LOW TEMPERATURE NORMAL-STATE RESISTIVITY OF COMBINATORIAL MBE THIN FILM $La_{2-X}Sr_XCuO_4$ SAMPLES IN HIGH FIELDS

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Introduction

For the cuprate $La_{2-x}Sr_xCuO_4$ (LSCO) the concentration of holes in the copper-oxygen plane, and hence superconducting transition temperature, is governed by the concentration of Sr in the as-grown sample. Common sample libraries of LSCO vary Sr by discrete steps of $\Delta x = 0.01$ or, less commonly, as fine a gradation as $\Delta x = 0.005$. Since many physical properties change dramatically with Sr concentration, one would like to be able to continuously tune Sr content in a single sample. Experiments reported here approach that ideal through growth of a thin film LSCO sample with a linear Sr concentration gradient. The sample is grown by MBE with the Sr molecular beam hitting the sample substrate at a grazing incidence, i.e. >60° from normal incidence. [1] This yields a gradient of 0.01 Sr concentration per 10 mm.

Results and Discussion

To measure longitudinal resistivity and Hall resistance, a Hall bar is lithographically etched along the Sr gradient, with 60 voltage contacts positioned along the channel of the Hall bar. This gives a Δx =0.0002 between neighboring contacts, a Sr resolution that is effectively continuous in a single sample. Sixteen simultaneous resistivity traces are measured using a synchronous digital multi-channel lock-in developed at the MagLab pulsed field facility. By applying a 33T magnetic field, superconductivity is suppressed, revealing the low temperature normal state down to 1.7K (Fig 1). Experiments are ongoing.

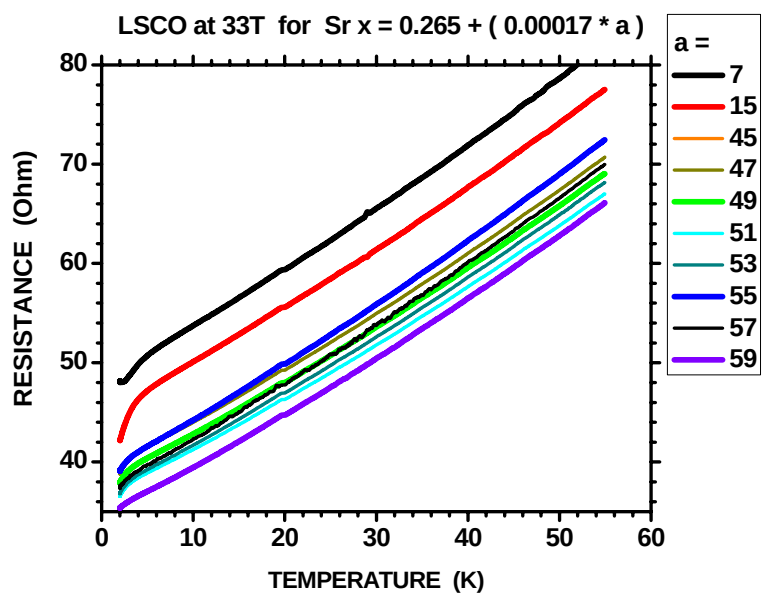

Figure 1. Ten R vs T traces from the linear-gradient Hall bar of $La_{2-x}Sr_xCuO_4$, with the value of Sr concentration determined by the equation at top and the value of the parameter 'a' given in the legend. All data are taken at a fixed magnetic field of 33 T.

References:

[1] G Logvenov, I. Bozovic, I Sveklo Proceedings of SPIE, Strongly Correlated Electron Materials: Physics and Nanoengineering (2005).