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Spin Pumping in High T_c Superconductor $La_{1.85}Sr_{0.15}CuO_4$ thin films

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1. Introduction

The field of spintronics, a prospering class of efficient spin-based magnetic memories and computing devices, has recently attracted great interest throughout the last decade. Generation and detection of spin currents in solid-state systems are the fundamental part in the field of spintronics. One method for generating and detecting spin currents is the combination of the spin pumping [1] and the inverse Spin-Hall effect (ISHE) [2,3]. Up to now, the spin pumping has been investigated in magnetic metal/paramagnetic metal films. However, there are not sufficient reports on the magnetic metal/oxide material system. In present research, the spin pumping has been studied on high T_c superconductor $La_{1.85}Sr_{0.15}CuO_4$ (LSCO) attached to $Ni_{81}Fe_{19}$ (Py) as ferromagnet to investigate the behavior of spin current at room temperature.

2. Method

The thin film of LSCO single crystal has been prepared by Pulsed Laser Deposition (PLD) method on $SrLaAlO_4$ (SLAO) substrate at (001) direction. The crystal growth is verified from RHEED pattern (Fig.1a) and XRD analysis. The superconducting transition temperature, T_c, is confirmed from temperature dependence of resistivity (Fig.1b) and found to be about 34K which is very close to the bulk crystal of $La_{1.85}Sr_{0.15}CuO_4$. Then 10nm of Py layer has been evaporated in a high vacuum. Spin pumping on Py/LSCO bi-layer film is done by Electron Spin Resonance (ESR) system (Fig.2a). To derive the Gilbert damping constant, spin pumping has been done in different thickness of LSCO (Fig.2b). Finally, from the spectral width of ESR signal and Hall voltage from ISHE signal, spin current in Py/LSCO system is derived.

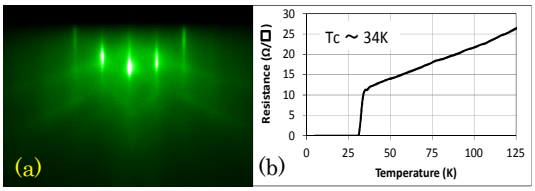

Fig.1: (a) RHEED pattern of ~110nm thick LSCO film, (b) The superconducting transition temperature.

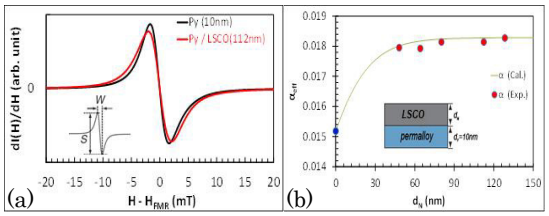

Fig.2: (a) Field dependence of the FMR signal and (b) damping constant of Py/LSCO system.

3. Summery

The damping constant in Py/LSCO system is ~0.018 which is lower than that of Py/Platinum. In this presentation, the present status of spin pumping in Py/LSCO film will be reported as well as main physics themes that the experiment strives to reveal.

References

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