High Field Superconducting Phase-Diagram of $Rb_{0.79}Fe_{1.69}Se_2$

E. D. Mun (NHMFL-LANL), A. Pathak (NHMFL), G. Li (NHMFL), T. Siegrist (FSU, Engineering), V. S. Zapf (NHMFL-LANL), L. Balicas (NHMFL)

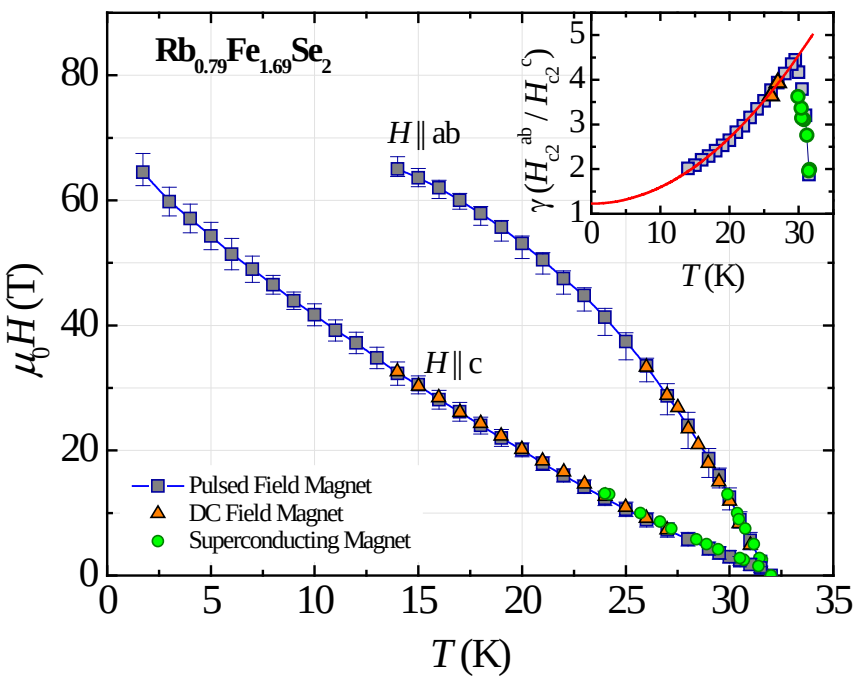
Introduction

Discovery of high-*T*c superconductivity in iron-based chalcogenides $A_yFe_{1.6+x}Se_2$ (A = K, Rb, Cs, and Tl) raised considerable attention since the materials exhibit unusual physical properties. The parent compound (y =1, x = 0) is an insulator, crystalizes into √5 × √5 × 1 I4/m Fe vacancy-ordering structure, and exhibits antiferromagnetic (AFM) order below a Neel temperature of ~560 K. Doping with alkaline metals or Tl (y < 1) apparently preserves the Fe vacancy ordering and gives rise to superconductivity in samples with close to 2:4:5 stoichiometry. Early transport and neutron-diffraction studies suggested that the superconductivity coexists with AFM order.

Experimental

We performed resistivity measurements in resistive magnets, and tunnel diode measurements, in superconducting and pulsed fields, in order to draw the phase diagram of $Rb_{0.79}Fe_{1.69}Se_2$

Results and Discussion



Field as a function of temperature *T* superconducting phase diagram for $Rb_{0.79}Fe_{1.69}Se_2$ single crystals and for both field orientations. The phase diagram includes data from superconducting resistive, and pulsed magnets. Inset: superconducting anisotropy as a function of temperature. Red line is a simple fit to quadratic in temperature term, extrapolated to the limit of zero temperature.

We observe a concave up curvature for the upper critical field for fields applied along the c-axis, which coupled to the temperature superconducting anisotropy, confirms that this compound is a multi-band superconductor, although its Fermi surface is composed only of electron-like sheets.

Conclusions

We did not detect any considerable difference between the phase diagrams of $Rb_{0.79}Fe_{1.69}Se_2$ and $K_{0.8}Fe_{1.76}Se_2$ [1] despite the considerable difference in ionic size between K and Rb.

Acknowledgements

L. B. is supported by DOE-BES through award DE-SC0002613.

References

[1] E. D. Mun *et al.*, Phys. Rev. B **83**, 100514(R) (2011).