

## Effects of HoMnO<sub>3</sub> nanoparticles addition on microstructural, superconducting and dielectric properties of YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7- $\delta$</sub>

### ABSTRACT

(YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7- $\delta$</sub> )<sub>1-x</sub>(HoMnO<sub>3</sub>)<sub>x</sub> ( $x = 0.0, 0.0025, 0.005, 0.01, 0.03$  and  $0.05$ ) ceramics were fabricated by introducing co-precipitation synthesized HoMnO<sub>3</sub> (HMO) nanoparticles during solid state reaction process of YBa<sub>2</sub>Cu<sub>3</sub>O<sub>7- $\delta$</sub>  (Y-123) superconductors. (Y-123)<sub>1-x</sub>(HMO)<sub>x</sub> samples were characterized using X-ray diffraction (XRD), field emission scanning electron microscope (FESEM) attached with energy Dispersive X-ray spectrometer (EDX), four-point probe measurement, AC susceptometer and impedance analyzer. Majority of XRD patterns were indexed to orthorhombic Y-123 phase. Besides, YBaMn<sub>2</sub>O<sub>5</sub> (1.5–3.6%) and YBaMn<sub>2</sub>O<sub>6</sub> (2.4–7.4%) phases were detected. FESEM images and EDX analysis showed the presence of agglomerated particulates related to Mn and Ho based phases residing in between the Y-123 grains. The superconducting behavior was significantly enhanced at  $x = 0.0025$  while there was no major depression noticed in critical temperature ( $T_{c-R=0}$ ) as the addition increased till  $x = 0.03$  ( $T_{c-R=0} = 88$  K). AC susceptibility curves of composites samples manifested sharp transitions for samples with  $x = 0.0025$  and  $0.005$ . Dielectric parameters  $\epsilon_r'$  and  $\epsilon_r''$  decreased as the frequency increased for all samples. The  $\epsilon_r$  versus frequency measurements showed increment in  $\epsilon_r'$  and  $\epsilon_r''$  values for all added samples as compared to Y-123 sample. The highest values for  $\epsilon_r'$  and  $\epsilon_r''$  were obtained for sample  $x = 0.05$  with the highest loss at lower frequency. The Nyquist plots of complex impedance were analyzed where two semi-arc circulars represent grain and grain boundary effect were deduced.

**Keyword:** Y-123; HoMnO<sub>3</sub>; Critical temperature; Solid state reaction; Co-precipitation; Impedance

