

## Effects of rare earth nanoparticles (M= Sm<sub>2</sub>O<sub>3</sub>, Ho<sub>2</sub>O<sub>3</sub>, Nd<sub>2</sub>O<sub>3</sub>) addition on the microstructure and superconducting transition of Bi<sub>1.6</sub>Pb<sub>0.4</sub>Sr<sub>2</sub>Ca<sub>2</sub>Cu<sub>3</sub>O<sub>10+δ</sub>1-x(M)x ceramics

### ABSTRACT

The effect of rare earth nanoparticles, M=Sm<sub>2</sub>O<sub>3</sub>, Nd<sub>2</sub>O<sub>3</sub> and Ho<sub>2</sub>O<sub>3</sub> added to (Bi<sub>1.6</sub>Pb<sub>0.4</sub>Sr<sub>2</sub>Ca<sub>2</sub>Cu<sub>3</sub>O<sub>10+δ</sub>)<sub>1-x</sub>(M)<sub>x</sub>, where x = 0.00 - 0.05, superconductor were studied by X-ray diffraction technique (XRD), resistivity (R), scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDX). The volume fraction of high-T<sub>c</sub> phase, Bi-2223, decreased from 84% for pure sample to 48, 30 and 23% at x = 0.05 for Sm<sub>2</sub>O<sub>3</sub>, Ho<sub>2</sub>O<sub>3</sub> and Nd<sub>2</sub>O<sub>3</sub> additions, respectively. The critical temperature T<sub>c</sub>(R=0) that is 102 K for the pure sample decreased to 78, 73 and 69 K at x = 0.05 for samples with Sm<sub>2</sub>O<sub>3</sub>, Nd<sub>2</sub>O<sub>3</sub> and Ho<sub>2</sub>O<sub>3</sub> nanoparticles additions, respectively. The additions of rare earth nanoparticles decreased the grain size and increased the random orientation of the grains. The results showed that the phases' formations, variations of lattice parameters and electrical properties are sensitive to the size of nanoparticles and magnetic properties of its ions.

**Keyword:** High T<sub>c</sub> phase (Bi-2223); Hole concentration; Pairing mechanism; Sm<sub>2</sub>O<sub>3</sub>, Ho<sub>2</sub>O<sub>3</sub> and Nd<sub>2</sub>O<sub>3</sub> rare earth nanoparticles