

Microwave Properties of MgB₂ Films Before and After Ion Milling

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The boride superconductor MgB₂ displays attractive features, e.g., for applications in three-dimensional microwave devices, in an intermediate temperature range. We have investigated the surface resistance R_s of MgB₂ films on c-cut sapphire at frequencies of 8.5, 19.6 GHz and 87 GHz. The films with $T_c=37$ K were prepared ex-situ by Mg vapor diffusion into an evaporated boron layer.

Part of the films was surface ion-milled immediately after growth. Both the as-grown and the ion-milled MgB₂ films showed very low surface resistance values, $R_s \sim 0.17$ (3.5) milli-Ohms at 8 K and 19.6 (87) GHz. For both types of films, R_s appeared to scale with T^2 up to temperatures close to 35 K. The R_s of some of the as-grown films was observed to degrade drastically with time, with its initial R_s unrestored even after multiple surface ion-millings. In contrast, the R_s -degradation of the once ion-milled MgB₂ films was much weaker. After a second ion-milling, the films even showed reduced R_s -values of ~ 0.09 (2.2) milli-Ohms at 8 K and 19.6 (87) GHz, despite slightly reduced T_c -values. The achieved R_s values are lower than for epitaxial YBaCuO. The results are discussed in terms of phase purity and aging effects of the MgB₂ films.

keywords : MgB₂ , Microwave, Ion milling