Effect of Nanosize $BaZrO_3$ Inclusions on Vortex Parameters in $YBa_2Cu_3O_{7-x}$

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Abstract - We report on the field dependence of the microwave complex resistivity data in $YBa_2Cu_3O_{7-x}/BaZrO_3$ films grown by PLD at various $BaZrO_3$ content. The data, analyzed within a recently developed general framework for the mixed-state microwave response of superconductors, yield the field dependence of the fluxon parameters such as the vortex viscosity and the pinning constant. We find that pinning undergoes a change of regime when the $BaZrO_3$ content in the target increases from 2.5 mol.% to 5 mol.%. Simultaneously, the vortex viscosity becomes an increasing function of the applied magnetic field. We propose a scenario in which flux lines are pinned as bundles, and a crossover from dilute point pins to dense c-axis correlated defects takes place between 2.5 and 5 mol.% in the BZO concentration. Our data are inconsistent with vortices occupying mainly the $BaZrO_3$ sites at low fields, and suggest instead that vortices occupy both $BaZrO_3$ sites and interstitials in the $YBa_2Cu_3O_{7-x}$ matrix, even at low fields.

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