# ELECTRICAL TRANSPORT PROPERTIES OF UNDERDOPED $Sm_{2-x}Ce_xCuO_{4-y}$ THIN FILMS AT LOW TEMPERATURES

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## Introduction

The phase diagram for the electron-doped high temperature superconductors $Ln_{2-x}Ce_xCuO_{4-y}$ (Ln = Pr, Nd, Sm, Eu) has not yet been completely established. One important issue is the behavior of the normal state transport properties at low temperatures, which is difficult to determine since the compounds are in the superconducting state. However, the low temperature region can be accessed through the application of large magnetic fields to suppress the superconductivity. Extrapolation of previous data taken at the NHMFL, Tallahassee, on optimally doped thin films [1] of $Sm_{2-x}Ce_xCuO_{4-y}$ (SCCO) yields an upper critical field $H_{c2}$ of ~ 12 tesla at 0 K, which agrees well with values for single crystals [2,3].

## Experimental

A target of under-doped $Sm_{1.875}Ce_{0.125}CuO_{4-y}$ was ablated using a KrF Excimer laser to produce thin films of SCCO at UCSD on Yttria-Stabilized Zirconia (YSZ) substrates. Electrical resistance measurements R (T, H) on thin films of SCCO were performed at high magnetic fields up to 17.5 T and at low temperatures 250 mK ≤ T ≤ 1 K, well below the superconducting critical temperature $T_c$ ~ 7.7 K for an underdoped sample of SCCO. The electrical resistance measurements were made using the 17.5/19.5 T superconducting magnet at the NHMFL, Tallahassee. The under-doped films had a Ce concentration of x = 0.125 whereas optimally doped SCCO has a Ce concentration of x = 0.15.

## Results and Discussion

Preliminary analysis of the magnetoresistance data contained in Figs. 1 and 2 shows a constant decreasing resistance at low temperatures with the suppression of the superconductivity through the applied field. The results indicate a metallic behavior down to the lowest temperatures measured. This is in contrast to previous results on $Pr_{2-x}Ce_xCuO_{4-y}$ [4] that display an insulator-like upturn in the resistivity for samples with Ce concentration up to optimal doping (x = 0.15); overdoped samples with x > 0.15 featured a metallic resistance to the lowest measured temperature.

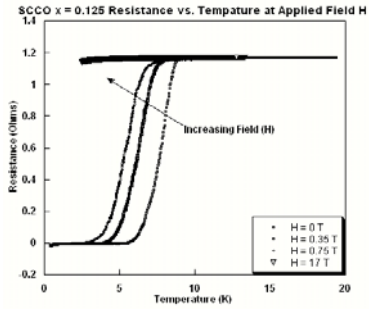


Fig. 1

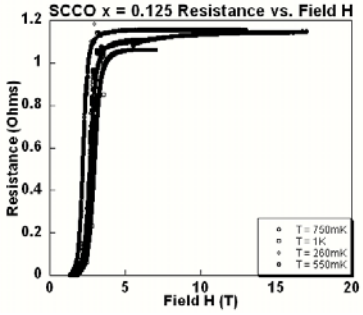


Fig. 2

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## References

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