Controlling Pinning Behavior of Domain Wall by Interaction between Constrictions and Magnetic Charge in Ferromagnetic Nanowires

Sung-Min Ahn*, Kyoung-Woong Moon and Sug-Bong Choe
Department of Physics, Seoul National University, Seoul, 151-747, Republic of Korea

It is important to understand physically how to control the domain wall(DW) accurately and reliably, because the field required to depin the DW from a constriction is sensitive to the DW structure and chirality [1-2]. Furthermore, the ability to control the depinning behavior of a domain wall through the geometrical structures of the magnetic wire allows the experimental study of fundamental physical properties of the DW motion. 620 nm wide, 20 nm thick permalloy nanowire with a notch and a transverse arm were fabricated using electron beam lithography, with edge to edge separation 10 nm and a symmetrical pad as shown in Fig. 1. The arrows indicate the magnetic field directions of Hsat and H_a are saturation field and horizontally applied field. The depinning behaviors are monitored by the Magento-Optic Kerr Effect(MOKE) signal detection at position **A** and **B** using a longitudinal MOKE measurement system. Fig. 2 summarizes the DW depinning field from pad and notch with transverse arm according to the angle of saturation field. It is clearly seen from open and closed circles as shown in Fig. 1. that injected DWs is pinned by external pinning force from a notch and the stray field generated from a diverging magnetostatic charge generated by a transverse arm. According to our results, the direction of magnetization of the nanobar affects the shape of the main potential experienced by the DW, whereas the pinning strength strongly depends on interaction with external pinning force of the notch.

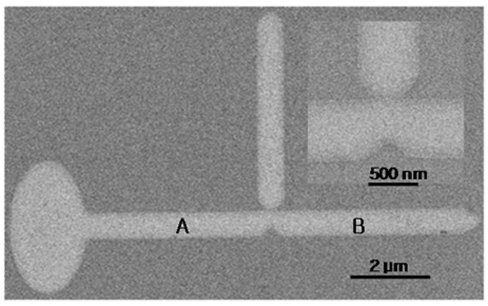

Fig. 1. SEM image of Ni81Fe19 nanowire with nanobar.

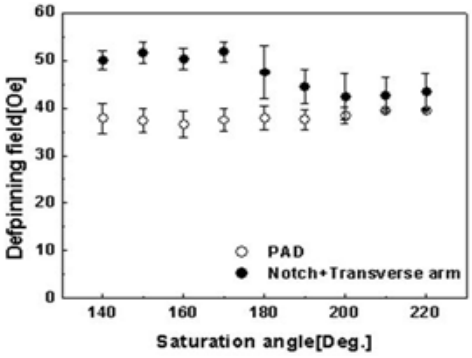

Fig. 2. Depinning field w.r.t. the angle of satuation field.

[1] D. Petit *et al., Phys. Rev. B*, **79**, 214405(2009).
[2] D. Atkinson, D. S. Eastwood, and L. K. Bogart, *Appl. Phys. Lett*. **92**, 022510(2008).