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Influence of $Pb(BO_2)_2$ Doping on Superconducting Properties of (Bi,Pb)-2223 HTS

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Abstract

The effect of lead borate $Pb(BO_2)_2$ doping on the phase formation and superconducting properties of (Bi,Pb)-2223 high-temperature superconductivity (HTS) has been studied. Samples with nominal composition $Bi_{1.7}Pb_{0.3-x}Sr_2Ca_2Cu_3O_y[Pb(BO_2)_2]_x$, $x = 0–0.3$, were prepared by the standard solid-state processing. The appropriate mixtures were calcined at 850 °C for 30 h. The resulting materials were pressed into pellets and annealed at 840 °C for 30 h in air. X-ray diffraction, resistivity, and critical current density measurements were performed on the undoped (reference) and $Pb(BO_2)_2$-doped (Bi,Pb)-2223 compounds. The dominance of the low-T_c 2212 phase over the high-T_c 2223 phase was observed in the reference sample. With the increasing of doping level, the

2223 phase is significantly enhanced and its increase is associated with the decrease of the 2212 phase. Our results show that the sample with x = 0.075 is the best in the present study. The calculated volume fraction of (Bi,Pb)-2223 phase increases from ~25 % for reference specimen to ~85 % for x = 0.075 in a short sintering time (60 h). The (Bi,Pb)-2223 sample with x = 0.075 (0.15 wt% boron) reveals significant enhancement of critical current density (from 25 up to 360 A/cm^2) compared to the reference sample. Obtained results could enable us to develop an accelerated and simple method for producing a high purity (Bi,Pb)-2223 superconducting materials by a proper amount of $Pb(BO_2)_2$ doping.

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