

Measurements of the Intrinsic Surface Impedance of Superconductor Films using a Modified Two-tone Dielectric-loaded Resonator Method

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Due to the importance of the surface resistance of superconductors for industrial applications as well as for basic research, establishment of a measurement standard for the surface impedance of superconductor films has been an international issue.

In measuring the intrinsic microwave surface impedance (Z_s) of HTS films using the dielectric-loaded resonator method, both the loss tangent of the dielectric and the penetration depth of the HTS films need to be known. In our measurement the RS of $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ (YBCO) films and the loss tangent ($\tan\delta$) of rutile and sapphire are measured by using the 'so-called' two-tone method as suggested by Kobayashi et al. [IEEE MTT-S Digest, 495, (2001)], and the penetration depth of the YBCO films were measured using a TE₀₁ δ mode sapphire-loaded resonator with a very small gap between the cavity and the top YBCO film. The gap between the cavity and the top plate enables to control the temperature of the top YBCO film separately while maintaining the temperature of the cavity at the same temperature. That means, the shift in the mode frequency of the resonator is solely attributed to the changes in the surface reactance of the YBCO film. In this scheme the fitted value of penetration depth of YBCO film can be obtained from $\lambda = \lambda_0 [1 - (T/T_c)^2]^{-1/2}$

Here we present usefulness of the modified dielectric-loaded resonator method and limits in the applicability of the two-tone method for measuring the intrinsic Z_s of superconductor films.

keywords : surface resistance, loss tangent, penetration depth, dielectric-loaded resonator.