Strong Reduction of the Field-Dependent Microwave Surface Resistance in YBCO with BaZrO₃ Inclusions

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Abstract - We present measurements of the magnetic-field-dependent microwave surface resistance in laser-ablated YBa₂Cu₃O₇-δ films on SrTiO₃ substrates. BaZrO₃ crystallites were included in the films using composite targets containing BaZrO₃ inclusions with mean grain size smaller than 1 μm. X-ray diffraction showed single epitaxial relationship between BaZrO₃ and YBa₂Cu₃O₇-δ. The effective surface resistance was measured at 47.7 GHz for 60 < T < 90 K and 0 < μ₀H < 0.8 T. The magnetic field had a very different effect on pristine YBa₂Cu₃O₇-δ and YBa₂Cu₃O₇-δ/BaZrO₃, while for μ₀H = 0 only a reduction of Tc in the YBa₂Cu₃O₇-δ/BaZrO₃ film was observed, consistent with dc measurements. At low enough T and in moderate fields, YBa₂Cu₃O₇-δ/BaZrO₃ exhibited an intrinsic thin-film resistance lower than that of the pure film. The results clearly indicate that BaZrO₃ inclusions cause a strong reduction of the field-dependent surface resistance. From the analysis of the data in the framework of simple models for the microwave surface impedance in the mixed state, we argue that BaZrO₃ inclusions result in very steep pinning potentials.

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