구연 B-(8)

Grain structure of $YBa_2Cu_3O_{7-\delta}$ film on chemical - etched MgO step

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1. INTRODUCTION

As the technology of growing high Tc superconducting film improves, Josephson junction fabrication has become a key technology in high Tc superconductor application, especially in microelectronic devices applications. Various attempts have been tried to fabricate YBCO Josephson junctions (Edwards et al 1992). In this paper, we report a step-edge junction fabrication technique which employs a simple chemical-etching of MgO substrate. The chemical etching method has, so far, been not so beautiful because the etched surface was not so good(Sugiura et al 1992).

2. EXPERIMENTAL

A step was obtained by etching the(100) surface of MgO substrate with a solution of H_3PO_4 and H_2SO_4mixture. The detailed etching process is described elsewhere(Park et al 1994). The $YBa_2Cu_3O_{7-\delta}$ film is then deposited using an off-axis RF magnetron sputtering system. The I-V characteristic of the junction was measured at 17K with 9.67GHz microwave irradiation and the microstructure of YBCO film on the step-edge was investigated with a transmission electron microscope (Hitachi H9000NA) operating at 300kV.

3. RESULTS AND DISCUSSION

The cross-sectional STEM image (Fig. 1) shows that the MgO step is 31° tilted and 300nm high, and the YBCO film is 100nm thick. The etched surface of MgO substrate is flat and very smooth without noticeable surface roughness in the range of nanometer to millimeter. At the concave side of the step is found a well-defined 40° thlt grain boundary (Fig. 2), which serves a s weak-links for Josephson junctions. The a-b plane at the slope is not parallel to the surface. Instead, it is tilted to 45° with respect to (100) plane of MgO substrate. This grain boundary structure is somewhat different from the results based on ion-milled MgO (Tanaka 1993) and $LaAlO_3$ (Jia & Urban 1992) steps in the point of a-b plane relationship between grains. we can not compare our TEM result with others based on chemical-etched steps because such data are not available. From the clear Shapiro steps at almost $20\mu V$ intervals (Fig. 3), we can say that AC Josephson effect exhibits in this sample.

In summary, we have demonstrated that Josephson junction can be fabricated by chemical-etching of MgO substrate.

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