Local Hall effect in a Hybrid InSb Hall Cross Junction

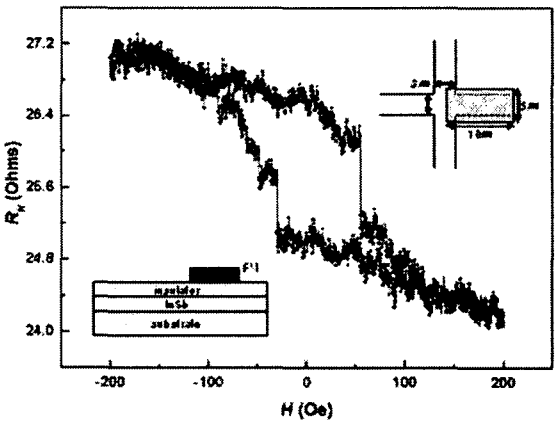
W. Y. Kim[1,3], J. Y. Chang[1], S. H. Han[1], S. K. Chang[2], and W. Y. Lee[3*]

[1] Nano Device Research Center, Korea Institute of Science and Technology, POB 131, Seoul 130-650, Korea
[2] Epixon CO., Ltd, 4103, LG Hall, KAIST, 373-1, Yousong-Gu, Gusong-Dong, Daejon, 305-701, Korea
[3] Department of Materials Science and Engineering, Yonsei University, Seoul 120-749, Korea

*Corresponding author: e-mail: wooyoung@yonsei.ac.kr, Phone: +82 2 2123 2834, Fax: +82 2 312 5375

A novel spintronic device based on hybrid ferromagnet/semiconductor microstructures has recently attracted considerable interest due to the possibility of device applications such as magnetic field sensors, integrated nonvolatile memory cells and logic gate. In this work, we present a hybrid Hall device incorporating a micron-scaled InSb semiconductor cross junction and a single microstructured ferromagnetic element. A 3 μm-wide cross junction was fabricated by standard microfabrication techniques using a high mobility n-type InSb ($n = 2.3 \times 10^{16}$ cm^{-3}, $\mu_H = 2.3 \times 10^4$ cm^2/Vs) on a Si substrate (see the inset of Fig. 1). After the junction patterning steps, a 50 nm-thick FeCo film was deposited in a dc magnetron sputtering system with a base pressure of 4×10^{-8} Torr, then patterned by optical lithography and liftoff.

We found a hysteric behavior in the R_H–H curve as shown in Fig. 1. This is believed to originate from the strong local magnetic field emanating from the edge of the FeCo film, when an applied magnetic field was parallel to the substrate. The Hall sensitivity of the hybrid cross junction was found to be 4.5 Ω/Oe, which is approximately two hundred times higher than that (0.02 Ω/Oe) in a InSb cross junction with a ferromagnetic element, obtained when an applied magnetic field was perpendicular to the substrate. Our results demonstrate that magnetic fringe fields from the edge of the ferromagnet generate a Hall voltage in a semiconducting Hall cross junction. We will discuss the effect of junction size on the induced Hall voltage.



References

[1] F. G. Morzon, Mark Johnson, M. L. Roukes, Appl. Phys. Lett. **71**, 3087 (1997)
[2] Mark Johnson, Brian R. Bennett, M. J. Yang, M. M. Miller, B. V. Shanabrook, Appl. Phys. Lett. **71**, 974 (1997)
[3] Mark Johnson, J. Vac. Sci. Technol. **A 16**, 1806 (1998)