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Strain-Energy Model for the Configuration of Self-Assembled Secondary Phase Nanorods in Epitaxial Nanocomposite Films

Self-assembled secondary phase nanostructures in epitaxial films provide a unique approach to design and tailor physical properties of nanocomposite films by controlling the morphology of the nanostructures. Impurity-doped high-temperature superconducting films is an excellent example among other oxide nanocomposites and the formation of vertically-aligned secondary phase oxide nanorods has been extensively studied for the enhancement of magnetic pinning properties of the films. To achieve an optimal pinning efficiency for superconducting film applications, it is important to control nanostructure configuration with a desired nanostructure density through selecting compatible dopant materials or film fabrication conditions. Such a control requires an understanding of the underlying physics of the formation of the nanostructures. In the formation of secondary phase nanostructures in epitaxial films, the lattice strain due to the lattice mismatch between the film matrix and dopant has been recognized as a primary driving force determining the morphology of the nanostructures. In this talk, I will discuss how to model the elastic energy of the coherently strained lattice and the non-coherent interfacial energy on the nanostructure surface for studying the configuration of nanostructures in epitaxial nanocomposite films.

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