Resonant Magnetization Switching Conditions of an Exchange Coupled Bilayer under Spin Wave Excitation

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[**Introduction**] In order to simultaneously satisfy the needs of thermal stability of magnetization and writability of information for ultrahigh density magnetic recording devices, alternative recording techniques are required to reduce the switching field (H_{sw}) of materials with high magnetic anisotropy (K_u), *e.g.*, $L1_0$-FePt. Recently, a novel method called the spin wave-assisted magnetization switching (SWAS) has been proposed and demonstrated [1, 2]. For an exchange-coupled bilayer consisting of a hard $L1_0$-FePt layer and a soft $Ni_{81}Fe_{19}$ (Py) layer, the excitation of spin wave in Py leads to a significant H_{sw} reduction of $L1_0$-FePt. Due to its origin of spin wave excitation, this technique carries some unique characteristics different from the conventional microwave assisted switching. In this study, we revealed the switching conditions of SWAS for the in-plane magnetized $L1_0$-FePt / Py bilayer using a pulse-like rf magnetic field (h_{rf}). We found that the H_{sw} reduction occurred only in a limited region following the dispersion relationship of the perpendicular standing spin wave (PSSW) modes in Py.

[**Experiment**] The stacking structure of the thin film was MgO (110) subs. // Cr (10 nm) / Pt (10 nm) / Au (40 nm) / FePt (10 nm) / Py (100 nm) / Au (10 nm). The FePt layer was epitaxially grown on the Au buffer layer at a substrate temperature of 350 ºC in order to promote the $L1_0$ ordering. The thin film was microfabricated into a coplanar waveguide (CPW) with an FePt / Py bilayer element (28×2 μm^2) on the signal line of CPW. A pulse-like h_{rf} (200 msec duration) with a certain f was applied using a signal generator at a certain magnetic field (H_{pulse}). The magnetization switching was detected by measuring the anisotropic magnetoresistance effect of the device. f and H_{pulse} were varied systematically, which enabled us to construct the maps of switching conditions in the f - H plane. The results showed a limited region corresponds to the switching conditions of SWAS, which coincided with the dispersion relationship of the PSSW modes in Py. The map of switching conditions was well reproduced by numerical simulation. These results indicate that SWAS is a resonant magnetization switching process, and has potential for a selective switching technique in multilevel recording media.

[1] T. Seki, *et al.*, *Nat. Commun.*, **4**, 1726 (2013).

[2] W. Zhou, *et al.*, *Phys. Rev. B* **94**, 220401(R).