Measurement of magnetic anisotropy energy in ferromagnetic nanostructure with different temperatures

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The application of ferromagnetic materials, which have magnetic anisotropy perpendicular to the plane, is expected to provide the improvement of recording density in magnetic data storage devices such as hard disk drive and magnetic random access memory. The properties of such devices are influenced by the strength of magnetic anisotropy and the temperature of device. In this study, we have determined magnetic anisotropy energy by means of extraordinary Hall effect measurement with rotating the sample and changing temperature by control the current.[1]

To measure the extraordinary Hall voltage and reduce the temperature gradient of the sample, cross-shaped Pt/Co multilayer structure with perpendicular magnetic anisotropy was patterned by electron-beam lithography and Ar ion etching of magnetron sputtered films. The widths of the horizontal and vertical bars are 2 μm. Ti/Au electrodes were positioned using optical lithography at the ends of Hall cross structure to apply current into the horizontal bar and measure the voltage of the vertical bar.

The extraordinary Hall voltage was measured under an external magnetic field with rotating around the easy axis and then analyzed the value of Hall voltage with angle deviation based on the Stoner-Wohlfarth theory to determine the magnetic anisotropy field. As plotted in figure, anisotropy field decreases when J increases. Further analysis including temperature dependence will be discussed.

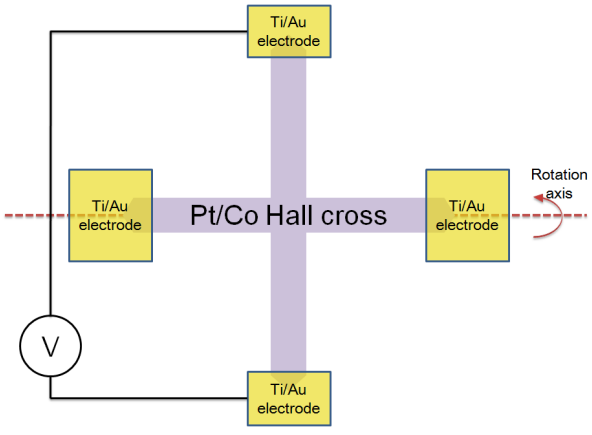

Fig. 1. Schematic diagram of the sample

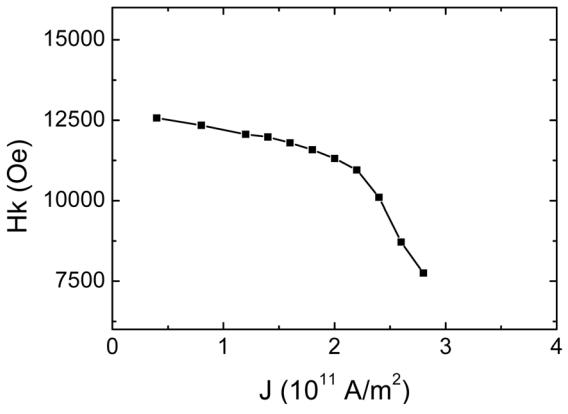

Fig. 2. Magnetic anisotropy field(Hk) with respect to the current density(J)

References

[1] K.-W. Moon *et al*., Rev. Sci. Instrum. **80**, 113904 (2009).