

Nonlinear Near-Field Microwave Microscope for RF Defect Localization in Superconductors

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Abstract - Niobium-based Superconducting Radio Frequency (SRF) cavity performance is sensitive to localized defects that give rise to quenches at high accelerating gradients. In order to identify these material defects on bulk Nb surfaces at their operating frequency and temperature, it is important to develop a new kind of wide bandwidth microwave microscopy with localized and strong RF magnetic fields. By taking advantage of write head technology widely used in the magnetic recording industry, one can obtain ~ 200 mT RF magnetic fields which is on the order of the thermodynamic critical field of Nb, on sub-micron length scales on the surface of the superconductor. We have successfully induced the nonlinear Meissner effect via this magnetic write head probe on a variety of superconductors. This design should have a high spatial resolution and is a promising candidate to find localized defects on bulk Nb surfaces and thin film coatings of interest for accelerator applications.

Index Terms - Harmonic generation, microwave microscope, magnetic write head, nonlinear Meissner effect, near-field RF superconductivity.

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