

Preface

Catalysis continues to be a strong and engaging area of research. New tools are being used to explore the complex processes taking place at the catalyst surface. Conversion of both traditional and new fuels to meet the challenge of clean energy is becoming more important. The reviews in this volume address these topics.

Jim Goodwin, Jr. and colleagues at Clemson University (Edgar Lotero, David Bruce, and Kaewta Suwannakarn, Yijun Liu, and Dora Lopez) review the application of solid acid catalysts for the synthesis of biodiesel from renewable sources. Biodiesel is produced by the acid-catalyzed esterification of fatty acids derived from renewables such as vegetable oil. Although this esterification can be carried out using homogeneous acid catalysts, there are clear process advantages to using heterogeneous catalysts—provided the necessary activity and selectivity can be achieved. The authors assess both the current processes that are based on homogeneous catalysts, as well as recent studies of heterogeneous catalysts, which have not been extensively reviewed to date.

Nitrides and oxynitrides represent a relatively new class of catalytic material. Justin Hargreaves and D. McKay (University of Glasgow, UK) show that these materials have only recently been explored for reactions (e.g., photocatalysis) beyond those that take advantage of their acid-base properties and their ability to mimic Pt-based catalysts. Tuning the acid-base properties of nitrides is possible by incorporating oxygen within their structure.

Cobalt-based Fischer-Tropsch catalysts are the subject of continuing interest as large-scale Gas-to-Liquids plants come on line. Fernando Morales and Bert Weckhuysen (Utrecht University, the Netherlands) look specifically at the effects of various promoters for these catalysts, particularly Mn. The effect of these promoters in controlling the activity and selectivity of the overall reaction can be critical in the overall process economics. This chapter also looks at new spectroscopic techniques that have recently been used to study the effects of these promoters.

The decomposition of methane is an important process since it can produce two valuable products: hydrogen and carbon filaments. Wayne Goodman (Texas A&M University) and Tushar Choudhary (ConocoPhillips) show that methane decomposition may be a viable alternative to conventional steam reforming as a source of hydrogen, without the formation of CO_x as a byproduct. The authors examine the effects of catalyst support and promoters, as well as the inevitable regeneration of the catalyst. The formation of carbon fibers, under certain conditions, makes this process an attractive one.

Another route to hydrogen for fuel cell energy applications is the catalytic reforming of liquid fuels. In a review by authors from the US Dept. of Energy (Dushyant Shekhawat, Dave Berry, and Todd Gardner) and Louisiana State University (Jerry Spivey), the catalysts used for this reaction are examined. Among the key issues in this process are carbon deposition and sulfur poisoning. These deactivation mechanisms are widely recognized as barriers to the widespread use of catalytic reforming. The kinetics of the complex reforming process, which includes partial oxidation, steam reforming, and shift reactions, are also reviewed.

Finally, the application of computational methods to the study of catalysis continues to increase dramatically. C.G.M. Hermse and A.P.J. Jensen (Eindhoven University of Technology, the Netherlands) present a review of the kinetics of surface reactions with lateral interactions. These methods can be used in predicting catalytic reaction mechanisms. In particular, the authors discuss the role of lateral interactions in adsorbed layers at equilibrium and the determination of lateral interactions from experiments—using the simulations to interpret experimental results. This chapter illustrates the increasing use of computational methods to understand and to design catalysts.

I welcome to this volume my Co-Editor and colleague at Louisiana State University, Kerry Dooley. He is well-known to many in the catalysis community for his research in acid-base catalysis. Among other responsibilities, he will serve as Meeting Co-Chair for the upcoming North American Catalysis Society meeting, to take place in Houston on June 17–22, 2007.

As always, comments are welcome.

James J. Spivey

Gordon A. and Mary Cain Dept. Chemical Engineering
Louisiana State University
Baton Rouge, LA 70803
jjspivey@lsu.edu

Kerry M. Dooley

Gordon A. and Mary Cain Dept. Chemical Engineering
Louisiana State University
Baton Rouge, LA 70803
dooley@lsu.edu