Edelstein Effect Induced Spin Polarization and Anisotropic Magnetoresistance in Rashba 2DEG

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In a charge current flowing 2DEG channel, Rashba spin-orbit coupling generates local and bulk spin polarization through spin Hall effect and Edelstein effect, respectively. Spin Hall effect accumulates opposite spins at both edges of channel, so spin current is induced perpendicular to charge current direction. On the other hand, Edelstein effect induces spin polarization with a direction of Rashba effective magnetic field and it makes charge current itself spin polarized. Spin polarization is the most important value in spin related phenomenon, however, it is not easy to quantify the spin polarization experimentally.

In this research we measured anisotropic magnetoresistance (AMR) to determine the spin polarization induced by Edelstein effect. External magnetic field is applied and rotated in 2DEG plane, and AMR is measured for various currents and gate voltages. In 2DEG structure, Rashba effective field is constant for a current, so direction of spin polarization is also fixed unlike AMR in ferromagnetic materials. It makes difference in resistance level (ΔV_A) for parallel and antiparallel ordering between external magnetic and Rashba effective field. Finally we could find out that spin polarization can induce AMR without ferromagnetism and measured AMR (ΔV_A) agrees with spin polarization predicted by Edelstein.