MATERIALS SCIENCE and ENGINEERING SEMINAR

Co-Sponsored by the Center for Hybrid, Active, and Responsive Materials

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Coupling a Molecular Understanding to the Solution Synthesis of Nanomaterials

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Intense research efforts have been dedicated to the solution synthesis of nanomaterials. As a result, there is an extensive range of reported procedures that offer precise control over the size, shape, and composition. This control is in large part facilitated by the many synthetic handles offered by this method, including precursors, ligands, and solvent with wide temperature ranges. However, the advancements in this area have driven by trial and error leaving a large gap in understanding of the molecular chemistry of the materials synthesis. This gap makes it difficult to address reproducibility issues and hinders the rational synthesis of predicted/underexplored materials. My group's research is in part focused on making contributions to close this knowledge gap. In this talk I will share initial efforts to understand the molecular chemistry behind the role of halide precursors in driving structure/phase control in the synthesis of MnX (X =S, Se) nanoparticles. The Mn chalcogenide system, having three known polymorphs and being Earth-abundant, is a great target towards developing a better understanding of factors that control crystal structure selectivity. The polymorph/phase control can be achieved by varying the Mn halide precursor, under otherwise identical conditions as confirmed by powder X-ray diffraction. We will discuss a number of control experiments, including ligand, temperature, and aliquot studies that were employed to obtain insights into the reaction pathway. These studies were complemented with TEM and surface characterization. I will also present some insights into the synthesis of oxygen-deficient In_2O_{3-x} which displays an enhanced optical absorption range. Growth studies coupled to mechanistic insights show two converging paths that lead to the formation of this material that has wide range of potential applications.

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