Magnetoresistance induced by the Rashba effect in the $LaAlO_3/SrTiO_3$ interface

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In the field of spin-based devices, spin-orbit interaction is very fascinating mechanism, becasue spin and charge can be simultaneously modulated at the same time. Using a high mobility semiconductor channel, gate controlled spin precession has been reported [1]. Recently, the oxide based two-dimensional system has a great concern in the field of spin electronics because it shows interesting electronic and magnetic properties. $LaAlO_3/SrTiO_3$ (LAO/STO) has an inherent space inversion asymmetry causing an internal electric field near the interface. The Rashba spin-orbit coupling arising from this structural characteristics has a considerable influence on spin transport. However, the detection of Rashba effect using the conventional Shubnikov-de Haas oscillation or weak antilocalization method is not simple due to the relatively low mobility. In this research, we detect Rashba effect induced mobility change in a LAO/STO interface using spin filtering effect [2, 3]. Due to the different barrier heights, the applied magnetic field produces two different conductivities for spin-up and -down electrons.

In order to observe the Rashba effect, transport measurement of the Hall bar is performed at 1.8 K. The channel consists of a 5nm LAO layer on the STO substrate. The bias current induces Rashba spin splitting which results in the different carrier concentrations for spin-up and -down electrons. When the magnetic field is applied parallel or antiparallel to the Rashba field, the magnetoresistance of the channel is measured.

In a LAO/STO interface, the Rashba field induced magnetoresistance change is observed which is dependent on the sign and magnitude of the field. Our systematic study revealed that these results come from spin dependent transport, by which we obtained quantitative strength of the Rashba coupling. This Rashba strength is highly dependent on temperature: it varies from 2.6×10^{-12} eVm to negligible value in the temperature range of 1.8 ~ 12 K.

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