, there is no disadvantage to this approach.

The chapters are sensibly arranged according to the nature of the reactions. This is an approach which most chemists will think more useful than any alternatives, e.g. arrangement according to the metal involved. The chapters proceed as follows: Chapter 1 discusses the properties of ligands; Chapter 2 is concerned with isomerization and rearrangement, and Chapter 3 with epoxidation of alkenes. Chapter 4 covers alkene oxidation, Chapter 5 and 6 the use of unsaturated compounds and π -allyls as synthetic intermediates. Chapter 7 continues the synthetic theme, considering the use of π -complexes as synthetic intermediates. Chapter 8 covers σ -complexes as nucleophiles; Chapters 9 and 10 cover insertions. Chapter 11 discusses cycloaddition reactions and Chapter 12 is concerned with carbene complexes; in Chapter 13 various methods of protecting groups or compounds are considered. Chapter 14 is concerned with the important area of natural-product synthesis and Chapter 15 covers heterocyclic synthesis. The important synthetic process of hydrogenation is covered in Chapter 10. The Index is very detailed and useful (it is 17 pages in length).

Clearly this book is invaluable to the group to whom it is most directly aimed, viz. those who are involved with organometallics in synthesis. However, this Reviewer believes it should be on the desk of all organometallic chemists. It is also particularly useful for those who teach the subject at undergraduate or postgraduate level. The cost is not out of proportion to the usefulness of the book, which is a valuable continuation of an important text and continues to be a fitting memorial to the work of Francis McQuillin.

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