

Book Review

Activation and Catalytic Reactions of Saturated Hydrocarbons in the Presence of Transition Metal Complexes

Alexander E. Shilov, Georgiy B. Shul'pin, Kluwer, Dordrecht, The Netherlands, 2000, pp. xiv + 534, ISBN 0 7923 6101 6, GB£ 142, US\$ 228, NLG 400

The activation of saturated hydrocarbons is really no problem, a little dioxygen and a match being sufficient in most cases. However, the controlled activation is another matter and attempts to achieve this and to obtain useful products have been at the forefront of much activity in recent years. One would dearly like to make higher hydrocarbons from methane, or even use methane as a reducing agent, trapping the hydrogen and leaving the carbon in some form other than carbon dioxide. Alexander Shilov has been one of the major players in this game, and his contributions are amongst the most important, ranking alongside his pioneer contributions to dinitrogen chemistry. A book from his pen is one to be welcomed.

This is a long book, covering areas that are often neglected by hydrocarbon activators. The documentation is very detailed, and includes a considerable amount of Russian and Soviet literature that is not easily available in the West. Unfortunately, some of this is packaged in multiple references with perhaps twenty or more citations, which does not make them so easy to unravel.

The book begins with a summary of processes of C–H bond activation, particularly those promoted by metal complexes, which are described as ‘true’ (organometallic) activation, activation via a ligand (rather than directly with the metal) and reaction with an independent reactive species. This is followed by a review of transformations in the absence of metals, which doesn’t really fall within the remit of the book. Characteristically, this section has fifty-nine, mainly portmanteau, references. The next section deals with activation by solid metals and metal oxides. These are also probably not to be considered as complexes, and once again, the book’s title does not do justice to the much broader coverage of the text. Finally, one-quarter way through the book, low-valent metal complexes are considered. The treatment is reasonably complete, though not so easy to read, because of the condensed

nature. A brief chapter on activation by metal ions, atoms and complexes in the gas phase is followed by a detailed discussion of mechanisms of C–H bond splitting by low-valent metal complexes. This deals with both experimental and theoretical aspects, but is somewhat separated from the earlier chapter which describes the relevant chemistry. I must also confess to not believing that the term ‘low-valent’ is very useful, and I much prefer the more complicated term ‘low-oxidation-state’, which is precise and has been less widely abused.

There follows a long discussion of activation by platinum complexes, a subject to which the authors have made significant contributions, and a further chapter on hydrocarbon reactions with high-valent metal complexes. Much of this refers to reactions of arenes, which are not usually regarded as saturated hydrocarbons, though the rest deals with alkane reactivity. Overlap with reactions of metal oxides also occurs, because, for example, a metal oxo-complex is surely a kind of modified oxide.

The remaining three chapters deal with catalytic oxidations by molecular oxygen, as opposed to the non-catalysed reactions discussed earlier, homogeneous catalytic oxidation by peroxides and other oxygen-atom donors (again arenes are considered as well as alkanes), and oxidation in cells in biology, which also considers some model chemistry. As usual, the references are numerous.

In summary, this book represents a tremendous amount of effort, and it will doubtless be useful to a wide range of chemists. It is uneven, the material could have been better organised, and its coverage is considerably wider than the title would suggest. In this, the authors do themselves a disservice. The analysis of the material sometimes reflects views that some would regard as contentious, but overall this book will serve as a valuable reference for some time to come.

G.J. Leigh
*School of Chemistry,
Physics and Environmental Science,
University of Sussex,
Brighton BN1 9QJ,
UK*