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Observation of Reflection and Tunnel Effect in Photoinduced Spin Waves by Spatio-Temporally Resolved Imaging

Univ. of Tokyo[1], Kyushu Univ.[2] ○Isao Yoshimine[1], Takuya Satoh[2], Tsutomu Shimura[1]

E-mail: yoshi3ne@iis.u-tokyo.ac.jp

Spin wave is propagating disturbance in magnetically ordered materials without Joule heating because net electron charges do not flow. It is expected that spin wave can be applied to information processing devices with low energy consumption.

We developed imaging method which enables temporal resolved measurement of 2D-waveform of the spin wave. We studied propagation of the spin wave in finite elements by spatio-temporally resolved imaging.

Propagation of a spin wave was measured by pump-probe method and 2D-imaging using CCD camera [1]. The spin wave was generated by a circularly polarized light pulse via the inverse Faraday effect. The pump pulses with 1300 nm wavelength and 150 fs time duration were focused on a $Gd_{3/4}Yb_{2/3}BiFe_5O_{12}$ single crystal to a spot diameter of 80 μm. In-plane external magnetic field **H** = 1 kOe was applied to make the sample monodomain.

In Fig. 1(a), the waveform of spin wave excited at the spot 200 μm apart from the edge of the sample with 110 μm thickness is shown. Interference between the excited spin wave and reflected spin wave at the edge was observed. In Fig. 1(b), the waveform of spin wave excited in the sample which has 40 μm thickness and 50 μm air gap is shown. Tunneling of the spin wave through the gap [2] was observed.

[1] I. Yoshimine *et al.*, the 69th JPS annual meeting, 28aAF-2 (2014).

[2] T. Schneider *et al.*, EPL **90**, 27003 (2010).

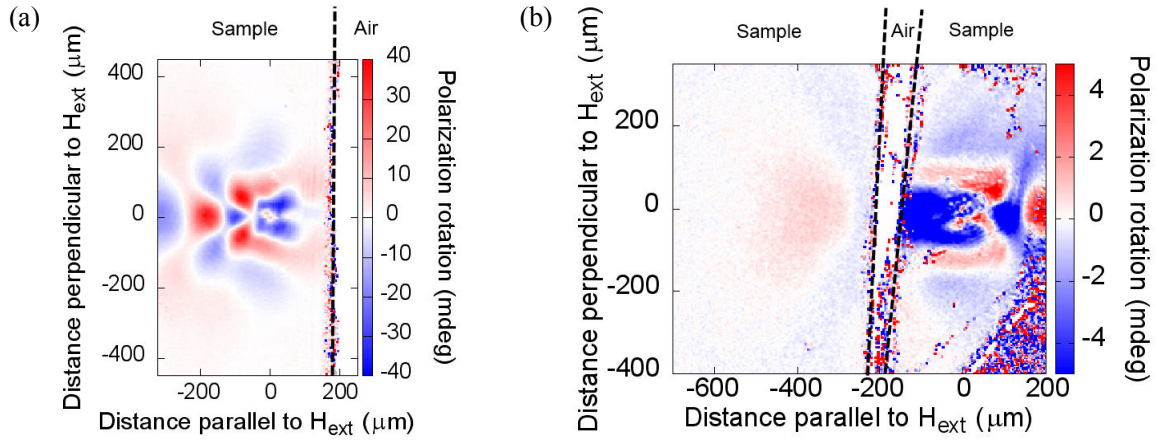

Fig.1 Waveform of the spin wave (a) reflected on the edge of the 110 μm thick sample, and (b) propagated through an air gap of 50 μm in the 40 μm thick sample. Delay of the pump and probe pulse is 1.8 ns. The origin position is a spot on which the pump pulses were focused. Dashed line indicates the edge of the sample.