HIGHLANDS IN CHEMISTRY SEMINAR SERIES

Sept 26, 2025

2:30 PM ET

Hahn Hall North 140

Professor Michelle Personick
University of Virginia

"Electrochemical Tools for Disentangling the Real-Time Chemistry of Metal Nanoparticle Growth"

Precise control over nanoparticle shape, size, and composition is important for understanding fundamental properties of these materials and for designing new materials to meet emerging applications. Solution-based chemical nanoparticle synthesis has proven to be a highly successful method for tailoring the structural properties and composition of nanoparticles. However, much of the successful development of syntheses for shaped nanoparticles has, by necessity, been achieved through trial-and-error approaches due to the high degree of complexity of the nanoparticle growth environment. A more detailed understanding of the fundamental chemistry that underlies metal nanoparticle growth will facilitate the directed design of new nanoparticle architectures, particularly for compositions where well-defined nanoparticle synthesis has thus far been prohibitively challenging. In addition, nanoparticle syntheses can be strongly sensitive to trace contaminants, leading to issues of irreproducibility, and these sensitivities may be unknown when a synthesis is initially reported. Together, these challenges point to a critical need for a method of benchmarking and reporting some measure of the optimal reaction chemistry during the synthesis, not just the physical properties of the nanoparticles.

To meet these needs, our research group has developed an integrated approach for using in situ electrochemical measurements to design, benchmark, and troubleshoot syntheses of shaped metal nanoparticles. Importantly, these electroanalytical measurements provide a means of benchmarking the real-time chemistry of newly developed nanoparticle syntheses—information which is currently not available in the literature or even possible to report. This talk will describe recent examples in which we have used this approach to troubleshoot the influence of detrimental and adventitious contaminants in the synthesis of metal nanoparticles, including ideas for how the approach could be broadly implemented in the field of nanoparticle synthesis. In addition, the talk will discuss how these electrochemical measurements can serve as a roadmap for the translation of nanoparticle syntheses directly from colloidal growth to electrodeposition, and vice versa.