New Routes to Complex Oxide Functionality through Solid-Phase Epitaxial Crystallization

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Complex oxide materials exhibit fascinating physical phenomena ranging from correlated-electron physics, to magnetism, and optic and piezoelectric functionality. The synthesis of these materials has often employed powerful epitaxial growth techniques that include the direct growth of crystals from the vapor. A complementary approach involving epitaxial crystallization from the solid amorphous form of the complex oxide compounds involves different kinetic phenomena than growth from the vapor. As a result, opportunities arise to broaden the range of compounds that can be grown epitaxially, to create new epitaxial forms in non-planar geometries, and to synthesize oxides with controlled arrays of crystallographic defects. This talk will describe the underpinning phenomena of solid-phase epitaxial crystallization in reduced geometries and highlight specific examples in the synthesis of correlated-electron transparent conductors, challenging oxide buffer layer substrates for compound semiconductor epitaxy, and the formation of defects in lateral crystallization in patterned geometries. Directions extending from these areas that will potentially allowing the integration of some types of complex oxides in non-epitaxial substrates will also be discussed. Finally, complementary opportunities to characterize complex oxides in nanoscale geometries using advanced synchrotron x-ray scattering approaches will be described.