

Book Review of Heterogenized Homogeneous Catalysts for Fine Chemicals Production: Materials and Processes

Heterogenized Homogeneous Catalysts for Fine Chemicals Production: Materials and Processes. Edited by Pierluigi Barbaro and Francesca Liguori (both at Consiglio Nazionale delle Ricerche, Sesto Fiorentino, Firenze, Italy). From the series, *Catalysis by Metal Complexes*. Edited by C. Bianchini, D. J. Cole-Hamilton, and P. W. N. M. van Leeuwen. Springer Science + Business Media: Dordrecht, Heidelberg, London, New York. 2010. \$189. ISBN 978-90-481-3695-7.

Heterogeneous catalysts have traditionally been preferred in industrial applications because of their robustness, but homogeneous and enzymatic catalysts are often a better choice for more complex catalysis. These catalysts have traditionally been treated as three different areas of study. Bridging the gap in research among the three requires a multidisciplinary approach. Supported single-site catalysts, such as those reviewed here, may be the solution in that they could offer the unmatched selectivity of homogeneous complexes paired with the convenience of solid substrates.

For a compelling introduction to the field, I encourage readers to start this book with the enlightening Chapter 7. It is revealing that after almost 50 years since the initial patents for anchoring of homogeneous catalysts in heterogeneous supports and 30 years of strong academic research, there are not yet indications of industrial applications, with the possible exception of heteropolyacids attached to alumina supports that were commercialized by two catalyst suppliers. In Chapter 7, a case study for the long development of an industrial process is described and insights are given about the causes that made the final catalyst not commercially viable. One of the conclusions is that after balancing the added value of products, in favor of fine chemicals, with the high cost and time required for research and development of new catalysts, in favor of bulk chemicals, the “sweet spot” for introducing new heterogenized catalytic processes could be located somewhere between the fine and bulk chemicals industrial segments. Therefore, the field may not be constrained to only fine chemicals production as suggested by the title in the book.

The overview of fine chemicals synthesis through heterogenized catalysts in Chapter 1 and the descriptions of the solid supports and their influence on the final performance of catalysts presented in Chapters 2–6 are very clear and detailed. These chapters could serve as an excellent introduction to this area for the beginning practitioner. Chapter 8 on chemical reaction engineering may be better suited for another book, since two-thirds of it do not directly relate to the main theme of this monograph. The next three chapters, 9–11, covering historical and current research on the applications of heterogenized catalysts, not only are a good introduction for beginners but also will serve as a very useful reference source to active scientists already in this area. The majority of the applications described through the book are related

to enantioselective reactions, as expected from the nature of the most appealing immobilized catalysts. One of the challenges highlighted in these chapters is that immobilized complexes have to be stable under all the oxidation states involved during the catalytic cycle to prevent leaching from the support. The chapter presenting initial work related to theoretical simulations, which are computationally costly for these very complex systems, offers an encouraging view of how the molecular description of the catalysts can help to guide the development of robust structures during the whole catalytic cycle. At the end of the book there is a short, not all-inclusive chapter on experimental techniques, which, combined with examples from the other chapters on the use of DRUV—vis, Raman, and EPR for heterogeneous systems, gives a useful summary of currently available experimental options.

Although there is some redundancy in the chapters—for example, the reader is acquainted with the full 12 principles of green chemistry in Chapters 1 and 12—overall, Barbaro and Liguori have assembled a solid volume on the current state in the field of the heterogenization of homogeneous catalysts, giving a clear overview of its advances, difficulties, and future potential.

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