Magnetotransport in Underdoped Cuprates

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Introduction

The nature of the ground state at low doping and the effects of magnetic field have been central issues in the studies of cuprate high-temperature superconductors. In addition, at very low doping, different types of magnetic textures may be stabilized depending on the geometry and character of the dopants. In order to address these issues, we have performed magnetotransport measurements on single crystals of La_2CuO_4 doped with either Li ($La_2Cu_{1-x}Li_xO_4$ or Li-LCO) or Sr ($La_{2-x}Sr_xCuO_4$ or LSCO), and on LSCO films grown by molecular-beam epitaxy.

Experimental

Measurements of the in-plane magnetoresistance (MR) were carried out over a wide range of temperatures (from ~0.020 K up to ~60 K) and magnetic fields up to 35 T, utilizing the following systems: SCM-1, SCM-2, 35 T in cell 12, and 31 T in cell 7.

Results and Discussion

The MR measurements on LSCO films with x=0.06 carried out in cell 7 were used to determine the field where superconducting fluctuations are fully suppressed. This completed the set of data that had been obtained earlier and, in fact, completed the project on the emergence of high-temperature superconductivity from the glassy insulating state at lower doping. This work was published in Ref. [1].

A single crystal LSCO with x=0.06 and an LSCO film with x=0.07 were measured in SCM-1, SCM-2 and cell 12 in order to investigate the magnetic-field-driven superconductor-insulator transition. The results of that project are being prepared for publication.

A lightly doped Li-LCO crystal was measured in cell 12 to look for signatures of anomalous spin textures, such as Skyrmions. The results of those experiments are still being analyzed.

Conclusions

Our work sheds new light on the nature of the doping-driven and magnetic-field-driven superconductor-insulator transitions in copper-oxide superconductors. In addition, it should provide new insights into the mechanisms that can stabilize or suppress topological excitations in complex magnetic systems.

Acknowledgements

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References

[1] Shi, X., *et al*., Nature Mat., **12**, 47 (2013).