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Detection of photo-induced ferromagnetic resonance in Co/Pd multilayers with oblique incidence angles

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We have proposed the concept of optical buffer memory on the basis of non-equilibrium state of magnetization caused by the ultra-short laser pulses [1,2]. Preferred device structures which suit for those applications would be a hybrid structure consisting of an optical waveguide and a magnetic thin layer with sufficient magneto-optical coupling between the two constituent components. In this kind of structure, the excitation of the magnetic layer as well as the detection of non-equilibrium magnetization will be carried out via the waveguide/magnet interface by the light which propagates through the optical waveguide.

With such a scenario in mind, we have investigated the dependence of incident angle of detection laser pulses on the amplitude of photo-induced ferromagnetic resonance (phi-FMR) in the ultra-thin Co/Pd multilayers of $[Co(0.78nm)/Pd(0.81nm)]_5$/Pd(4.86nm)/Ta (2.18nm)/Si (110). Experiment of phi-FMR was carried out by time-resolved magneto-optical (TRMO) spectroscopy on the basis of pump-and-probe technique using a mode-locked Ti: sapphire laser with wavelength, pulse duration, and repetition of λ = 790 nm, Δ = 90 fs, and Γ = 80 MHz, respectively. The fluences of linearly-polarized pump and probe beams were fixed at 7.96 and 0.040 $\mu J/cm^2$ per pulse, respectively. The pump beam was impinged nearly normal to the sample surface (Fig. 1).

Shown in Fig, 2 is a plot of phi-FMR amplitude vs. incident angle of probe pulses. For *s*-polarized probe pulses, the precession amplitude decreases monotonously with increasing θ_{probe}, and becomes less than the detection limit at around θ_{probe} = 65°. For *p*-polarized probe pulses, the phi-FMR almost vanishes at around θ_{probe} = 65° but recovers at θ_{probe} = 70 – 74°. Knowing the angular dependence of polar Kerr rotation (PKR) measured separately (Fig.3) [3], the observed vanishment of phi-FMR at θ_{probe} = 65 – 70° can be understood in terms of the abrupt polarization switching in PKR around the same incident angle region.

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[3] C. Y. You and S. C. Shin, *Appl. Phys. Lett*. **69**, 1315 (1996).

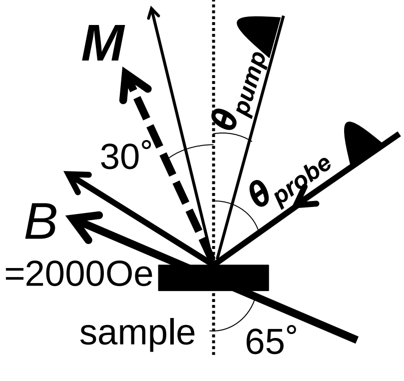

Fig. 1 Schematic illustration of experimental set up for angle dependent probe measurement. θ_{pump} = 2° whereas θ_{probe} was changed between 20 ~ 80°.

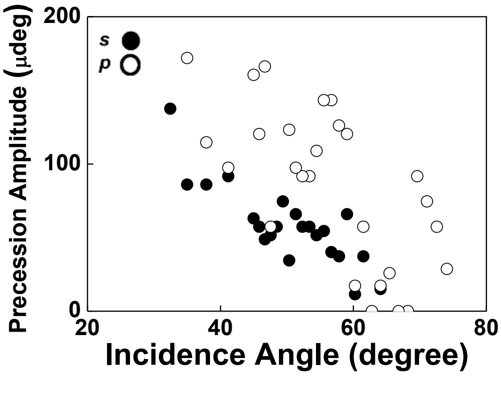

Fig. 2 TRMO signals obtained with various θ_{probe}.

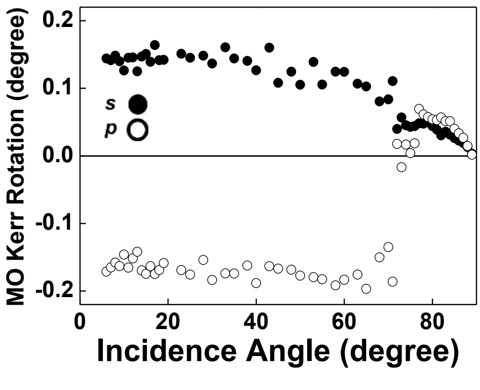

Fig. 3 Magnitude of static polar Kerr rotation as a function of incident angle of a linearly polarized cw-light beam.