Materials Transformations at Solid-Liquid Interfaces

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Abstract: Solid-liquid interfaces play an important role in materials applications ranging from solution based synthesis to energy conversion and storage, catalysis, corrosion and water separation. An understanding and ultimately control of the dynamic processes at solid-liquid interfaces govern the success and lifetime of functional devices and components. In the past a few years, my group has been studying materials transformations at the solid-liquid interfaces primarily by developing and applying liquid environmental electron microscopy. In this talk, I will show some results on the study of nanoparticle growth in solution and precipitation/dissolution at electrode-electrolyte interfaces. It is known that catalysis and other surface-enhanced properties of nanoparticles are highly dependent on their shape and surface structure. However, how facets develop and how structure evolves during growth is largely unknown due to the lack of direct observation. Using in situ liquid cell TEM, we have been able to identify unique growth mechanisms of nanocrystals. We found rules that have been applied to bulk systems break down at the nanoscale. For instance, the facet development of Pt nanocubes during growth drastically differs from what is predicted by the Wulff construction, a widely accepted surface energy minimization theorem. In addition to the simple noble nanoparticles, we have also been able to systematically study oxide and complex heterostructured nanoparticles. In the second part of the talk, I will present the study of electrochemical processes for battery applications using in situ electrochemical liquid cells. Dissolution-deposition at the electrode-liquid electrolyte interfaces including phase transformations of the precipitates during charge cycles in lithium ion nanobatteries will be discussed.

Biography: Dr. Haimei Zheng has been a staff scientist in Materials Sciences Division at Lawrence Berkeley National Laboratory since 2010. She is also an adjunct faculty in Materials Science Department at University of California, Berkeley. Dr. Zheng earned her Ph.D with Prof. Ramamoorthy Ramesh and Prof. Lourdes Salamanca-Riba at University of Maryland, College Park. She moved with Prof. Ramesh to UC Berkeley in her last year of graduate study and stayed within the group for two years before becoming a postdoc with Prof. Paul Alivisatos in Chemistry at UC Berkeley and jointly at National Center for Electron Microscopy of Lawrence Berkeley National Laboratory. Dr. Zheng currently researches physical and chemical processes of materials at the atomic level with a focus on growth, transformations and structure-function relation of materials.