GROWTH OF YBCO SUPERCONDUCTING THIN FILMS BY MAGNETRON SPUTTERING

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ABSTRACT

The superconducting films of YBCO on substrate of single crystal $SrTiO_3$ or $LaAlO_3$ were successfully fabricated by either dc or rf magnetron sputtering. Several results are given in this paper. The excellent superconductivity of the films is obtained on the substrate of $SrTiO_3$ single crystal, which has a surface parallel to (100). These films are highly-oriented with the c axis normal to their planes. They exhibit zero-resistive transition temperature 91K and large critical current density 3×10^6 A/cm² at 77K. The films deposited on $LaAlO_3$ have the same superconductivity to those on $SrTiO_3$. These two kinds of films look very smooth and mirrorlike. Their roughness is typically 105 Å while the roughness of our substrate is about 125 Å. In the best case, the roughness of about 20 Å was obtained. SEM study indicates that grains are submicrons in size.

The superconducting films were also prepared on the $SrTiO_3$ (110) substrate. Their X-ray diffraction pattern shows only two peaks corresponding to (110) and (220) respectively. SEM micrograph for those films shows that it is composed of many elongate grains closely linked each other. Such films have the same resistive-temperature curve to those on the $SrTiO_3$ (100) substrate, but their Jc is lower.

We have found that the precise stoichiometry of "123" composition of the target material, the exact control of sputtering condition and in-situ plasma oxidation posttreatment after sputtering are crucial factors governing the quality of the superconducting film in our experience.

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