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Scanning Tunneling Spectroscopy of Reentrant Superconductivity in the Ferromagnetic Superconductor ErRh_4B_4 ¹

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ErRh_4B_4 is a reentrant superconductor. As temperature is lowered it transits to the superconducting state at 8.5 K, there is coexistence with magnetic ordering between 1.2K and 0.7K, and then it is a normal ferromagnetic material. We have used a scanning tunneling microscope, STM, to investigate the superconducting and magnetic properties of a ErRh_4B_4 single crystal from 300 mK up to 8.5K. We used a superconducting tip as the probe of the STM in order to enhance the different features present in the tunneling spectra corresponding to the ErRh_4B_4 density of states. The use of the superconducting probe allowed a detailed study of the destruction of superconductivity as ferromagnetic order develops. The perturbation of the ErRh_4B_4 superconducting density of states in the coexistence region is followed as function of temperature and external magnetic field. Spatial variations of the electronic density of states were detected by scanning tunneling spectroscopy maps at different temperatures and fields, and its correlation with the topographic features of the sample is investigated. These STM measurements allowed also the determination of a magnetic field vs. temperature phase diagram of the studied single crystal.

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