The effect of Ba substitution at Sr site in Bi-2223 high-\(T_C\) superconductors

H Salamati, T Morshedloo, P Kameli, M Baghi, I Abdolhosseini, H Ahmahvand, D Sohrabi

Department of Physics, Isfahan University of Technology, Isfahan 84156-83111
E-mail: Salamati@cc.iut.ac.ir

Abstract

\(\text{Bi}_{1.8}\text{Pb}_{0.4}\text{Sr}_{2-x}\text{Ba}_x\text{Ca}_{2.2}\text{Cu}_3\text{O}_y\) (\(x=0, 0.1, 0.2, 0.3\)) samples were prepared by a conventional solid state reaction method. The effect of Ba substitution at Sr site in Bi-2223 high-\(T_C\) superconductors have been investigated by the XRD, SEM, dc electrical resistivity and ac susceptibility. XRD and SEM analysis indicated Ba substitution decreased temperature of 2223 phase formation. The highest 2223 phase fraction was obtained for the sample with \(x=0.1\) (A1 sample). This phase decreased by increasing Ba concentration (\(x>0.1\)). Ba doping up to \(x=0.1\) decreased impurity phases but doping more than 0.1 increased. Dc electrical resistivity data and ac susceptibility measurements showed the transition temperature of grains and grain boundaries (\(T_c\), \(T_{cj}\)) increased and the transition width (\(\Delta T_c\)) decreased for A1 sample. This behavior can be described by decreasing impurity phases and increasing 2223 phase. Flux pinning force and intergranular critical current densities (\(J_{cm}\)) of A1 sample increased. It was suggested it is because of a small precipitation of Ba in grain boundaries as effective pinning centers. Ba doping more than 0.1 reduced the intergranular coupling and increased weak link behavior by increasing impurity phases. It decreased \(T_{cj}\), \(J_{cm}\) and flux pinning force.

Keywords: Bi-based superconductors, Barium substitution, 2223 phase formation, critical current density

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