H$_2$ of High Temperature Superconductivity at a Hetero-junction Between Two Non-superconducting Cuprates

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Introduction

Single phase antiferromagnetically (AF) ordered La$_2$CuO$_4$ and non-superconducting extremely overdoped La$_{1.55}$Sr$_{0.45}$CuO$_4$ have been grown in different hetero-interface combinations. While neither of these single phase compounds is superconducting, the interface of the bi-layer hetero-junctions exhibits High Temperature Superconductivity (HTS). In one distinct combination the superconducting transition $T_c$ is 25% greater than optimally doped La$_{1.84}$Sr$_{0.16}$CuO$_4$. By measuring the transport properties (in-plane resistivity) we determine the temperature dependence of the upper critical field $H_{c2}$ in this new material. It is known that HTS materials with the most anisotropic transport exhibit the most anomalous behavior of $H_{c2}(T)$. The growth of this sample ensures that the transport is strictly two-dimensional because of its physical geometry. As such, our proposed experiments will be studying HTS in the (nearly) perfectly 2D regime.

Results and Discussion

We have measurements of a bi-layer sample in applied magnetic fields up to 18T. Figure 1 shows the $H_{c2}$ curve. The positive curvature of $H_{c2}(T)$ is greater for the bi-layer sample versus that of La$_{1.84}$Sr$_{0.16}$CuO$_4$ (optimally doped). Typically the greater the positive curvature the greater the anisotropy$^2$. The temperature dependence of $Hc2(T)$ is that expected of two dimensional transport, unlike an optimally doped material. Experiments are ongoing.

![Figure 1](image_url) 

Figure 1 $H_{c2}$ measurements of La$_{2-x}$Sr$_x$CuO$_4$ and bi-layer sample. The bi-layer appears highly two dimensional with the same $Hc2$ behavior as underdoped La$_{2-x}$Sr$_x$CuO$_4$.

References: