

Electrical Control of Spin Precession

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I will discuss about spin related transport and its application for spintronics in an InGaAs based two dimensional electron gas (2DEG). The strength of spin-orbit interaction (SOI) can be tuned by an external gate electric field [1] because the Rashba SOI caused by structural inversion asymmetry is dominant in an InGaAs based 2DEG. The gate voltage dependence of SOI strongly depends on the quantum well (QW) thickness in InP/InGaAs/InAlAs asymmetric QWs. The suppression of weak anti-localization (WAL) is observed by applying in-plane magnetic field. This is because the momentum dependent effective magnetic field is partially aligned by in-plane magnetic field and the spin relaxation time is enhanced [2].

Gate controlled SOI can offer novel functionality for controlling spin degree of freedom. A spin interferometer is proposed in a mesoscopic ring structure [3]. In order to distinguish spin interference from other spurious effects, we have measured time reversal symmetric Altshuler-Aronov-Spivak (AAS) oscillations in an array of mesoscopic loops [4]. The AAS oscillation amplitude which does not depend on the electron wavelength but depends on spin precession angle shows an oscillatory behavior as a function of gate voltage. The observed spin interference period is consistent with gate voltage dependence of SOI. This result shows that the spin precession angle can be controlled by the gate voltage [5]. We have also proposed a Stern-Gerlach spin filter [6] based on spatially inhomogeneous SOI.

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