CHEMISTRY LETTERS, pp. 939-940, 1988. © 1988 The Chemical Society of Japan

Preparation of $YBa_2Cu_3O_{7-x}$ Films by Chemical Vapor Deposition

Hisanori YAMANE,* Hideyuki KUROSAWA,† and Toshio HIRAI
Institute for Materials Research, Tohoku University,
Katahira 2-1-1, Sendai 980
†RIKEN Co., 810 Kumagaya, Saitama 360

$YBa_2Cu_3O_{7-x}$ films were prepared on yttria stabilized zirconia substrates at a deposition temperature of 1073 K under reduced pressures using β-diketonate chelates of Y, Ba, and Cu as source materials for CVD.

Since the discovery of $YBa_2Cu_3O_{7-x}$[1] with superconducting transition temperatures greater than the boiling point of liquid nitrogen (77 K), various techniques such as vacuum deposition, sputtering, plasma spray, painting, and dipping have been applied to prepared $YBa_2Cu_3O_{7-x}$ films. However, there seems to be no report for the preparation of $YBa_2Cu_3O_{7-x}$ films by chemical vapor deposition(CVD).

In this study, the $YBa_2Cu_3O_{7-x}$ films were formed using β-diketonate chelates of Y, Ba, and Cu as source materials for CVD. The metal chelates, evaporated at 373-523 K, were carried with Ar gas into a CVD reactor, while oxygen gas was separately introduced into the reactor. The total gas flow rate was 300 ml/min and the mole ratio of Ar/O_2 was about two. The gas pressure in the reactor was maintained at 1.3 kPa. The substrate used was yttria stabilized zirconia(YSZ). The deposition temperature was 1073 K. The growth rates of the films were about 0.8-1 μm/h. After the deposition, the films received the oxygen in-situ treatment. That is, the films were cooled in one atmosphere of oxyen from the deposition temperature to 573 K over a period of 30 minutes and then quenched to room temperature.

Figure 1 shows an X-ray diffraction pattern of a film with the YSZ substrate.

The diffraction angles and relative intensities of the peaks, except for those of YSZ, $BaCuO_2$, and CuO, agreed with the values reported for orthorhombic $YBa_2Cu_3O_{7-x}$.[2] The lattice parameters estimated from the peaks of (003), (005), (113), (200), (115), and (123) were a=3.889, b=3.822, and c=11.670 Å.

Figures 2(a) and (b) show scanning electron micrographs of a deposition surface and a cross section of the film, respectively. The growth of plate-like crystals was observed as shown in Fig. 2(a). We believe that oriented films can be grown by appropriate control of the CVD parameters. Figure 2(b) shows that the film was dense.

In summary, we have succesfuly prepared the $YBa_2Cu_3O_{7-x}$ dense films by CVD using β-diketonate metal chelates as source materials.

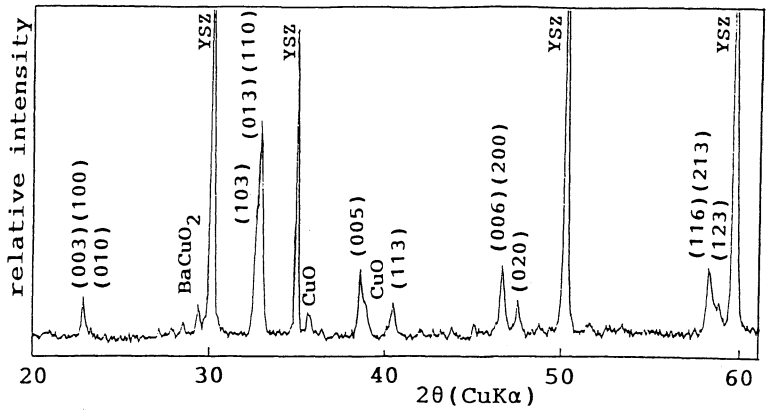

Fig.1. X-Ray diffraction pattern of a film with the YSZ substrate. Indexed peaks were associated with orthorhombic $YBa_2Cu_3O_{7-y}$.

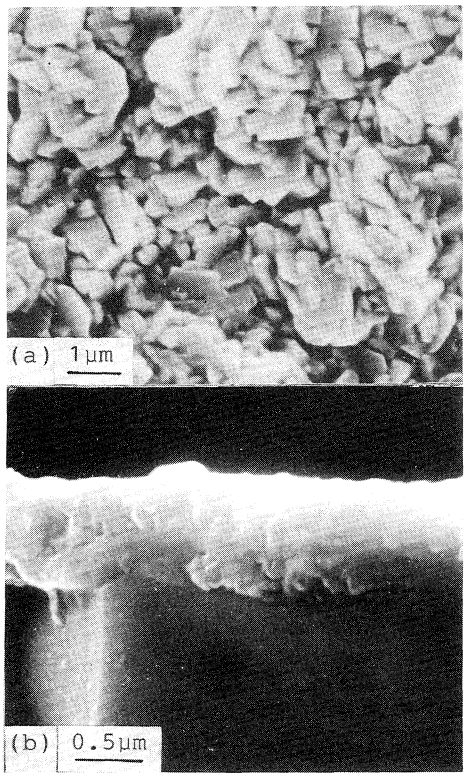

Fig.2. SEM micrographs of a film, (a)deposition surface and (b)cross section.

References

1) M.K. Wu, J.R. Ashburn, C.J. Torng, P.H. Hor, R.L. Meng, L. Gao, Z.J. Huang, Y.Q. Wang, and C.W. Chu, Phys. Rev. Lett., 58, 908 (1987).

2) R.J. Cava, B. Batlogg, R.B.van Dover, D.W. Murphy, S. Sunshine, T. Siegrist, J.P. Remeika, E.A. Rietman, S. Zahurak, and G.P. Espinosa, Phys. Rev. Lett., 58, 1676 (1987).

(Received March 2, 1988)