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

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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

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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.