

Preface

It is my pleasure to welcome Prof. George Roberts of NC State University as my co-editor for Volume 17 of this book series. We have worked together to provide reviews of current topics in catalysis, and we trust that the subjects presented here are of interest.

Catalysis continues to be applied to a wide range of chemical reactions. New applications of catalysis, new synthesis methods, and new research into the molecular level mechanisms have provided insight into the applied and fundamental processes occurring on the working catalyst.

For example, Kerry Dooley (Louisiana State University, Baton Rouge, LA) reviews the catalysis of condensation reactions leading to ketones. There are a number of such reactions: aldol condensation and decarboxylation/condensation of acid and aldehydes, for instance. Despite a great deal of industrial and academic interest in these reactions, the mechanisms are not entirely clear. This is because of the change in mechanism (and product distribution) with temperature, and the complexity of the reaction. Prof. Dooley provides a detailed review of the most important reactions leading to ketones on a range of catalysts.

Jozef Margitfalvi and Sandor Gőbölös (Hungarian Academy of Sciences, Budapest, Hungary) provide a comprehensive review of the interaction of metal and metal ions in nanoscale clusters. They show that there are unique catalytic properties derived from the molecular interaction of these types of clusters. Their review summarizes the literature on five case studies that exemplify this type of interaction: Sn-Pt, supported Au, Sn-Ru, Re-Pt, and several Cu-containing catalysts. They discuss both oxidation and hydrogenation reactions on these types of catalysts, and provide detailed summaries of the literature, as well as examples from research in their own labs.

S. Rojas, S. Eriksson, and M. Boutonnet (KTH, Stockholm, Sweden) focus on the use of microemulsion techniques for catalyst synthesis. They discuss this as an alternative to traditional methods such as impregnation, ion exchange, and use of organometallic complexes. One specific advantage of the microemulsion method is that it results in a typically narrow particle size distribution. This is true because the metal particle is formed without being influenced by the support. They describe the specific processes used to prepare catalysts with this technique.

Jim Goodwin, Soo Kim, and William Rhodes (Clemson University, Clemson, SC) review the concept of turnover frequency, a widely used measure of catalytic reaction rates. They review various methods of measuring this property: chemisorption and isotopic tracing, for example. Their analysis also compares TOF values for structure-insensitive reactions like methanation and structure-

sensitive reactions like ethane hydrogenolysis. Isotopic tracing is shown to be a more accurate measure of true catalytic turnover frequency.

Catherine Heneghan, Stuart Taylor, and Graham Hutchings (Univ. Cardiff, Cardiff, UK) discuss the oxidation of volatile organic compounds using heterogeneous catalysts. This review supplements considerable work done by this research group in the past. Their review deals with both the more widely used noble metal catalysts as well as metal oxides. The different mechanisms on these two classes of materials are presented and analyzed. As the authors state, this may lead to the development of a catalyst with applicability to the wide range of VOCs that must be dealt with in industry.

Mehri Sanati, Mohammad Rahmani, Khashayar Badii, and Mostafa Faghihi (Univ. Växjö, Växjö, Sweden), Neil Cruise and Ola Augustsson (Perstorp Formax, Perstorp, Sweden), and Jerry Spivey (Louisiana State University, Baton Rouge, LA) also review VOC oxidation catalysts, but focus on the deactivation processes that take place in industrial practice. Specifically, they focus on the deactivation mechanisms associated with silica and phosphorous poisoning. General mathematical models of the deactivation process are presented, and applied specifically to deactivation of VOC oxidation catalysts.

Mayfair and Harold Kung, along with Colleen Costello (Northwestern University, Evanston, IL) review catalysts for CO oxidation over Au catalysts. This is an important reaction in the development of fuel processors to produce hydrogen for fuel cells. The authors discuss the unusual behavior of nanoparticles of Au, and point out that there is no consensus on the nature of the active site and the mechanism. Their review focuses on the preparation and effect of the support, the nature of the active site, the mechanism, and deactivation of these catalysts.

Finally, Carlos Querini (INCAPE, Santiago, Argentina) reviews the literature dealing with the characterization of coke. The difficulty in identifying the chemical and physical properties of coke on the working catalyst are well known. The author describes temperature programmed methods, spectroscopy, and extraction methods as alternatives to characterize the structure of coke. He provides specific examples of these methods in a way that will be helpful to those working in the field.

The editors wish to thank the authors for the effort they have put into these chapters, and the Royal Society of Chemistry for their support. Comments and suggestions are welcome.

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