Abstract:
Environmental transmission electron microscopy allows the imaging of materials in the presence of relatively high pressures of gas (several Torr) without loss of either spatial or temporal resolution. As such it is an ideal technique for interrogating how catalytic nanoparticles respond to changes in reactive environments. In this presentation, I will review our work concerning carbon nanotube nucleation and growth as a model system for the study of many of these same processes. In the first part of the presentation, I will describe how dynamic changes in the catalyst morphology are correlated with the termination of growth in vertically aligned SWNT arrays. In particular, we have investigated how the processes of catalyst coarsening, Ostwald ripening and diffusion into the catalyst support can lead to growth termination, and we will describe how changes in the growth feedstock – in particular the incorporation of controlled amounts of water vapor – can alter the catalyst evolution. In the second portion of the presentation, we will describe how altering other aspects of the growth feedstock – in this case the carrier gas, in combination with the water vapor content – can not only affect catalyst morphological evolution, but can also significantly bias the chiral distribution of the resulting nanotubes. We will correlate the changes in growth ambient with a faceting / defacting transition, as well as a resulting change in the rate of Ostwald ripening. Finally, I will describe several cases (some based on user interactions) where these same approaches can be used to investigate model catalyst systems more generally.

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