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Effect of Sb substitution on the superconductivity of $Bi_2(Ca, Sr)_{n+1}Cu_nO_{4n+2}$ ($n = 1, 2$ and 3) systems*

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Abstract. Effect of incorporation of Sb in place of Bi in the bismuth cuprate superconductors has been examined. The nominal compositions studied are $MCa_{1.5}Sr_{1.5}Cu_2O_{8+\delta}$ and $MCa_2Sr_2Cu_3O_{10+\delta}$, where $M = Bi_{2-x}Sb_x$ or $Bi_{1.5-x}Sb_xPb_{0.5}$. Different preparative routes such as the ceramic method, the matrix route as well as the melt route were employed to prepare the materials. No indication of either Sb entering the lattice or enhancement of T_c is noted from resistivity, magnetic susceptibility and microwave absorption measurements.

Keywords. Oxide superconductors; bismuth; antimony; dopant effect.

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1. Introduction

In the recently discovered superconducting Bi–Ca–Sr–Cu–O oxide system, phases with the general formula $Bi_2(Ca, Sr)_{n+1}Cu_nO_{4n+2}$, with $n = 1, 2$ and 3 have been synthesized and characterized (Maeda *et al* 1988; Rao and Raveau 1989). The superconducting transition temperature appears to scale with n, but pure phases are seldom formed. At the microscopic level, intergrowth structures with different n values are observed (Ganapathy *et al* 1988) and mostly the bulk preparations contain a mixture of phases with different values of n.

The Bi–Ca–Sr–Cu–O system has at least two superconducting phases namely $Bi_2Sr_2CaCu_2O_{8+\delta}$, a low T_c (80 K) phase and $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$, a high T_c (110 K) phase. Synthesis of the high T_c phase has been problematic and requires long sintering under carefully controlled preparative conditions. The addition of foreign elements to the Bi–Ca–Sr–Cu–O system could change the free energy of formation of the high and low T_c phases (Luo *et al* 1989). Partial substitution Pb ions into the Bi site enables a larger volume fraction of phases with higher n values to be formed and hence higher $T_{c(0)}$ can be observed (Takano *et al* 1988). Recently Hongbao *et al* 1989 and Chandrachood *et al* 1989 had reported enhancement of $T_{c(0)}$ up to 120 K and 132 K in Sb doped Bi–Ca–Sr–Cu–O with and without Pb. However, many research groups have not been able to reproduce these results (Maeda *et al* 1989; Pissas and Niarchos 1989). We have investigated the effect of Sb substitution in the Bi–Ca–Sr–Cu–O system by preparing the required compositions by different preparative routes. Our

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