Measurements of the Penetration Depth of MgB_2 and $YBa_2Cu_3O_{7-\underline{\Omega}}$ Superconductor Films by Using Sapphire Resonators with Short-Circuited Parallel Plates

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A measurement method that enables to measure the penetration depth (λ) of superconductor films by using a short-ended parallel plate sapphire resonator is introduced. Variations in the λ of c-axis-oriented MgB_2 and $YBa_2Cu_3O_{7-x}$ films could be measured down to the lowest temperature using a sapphire resonator with a $YBa_2Cu_3O_{7-x}$ film at the bottom. A model equation of $\lambda = \lambda_0 \left[1 - (\frac{T}{T_C})^{\tau} \right]^{-1/2}$ for MgB_2 films appeared to describe the observed variations of the resonant frequency of the sapphire resonator with temperature, with λ_0, $\blacklozenge$, and T_C used as the fitting parameters. Merits of using the sapphire resonators with short-circuited parallel plates are discussed.

Keywords: penetration depth, superconductor film, dielectric resonator, short-ended