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Phase Formation and Conductivity Fluctuation Investigation in Nanoparticle SnO_2-Added $Y_3Ba_5Cu_8O_{18\pm\delta}$ Polycrystalline Superconductor

© N. Ghaedsharafi, G. Shams¶, Z. Soltani

Department of Physics, Shiraz Branch, Islamic Azad University, Shiraz, Iran

¶ E-mail: shams@iaushiraz.ac.ir

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The influence of 0.00, 0.20, 0.40, 0.50, and 0.60 wt% nano-sized tin oxide (SnO_2) particles on electrical conductivity fluctuation in normal and superconducting state of the $Y_3Ba_5Cu_8O_{18\pm\delta}$ (denoted as Y-358) polycrystalline samples is studied. Phase formation and microstructures have been systematically examined. By increasing the content of SnO_2 in YBCO matrix, X-ray diffraction technique showed slight variation in lattice parameters and overall reduction in the orthorhombicity. Scanning electron microscopy observations and the crystallite size calculation also revealed that the grain size and the average crystallite size decreased compared to the SnO_2-free sample. Aslamazov–Larkin and Lawrence–Doniach prototypes were used to analyze conductivity fluctuations based on the electrical resistivity $\rho(T)$ measurements. Superconducting transition temperatures T_c and T_{LD} have been reported. The influence of SnO_2 addition on the superconducting properties indicates that with the addition of SnO_2 nanoparticles into Y-358 compound, some parameters values such as zero-resistance critical temperature $T_{c\,zero}$, coherence distance alongside the c axis at 0 K $\xi_c(0)$, and super-layer length d decrease in total, while anisotropy γ, critical magnetic fields $B_{c1}(0)$, $B_{c2}(0)$, and critical current density $J_c(0)$ increase in SnO_2-added Y-358 specimens compared to the pure one. The reasons corresponding to these scenarios are discussed in details.

Keywords: phase formation, conductivity fluctuation, SnO_2 nanoparticle, Y-358.