

Superconducting and Electrical Transport Properties of $(\text{Bi}_{1.4}\text{Pb}_{0.6})\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$ with Nano- $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4$ Addition

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The effects of nano- CoFe_2O_4 addition on the superconducting and transport properties of $(\text{Bi}_{1.4}\text{Pb}_{0.6})\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_{10}$ high temperature superconductor (Bi-2223) were studied. Bi-2223 superconductor samples were prepared using co-precipitation method. 0.01 to 0.05 wt.% of $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4$ magnetic nanoparticles with average size of 20 nm was added to enhance the flux pinning and improve the transport properties of the Bi-2223 superconductor [1-2]. The $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4$ particle size is larger than the coherence length, ξ and smaller than the penetration depth, λ of Bi-2223 ($\xi = 2.9$ nm, $\lambda = 60 - 1000$ nm for Bi-2223 [3]). The critical temperature (T_c), critical current density (J_c), phase formation and microstructure of the samples were investigated. As shown in Fig. 1, all samples with addition of nano- $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4$ showed higher J_c compared to non-added sample. The sample with 0.01 wt.% addition showed the highest T_c and J_c . A higher amount of addition (>0.01 wt.%) leads to degradation of both T_c and J_c . This study shows that small addition of $\text{Co}_{0.5}\text{Ni}_{0.5}\text{Fe}_2\text{O}_4$ nanoparticles can effectively enhance the transport critical current density in Bi-2223 superconductor.