

PHASE-SENSITIVE NONLINEAR NEAR-FIELD MICROWAVE MICROSCOPY ON MgB₂ THIN FILMS

B.G. Ghamsari, S. M. Anlage, T.M. Tai [UMD, College Park, Maryland, USA]

Abstract

MgB₂ has recently attracted much attention as a coating for Nb to enhance the RF critical field in Superconducting Radio Frequency (SRF) cavities. However the surface properties of MgB₂, including its intrinsic nonlinearities as well as various types of defects, can limit the RF performance of such cavities. This work presents phase-sensitive nonlinear near-field microwave microscopy on MgB₂ films. An intense localized RF magnetic field is induced on the surface of MgB₂ films by means of a magnetic write head, and the amplitude and phase of the third harmonic voltage generated by the film are measured. Power and temperature dependence of the third harmonic response are studied to identify the dominant mechanism of nonlinearity in the film under different operating conditions, and a phenomenological model is developed to relate the nonlinear response to the local critical RF field. The method could be generalized by scanning the probe over the sample, and possibly over various defects, to generate a map of the critical RF field and enable classification of different types of defects in terms of their effect on the RF performance of MgB₂.

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