

Effect of nano-sized Co₃O₄ addition on the transport properties of YBa₂Cu₃O_{7-δ}

ABSTRACT

The effect of nano-sized Co₃O₄ (10 - 30 nm) addition on YBa₂Cu₃O_{7-δ} (Co₃O₄)_x with x = 0 to 0.12 wt.% has been investigated by powder X-ray diffraction method, dc electrical resistance measurements and scanning electron microscopy. The Co₃O₄ particle size was larger than the coherence length but smaller than the penetration depth of the YBa₂Cu₃O_{7-δ} superconductor. The onset transition temperature (T_c onset) showed no significant changes for low Co₃O₄ addition (x ≤ 0.02 wt. %) and then decreased monotonically with the increase in Co₃O₄ content indicating a pair-breaking like mechanism in T_c suppression for x = 0.03 to 0.12 wt. %. A sudden broadening of the superconducting-transition-width for x ≥ 0.11 wt. % was also observed. The transport properties were measured and related to the microstructure. Scanning electron micrographs showed homogeneous distribution of Co₃O₄ throughout the samples and the distance between particles was smaller than 1 μm but larger than the typical Abrikosov vortex lattice constant.

Keyword: Nano Co₃O₄ addition; Electrical resistance; YBa₂Cu₃O_{7-δ} superconductor