SB08

Direct Observation of DW Motion Induced Nano-second Current Pulse

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Recently, the current-driven domain wall (DW) motion in magnetic nanowires has been attracted much attention [1,2]. In this phenomenon, a DW moves in the opposite direction of the current flow. In this contribution, we present the magnetic force microscopy (MFM) observation of the DW motion induced by a nano-second pulse.

Samples were fabricated by lift off method in combination with electronbeam lithography onto thermally oxidized Si substrates. Figure 1 shows a schematic illustration of a top view of the sample. The sample consists of an arched $Ni_{81}Fe_{19}$(Py) wireswith periodic symmetrical notches. The thickness of the Py wires and the period of the notches were 30 nm and 940 nm, respectively. And two Cr/Au electrodes were attached to inject pulsed-current.

First, a magnetic field of 1 kOe was applied in the direction shown in Fig. 1 and then it was reduced to zero to inject DWs in the Py wires. Figure 2(a) shows an MFM image of the part of the sample after the injection of the DWs. All observations were curried out at room temperature. After the observation of Fig. 2(a), a pulsed-current ($1.4 \cdot 10^{12}$ A/m^2, 7 ns) was applied through the wires in the absence of a magnetic field. Then, some DWs moved into the next notches as shown in Fig. 2(b). This shows that DW can be moved by a nano-second current pulse. However, the DW sometimes moved in the same direction of the current flow[3]. This can be attributed to the Joule heating in the sample by applying high current density.

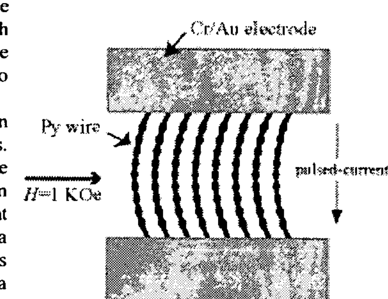

Fig. 1. Schematic illustration of a top view of the sample.

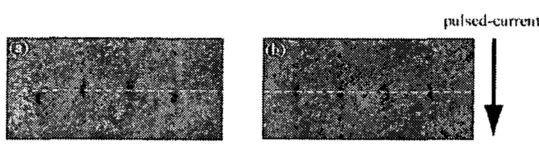

Fig. 2. (a) MFM image of the sample after the injection of the DWs. (b) MFM image of the sample after applying a pulsed-current (1.4×10^{12} A/m^2, 7 ns) through the wires.

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SB09

Depinning Field from Symmetric Notches of Co/Pd Multilayer Nanowireswith Perpendicular Magnetic Anisotropy

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Ferromagnetic nanowires drew great technological attention, largely motivated by the possible application to memory and logic devices [1,2]. To achieve a higher density, nanowires with perpendicular magnetic anisotropy have been also recently proposed. In these nanowires, notches were commonly introduced for control of the domain wall position in nanowires. Here we report micromagnetic prediction on the domain-wall depinning field from notches of perpendicularly magnetized Co/Pd multilayer nanowires. For calculation, two symmetric right-angled triangular notches with height h were located at the centre of a nanowire as shown in the figure. The nanowire has the width w and the length $10w$. Typical magnetic properties of (2-Å Co/11-Å Pd)$_4$ were employed in the calculation as the saturation magnetization 2.1×10^5 A/m, the exchange stiffness 4.6×10^{-12} J/m, and the crystalline anisotropy 1.0×10^5 J/m^3 [3]. The domain wall was initially located at the notch and then, the equilibrium state was calculated for each applied magnetic field with increment of 0.1 mT up to the depinning field at which the wall escaped from the notch. The figure shows the simulation results of the depinning field with respect to (a) the notch height and (b) the channel width for several wire widths as denoted in the figure. Quite interestingly, the depinning field gathered into a unique curve as a function of the channel width l, irrespective to the wire width for the notches larger than 10 nm. The unique curve was fitted by $H_{depin} = 260 \cdot l^{0.8}$, where the depinning field was in mT and the channel width was in nm. We therefore propose a universal phenomenological equation of the depinning field in perpendicularly magnetized nanowires.

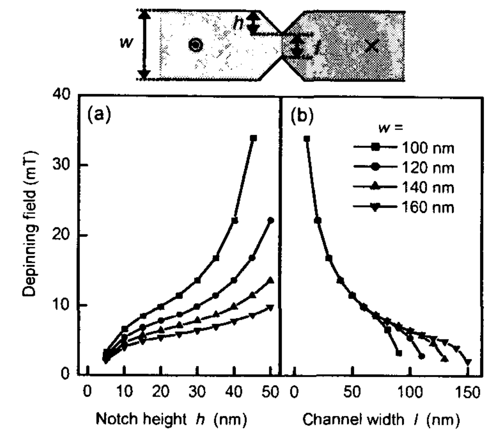

Fig. 1. Depinning field with respect to (a) the notch height and (b) the channel width

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