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Micromechanical Model for Structural Transition of Secondary Phase Oxide Nanorods in Epitaxial YBa2Cu3O7−_Films JACK SHI, JUDY WU, University of Kansas Dept. of Physics & Astronomy — A micromechanical model based on the theory of elasticity has been developed to study the configuration of self-assembled secondary phase oxide nanostructures in high temperature superconducting YBa2Cu3O7−_(YBCO) films. With the calculated equilibrium strain and elastic energy of the impurity doped film, a phase diagram of lattice mismatches vs. elastic constants of the dopant was obtained that predicts the energetically-preferred orientation of secondary phase nanorods. The structural transition of the nanorods orientation was studied with impurity doped YBCO films on vicinal SrTiO3 substrates. It was found that the increase of the vicinal angle of the substrate leads to a substantial change of the strain field in the film, resulting in a transition of the nanorod orientation from the normal to in-plane direction of the film. The calculated threshold vicinal angle for the onset of the transition and lattice deformation of the YBCO film due to the inclusion of the nanorods are in very good agreement with experimental observations. This result sheds lights on understanding of the role of the film/substrate lattice mismatch in controlling self-assembly of dopant nanostructures in matrix films.

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