

## Effect of $\text{Co}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$ Nanoparticle on AC Susceptibility and Electrical Properties of $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ Superconductor

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Magnetism and superconductivity are mutually exclusive phenomena and their interaction is an interesting topic to study. In this work the effect of  $\text{Co}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4$  (CZFO) nanoparticle with size 20-50 nm on  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  (YBCO) is reported. The samples were prepared using solid state reaction with starting composition  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}(\text{Co}_{0.5}\text{Zn}_{0.5}\text{Fe}_2\text{O}_4)_x$  with  $x = 0$  to 0.4 weight percent (wt. %). All samples exhibited single YBCO phase as shown from the XRD patterns. The grain size was reduced with CZFO addition. The transition temperature ( $T_c$ ) from resistance measurements showed a slight increase from 90 K ( $x = 0$ ) to 91 K ( $x = 0.1$ ) followed by a suppression for  $x \geq 0.2$ . The peak temperature,  $T_p$  of the imaginary part of the susceptibility  $\chi''$ , was around 79 to 76 K in the  $x = 0$  to 0.3 samples. However, a drastic decrease to 60 K was observed in the  $x = 0.4$  sample indicating weakening of intergrain coupling which resulted in coupling losses as CZFO was added. The  $x = 0.1$  sample showed the highest  $T_c$  and the critical current density,  $J_c$  among all the samples studied. These results were compared with other materials addition to  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ .

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**Keywords:** coherence length; penetration depth; nanoparticles; intergrain current density

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