

Superconductivity of Y₂O₃ and BaZrO₃ nanoparticles co-added YBa₂Cu₃O_{7- δ} bulks prepared using co-precipitation method

ABSTRACT

In this work, polycrystalline samples of nominal composition YBa₂Cu₃O_{7- δ} with co-addition of 5.0 mol% of Y₂O₃ and x mol% of BaZrO₃ (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 occurrence of orthorhombic-tetragonal phase transition. The average grain size was increased from $0.30 \pm 0.02 \mu\text{m}$ for the pure sample to $0.47 \pm 0.03 \mu\text{m}$ 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. T_c-onset was decreased with co-addition of Y₂O₃ and BZO probably because of reduced hole concentration. The higher Josephson's current, I₀ 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, J_{cm} based on the Bean critical state model is 1.88 A/cm² at T_p = 84.8 K for the pure sample. The highest J_{cm} obtained is 2.10 A/cm² at T_p = 85.4 K for 2.0 mol% BZO co-added sample.