Applied Homogeneous Catalysis

As indicated by several relatively recent Nobel Prize awards, research in transition metal homogeneous catalysis continues to be an attractive area for both academic and industrial chemists. Apart from the well-known and important metal-catalyzed processes for the production of bulk chemicals, there is a strong interest from pharmaceutical companies in using chiral metal catalysts for the enantioselective synthesis of a variety of intermediates.

In contrast to many texts concerned with aspects of homogeneous catalysis, this useful book by Behr and Neubert offers a very broad and more industrially orientated approach to the subject. For instance, in almost every chapter, one finds valuable technical flow diagrams for the processes leading to the various products. Furthermore, the book contains chapters on subjects such as thermal separation, immobilization on solid supports, catalyst separation (an important aspect of any industrial catalytic process), thermomorphic solvent systems, and process development, all of which clearly emphasize the applied tone of this book.

After introducing and defining the general area, the authors give a brief history of the subject in connection with the synthesis of inorganic, organic, and fine chemicals. This is followed by a brief but interesting presentation concerned with worldwide industrial production of chemicals by homogeneous catalysis, including a breakdown between bulk, fine, and specialty chemicals. Early on, the authors introduce Sheldon's environmental *E*-factor (mass of by-products divided by the mass of product) applied to the processing of crude oil and the production of bulk chemicals, fine chemicals, and pharmaceuticals, so that the reader is immediately concerned with both environmental and economic issues. Indeed, in their discussion concerned with supercritical fluids and fluorous solvents, they note: "In fact, in the majority of cases, high cost is the main drawback when seeking to use an alternative solvent".

Throughout the text, one finds tables of relevant information (such as physical data for 69 different solvents, a comparison of several different propene hydroformylation processes, Internet information about the prices of metals, or the addresses of manufacturers and distributors of various useful products).

This does not mean that the basic chemical aspects are neglected. As one might expect, there are several chapters devoted to the coordination chemistry and organometallic chemistry associated with metal-catalyzed homogeneous reactions, with some emphasis on the use and applications of P-donor ligands, especially in enantioselective catalysis. These provide the structure for understanding how metals are capable of transforming feedstocks into useful intermediates and products. Furthermore, at least 15 chapters deal with the catalytic applications of various reagents (for example, hydrogen, olefins, acetylenes, alkanes, CO, and CO_2), complete with information from the organometallic chemistry literature about mechanisms associated with transformations into the desired products. All of the chapters end with summaries of the main points (take-home messages) and good-to-excellent lists of literature citations.

Summarizing, this is a useful textbook for beginning students, and will provide a broad introduction to the topic of applied homogeneous catalysis. However, the book's approach to the subject results in both its strength and its weakness. In their 41 chapters, the authors present a variety of topics ranging from fundamental organometallic chemistry to process development, and it is, of course, impossible to cover the many individual subjects in any depth, although the authors are to be praised for their efforts. In reality, "the devil is in the detail". Homogeneous hydrogenation of terminal olefins is often carried out using a rhodium catalyst; however, for tertiary and tetra-substituted compounds, an iridium catalyst might be preferred. The choice of the phosphine ligand in hydroformylation chemistry is not so simple, and can require empirical fine-tuning. Further, manufacturers sell groups of chiral mono- and bidentate ligands because enantioselective catalysis is still something of a fine art. Nevertheless, this text represents a solid introduction to the area, and is certainly to be recommended for teaching at the undergraduate level.

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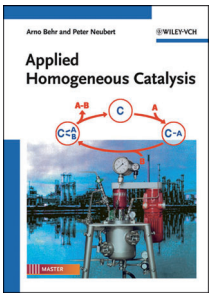
DOI: 10.1002/anie.201208808



Applied Homogeneous Catalysis
By Arno Behr and Peter Neubert. Wiley-VCH, Weinheim, 2012. 688 pp., softcover, € 69.00.—ISBN 978-3527326334