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Journal of Organometallic Chemistry 595 (2000) 303

Book Review

Activation of Unreactive Bonds and Organic Synthesis, Edited by S. Murai, Springer-Verlag, Berlin and Heidelberg, 1999, pp. 272. US$ 139, DM 198 (hbk), ISBN 3-540-64862-3

Not too long ago, there was a strict borderline between organic and inorganic chemistry and only in the second half of this century has modern organometallic chemistry helped to overcome this barrier. Today, when so much emphasis is placed on catalysis, new materials, economic and environmentally friendly processes and modern organic synthesis, nobody can avoid organometallic compounds any longer. They offer the key to many problems in the above-mentioned areas.

This book is an excellent contribution to this very fast-growing field. Sixteen authors, including the editor, contributed ten chapters to volume 3 of the series, 'Topics in Organometallic Chemistry'. All chapters deal with the activation of bonds that were considered as 'inert' not too long ago. Thanks to appropriate organometallic compounds, unreactive bonds can be activated stoichiometrically or even catalytically. These can be C–H, C–C, C–F, C–Cl, Si–Si, C–O and even N≡N bonds that can be cleaved with transition metal complexes and the fragments used for reactions with other molecules. After a more general survey in the first chapter, the following chapters go into more details and describe various synthetic methods and applications and model compounds for theoretical studies. Typical examples deal with the metal-induced activation of C–H and C–C bonds in alkanes to give oxidation addition products or addition of C–H bonds to double or triple carbon–carbon bonds. The insertion of carbon monoxide or the isocyanide group into C–H bonds or the dehydrogenation of alkanes and arenes also proceeds via transition-metal-induced activation reactions. A special chapter is dedicated to activation reactions of methane and ethane by metal complexes and their reactivity in strong acids. This topic is not only of great scientific interest, but also of practical interest, because alkanes are the cheapest petrochemical feedstock.

The detailed treatment of fundamental principles is very helpful in this book because it explains most phenomena and inspires further research and applications. What is the driving force for the scission of a thermodynamically stable C–H or C–C bond in an organic molecule so that it undergoes an oxidative addition reaction with a metal? How can molecules without a functional group be activated? All these questions are answered and somehow we always end up with the same conclusion: 'The secret is the transition metal'. The electron density at the metal can be controlled by the 'right' ligands. These parameters make the difference and allow the 'right' kinetics. In some special cases, photochemistry is a helpful tool and can assist in the activation of unreactive bonds — still an endless field to explore.

A very attractive feature of the book are the numerous drawings and reaction schemes of the most important reactions and model compounds. This allows a very efficient and rapid orientation. For those who are looking for references or examples in the literature, this book is an excellent source to define the state of the art. Besides the usual transition-metal complexes, lanthanide complexes also contribute to the scope of this chemistry and offer new applications for synthesis and catalysis.

As an organometallic chemist working in the field of catalysis, this book provides a real enrichment not only for colleagues and graduate students who work in this area but also for those who are interested in organic and organometallic chemistry and especially in the development of new petrochemical feedstocks. To my knowledge, this book is the most comprehensive one of its kind in the field of 'transition-metal-induced activation of unreactive bonds' and I can recommend it to individuals and to libraries.

Helmut Guido Alt
Laboratorium für Anorganische Chemie,
Universität Bayreuth,
D-95440 Bayreuth,
Germany

PII: S0022-328X(99)00637-3