High Field Heat Capacity of the Cuprate Hg 1201

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Introduction

$YBa_2Cu_3O_{6+\delta}$ (YBCO6+δ), its electronic structure or "Fermi surface", and the interplay of superconductivity are currently a topic of much discussion. This is well demonstrated by a large body of recent work at multiple high magnetic field laboratories, including the NHMFL. A reconstruction of said Fermi surface and a quantum critical point that is predicted to exist in the superconducting region of the temperature-versus-δ phase diagram, may represent a key part of the puzzle of high temperature superconductivity. The next step in understanding the newest physics in the cuprates is comparisons to other materials. One excellent opportunity for this exists in samples of $HgBa_2CuO_{4+\delta}$ (Hg1201). These samples have similar superconducting transition temperatures to those of YBCO6+δ, but differ in key aspects with respect to the structure. While YBCO samples have been widely studied in high magnetic fields, there have been relatively few experiments on Hg1201.

Experimental

Work was carried out at the NHMFL DC facility in Tallahassee in Cell 12 utilizing the 35 T resistive magnet and the Oxford top-loading cryostat. Preparation work including thermometry was done at the pulsed facility at Los Alamos National Laboratory in the 65 T short pulse and 60 T controlled waveform magnet systems. The technique utilizes a combination of the user program hardware and user-built, "home-made" hardware.

Results and Discussion

Significant achievements in maximizing data quality mark the most important results of 2012. The combination of user-built and NHMFL user program hardware shows great potential for future use. The samples showed in general terms, the expected behavior in the specific heat, as shown in **Figure 1**.

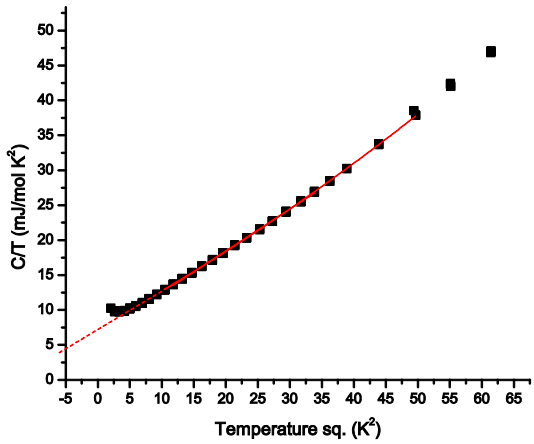

Figure 1. Heat capacity over temperature versus temperature squared plot for 1 sample of Hg1201. The samples display a linear behavior, which is universal to all crystalline materials in the low temperature limit.

Cuprates are particularly interesting to study in high fields, because the energy scales of the superconductivity are similar to the electronic coupling to the magnetic field at many Tesla, and Hg1201 is no exception.

Conclusions

This material and technique show great promise.

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