

# Non-invasive Measurements of the Thickness of Thin Superconductor Films and Metallic Films by Using the Dielectric Resonator Method

Hyun Kyung Han<sup>a</sup>, J. H. Lee<sup>b</sup>, E. K. Park<sup>b</sup>, H. S. Jung<sup>b</sup>, C. S. Lee, Sang Young Lee<sup>a, b</sup>  
Byungjoo Lee<sup>c</sup> and Byungwoo Park<sup>c</sup>

<sup>a</sup> *department of Advanced Technology Fusion and Center for Emerging Wireless Transmission Technology, Konkuk University, Seoul 143-701*

<sup>b</sup> *Department of Physics and Center for Emerging Wireless Transmission Technology, Konkuk University, Seoul 143-701*

<sup>c</sup> *School of Materials Science and Engineering, Seoul National University, Seoul 151-744*

The film thickness is one of the most important parameters for obtaining the intrinsic surface impedance of thin superconductor films as well as for controlling the critical current of Josephson junctions prepared for SQUID applications. Although the film thickness has successfully been measured using SEM, step-profilometer( $\alpha$ -step) and ellipsometry etc., we either made the films under test unusable by using the SEM method and the  $\alpha$ -step method, or experienced inaccuracy in the measured thickness of thin films.

We investigated possibility of using the dielectric resonator method, a method widely popular for the surface resistance of superconductor films, for measuring the thickness of thin superconductor films in a non-invasive way. The relation between the effective surface resistance ( $R_s^{eff}$ ) and intrinsic surface resistance ( $R_s$ ) of thin superconductor films was used to estimate the film thickness from the measured  $R_s^{eff}$ . We prepared  $YBa_2Cu_3O_{7-\delta}$  thin films having the thickness of 100-600nm by using the dc-magnetron sputtering method, for which the thicknesses were measured using a 8.5 GHz rutile resonator and a ~39 GHz sapphire resonator. We compared the measured thickness with that obtained using SEM. Attempts were also made to measure the thickness of various Pt films. Merits and demerits of using the dielectric resonator for the thickness measurements are discussed.

keywords : thickness, superconductor film, effective surface resistance, microwave, dielectric resonator