Co/Pt 多層膜を用いたマイクロ波アシスト磁化反転

Microwave-assisted magnetization switching by using a Co/Pt multilayer

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Microwave-assisted magnetization switching (MAS) has attracted attention as one of the ultra-high density magnetic recording technologies in a hard-disk drive. In MAS, a dc magnetic field for the magnetization switching in recording bits is greatly reduced with the assistance of a radio frequency (rf) magnetic field. So far, the MAS is demonstrated by using a linearly-polarized rf magnetic field. Theoretically [1,2], it is predicted that the MAS for a circularly-polarized rf field is more efficient than that for a linearly-polarized rf field. However, until now the MAS for a circularly-polarized rf field has not been experimentally reported.

We prepared a Co/Pt multilayer having perpendicular magnetic anisotropy, which consists of sub./Ta 3.0/Ru 6.0/Pt 2.0/[Co 0.24/Pt 0.16]$_3$/Co t_{Co}/[Co 0.24/Pt 0.16]$_3$/Pt 0.3/Ru 2.0 (unit in nanometer), in which the t_{Co} was 1.0 nm or 1.7 nm. The effective anisotropy fields of the film were, respectively, evaluated to be 4.0 kOe and 10.5 kOe for t_{Co} = 1.0 nm and 1.7 nm by using a vibrating sample magnetometer. The Co/Pt single dot with a diameter (D) of ~100 nm was fabricated by using electron beam lithography and Ar ion etching. The Ta/Ru underlayer was fabricated to form a Hall cross shape. After covering the dot with a 30 nm SiO_2 layer, a 100-nm-thick Cr/Pt RF line is sputter-deposited. Figure 1 shows the device image taken by an optical microscope with the measurement setup. By injecting an rf current through the RF line, a linearly-polarized rf field is excited. The magnetization switching is detected from the Hall voltage change through the anomalous Hall effect. Figure 2 shows the results of Hall measurement. Clear square hysteresis indicates that the device has perpendicular magnetic anisotropy. We will discuss the effect of linearly-polarized and circularly-polarized rf fields on MAS.

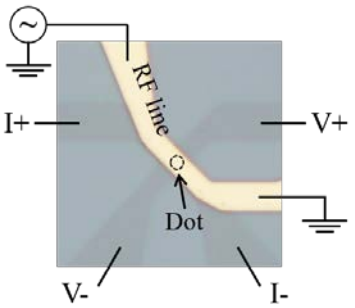

Fig. 1 Device image and measurement setup. The DC line to measure the Hall resistance is shown as I+, I-, V+, and V-. The dot is marked by the dashed circle.

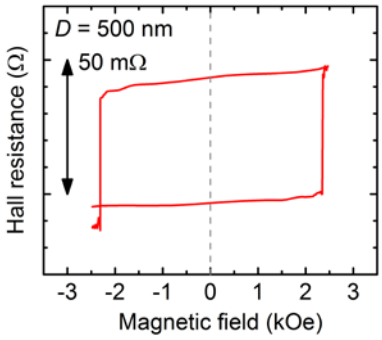

Fig. 2 Result of the Hall measurement in the device with D = 500 nm.

[1] J.-G. Zhu and Y. Wang, IEEE Trans. Magn. **46**, 751 (2010). [2] S. Okamoto *et al.*, J. Appl. Phys. **107**, 123914 (2010).