Faculty of Engineering and Applied Science

Chemical Engineering Seminar Series

Queen's University

Electrochemical Promotion and Metal Support Interaction Phenomena in Heterogeneous Catalysis: Application to Oxidation of Volatile Organic Compounds (VOCs)

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Thursday, March 10, 2016, 2:30pm

Dupuis Hall, Room 215

ABSTRACT

Electrochemical Promotion of Catalysis (EPOC) also called Non-faradaic Electrochemical Modification of Catalytic Activity (NEMCA) can be applied to increase both the activity and the selectivity of heterogeneous catalysts. EPOC or NEMCA refers to the pronounced and reversible changes in the catalytic properties of conductive catalysts deposited on solid electrolytes caused by the application of a small (in the range of mA) electrical current or potential. The significant and often highly non-faradaic increase in the catalytic reaction rate, as well as the enhancement of product selectivity that are induced when applying very low currents, are often reversible and return to the value observed prior to application of the electric stimulus. The effect has been shown via several surface spectroscopic and electrochemical techniques to be caused by electrochemically controlled migration (back spillover) of promoting ionic species (e.g., O^{2-}, Na^{d+}, K^{d+}, etc.) from the solid electrolyte to the metal gas interface.

Electrochemical promotion and metal-support interaction (MSI) have long been viewed as two separate phenomena; however, more recently it has been shown that, functionally, for ionic and mixed ionic-electronic conducting materials, both are linked by the transfer of ionic species at the interfaces. The difference between the two phenomena has been shown to be only operational. It has been said that EPOC is electrochemically controlled MSI; likewise, MSI is considered as self-induced EPOC.

First, the concept of EPOC phenomenon and its origin will be presented, following by the discussion of EPOC and MSI at the Ru, and Pt-based nano-structured catalyst interfaced with yttria-stabilized zirconia (Y_2O_3-ZrO_2) and cerium oxide (CeO_2) in the instance of ethylene and carbon monoxide oxidation reactions.