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Asymmetric Magnetoresistance in Double Magnetic barrier Device

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Hybrid ferromagnet-semiconductor structures have been a focus of recent studies on the fundamental physics of a two-dimensional electron gases (2DEG) and their potential applications to spintronic devices, magnetic field-sensor and non-volatile storage cells. In such devices, the motion of the electrons in the semiconductor can be controlled by using local non-homogeneous magnetic fields. The magnetic inhomogeneity arises from the partial magnetic flux (fringe field) which comes from the magnetization of a ferromagnetic element located on top of the semiconductor surface (see Figs. 1 (a)).

In this report, we demonstrate a new device which is based on hybrid ferromagnet-semiconductor structure. Our device is made of InAs 2DEG with a cobalt (Co) gate located on top of the sample as shown in Fig. 1(b). Our device has a large MR effect and it's MR is quite asymmetric, i.e., big difference in MR according to the direction of the magnetization of Cobalt gate as shown in Fig.1 (c). This asymmetric characteristics indicate our device can be a good candidate for a high density non-volatile RAM. There are several practical advantages of our device over the recently reported EMR[1] and hybrid Hall type [2] device.

[1] S. A. Solin, et. al, Science, 289, 1530 (2000); Appl. Phys. Lett. 80, 4012 (2002).

[2] Mark Johnson, et. al, Appl. Phys. Lett. 71, 974(1997).

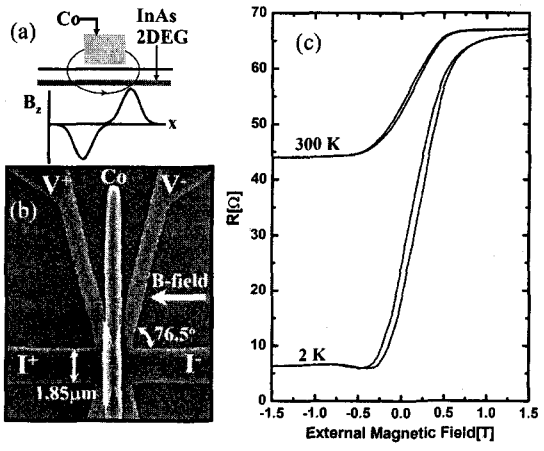

Fig. 1. (a) Schematic diagram of the device structure and profile of the magnetic field (B_z) caused by the fringe filed near edge of Co gate. (b) SEM image of the device. (c) MR data at 2K and 300K.