A MODEL FREE REAL SPACE RECONSTRUCTION OF THE MAGNETIC FIELD DUE TO THE VORTEX LATTICE

Abstract

by

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Typically small angle neutron scattering (SANS) experiments on the vortex lattice of type II superconductors measures only the first order Bragg reflections. If higher order Bragg reflections are measured they are simply ignored. In our study, the measured higher order Bragg reflections allow us to perform a more comprehensive data analysis with minimum theoretical input.

We have performed SANS experiments on the non-magnetic members, YNi2B2C and LuNi2B2C and the magnetic member, TmNi2B2C of the rare-earth nickel borocarbide family of superconductors. With an unprecedented number of reflections observed, we are able to analysis the vortex lattice form factors in a model free fashion to calculate the magnetic field modulation. LuNi2B2C displayed highest number of observed Bragg reflections where up to the (32) reflection was measured. With our model free analysis of the magnetic field modulation, we compare our results with numerical calculation based on the quasiclassical Eilenberger theory performed by Ichioka *et. al.* Our results are

most consistent with an anisotropic superconducting gap, either *d*-wave or anisotropic *s*-wave.

The magnetic field reconstruction in all three materials studied are consistent and robust. While the absolute values of the field does change with variation of the form factors, the overall features do not change. The radius of the vortex core, defined as the maximum in the superconducting screening current, was calculated and agreed reasonably with coherence length measurements. The current around the vortex displayed a four-fold anisotropy which is typical of the borocarbides. The vortex lattice was measured in both square and rhombic unit cell symmetries. A symmetrization of the rhombic unit cell to square unit cell shows no appreciable change in the magnetic field reconstruction. With measurements done on both magnetic and non-magnetic borocarbides, we are able to estimate the interaction between magnetism and superconductivity on the measured vortex lattice form factors in TmNi2B2C.