CP06

Determination of Spin-Orbit Interaction in InAs Heterostructure

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Spin-orbit interaction (SOI) gives a useful tool to control spin precession in semiconductor without external magnetic field. The Rashba effect induced by spin-orbit interaction enables to imagine the spin field effect transistor in which the resistance modulation is achieved by precession of spins moving in a channel. The oscillatory magnetoresistance was measured to determine SOI parameter of inverted type high electron mobility transistor structure where InAs quantum well is inserted to InAlAs/InGaAs barrier layer. The band structure and electron charge distribution of the structure was calculated using WinGreen simulator. Observed SOI parameter is large enough to produce high Rashba field of about a few Tesla. The magnitude of the SOI parameter is subject to change with the InAs quantum-well thickness.

Index Terms-Quantum well, Rashba effect, Shubnikov-de Hass oscillation, spin-orbit interaction.

CP07

Spin Interaction Effect on Potentiometric Measurement in a Quantum well Channel

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In the potentiometric geometry, spin-orbit interaction field, which can arise from an asymmetry of the potential well, induces imbalance of carrier densities between spin-up and -down electrons. In this experiment, we utilized an InAlAs/InGaAs/InAlAs single quantum well channel with two ferromegnets. The sizes of ferromagnetic electrodes are 0.4 μm× 21 μm (FM1) and 2.4 μm ×17 μm (FM2). Figure 1 shows the measurement geometry and the detected signal with varying the magnetic field at T = 1.8 K. This magnitude of signal depends on spin polarization of ferromagnet and spin-orbit interaction parameter of quantum well. In the typical cases, the detected signal ($R = V/I$) will follow the magnetization of detected ferromagnet (FM1). However, in this geometry neighboring ferromagnet (FM2) affect on the detective signal. The transition points, $B1$ and $B2$ are matched with switching fields FM1 and FM2, respectively. Considering field sweep up process, the potential remains high state before increasing field up to $B2$ and the potential is low state beyond $B = B1$. When B is between $B1$ and $B2$, the alignment of two ferromagnets is antiparallel. In this state, FM2 interact with spin state of quantum well and plays the role of a spin sinker. The spin absorption of FM2 reduces detective potential at FM1 even before switching the magnetization of FM1.

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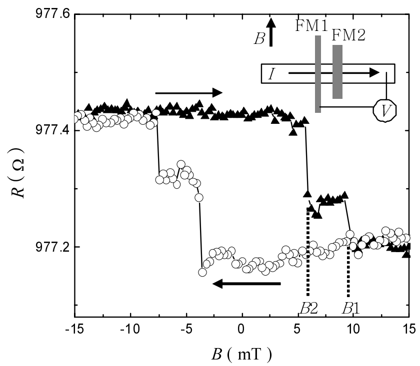

Fig. 1. Spin interaction effect on potentiometric measurement.

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