Growth under the influence of chemistry: understanding the evolution of microstructure and the emergence of crystallinity during the early stages of growth

Abstract

Materials growth is a ubiquitous process. However, except for a small subset of conditions, predicting the microstructure of a material for a given synthesis process is still extremely challenging, particularly at low temperatures, where surface and bulk mobility of species are low.

In this talk, I will focus on how we are leveraging the extreme reproducibility of atomic layer deposition, in-situ characterization techniques, and the capabilities at the Advanced Photon Source to study the evolution of sub-nm oxides from isolated, single cation clusters to a bulk-like structure. In addition to being relevant for many different applications, these layers constitute the building blocks of metastable phases that are enabled by low temperature growth conditions. These include highly anisotropic laminate materials and hybrid organic-inorganic materials in which inorganic phases can be nucleated within polymers.