Magnetization switching of a ferrimagnetic amorphous Gd-Fe-Co single dot under an assistance of rf field

Y. M. Lu, S. Okamoto, N. Kikuchi, B. Lao, Y. Kusanagi, and O. Kitakami
Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai 980-8577, Japan

Microwave assisted magnetic recording (MAMR) [1], which consists of microwave assisted magnetization switching (MAS) and an rf field generator of spin torque oscillator (STO), is one of the prospective ultra-high density recording technologies. Based on MAMR technology, a multilevel recording scheme and an antiferromagnetically coupled (AFC) media has been proposed to further enhance the recording density [2-4]. For these technologies, it is very important to control the dipole interaction between adjacent bits and the interlayer antiferromagnetic coupling. A ferrimagnetic alloy such as amorphous Gd-Fe-Co is a possible candidate material due to its very low saturation magnetization and very good controllability of magnetic properties by changing the composition of Gd and (Fe-Co). Moreover, AFC media is easily obtained by simply stacking Gd-rich and (Fe-Co)-rich layers. But so far, there has been no report on MAS experiment using a ferrimagnetic material. In this work, we have examined the MAS behaviors of a Gd-Fe-Co single dot with the diameter down to sub-micro scale. The sample structure is MgO sub./Pt(25 nm)/Ta(1 nm)/Gd-Fe-Co(10 nm)/Ta(3 nm). The Pt/Ta underlayer is used as an electrode for anomalous Hall effect (AHE) measurement. Gd-Fe-Co layer is patterned into a dot, and Au stripline is fabricated just above the dot with an insertion of an insulating layer.

Figure 1 shows representative AHE curves of the Gd-Fe-Co dot with the diameter of 1 μm. The AHE curve exhibits that the switching field H_{sw} in the absence of the rf field is around 310 Oe, which is much smaller than the effective anisotropy field of 1 kOe. Under the assistance of rf fields with the amplitude of 130 Oe, H_{sw} significantly decreases without changing the shape of AHE curve. Figure 2 shows the frequency dependence of H_{sw}. H_{sw} monotonically decreases with the rf frequency *f* and takes a minimum of 110 Oe at *f* = 3.5 GHz, indicating 61% of switching field reduction.

Reference

[1] J-G. Zhu *et al.*, *IEEE Trans. Magn.* **44**, 125 (2008). [2] S. Okamoto *et al.*, *J. Phys. D: Appl. Phys.* **48**, 353001 (2015). [3] T. Yang *et al.*, *J. Appl. Phys.* **114**, 213901 (2013). [4] H. Suto *et al.*, *Phys. Rev. Appl.* **5**, 014003 (2016).

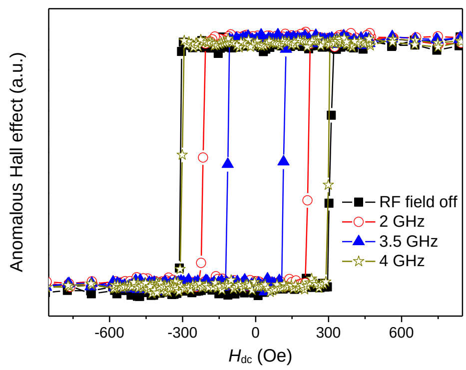

FIG. 1. Normalized AHE curves with and without the rf field application for a perpendicularly magnetized Gd-Fe-Co single dot.

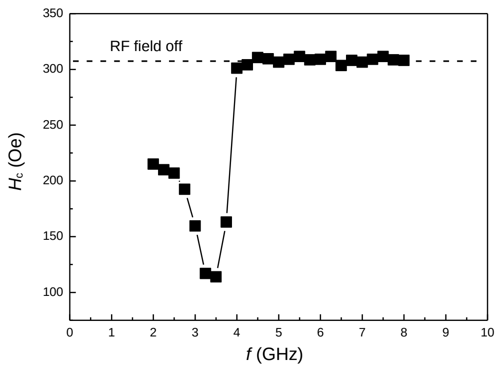

FIG. 2. The switching field of Gd-Fe-Co dot as a function of rf frequency.