Magnetoresistivity of the Cuprate Superconductor $Nd_{2-x}Ce_xCuO_{4-\delta}$ (NCCO)

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Introduction

Understanding the enigmatic normal-state of the cuprates is considered to be a key step toward the elucidation of their superconductivity at unprecedentedly high temperatures. Our recent quantitative planar dc-resistivity measurements in the pseudogap phase of the model hole-doped cuprate compound $HgBa_2CuO_{4+\delta}$ (Hg1201) revealed Fermi-liquid-like behavior ($\rho \propto T^2$) [1]. This observation motivated optical conductivity measurements that reveled in underdoped Hg1201 the scattering rate exhibits the quadratic frequency dependence, and the temperature-frequency scaling expected for a Fermi liquid [2]. In the same regime magnetoresistivity studies revealed the quadratic field dependence (Fig. 1) and the scaling between the field and resistance characteristic for Fermi-liquids [3]. Motivated by the results obtained on the hole-doped side of the phase diagram, we have conducted a quantitative study of the transport properties of the electron-doped cuprates with the final aim of fully understanding the nature or at least the different aspects of the normal-sate.

Experimental

To measure the magnetoresistance of NCCO in broad temperature range (2-300K) we have benefited from the large static fields (up to 35T) available at Tallahassee, NHMFL.

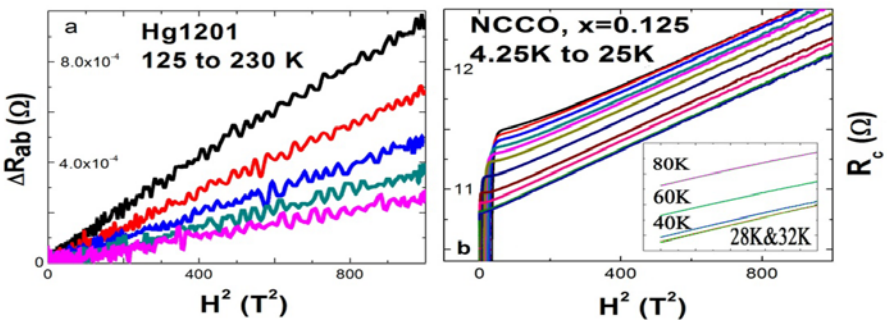

Figure 1. Magnetoresistance for under-doped Hg1201 and NCCO single crystals. Isothermal field dependences of (a) the *ab-plane* transverse resistance for Tc=71 K Hg1201 and (b) the *c-axis* longitudinal resistance for *x*=0.125 NCCO. Both hole-doped Hg1201 and electron-doped NCCO reveal, at temperatures above T_c, a pure H^2 dependencies.

Results and Discussion

The observation of the quadratic field dependencies in both systems is rather intriguing indicating that perhaps the origin of such a behavior could be the same. It is now well documented that the transport in the hole-doped cuprates can be well described within the Fermi-liquid picture. One may wonder whether certain aspects of such behavior are also present on the electron-doped side of the phase diagram. Notably, in both systems pocket like structures are revealed by magnetoresistivity in large magnetic fields [4].

Conclusions

Magnetoresistivity is a powerful tool to investigate the normal state properties of the high-temperature superconductors and provides key information not only about the normal state properties but also about the topology changes of the Fermi surface. Quadratic temperature and magnetic field dependence of the dc-resistivity are established to be the benchmarks of underdoped cuprates. The similarity between the magnetoresistivities in electron- and hole-doped cuprate calls for a continuation and deepening of the study of these compounds.

Acknowledgements

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References

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