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Thesis Title: Experimental Study of a Magnetic Field-Induced Anomalous Microwave Effect in High-Temperature Superconducting Thin Films

Abstract

A magnetic field-induced anomalous microwave effect in high-temperature superconducting $YBa_2Cu_3O_{7-\delta}$ thin films is observed and studied systematically using microwave resonator techniques. The anomalous effect is characterized by a reduction of surface impedance, $Z_s=R_s+jX_s$, in weak dc magnetic fields. Basic features of the anomalous effect, such as frequency dependence and temperature dependence, are revealed through well-designed experiments. By studying the hysteretic properties of $Z_s(H_{dc})$, it is proved that the anomalous effect happens in a vortex-free state. Furthermore, a comparative study of different samples suggests that the anomalous effect strongly correlates to the microstructure of the thin films, especially the *a*/*c* type grain boundaries. A phenomenological model based on weak link is thus proposed to describe the anomalous effect. The simulation results fit with the experimental data qualitatively. The relevant theories on the origin of the anomalous effect are also discussed.

Keywords: high-temperature superconductor; $YBa_2Cu_3O_{7-\delta}$; thin film; surface impedance; magnetic field-induced anomalous microwave effect; grain boundary.