

Giant interlayer tunneling magnetoresistance in layered manganite

C. J. Won^{1,*}, J. J. Yang²⁺, S. W. Cheong², N. Hur¹

¹Department of Physics, Inha University

²Rutgers Center for Emergent Materials, Rutgers University

⁺Present : Department of Physics, University of Virginia

I. Introduction

Ruddlesden-Popper family $(A,A')_{n+1}TMnO_{3n+1}$ (TM = Transition Metal) is a form of layered perovskites structure which include the intermediate block layer. [1] When the stacking number n is 2, the $(A,A')_{n+1}TMnO_{3n+1}$ structure become a bilayer structure $(A,A')_3TM_2O_7$ which consists of two perovskite stacks and one block layer. The layered manganites $La_{1+2x}Sr_{2-2x}Mn_2O_7$ ($n = 2$) have conducting bilayer manganite separated insulating $(La,Sr)_2O_2$ layers. [2] In this report we present the interplane and in-plane magnetoresistance of doped layered manganites single crystal below magnetic ordering temperature.

II. Experiment Method

Doped LSMO single crystals used in our experience were grown by the Floating Zone method. All samples were polished to rectangular shape and etched in bromine-ethanol. Resistivity measurements was performed with Physical Properties Measurement System (PPMS, Quantum design) using a conventional 4 probe method. Magnetic properties were measured by using Magnetic Properties Measurement System (MPMS, Quantum design).

III. Results and Discussion

The temperature profiles of resistivity along c -axis under several magnetic fields displays in Fig. 1. In $La_{1-x}Sr_xMnO_3$ and $La_{1+2x}Sr_{2-2x}Mn_2O_7$, the rise of transition temperature by magnetic fields leads to a giant magnetoresistance at transition temperature. The insulating behavior below T_C is almost fully suppressed with applied magnetic fields near 5000 Oe. Resistivity without magnetic fields $\rho(0)$ is about $\sim 10000\%$ larger than resistivity with magnetic fields $\rho(H, H > 0.5 \text{ T})$. The MR at 2 K on LSMO single crystal is displayed in the inset of Fig. 1, which shows dramatic resistivity drop and saturated value after applied magnetic field of ~ 7000 Oe. This MR value below T_C is extremely larger than MR value of non-doped case. It can be possible to understand since the tunneling magnetoresistance effects arise between magnetic multilayers.

IV. Summery

we have presented the enhanced interlayer tunneling magnetoresistance in doped $La_{1+2x}Sr_{2-2x}Mn_2O_7$ single crystal below T_C . The drastically out-of-plane magnetoresistance observed in magnetic fields perpendicular to the bilayers indicates that spin-polarized magnetic layers in single crystal show as a stack of ordered spin valve.

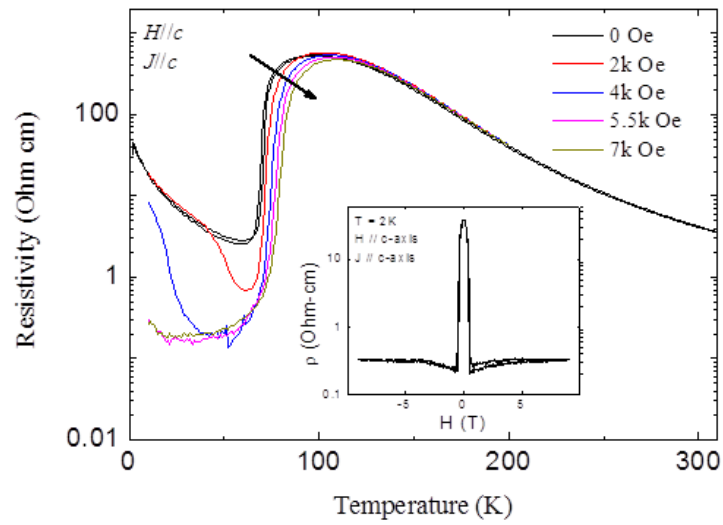


Fig. 1 Resistivity properties with several fixed magnetic fields ($H = 0, 2000, 4000, 5500, 7000$ Oe) of doped LSMO single crystal as function of a temperature. The magnetoresistance at 2 K with 9T is shown in the inset.

V. References

- [1] B. V. Beznosikov and K. S. Aleksandrov, Crystallography Reports, Vol. **45** No. 5 792-798 (2000).
- [2] T. Sugiura, K. Iwahashi, K. Horai, and Y. Masuda, J. Phys. Soc. Jpn. **39**, 647 (1975).