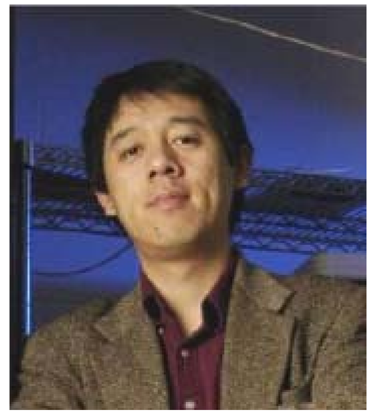
NEBRASKA CENTER FOR ENERGY SCIENCES RESEARCH

Cycle 5 – Energy Research Grants

Nanostructured Design of Catalysts for Converting Glycerol to Value-Added Chemicals



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ABSTRACT:

The goal of this project is to develop a class of catalyst, metal clusters supported on cerium oxide nanotubes, for selective conversion of glycerol into commercially value-added organic acid chemicals.

Glycerol is a by-product from the production of biodiesel via trans-esterification of fatty acids. With the fast growing U.S. biodiesel production, the biodiesel industry is facing an enormous supply of glycerol. It is imperative to find ways to efficiently convert this excess and cheap glycerol chemical feedstock into different valuable commodity chemicals to keep biodiesel industry profitable and to reduce the environmental footprint. Various reaction schemes have been explored to transform glycerol to value-added chemicals, such as oxidation, hydrogenolysis, and hydrogenation. Nonetheless, highly selective and energy efficient catalytic processes for these reaction pathways to produce various selective acid products are yet to be well established.

Cerium oxide is a well-known cracking catalyst for petroleum hydrocarbon feedstock. Nanostructured catalysts often exhibit unusual chemical reactivity and have much larger surface area than their bulk counterparts. Metal clusters supported catalysts have been demonstrated to yield highly oxidative catalytic reactivity due to the strong-metal-support-interaction. We postulate that cerium oxide nanotubes supported metal clusters can lead to highly effective oxidative catalysts for oxidative conversion of glycerol to produce lactic acid, tartaric acid, formic acid and glyceric acid. Metal clusters with different reduction potential including gold, silver, copper and palladium will be utilized to decorate these cerium oxide nanotubes and modulate their oxidative potential to yield selective products. Computation modeling will be applied to elucidate possible reaction pathways for these reactions and provide molecular insights into the selectivity on the supported metal clusters.