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Literature Seminar

When: March 24, 2022
Time: 12:00 p.m.
Location: CBLL-16

Synthesis and Characterization of Multi-metallic Nanoparticles and Nanoclusters

Abstract:
Multi-metallic nanoparticles and nanoclusters are a new class of materials that have recently been developed for many applications in the industrial, health, and energy sectors.[1] To synthesize such clusters a number of approaches have been reported. Interestingly, these classes of nanoparticles offer heterogeneity due to the presence of multiple elements, which provides unique physical and chemical properties. The analysis of these materials is crucial to determine the size distribution, metal composition, and atomic arrangement of the metals within the nanoparticles. Scanning Transmission Electron Microscopy (STEM) and X-ray Absorption (XANES and EXFAS) are two useful methods for obtaining this information. In this seminar, I will discuss the synthesis of multi-metallic nanoparticles, describe these two different characterization techniques used, and discuss the application of these techniques in a few specific reports. In the first report, Hu and co-workers describe the scalable synthesis of PtPdFeCoNi high-entropy nanoparticles (HEP-NPs) on 2D carbon-based support material using a roll-to-roll process that employs microwave heating. HAADF-STEM images of HEP-NPs and energy dispersive x-ray spectroscopy (EDX) line scans along the diameter of the NPs confirmed their high entropy distribution.[2] Second, Xie and co-workers used electrospray ionization mass spectrometry to monitor the synthesis and diffusion of single gold atoms into $Ag_{25}(MHA)_{18}$ with *in-situ* UV-Vis absorption spectroscopy.[3] Third, Frenkel and co-workers discussed the synthesis and importance of bimetallic Pt−Ni for catalysis of the reverse water gas shift (rWGS) reaction. The authors report XANES and EXFAS data to show the activity and bonding interaction between the support and the catalyst for CO_2 reduction.[4] In summary, multi-metallic nanoparticles have been successfully synthesized via multiple methods with desired geometry and shown outstanding performance in catalysis and drug delivery. The subsequent development in synthetic methods and the detailed analysis of such nanoparticles will lead to improvements in their controlled synthesis and properties for many different applications that can benefit society.

References:

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4. Liu, D.; Li, Y.; Kottwitz, M.; Yan, B.; Yao, S.; Gamalski, A.; Grolimund, D.; Safonova, O. V.; Nachtegaal, M.; Chen, J. G.; Stach, E. A.; Nuzzo, R. G.; Frenkel, A. I. Identifying dynamic structural changes of active sites in Pt–Ni bimetallic catalysts using multimodal approaches. *ACS Catal*, **2018**, *8*(5), 4120-4131. https://doi.org/10.1021/acscatal.8b00706