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High Power Laser Induced Spin Precessional Dynamics of CoFeB Films

Y. Sasaki[1], S. Mizukami[2], S. Iihama[1], H. Naganuma[1],
M. Oogane[1], T. Miyazaki[2], and Y. Ando[1]
[1]Department of Applied Physics, Tohoku University, Sendai 980-8579, Japan
[2]WPI-AIMR, Tohoku University, Sendai 980-8577, Japan
E-mail: sasaki2100@mlab.apph.tohoku.ac.jp

The laser-induced dynamics has been used to investigate various spin dynamics in films with perpendicular magnetic anisotropy (PMA). We have reported laser-induced precessional dynamics and damping of PMA CoFeB films at lower power [1,2] In this study, we investigated the laser power dependence of demagnetization and damping for PMA CoFeB films to obtain the insight into the temperature rising effect on spin dynamics and damping, which is important from both the fundamental and practical points of view.

Films were fabricated using the ultrahigh vacuum magnetron sputtering method. The stacked structure was Ta(5)/CoFeB(1)/MgO(2)/Al(2) (thickness is in nm) deposited on thermally oxidized Si substrate. Laser-induced dynamics was measured using the standard pump-probe magneto-optical set-up with a Ti: Sapphire laser and a regenerative amplifier [1,2]. Fig. 1 shows the ultrafast demagnetization and recovery dynamics for the film with different pump laser power (fluence) F_p. Demagnetization ratio negatively increases with increasing F_p and seems to saturate at F_p = 3 mJ/cm^2. Fig. 2 shows the precessional motion of magnetization at fixed field angle with F_p corresponding to those in Fig. 1. Precession amplitudes exhibit maximum at the intermediate F_p values, whereas the damping did not change significantly even though the spin temperature raised. This work was supported by KAKENHI (No. 24686001).

[1] S. Iihama *et al.*, APEX **5**, 083001 (2012).
[2] S. Iihama *et al.*, Phys. Rev. B 89, 174416 (2014).

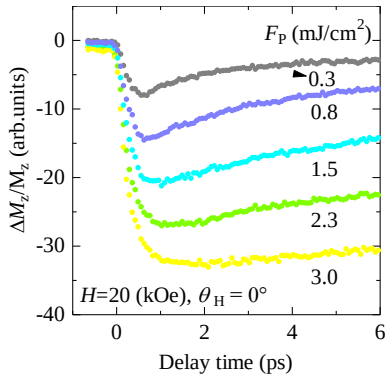

Fig.1 Ultrafast demagnetization of the CoFeB PMA film with different pump fluences F_p.

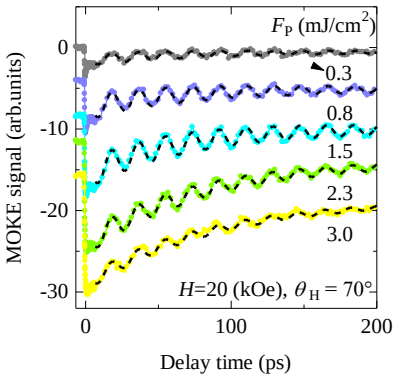

Fig.2 Precessional dynamics of CoFeB the PMA film with different pump fluences F_p.