2021 UA TRICAMPUS MSE SPRING SEMINAR SERIES

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Promoting Oxide-Gas Interaction by Oxide Partial Decomposition

The ability to produce supported metal nanoparticle catalysts via exsolution from a perovskite type oxide support under reducing conditions has been known for some time and is used in some formulations of automotive emissions control catalysts. The ability to re-dissolve and exsolve the metal via redox cycling has led to these systems being referred to as smart or regenerable catalysts. While this phenomenon is well known, the mechanism by which the transition metal is exsolved from the oxide host is still poorly understood. The relationships between the exsolution process and the resulting structure of the metal nanoparticles are also not well understood. In this talk I will discuss our recent mechanistic studies of the exsolution process. Using well-defined model systems and detailed structural analysis by electron microscopy and atomic force microscopy, the nucleation and exsolution of Ni particles from Ni-doped strontium titanate was monitored. These studies show how exsolution produces unique surface structures consisting of metal particles partially submerged in pits on the oxide surface. I will show that this particle-in-a-pit morphology imparts unusually high thermal stability as well as significantly decreased carbon filament formation. Metal exsolution control will be discussed for epitaxial perovskite oxide thin films with respect to the crystallographic orientations. The pre-imposed strain relaxation results in larger amount of metal exsolution; however, the population density, size, and degree of embedment was determined by metal-oxide matrix interface energy. Finally, partial decomposition in the calcium-containing ternary oxides was investigated for post-combustion CO2 capture application.

Prof. Tae-Sik Oh received his Ph.D. in Materials Science at California Institute of Technology where he performed research focused on thin film electrode fabrication for solid oxide fuel cells. Prior to joining the Chemical Engineering department at Auburn University in 2016, he studied oxide partial decomposition for heterogeneous catalyst design as a postdoctoral researcher in University of Pennsylvania. He is currently the Alabama Chapter President for Korean-American Scientists and Engineers Association. His research group is interested in understanding solid-gas, solid-liquid, and solid-solid interface phenomena and application of the new knowledge to real-world problems in energy and environment.

Wednesday, February 10 - 2 pm CT

Zoom Link: https://uab.zoom.us/j/97887766737

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