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Influences of Nb addition on structural and superconducting properties of (Bi-Pb) -2223 superconductors

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In this research, the effects of Nb_2O_5 addition on the BPSCCO superconducting system were investigated by X-ray diffraction (XRD), scanning electron microscopy (SEM) and DC electrical resistivity (R-T). Samples of this study were prepared by using the well-known conventional solid state reaction method which is indicated by the formula of $Bi_{1.65}Pb_{0.35}Sr_2Ca_2Cu_3O_{10+\delta}$+x Nb_2O_5 (x=0, 0.1, 02, 0.3, 0.35). The room temperature X-ray diffraction patterns of all samples indicated coexistence of the high-T_c (Bi-2223) and the low-T_c (Bi-2212) phases with the orthorhombic structure. In addition, some impurity phases such as $SrCu_2O_2$, $CuNb_2O_6$, $CaCuO_3$ and CuO were also detected by using match 3.3 software in the diffraction angle range between 2-60º for some samples. However, the optimum concentration of the high-T_c (Bi-2223) phase was found for the sample with 0.35 of Nb addition. Also, only in this sample, a small amount of the Bi-2201 phase was indicated. DC electrical resistivity measurements showed that smallest critical temperature for the sample with 0.35 of Nb addition with amount of 17K. Furthermore, from the R-T graphs it can be seen that the value of resistivity corresponding to T=110K of samples (A–E) is 0.00266, 0.00152, 0.00226, 0.00193 and 0.02051 Ω.cm, respectively. From these, it can be concluded that with the addition of Niobium up to x=0.3 decreases the resistivity of the samples and the electrical properties improve but not regularly with the rise of Nb concentration. In contrast, resistivity increases dramatically in sample E with x=0.35. The morphology and approximated size of the grains were investigated by using the scanning electron microscopy (SEM). SEM micrographs of the polished surface of the samples indicated that grain size distribution and connectivity between the superconducting grains changes with the addition of the Nb ions. In addition, from these micrographs, it can be seen that in sample E with x=0.35 the spaces between the superconducting grains and voids increases. Based on these observations, it can be said that in BPSCCO superconducting system: The Nb_2O_5 addition affects the superconducting properties, negatively and the electrical properties improve but irregularly with the rise of Nb-concentration up to x=0.3.

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