Propagating Properties Depending on 80NiFe-Films Thickness for Pulse Laser-Induced Spin Wave

○A. Kamimaki[1], Y. Sasaki[1], S. Iihama[2], Y. Ando[2] and S. Mizukami[1]
(1. WPI-AIMR, Tohoku Univ. 2. Dept. of Appl. Physics, Tohoku Univ.)
E-mail: a.kamimaki17@mlab.apph.tohoku.ac.jp

Propagating spin wave (PSW) has been mainly studied by using micro-wave antenna for realizing future's spin-based logic devices [1]. Nowadays, pulse laser-induced PSW is actively being investigated in magnetic metals and insulators [2, 3]. In magnetic metals, which have much smaller propagation length, an excitation mechanism and detail properties of PSW are not well understood. In particular, excitation mechanism has a fundamental issue because of heating effect. Here, we report propagating properties depending on 80NiFe-(Py)-films thickness for pulse laser-induced spin wave.

The Py films (thickness d =20, 50 and 100 nm) were prepared by magnetron sputtering method. PSW was observed by space-and-time resolved magneto-optical Kerr effect (STR-MOKE) [3]. The power of pump and probe beam are about 15 and 5 mW respectively. The external magnetic field $\mu_0 H_0$ = 0.3 T was applied with θ_0 = 5 deg., where θ_0 is measured from normal direction of the film surface. PSW is detected in the direction perpendicular to the magnetization. Fig. 1 shows the space-time mapping of pump-laser induced change in Kerr rotation angle $\Delta\theta_K$. The PSW was clearly observed, which exhibit Gaussian-type wave packets. The propagation length λ, which is shown in Fig. 2 as a function of the group velocity v_g, was estimated. They are consistent with those expected from the relation, $\lambda = v_g\tau$, with life time τ which was separately determined (dashed-line in Fig. 2)

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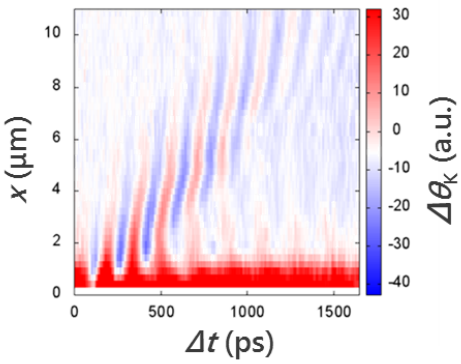

Fig. 1: Space-time mapping of pump-laser induced change in Kerr rotation angle $\Delta\theta_K$ (50-nm-thick film). Δt is pump-probe delay time, and x is scanning direction.

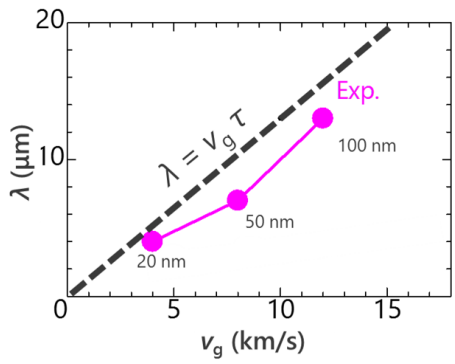

Fig. 2: propagation length λ vs group velocity v_g with different d. The dashed line is calculated with τ =1350 ps.