Doping Evolution of Magneto-transport in $SmFeAsO_{1-x}F_x$

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Introduction

We report the resistivity of a series of fluorine-doped $SmFeAsO_{1-x}F_x$ polycrystalline superconductors in magnetic fields up to 60T. For underdoped samples ($x < 0.15$), the low temperature resistive state is characterized by pronounced magneto-resistance and a resistive upturn at low temperatures. The "insulating behavior" is characterized by a log-T divergence observed over a decade in temperature. In contrast, the normal state for samples with doping $x > 0.15$ display metallic behavior with little magnetoresistance, where intense magnetic fields broaden the superconducting transition rather than suppress *Tc*. The location of the crossover coincides with the reported suppression of the structural phase transition (SPT) in the phase diagram for $SmFeAsO_{1-x}F_x$ series.

Experimental

The polycrystalline samples of $SmFeAsO_{1-x}F_x$ were synthesized using conventional solid state reaction [1] and cut into rectangular prisms with a typical size of 1.5 x 1 x 0.1 mm3. The resistivity ρ was measured using the standard four-terminal digital ac lock-in technique in continuous fields up to 35T and in pulsed fields up to 60T at the National High Magnetic Field Laboratory.

Results and Discussion

The resistivity of $SmFeAsO_{1-x}F_x$ exhibits a doping dependence with two key features in common with three-dimensional properties of the cuprate superconductors: a log-T divergence of the resistivity for more underdoped samples, and an insulator to metal crossover in the underdoped regime. A key difference between the Sm-oxyarsenide and the cuprates is the large magnetoresistance in the underdoped regime that extends to temperatures well above *Tc* and enhances the log-T divergence of the resistivity.

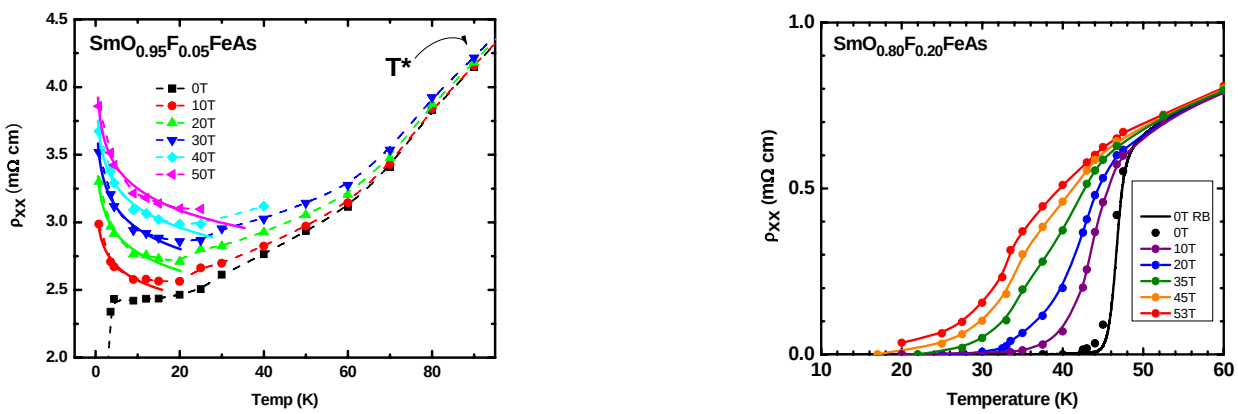

Figure 1: Resistivity versus temperature of the $SmFeAsO_{1-x}F_x$ samples with two different fluorine dopings studied in magnetic fields up to 60T. Note the strikingly different behavior for samples with $x < 0.15$ and those with $x > 0.15$. In addition to the clearly logarithmic "insulating" behavior at low temperatures, the lower doped sample also shows higher magnetoresistance in the normal state despite having higher resistivities.

Acknowledgements

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References

[1] S.C. Riggs, J.B. Kemper, Y. Jo, Z. Stegen, L. Balicas, G.S. Boebinger, F.F. Balakirev, A. Migliori, H. Chen, R.H. Liu, X.H. Chen, Cond-mat, arXiv: 0806.4011