Effects of Nano-Sized PbO on the Transport Critical Current Density and Flux Activation Energy of $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ Superconductor

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The effects of nano-sized PbO (10-30 nm) addition on the critical temperature, transport critical current density (J_c) and flux activation energy of $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}(\text{PbO})_x$ ($x = 0.00\text{-}0.45$ wt.%), prepared by the standard solid-state reaction method were studied. Powder X-ray diffraction method, electrical resistance measurements and scanning electron microscopy have been used to study the samples. The transport critical current density, J_c was measured using the four-point probe method. The flux activation energy, U was calculated from the resistivity versus temperature measurements using the Arrhenius-type equation. The highest superconducting onset temperature $T_{c \text{ onset}}$ was observed in the sample with $x = 0.35$ wt. % (94 K). The $x = 0.25$ wt. % sample showed the highest J_c . The activation energy ($U = 0.90$ eV) in zero fields showed a maximal plateau between $x = 0.20$ and 0.35 wt. %. Enhancement of J_c was explained as the increase in the activation energy as a result of nano-sized PbO addition.

Keywords: Activation energy; current density; microstructure; transition temperature

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