HIGH-FIELD PHASE DIAGRAM AND PINNING PHENOMENA IN THE INFINITE LAYER CUPRATE SUPERCONDUCTOR $Sr_{0.9}La_{0.1}CuO_2$

V. S. Zapf (NHMFL, Los Alamos, NM), A. D. Beyer (Dept of Physics, Caltech), C. R. Hughes (Dept of Physics, Caltech), N. C. Yeh (Dept of Physics, Caltech), C. H. Mielke (NHMFL, Los Alamos), N. Harrison (NHMFL, Los Alamos)

We have investigated the high magnetic field phase diagram and pinning phenomena in the infinite layer n-doped cuprate compound $Sr_{0.9}La_{0.1}CuO_2$. In the high-T_c cuprate superconductors, anisotropy has been suggested to play an important role in the superconducting pairing mechanism and the elevated T_c in both experimental and theoretical work. It is surprising therefore to find superconductivity (SC) T_c = 43 K in the infinite-layer cuprates $Sr_{0.9}La_{0.1}CuO_2$ (M = La, Gd), which exhibit only a 16% difference between the a and c tetragonal lattice parameters. Recent STM measurements of this compound indicate s-wave superconductivity with T_c = 43 K, and no evidence of a pseudogap in zero magnetic fields [1].

High quality polycrystalline and grain-aligned samples were provided by the group of S. I. Lee at Pohang Technical University in South Korea. The upper critical fields along the crystallographic c direction and in the ab plane (Hc_2^c and Hc_2^{ab}) were determined in pulsed magnetic fields up to 65 T using a tunnel diode oscillator (TDO) technique, and are shown in Fig. 1 as a function of temperature (T). The upper critical field is identified with the onset of a sharp transition in the penetration depth determined from the TDO measurement. TDO measurements on polycrystals were also performed, which showed a transition at the larger upper critical field, Hc_2^{ab}, and a kink at the lower field Hc_2^c, in excellent agreement with the results from the aligned samples. The irreversibility field H_{irr}^{ab}, determined from magnetization measurements in pulsed fields up to 60 T, is also shown in the figure.

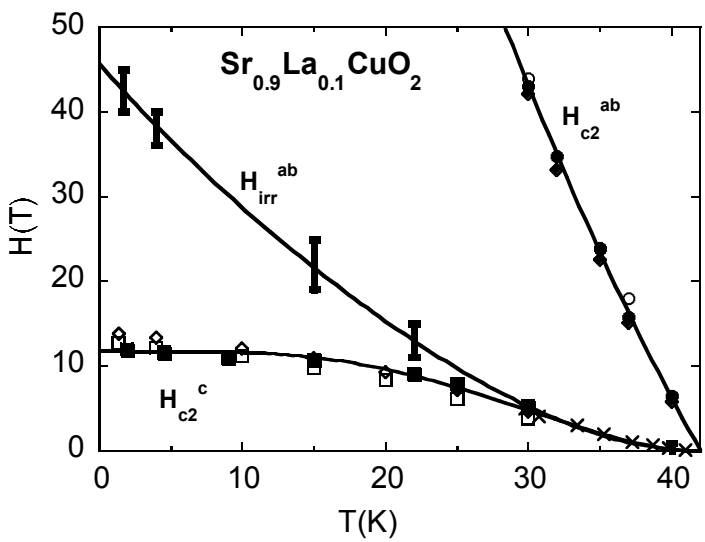

Fig 1: Upper critical field along ab and c crystallographic axis (Hc_2^{ab} and Hc_2^c), and irreversibility field H_{irr}^{ab} determined in pulsed field of Sr0.9La0.1CuO2 aligned polycrystals.

There is a large separation between Hc_2^{ab} and the irreversibility field H_{irr} , which extends down to zero temperature, suggesting the existence of field-induced quantum fluctuations perhaps due to a competing SDW. In spite of the significant anisotropy in the upper critical fields, χ_c is longer than the spacing between CuO_2 planes, indicating three-dimensionality of the orbital wave function.

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References

[1] C. T. Chen, et al, Phys. Rev. Lett. **88**, 227002 (2002).