Role of Nd_2O_3 nanoparticles addition on microstructural and superconducting properties of $YBa_2Cu_3O_{7-\delta}$ ceramics

ABSTRACT

The effects of Nd2O3 nanoparticles addition on microstructure, transport and AC susceptibility properties of YBa2Cu3O7–δ (Y123) superconductors were systematically investigated using X-ray diffraction (XRD), scanning electron micrograph (SEM), four point probe measurement and AC spectrometer. It was found that the added samples were predominant by Y-123 phase beside small amount of Y-211 and unreacted Nd2O3 secondary phases. All added samples preserved the orthorhombic structure similar to the pure sample and no orthorhombic-to-tetragonal transition occurred. The samples became more porous and their grain size significantly decreased with addition of Nd2O3. The addition of nano-Nd2O3 disturbed the grain growth of Y123, thus resulting in the degradation of superconducting properties of the samples. The superconducting transition temperature (Tc onset) of samples decreased from 92 K for x=0.0 to 78 K for x=1.0 wt.%, which could be attributable to oxygen vacancy disorder. From AC susceptibility result, the inter- and intra-granular loss peaks became wider and broader with increase of Nd2O3 addition due to the weakening of grains coupling. On the other hand, the inter-granular critical current density, Jcm, was found to increase with Nd2O3 addition and had the highest value at x=0.6, confirming that Nd2O3 nanoparticles acted as pinning centers in Y123 matrix.

Keyword: YBCO; Critical temperature; Co-precipitation; AC susceptibility; Critical current density; Rare earths