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Nanoalloy catalysts for petrochemical processes and sustainable energy conversion

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Nanostructured catalysts have found increasing applications in petroleum reforming, catalytic combustion, and energy conversion/storage. One important area involves low-temperature nanocatalytic combustion over metal nanocatalysts, converting pollutants such as CO and gas hydrocarbons (HCs) into harmless gases and reducing emissions of particulate matter (PM), CO, NO_x and HCs. The nanocatalytic combustion of biofuels such as alcohols serves as a heat source for thermoelectric energy conversion, a sustainable energy because the effectiveness in supplying liquid fuels from renewable resources. Another area of interests involves metal nanocatalysts for hydrogen production from petroleum by oxidative reforming, serving as a efficient and clean way for energy conversion in fuel cells where platinum-based nanocatalysts play an increasingly important role for catalytic enhancement. While the nanocatalyst market growth projects a multi-billion dollar global industry, a key challenge is the fundamental understanding of how the structure of such catalysts can be controlled precisely for achieving the desired catalytic properties in each of the above catalytic reactions. In this presentation, recent findings of the study of binary/ternary nanoalloy catalysts prepared by molecularly-engineered synthesis and processing will be discussed. Examples will focus on gas-phase catalytic reactions for hydrogen production, CO oxidation, nanocatalytic combustion of alcohols, and electrocatalytic reactions of oxygen in fuel cells and rechargeable batteries, highlighting new insights into the control of atomic-scale metal coordination and structural/chemical ordering based on a combination of synchrotron X-ray based techniques such as high-energy resonant X-ray diffraction and X-ray absorption fine structure spectroscopy, especially in correlation with the enhanced catalytic properties.

Biography

Chuan-Jian Zhong, Professor of State University of New York at Binghamton, has about fifteen years research experience working on design and synthesis of nanostructured catalysts for sustainable energy production, conversion and storage (e.g., fuel cells and rechargeable batteries) and chemical/biological sensors, before which he had five years experience in surface chemistry at Iowa State University/DOE–Ames Laboratory. He received National Science Foundation Career Award, SUNY Chancellor Award for Excellence in Scholarship and Creativity, and 3M Faculty Research Award. He is author of over 180 peer-reviewed articles, inventor of 12 US patents, and has given over 140 invited talks.

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