Correlation between the Homogeneity in the Microwave Surface Resistance and Crystal Structures of Large $YBa_2Cu_3O_{7-\delta}$ Films

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Large epitaxially grown $YBa_2Cu_3O_{7-\delta}$ (YBCO) films with 50 mm in diameter were prepared on MgO, annealed MgO and CeO_2-buffered *r*-cut sapphire (CbS) substrates, for which correlation between the homogeneity in the microwave surface resistance (R_S) and the crystal structures was studied. An automated measurement system based on a sapphire-loaded $TE_{01\delta}$ mode cavity resonator was used for investigating the positional dependence of the R_S at low temperatures. The R_S of YBCO on MgO appeared significantly better than that of YBCO on CbS throughout the measured temperatures, with the values of 340 μΩ, 600 μΩ and 1.03 mΩ at 45 K, 60 K and 77 K, respectively, for YBCO/MgO at 19.6 GHz. The positional dependence of the R_S appeared strongly correlated with that of the in-plane alignments of YBCO grains in each YBCO film, with low R_S observed at the positions where the full width at half maximum of the Φ-scan of (113) peak appeared small. However, no such correlation was observed between the R_S and the degree of the c-axis orientation of YBCO grains in each YBCO film. Our results show that the in-plane orientation of YBCO grains is one of the most important structural factors to be controlled to reduce the R_S of YBCO films and to improve the homogeneity in the R_S of large c-axis oriented YBCO films. Effects of annealing of the MgO substrate on the homogeneity in the R_S of large YBCO films are also discussed.

keywords : Microwave surface resistance, Crystal structure, YBCO, Homogeneity