シミュレーションによる静磁表面スピン波の非相反性の検討

Investigation of MSSW nonreciprocity by micromagnetic simulation

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Introduction

Spin waves have attracted much attention as a novel tool for future spintronic devices. One of the spin wave modes, magneto-static surface wave (MSSW), has been investigated intensively owing to their large signal and large attenuation length in a metal system. We focused on the nonreciprocity characteristics of MSSW, which is intensity difference depending on the propagation direction. We previously reported antenna width dependence of the nonreciprocity and showed the nonreciprocal propagation can be controlled by antenna configuration [1, 2]. In this report, we investigated the mechanism of the nonreciprocity using micromagnetic simulations.

Simulation

Micromagnetic simulations of the spin wave propagation were also performed using the Object Oriented Micromagnetic Framework (OOMMF). Excitation field of the SG type antenna was separately calculated. Using the calculated field shape, Gaussian pulse excitation with a pulse width of 50 ps was applied in OOMMF. The spin wave spectra were obtained by Fast Fourier Transformation (FFT). To estimate the nonreciprocity, an external field was reversed and the obtained results were compared.

Results and discussion

Simulated time dependent waveforms were converted to spin wave spectra by FFT. Typical intensity map of the spectra along the *x*-axis (propagation direction) is shown in Fig.1 (a). These spectra have a peak frequency around 6 GHz for 2 μm antenna. The inset shows the spin wave spectra at x = 12 μm (center of antenna position), which shows a similar shape to the experimental result. Fig. 1 (b) is *NR* map and the inset is the *NR* variation along *x*-axis at a peak frequency of the spectra. It shows the *NR* is almost constant, which is also consistent with previous report [3]. We obtained antenna width dependence of *NR* as shown in Fig.1 (c), and it showed qualitatively good agreement with the experimental results.

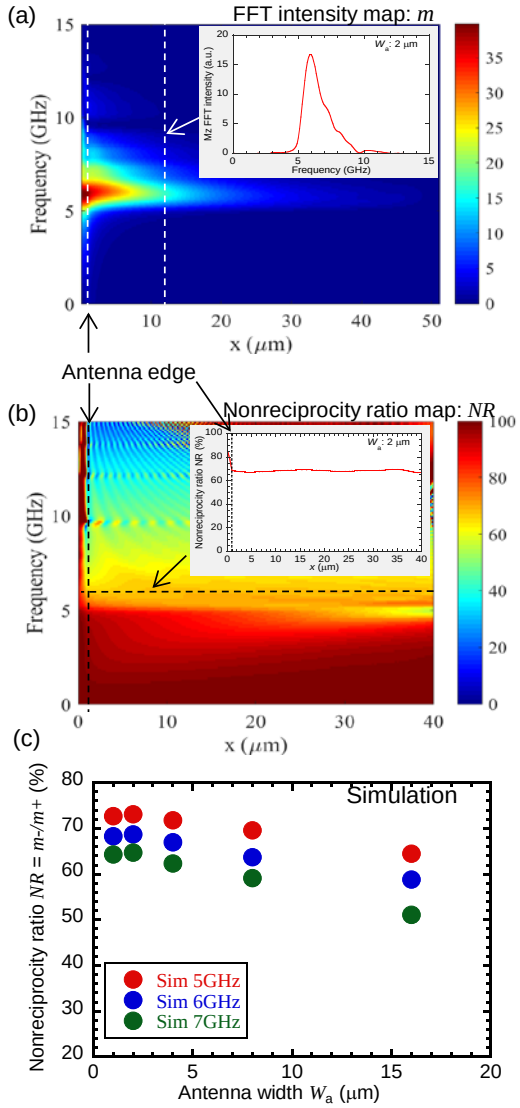

Fig.1 (a) FFT Intensity map of the spin wave spectra for sample with 2 μm antenna. The inset is the spin wave spectra at x = 12 μm. (b) Map of the nonreciprocity ratio *NR*. The inset is the *NR* along the propagation direction at about 6 GHz. (c) Antenna width dependence of *NR*.

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Reference

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