

Imaging of Magnetic Domains above the surface of the Superconducting Ferromagnet UCoGe

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We will present recent results on the coexistence of superconductivity ($T_{cs} = 0.45$ K) and ferromagnetism ($T_{cf} = 2.8$ K) in single crystals of the itinerant ferromagnet UCoGe. Macroscopic magnetization measurements will be compared with scanning microSQUID microscopy data taken at temperatures as low as 0.25 Kelvin. Our macroscopic measurements clearly demonstrate the coexistence of the two competitive orders. Notably, diamagnetic screening and a weak Meissner effect were detected in the ferromagnetic state. Our microscopic measurements show the formation of a spontaneous ferromagnetic state at zero applied magnetic field and the formation of ferromagnetic domains. The locally observed domain magnetization agrees with the magnetization derived from bulk measurements. The Ising nature of this ferromagnet is confirmed. The ferromagnetic domain size depends on whether the sample is superconducting and ferromagnetic or only ferromagnetic. The magnetic imaging, taking into account estimates of the penetration depth, is consistent with the formation of a spontaneous vortex lattice. The work is supported by French National Agency of Research (ANR) 09-BLAN-0146-02, J.R.K. acknowledges support from the Nanosciences Foundation of Grenoble