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Preparation of High-Tc Bi-Sr-Ca-Cu-O Films on Metal Substrates by Pyrolysis of 2-Ethylhexanoates

Seigo MAKIDA, Hiroyuki NASU,* Aiko MIYAMOTO, Takeshi IMURA, Yukio OSAKA, Takeo SHIONO,† and Takao NAKAMOTO†

Department of Electrical Engineering, Faculty of Engineering, Hiroshima University, Saijo, Higashi-Hiroshima 724

†Chemical Materials Research and Development, Showa Electric Wire and Cable Co. Ltd., Kawasaki-ku, Kawasaki 210

High-Tc superconducting Bi-Sr-Ca-Cu-O films were prepared on some metal substrates by pyrolysis of 2-ethylhexanoates. Although a high-Tc superconducting phase could seen for the films on stainless steel or silver substrates, only the films on silver substrates showed diamagnetism below 73 K and Tc(end)=68 K.

Since Bednorz and Müller first reported the La-Ba-Cu-O as a possible high-Tc superconducting oxide,[1)] many scientists have been studying new high-Tc superconducting oxides, and some stable high-Tc superconductors with Tc(end) above liquid nitrogen temperature[2-3)] have currently well known. For practical use of these materials, techniques to prepare films or wires are necessary to be established. In the previous works, some of the present authors successfully applied the pyrolysis technique of organic acid salts, particularly 2-ethylhexanoates, to prepare high-Tc Ba-Y-Cu-O or Bi-Sr-Ca-Cu-O (BSCCO) films on yttria stabilized zirconia (Toso ZYM-3).[4-6)] To use this technique for fabricating superconducting wires or ribbons, it seems to be indispensable that the films are formable on metal substrates of sheath. This work, therefore, reports the preparation of high-Tc BSCCO films directly on metal substrates by pyrolysis of 2-ethylhexanoates.

Commercially available Bi-, Sr-, Ca-, and Cu-2ethylhexanoates were used as starting materials (Nihon Kagaku Sangyo Co. Ltd.). Each raw material was dissolved in a suitable solvent such as toluene, and mixed and stirred as Bi:Sr:Ca:Cu=1:1:1:2 in molar ratio. The starting solution derived was dropped on Cu, stainless steel, Mo, W, Ag, and invar metal substrates. The subsequent drying, pre-heating and heat-treatment procedures can be found elsewhere.[4-6)] The thickness of the films was about 10 μm. The superconducting transition was measured by SQUID magnetometer and by the four point probe technique with constant current. X-Ray diffraction (XRD) patterns of the films were measured from $2\theta=2°$ to 70°, and XPS spectra and SEM were measured by Kratos 800 at Hiroshima Denki Institute of Technology.

Figure 1 shows the temperature dependence of magnetic susceptibility for the BSCCO film on Ag substrate. Slightly positive susceptibility drastically decreased at 75 K and monotonically decreased as temperature decreased. The diamagnetism has been detected below 73 K, indicating superconduction took place in the films, and the susceptibility at 8 K was approximately -5.0 emu/g at 5000 Oe. Figure 2 shows the temperature dependence of resistance of the films. Althouth the low resistance due to Ag substrate caused a little fluctuation of the data, Tc(onset) and Tc(end) were observed at 85 K and 68 K(±3 K), respectively. From the X-ray diffraction pattern (XRD), only the low-Tc (Tc(end)=75 K) BSCCO phase could be detected, but other impurity phases such as carbonates could not be seen. Furthermore, no carbon peak could be seen by XPS spectra except the contamination from the equipment, and thus it can be said that no residual carbon is detectable in the films. For other metal substrates, only the XRD patterns of the films on stainless steel showed the low-Tc phase, but no superconducting transition could be found down to 10 K. No serious cracking could be seen on the surface and also at the interface by SEM.

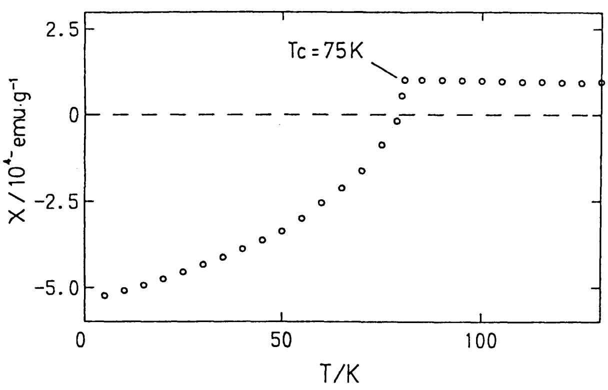

Fig.1. Temperature dependence of magnetic susceptibility for BSCCO films on Ag.

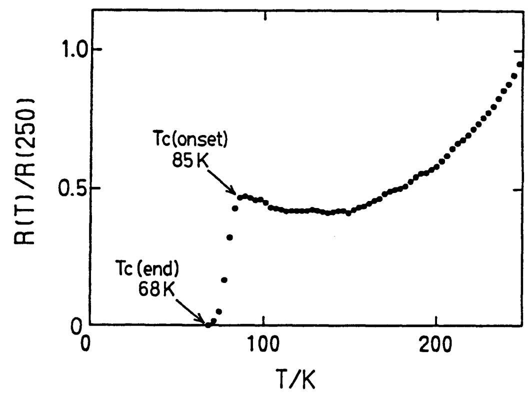

Fig.2. Temperature dependence of resistance for BSCCO films on Ag.

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