# REPRODUCIBLE SYNTHESIS OF HIGH-TEMPERATURE SUPERCONDUCTING PHASE IN Bi(Pb)-Ca-Sr-Cu-O SYSTEM

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Abstract. - The reproducible synthesis of nearly pure 110K phase is possible in the $Bi_{2-x}Pb_xCa_2Sr_2Cu_3O_y$ system with $0.2<x<0.5$. For $x<0.2$ predominates the low-temperature phase and for $x>0.5$ the multiphase samples are formed with $Ca_2PbO_4$ as the impurity phase.

## INTRODUCTION

The synthesis of high-temperature superconducting phase in the Bi-Ca--Sr-Cu-O system is difficult to control. It is observed that the addition of lead favours the formation and stabilization of 110K phase and supresses the growth of the 85K phase. Although the formation of the high-temperature superconducting phase was found for different ratios of the starting components[1,2], such as $Bi_{1-x}Pb_xCaSrCu_2O_y$, $Bi_{2-x}Pb_xCa_{1.5}Sr_{1.5}Cu_2O_y$ or $Bi_{2-x}Pb_xCa_2Sr_2Cu_3O_y$, and for different thermal treatments, the systematic description of the synthesis of this phase is missing. Here we report on the reproducible synthesis of this phase within $Bi_{2-x}Pb_xCa_2Sr_2Cu_3O_y$ system with $0<x<1$.

## EXPERIMENTAL PART

Samples of the composition $Bi_{2-x}Pb_xCa_2Sr_2Cu_3O_y$ were prepared by the solid state reaction of $Bi_2O_3$, $Pb_3O_4$, CuO, $CaCO_3$ and $SrCO_3$ in alumina boat at 850°C in the course of three weeks including pretreatment at 815°C overnight. Resistivity measurements were performed using standard four probe AC technique. Magnetic susceptibility was measured as described before[3]. The X-ray powder diffraction patterns were recorded by a Philips diffractometer using CuK $\alpha$ radiation.

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## RESULTS AND DISCUSSION

In order to control the formation of the high-temperature superconducting phase in the Bi(Pb)-Ca-Sr-Cu-O system a series of samples of the composition $Bi_{2-x}Pb_xCa_2Sr_2Cu_3O_y$ was prepared with $0<x<1$. The X-ray powder diffraction patterns of some selected samples are presented in Fig. 1 and resistivity as a function of temperature in Fig. 2. The sample with $x=0$ is predominately low-temperature superconducting phase (85 K) and only small amount of high-temperature phase is present (better seen from the resistivity curve in Fig. 2). With increasing of lead amount the intensity of the diffraction lines belonging to the low-temperature phase decreased and nearly vanished for $x=0.3$ as presented in Fig. 1. For $x=0.3$, 0.4 or 0.5 nearly pure high-temperature superconducting phase with a single transition to superconducting state at 110 K was reached.

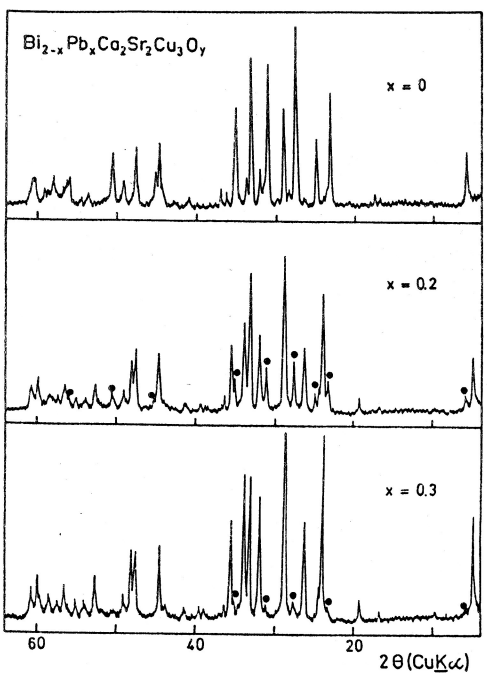


Fig. 1. The X-ray powder diffraction patterns of $Bi_{2-x}Pb_xCa_2Sr_2Cu_3O_y$ samples for different lead content; (•) low-temperature phase

The real ( $\chi'$ ) and imaginary ( $\chi''$ ) magnetic susceptibility was measured and the results for the sample with x= 0.5 are presented in Fig. 3. For the magnetic field value B <50 mG this sample exhibits a perfect diamagnetism at temperature below 100 K indicating the presence of the high--temperature phase in this sample only. The two-step like behaviour with steps laying at 110 K and 100 K (mid-point) was observed for the same sample with an additional d.c. magnetic field of B= 10 G. The low-laying step is induced by higher magnetic field and should be associated with intergrain connectivities and not with the presence of low-temperature phase, since its position is higher than that expected for the original low-temperature superconducting phase known in the Bi-Ca-Sr-Cu-O system.

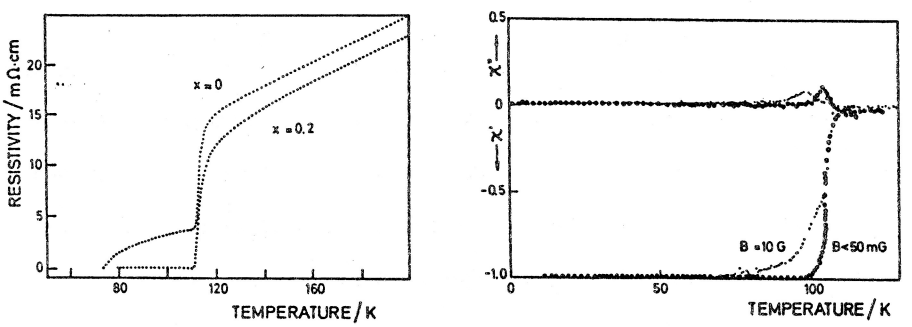


Fig. 2. Temperature dependence of the electrical resistivity for $Bi_{2-x}Pb_xCa_2Sr_2Cu_3O_y$ samples

Fig. 3. The real ( $\chi'$ ) and imaginary ( $\chi''$ ) magnetic susceptibility as a function of temperature for $Bi_{1.5}Pb_{0.5}Ca_2Sr_2Cu_3O_y$

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