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ESR AND X-RAY ANALYSIS OF SUPERCONDUCTING TRANSITIONS IN $c \approx 31$ AND $c \approx 37$ Å BSCCO SYSTEMS

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<u>Abstract</u>: The effect of starting composition on the formation and superconductivity of the two crystallographic phases characterized by $c \approx 31$ Å and $c \approx 37$ Å in pure and *Pb*-doped Bi - Sr - Ca - Cu - O systems has been examined by x-ray diffraction and field-modulated microwave absorption techniques.

1. Introduction

The complex behaviour of the superconducting transition in the Bi-Sr-Ca-Cu-Osystem has been attributed to the existence of two phases with $T_c \sim 110K$ and $T_c \sim 80K$ respectively. The lower- T_c phase was identified as $Bi_2Sr_2CaCu_2O_z$ (2212) and shows a layered structure with $c \approx 31$ Å. In analogy with the Tl-based compounds, the higher- T_c phase has been assumed to have a composition $Bi_2Sr_2Ca_2Cu_3O_z$ (2223), with $c \approx 37$ Å. We have studied the superconducting properties of several pure and Pb-doped compounds, which are representative of the two crystallographic phases, by x-ray diffraction and fieldmodulated microwave absorption.

2. <u>Results and Discussion</u> The examined samples are:

(a) $Di_2Si_2CuCu_2C_2$; (u,e) $Di_2Fv_{0.4}Si_{2.2}Cu_{2.2}Cu_3$	3.30z;
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- (b) $Bi_2Sr_2Ca_2Cu_3O_z$; (f) $Bi_2Pb_{0.4}Sr_2Ca_3Cu_4O_z$;
- (c) $Bi_2Sr_2Ca_3Cu_4O_z$; (g) $Bi_2Pb_{0.4}Sr_2Ca_4Cu_5O_z$.

Samples d and e have the same nominal composition but were subjected to different thermal treatment. The x-ray powder diffraction pattern show that samples a-d have the $c \approx 31$ Å structure and f-g the $c \approx 37$ Å one. Sample e shows predominantly the c-longer phase peaks, but appreciable $c \approx 31$ Å contribution is still present. We have recorded the low-field non-resonant microwave absorption, which characterizes the new high- T_c materials in the superconducting phase [1]. The details of X-band ESR measurements are reported in [2]. In Figs. 1 and 2 the absorption profiles vs temperature are shown for a-c and d-g respectively. In a temperature-sweep mode a peak in the derivative absorption is expected at T_c [3]. It appears (Fig. 1) that samples with $c \approx 31$ Å are characterized by a complex superconductive transition in the 75-110K temperature range. By increasing the Ca and Cu content, the relative importance of the 110K absorption region increases

correspondingly. However, the absence of a sharp peak indicates a possible wide distribution of transition temperatures. It must be noticed that, in spite of the significant increase of the higher- T_c absorption in Fig. 1, the x-ray diffraction patterns don't show any appreciable trace of the $c \approx 37 \text{\AA}$ phase.

As regards the Pb containing samples, those showing the $c \approx 37$ Å structure are characterized by a single transition at $T \sim 105K$ (Fig. 2) more pronounced for higher nominal Cu content. The case of sample e is indicative of superposition of spectra in line with the mixed structure shown by the x-ray data. The influence of the thermal treatment is illustrated by the behaviour of sample d that, by annealing, is progressively transformed into the c-longer compound e, as evidenced by the appearance of the characteristic peak.

In the $c \approx 31$ Å samples, the 110K transition was frequently attributed to intergrowths of the $c \approx 37$ Å phase. This explanation seems us somewhat doubtful. In fact, apart from the lack of a specific x-ray indication in this sense, the ESR spectra show systematic differences between the two c possibilities in the superconductive onset and in the absorption profile. Moreover, in sample c (Fig. 1) an important contribution of higher- T_c transition is found, without any x-ray evidence of the $c \approx 37$ Å phase. A different explanation may be related to electronic structure modification induced by Ca, Sror Cu substitution for Bi, which could influence the transition temperature.



- 3. <u>References</u>
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