Polymer-Supported Platinum Metals Catalysis

CATALYSIS BY POLYMER-IMMOBILIZED METAL COMPLEXES

BY A. D. POMOGAILO, Translated from the Russian by N. M. Bravaya and A. V. Kulikov, Gordon and Breach Science Publishers, The Netherlands, 1998, 424 pages, ISBN 90-5699-130-2, U.S.$135, £86

This book reviews the relatively new and interesting field of metal catalysts attached to polymer supports. It is an English translation of the Russian edition, originally published in 1988, with some additions. Hence the references only cover work up to 1991. The book is valuable for giving an insight into the large volume of work on polymer supported metal catalysis that was carried out in the former U.S.S.R.

The immobilisation of catalysts on polymer supports, in a bid to combine the advantages of homogeneous and heterogeneous catalysis, is a growth area. The industrial market for homogeneous catalysts is increasing due, in part, to their increased activity and selectivity over heterogeneous catalysts. However, there are problems with the recovery of expensive metals and ligands from the reaction mix, thus, using supported homogeneous catalysts may address this.

The types of reactions performed by such catalysts are described in chapters on hydrogenation, oxidation, polymerisation and activation of small molecules, with the chapters on hydrogenation and oxidation being of particular interest.

The influence of support, solvent and metal/ligand ratio on catalyst activity is described in the chapter on hydrogenation. Direct comparisons between polymer-supported catalysts and homogeneous platinum group metals catalysts employed in industrially relevant reactions are particularly useful. Not surprisingly, this chapter is dominated by the use of rhodium and ruthenium in hydrogenation and hydrogen transfer reactions. The topical subjects of colloids in catalysis and enantioselective hydrogenation are mentioned, but in less detail and do not reflect the current state-of-the-art.

The chapter on oxidation concentrates on the oxidation of hydrocarbons and oxygen-containing substrates. The oxidation of polymer- and sulfur-containing substrates is also reported. While this part of the book is dominated by the chemistry of copper, chromium and manganese, the platinum group metals are mentioned, mainly in the oxidation of alcohols.

There is an interesting description of research on the catalytic activities of polymeric metalloporphyrins and phthalocyanines, which have the advantages of chemical and thermal stability. Professor Pomogailo touches on the use of polymeric metalloporphyrins in modelling enzymes – linking the fields of chemical- and bio-catalysis. The polymeric matrix is of prime importance in these oxidation reactions, facilitating selective oxidation of substrates, while separating the product from the catalyst for ease of isolation.

The concluding chapter contains two useful Tables; the first summarises polymer supports with different metals and the reactions they are commonly used in; the second provides a comparison of properties associated with heterogeneous, homogeneous and polymer-immobilised catalysts.

The index, however, is a little disappointing, key subjects which are described in the text are missing, for example metalloporphyrin and enzymes. There is far more detail in the book than a glance through the index would suggest.

In short, the book gives detailed coverage of the use of polymer-supported catalysis in a wide range of reactions and shows that the macroligand can be used to control the localisation of the metal centre, easing investigation of the catalytic mechanism. This in turn provides the exciting possibility of learning more about mechanisms involved in homogeneous, heterogeneous and biocatalysis. Professor Pomogailo has produced a thorough and interesting overview of his experience, and gives the reader some useful insights into research performed inside the former U.S.S.R.

E. SLADE

Elizabeth Slade is a Principal Scientist in the Chemicals and Colours Group at the Johnson Matthey Technology Centre. Her main interest is the development of new homogeneous, heterogeneous and supported homogeneous catalysts using high throughput screening techniques.