Spin Filtering Device by Rashba-Aharonov-Bohm Interferometer

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The controlled generation, manipulation and detection of spin-polarized currents in semiconductor is an important issue in spintronic devices [1]. The great variety of spin related techniques have been experimentally demonstrated so far. All of them, however, make use of the classical electromagnetic force or torque acting locally on the magnetic moment associated with the spin. The Rashba spin-orbit interaction has been focused to manipulate spin currents. Furthermore, the quantum point contact (QPC) having the Rashba interaction was recently proposed as a spin-current generator. [2], [3], [4]

In this work, we study an alternative way to manipulate spin polarized current using purely quantum-mechanical and nonlocal method by adopting wave interference effect. The principal mechanism of the proposed spin polarizer contains Aharonov-Bohm (AB) and Aharonov-Casher (AC) phase. AB effect relies on the electron's charge under magnetic field while AC effect comes from electron's magnetic moment with electric field. The Rashba spin-orbit interaction is responsible for AC effect in our device and provides a spin-dependent phase factor.

Our devices were fabricated on the InAs quantum well structures using electron-beam lithography and wet etching process. We were connected two QPCs in series. QPCs connected to the series form the ballistic interference system. An external magnetic field was applied in perpendicular with the ballistic interference system. We have been observed the AB-oscillation at the low temperature. We believe that these data can be an evidence for our interference system to work as a spin polarizer. These devices perform as the spin filter. By avoiding the use of ferromagnetic contact, such interference system may make feasible the development of a variety of spintronic devices.

참고문헌

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