小さい磁壁抗磁力を持つ Gd-Fe 合金を用いた電流誘起磁壁移動の研究

Investigation of current-induced domain wall motion in Gd-Fe alloy wire with low domain wall propagation field

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[Introduction] Manipulating magnetic domain wall (DW) using electric current has been paid much attention from the viewpoint of device application such as new types of magnetic memories and logic circuit. Recently, the current-induced domain wall motion (CIDWM) whose driving forces are spin orbit torque (SOT) originated from the spin Hall effect (SHE) and Dzyaloshinsky-Moriya interaction (DMI) have been reported. In the case of CIDWM by the SOT, its threshold current density determined by DW propagation field. In this study, we observed the CIDWM in Ta/Gd-Fe/TaO_x and Ta/Gd-Fe/W/TaO_x multilayered wires with low DW propagation field.

[Experiment] Ta/Gd-Fe/TaO_x and Ta/Gd-Fe/W/TaO_x wires were deposited on a thermally oxidized Si substrates by using DC magnetron sputtering. The 5-μm-wide wires were fabricated by electron beam lithography. The magnetic properties of the Gd-Fe wires were observed by using anomalous Hall effect. The CIDWM was observed by using Polar Kerr microscope.

[Result] We estimated the DW propagation field in the Gd-Fe wires to be 30 Oe by measuring anomalous Hall effect. Figure 1 shows Kerr images of the Ta/Gd-Fe/TaO_x wire under a pulse current. As shown in Fig. 1, the DW was clearly driven by the current along current flow direction. However, we found that the direction of CIDWM in the Ta/Gd-Fe/W/TaO_x was opposite to that in the Ta/Gd-Fe/TaO_x. It indicates that the driving force of CIDWM is the SOT from the Ta or W layers. We also found that the threshold current density for the CIDWM in the Ta/Gd-Fe/TaO_x is 0.3×10^{11} A/m^2.

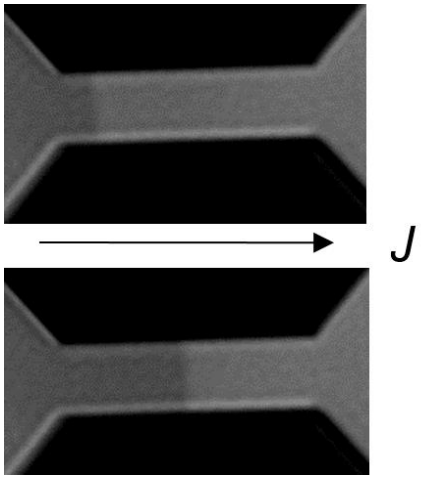

Fig.1 Kerr images of Ta/Gd-Fe/TaO_x wire under a pulse current.

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