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Editorial

Heterogeneous catalysis has been widely used by various industries including chemical, petroleum, power, automobile, environmental, etc. It not only affects our daily life but also represents a great potion of our economy. Improving process productivity and efficiency has been a critical on-going goal of the research community for a long time.

Many catalytic processes have been limited by thermodynamics resulting in low productivity. Others are inherited with high activation energy which, in consequence, results in low selectivity to desired products. Plasma technology combining with catalysis provides a unique way to separate the activation steps from selective reactions. The combination introduces additional clean energy, electricity, for plasma generation and efficient chemical activation to break the thermodynamic limitations. Because of the recent progress of atmospheric pressure non-thermal plasma technology it is foreseeable that plasma catalysis could contribute significantly to the revolution of industries and society toward high productivity and sustainable environment.

The International Symposium of "Plasma Technology and Catalysis" at New Orleans, LA, USA in March 2003 provided the opportunity to gather most plasma catalysis experts to exchange ideas and report progresses in the area. Selected papers were peer-reviewed and organized for this special issue. It is divided into two sections including plasma-catalytic processes and plasma preparation of catalysts.

The "Plasma-Catalytic Processes" section includes both application oriented studies aiming at the demonstration of efficient plasma-catalytic conversion and mechanistic studies assessing the reaction kinetics of plasma-catalytic hybrid processes. Thomas Hammer's review covering NO_x reduction and methane steam reforming is followed by seven methane conversion papers using various low temperature plasma techniques. During the last couple of decades the catalytic studies of direct upgrade of natural gas have been limited by the low selectivity ceiling due to high energy requirement of methane activation. Now it is possible to remove this ceiling by the addition of plasma energy with catalysis. The following six VOC oxidation and abatement papers and four NO_x control papers, which are interconnected by the VOC and NO_x combined study by Kirkpatrick et al., are contributions of the plasma catalysis technology to address environmental problems. Finally the low pressure study of Guyon et al. on the recombination of atomic oxygen on catalytic surfaces aims at understanding fundamental plasma-catalytic effects.

The "Plasma Preparation of Catalysts" section consists of non-thermal plasma and thermal plasma approaches for the synthesis of novel catalysts with high dispersion of metal and metal oxides. The non-thermal plasma approach is effective to achieve high dispersion because it avoids high temperature calcination and/or reduction processes to increase the dispersion of the catalytic species, and it improves the interaction of catalytic species with the support to minimize the mobility of the active centers. Thermal plasma techniques, on the other hand, can atomize raw materials and quickly cool and recombine atoms to novel materials. The technique has been optimized by Prof. G. Vissokov. He has demonstrated many unique catalysts that have wide commercial applications. The economic of the catalyst synthesis process is greatly improved when used catalysts are applied as the raw materials. J. Phillips uses Plasma Torch to synthesize carbon supported metal catalysts and the thermal plasma technique has been extended to the synthesis of nanotubes by Prof. Tian.

Although many promising results have been obtained and reported in this issue, little fundamental studies to understand the phenomenon were done. It is one of our goals to stimulate more mechanistic studies to understand the impact of both non-thermal and thermal plasma techniques on physical and chemical properties of surfaces. The other is to prompt the investigation of intermediate generation and control during plasma-catalytic processes. It is desirable to tailor made highly energetic and appropriate intermediates to control the reaction selectivity and to minimize the energy requirement for both plasma generation and the processes. We hope this issue serves as the stepping stone to promote the understanding of plasma catalysis and extend the application of plasma technology in more catalytic processes.

Finally, we like to express our appreciation to all the authors for their contributions. We also owe special thanks to all the reviewers. It is their careful review of the creative work that makes this quality issue possible.

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