Zeitschrift: Helvetica Physica Acta
Band: 62 (1989)
Heft: 6-7

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DOI: https://doi.org/10.5169/seals-116095

Bi-Sr-Ca-Cu-O LASER DEPOSITED THIN FILMS: A COMPARISON BETWEEN RESISTIVITY AND MAMMA RESPONSE.

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Abstract: Bi-Sr-Ca-Cu-O thin films were deposited by Laser Ablation on a number of oriented single-crystal substrates. The films were composed of a single superconducting phase with transition (R=0) at T=70 K. The relation between phase purity and processing parameters was studied by ac-resistivity measurements and by the Magnetically Modulated Microwave Absorption (MAMMA) technique.

1. Introduction

Among many different approaches attempted for the deposition of high-T_c superconducting thin films, the Laser Ablation Process technique is emerging as a very good method for depositing systems with a certain degree of structural complexity like the high-T_c superconducting ceramics. One of the numerous advantages is the excellent control on the stoichiometry of the deposited films. The final quality of the film is critically dependent on deposition and post-deposition processing. In order to use these thin films for applications in microelectronic, the analysis of superconducting properties has to be performed using a highly sensitive, fast, non-destructive method. The MAMMA response compared to resistivity measurements, was proved [1] to be an ideal technique since it has an inherent high sensitivity and it allows to determine the average critical temperature of the whole system.

2. Results and discussion

Thin films with thickness of 1-2 μm were deposited using a single target with nominal composition $BiSrCaCu_2O_y$. The target showed a predominance of the

2212-phase. The substrate (crystalline ZrO_2 or MgO or SiO_2) was mounted in a vacuum cell and heated in the range 25°-300°C during the deposition. An excimer laser ArF (193 nm) with average pulse energy of 150 mJ and 10 pps was focalized on the target surface (focal spot size = 0.5 mm^2). The as-deposited films were amorphous and insulating. The crystallization of the superconducting phase was obtained after a few minutes annealing in air at high temperature. The annealing process is extremely critical [2] and a satisfactory phase purity was obtained only for a narrow range of temperature and duration of the heat treatment. The utility of using a global analysis of superconducting properties of the samples, like the one obtained by MAMMA measurements, is illustrated in Fig. 1. It is shown that the best phase purity (related to the width of the MAMMA peak) was obtained only for a few degree difference in the annealing temperature and for short annealing time.

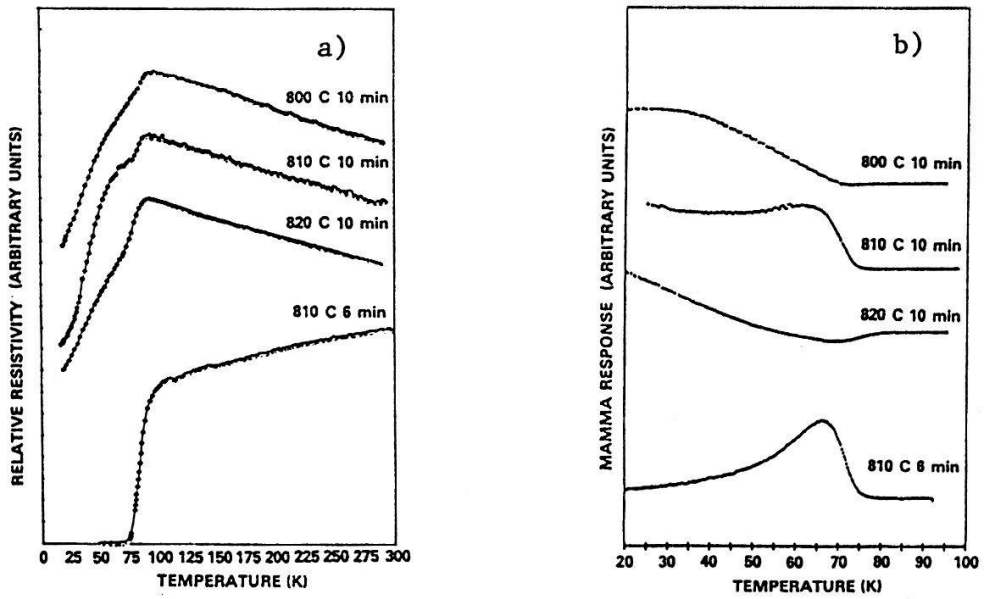

Fig. 1 - a) resistivity and b) MAMMA measurements for films deposited on unheated zirconia (from [2]).

3. References

[1] B. F. Kim et al., J. Appl. Phys. 63, 2029 (1988)

[2] B. F. Kim et al., Proc. TFS, Colorado 1988