Superconductivity of Y_2O_3 and $BaZrO_3$ nanoparticles co-added $YBa_2Cu_3O_{7-\delta}$ bulks prepared using co-precipitation method

ABSTRACT

In this work, polycrystalline samples of nominal composition $YBa_2Cu_3O_{7-\delta}$ with co-addition of 5.0 mol% of Y_2O_3 and x mol% of $BaZrO_3$ (BZO) nanoparticles (x = 0.0, 1.0, 2.0, 3.0, 5.0 and 7.0) were prepared using co-precipitation (COP) method. Data of X-ray diffraction (XRD) showed that all the samples were composed of Y-123 as the major phase and Y-211 as the minor phase. XRD peak of BZO was also observed in the samples co-added with BZO nanoparticles. Refinement of lattice parameters of a, b, and c-axis showed that the orthorhombic structure of the samples was retained without occurance of orthorhombic-tetragonal phase transition. The average grain size was increased from 0.30 ± 0.02 μm for the pure sample to 0.47 ± 0.03 μm for the sample with 7.0 mol% BZO as revealed by the scanning electron microscope images. Plots of normalized resistance versus temperature showed metallic behavior in the normal state and a single step transition in the samples. Tc-onset was decreased with co-addition of Y_2O_3 and BZO probably because of reduced hole concentration. The higher Josephson's current, Io of the samples with co-addition of 0.0–2.0 mol% BZO compared with that of the pure one is likely to be due to improved grain coupling as shown by the AC susceptibility measurement. The calculated intergranular critical current density, Jcm based on the Bean critical state model is 1.88 A/cm² at Tp = 84.8 K for the pure sample. The highest Jcm obtained is 2.10 A/cm² at Tp = 85.4 K for 2.0 mol% BZO co-added sample.