Measurement of the Nematic Susceptibility of $Ba(Fe_{1-x}Co_x)_2As_2$ in High Magnetic Field

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Introduction

The in-plane resistivity of $Ba(Fe_{1-x}Co_x)_2As_2$, a canonical iron-pnictide superconductor, exhibits a remarkably large response to uniaxial strain. The ratio of the associated in-plane anisotropy to the applied strain (-dη/dε) is proportional to a quantity of fundamental interest, the "nematic susceptibility" (J.-H. Chu, *et al.*, Science, **337**, 710-712 (2012).). The goal of the current experiment is two-fold. First, to see how the induced anisotropy is affected by magnetic fields, and second, to suppress T_c so that the nematic susceptibility can be measured to lower temperatures.

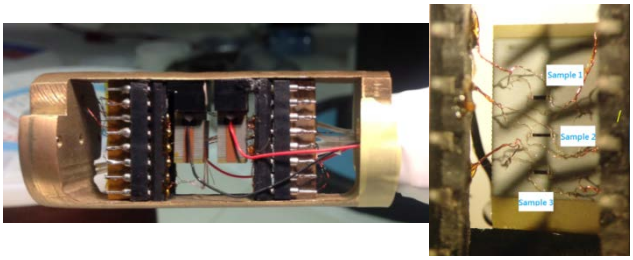

Figure 1. Left: Photograph of the probe. Right: Each piezo stack is glued on a 16-pin connector with 3 samples on top of it, allowing simultaneous measurement of up to 6 samples.

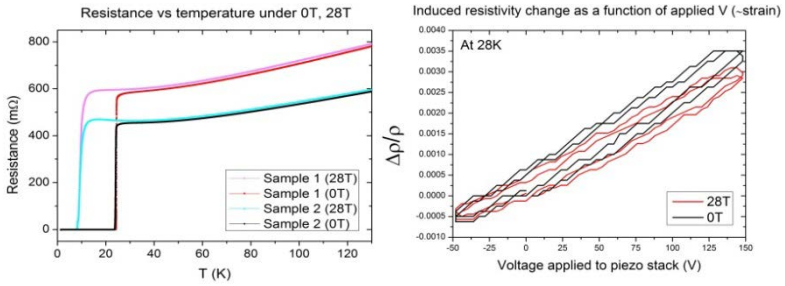

Figure 2. Left: R vs T of representative $Ba(Fe_{1-x}Co_x)_2As_2$ samples, showing suppression of T_C in an applied field of 28T. Right: Representative data showing the induced change in the resistivity for a specific sample in zero field and at 28T.

Results

For these initial experiments, we mounted two piezoelectric stacks (**Figure 1**(a), used to provide uniaxial strain) on the 32-pin probe enabling simultaneous measurement of up to 6 samples (**Figure 1**(b)). Signal-to-noise characteristics of measurements of the induced change in the resistivity remained good in fields up to 28 T (the maximum used for these initial tests).

Representative data showing the temperature dependence of -dη/dε for five different Co concentrations are shown in **Figure 3**. The applied magnetic field has a strong effect, suppressing -dη/dε. These initial experiments indicate that piezoresistance measurements using this novel piezo technique are feasible in high magnetic fields, opening the way to further studies probing, for instance, the temperature dependence of the nematic susceptibility in a possible quantum critical regime.

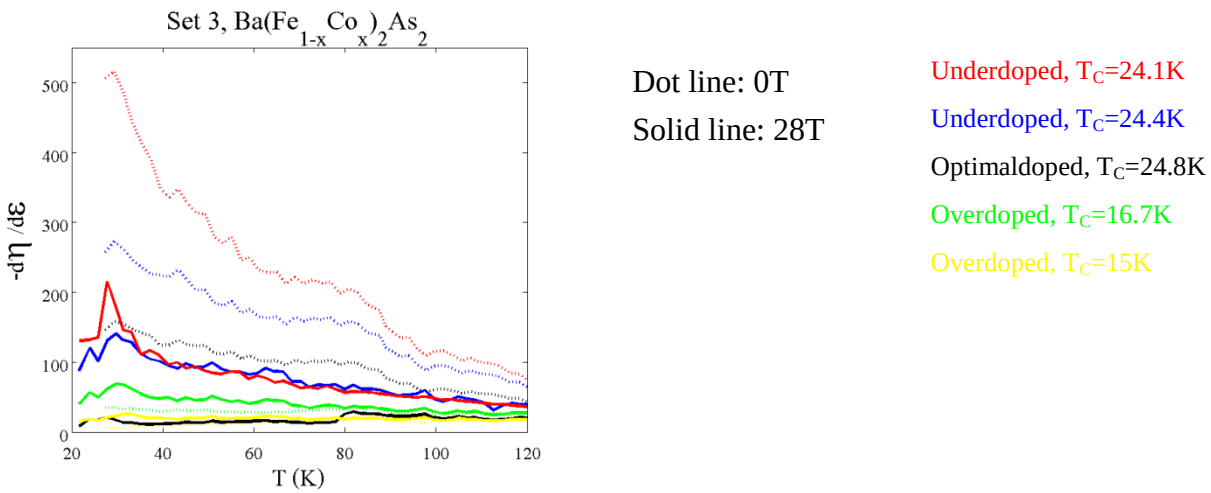

Figure 3. Temperature dependence of the nematic susceptibility (-dη/dε) of 5 $Ba(Fe_{1-x}Co_x)_2As_2$ samples from underdoped to overdoped region. Dot and solid lines are the data taken at 0T and 28T respectively.