QE02

Characteristics of Domain Wall Motion in CoFe Films for GHz Frequency Use

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CoFe magnetic thin films with high saturation magnetization M_s and large in-plain uniaxial magnetic anisotropy field H_k have attracted great interest for GHz frequency use, because the high saturation magnetization can bring the higher permeability and the higher ferromagnetic resonance frequency[1]. Soft magnetic properties for the high frequency use include the combination of low coercive force H_c and large H_k, which are essential conditions for coherent spin rotation under the high frequency magnetic field [2]. In this work, dynamic magnetization processes were studied in CoFe films with high saturation magnetization by using a time-resolved imaging technique.

CoFe magnetic thin films were prepared on glass substrate using an RF magnetron sputtering method at argon pressures of 3×10^{-3} Torr. A slit-patterned CoFe film with a width of 1mm was used for the domain observation. The thickness of the CoFe specimen was 715 nm. The $4\pi M_s$ of the CoFe film was 24.4 kG. The uniaxial magnetic anisotropy H_k was 50 Oe along the longitudinal direction of the patterned specimen. The coercive force H_c measured in the direction of easy magnetic axis was 10.5 Oe.

A square wave magnetic field, H, with a frequency, f, was applied along the easy direction of magnetization of the specimen. The domain walls lie along easy axis and move toward the specimen edge driven by the applied field. The magnetic domain configuration during motion was observed by means of a Kerr observation system equipped with a CCD camera synchronized to the laser illumination, in which the exposure time is set at 1/12f. The domain wall velocity, v, was found to increase with increasing the driving field as μ(H-Hc). The domain wall mobility, μ, increases linearly with f in the low frequency region. The mobility reaches maximum of 1.2 m/sOe at 100 kHz and then decreases as shown in Fig.1.

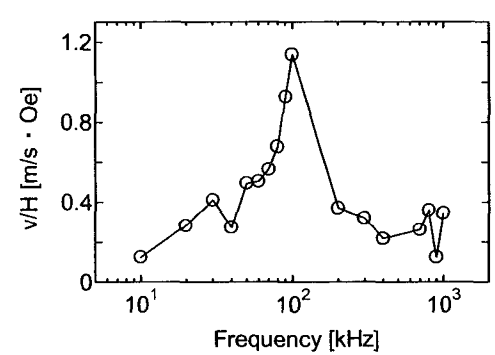

Fig. 1. Dependence of domain wall mobility on the driving field frequency.

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QE03

Strong Radiation of Spin Waves by Core Reversal of a Magnetic Vortex and Wave Properties of Spin Waves Traveling in Magnetic Nanowires

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Spin-waves (SWs) propagating at speeds ≥ 1.0 km/s through magnetic nanowire-waveguides (MNWs) have attracted considerable attention from the viewpoint of their promising applications for a new paradigm of logic devices [1]. In such devices, information signals can be generated by SW excitations from a local area, and then delivered by propagating SWs through MNWs, and finally manipulated through the superposition of SWs. However, the device conception of Ref. 1 assumes only small-amplitude SWs. To make SWs applicable practically, it is thus crucially important to excite SWs with sufficiently large amplitudes from a local area [2] like electromagnetic-wave radiation, as well as to confirm the fundamental wave behaviors of the SWs propagating along MNWs.

In the present study, we report the finding of a simple, but novel and controllable method of reliable generation of strong SWs by using a magnetic vortex (MV) core [3]. We also report on the wave behaviors of SWs injected into MNWs, as studied by micromagnetic simulations. We used a model system consisting of a circular shaped Permalloy (Py) dot with a radius of 150 nm connected to a Py MNW of thickness L = 10 nm, width w = 30 nm and length l = 700 nm, as seen in Fig. 1(a). The equilibrium configuration of magnetization (**M**) is the ground vortex state in the geometry with zero magnetic field as shown in Fig. 1(a). Then it is perturbed by a sinusoidal magnetic field pulse, applied only to the circular dot along the +y direction. The temporal variation of the local **M** from the initial MV state shows that the radial SWs are generated from the MV core as shown in Fig. 1 (b), by virtue of localized large torques employed at the core region. Radiated SWs manifest propagation, reflection, transmission, interference, and dispersion, when traveling along MNWs. These results offer a preview of the generation, delivery, and manipulation of SWs in patterned magnetic elements, which are applicable to information-signal processes in potential SW devices [4].

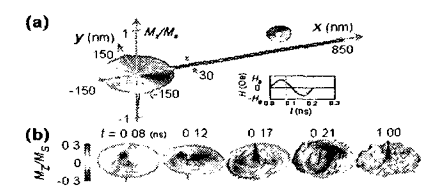

Fig. 1. (a) Py model geometry. The colors represent the in-plane orientations of the local **M**, as indicated by the color-coded wheel. The inset shows an applied sinusoidal field pulse with the period of 0.2 ns and H_a = 300 Oe. (b) Perspective-view images of the spatial distributions of M_z / M_s in the circular dot at the indicated times.

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