Effects of Proton Irradiation on the Surface Resistance and the Microwave Conductivity of MgB_2 Films

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Enhanced critical current density observed for superconductors having single energy gap after proton irradiation has been attributed to increased pinning strength. Here we study effects of proton irradiation on the microwave properties of MgB_2 films having two energy gaps. MgB_2 films prepared by co-evaporation and the 'two-step process' were irradiated with proton beams of 7 MeV and 1 μA. Proton irradiated MgB_2 films show reduced critical temperature and the surface resistance at temperatures below ~25 K compared to the as-prepared ones. The slope of the R_S vs temperature curve appeared to change at low temperatures after proton irradiation, which reveal enhanced π-band energy gap due possibly to enhanced interband scattering between the σ-band and the π-band. Reduced critical temperature observed for the proton-irradiated MgB_2 films could also be explained within the context of the increased interband scattering scenario. Dependences of the RS of MgB_2 films on the proton beam energy and the proton fluence are discussed.

Keywords : Magnesium diboride, proton irradiation, surface resistance, conductivity