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Electron doped cuprates with a positive Hall coefficient

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Since the discovery, superconducting cuprates with the Nd_2CuO_4 (T') structure have been associated to electron-doped cuprates simply due to the coincidentally observation that the Hall coefficient shows a negative sign when tetravalent Ce^{4+} is substituted for trivalent Nd^{3+} [1]. While several studies have revealed that the Hall coefficient is negative, it does not bode well to fit to the Fermi surface reported by angle resolved photo emission spectroscopy (ARPES) studies as the Fermi surface appears hole-like rather than electron-like [2]. It has been reported that the sign of Hall coefficient has a strong dependence on the condition of post-growth annealing under reducing atmosphere [3, 4], which is vital for the induction of superconductivity irrespective of the substituted Ce^{4+} concentration. Here we report on the electronic transport properties of Pr_2CuO_4, a cuprate commonly associated to an antiferromagnetic insulator which eventually becomes superconducting upon doping and annealing [5].

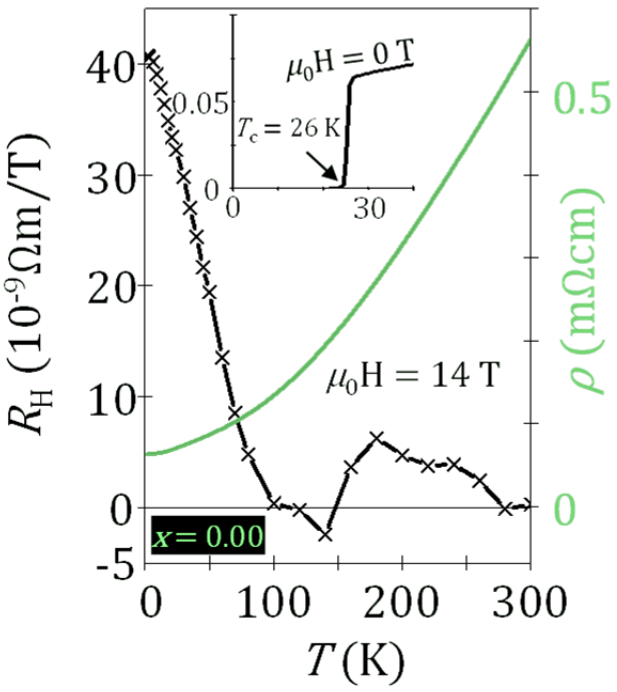

Figure 1. Temperature dependence of the resistivity (green line) and the Hall coefficient (black line) of Pr_2CuO_4 measured under an external magnetic field of 14 T. The inset shows the temperature dependence of the resistivity at 0 T. The superconducting transition temperature T_c = 26 K.

Fig. 1 shows temperature dependence of resistivity and Hall coefficient of our MBE-grown Pr_2CuO_4 thin films (1000 Å thick) with T_c of 26 K [5]. In contrast to earlier reports on superconducting $Pr_{2-x}Ce_xCuO_4$ and $Nd_{2-x}Ce_xCuO_4$, the Hall coefficient is positive, thus similar to the sign of superconducting Pr_2CuO_4 films [3] grown by MOD. The positive Hall coefficient reported for superconducting $Pr_{2-x}Ce_xCuO_4$ with low x ($0.04 \leq x \leq 0.16$) [4] suggests that the Fermi surface of the electron-doped T' cuprates is hole-like and not associated to the doping level, in agreement to ARPES investigations. We associate the appearance of a negative Hall coefficient to remnant apical oxygen atoms which obscures the antiferromagnetic exchange interaction and renders the ideal crystal lattice with square-planar coordinated copper sites.

References:

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