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Magnetic Domain Walls in the Edge of Patterned NiO/NiFe bilayers

Dept. of Computer and Electronic Phy., Sangji University
D. G. Hwang*, S. S. Lee
Dept. of Physcis, Dankook University
J. K. Kim
Dept. of Electrical and Computer Eng., Univ. of Maryland
R. D. Gomez

The magnetic domain walls at the edges of a large patterned and exchanged-biased NiO/NiFe(10nm) bilayers and their motions with applied field were investigated by magnetic force microscopy. The NiFe film was deposited over the NiO(10 ~ 60 nm) film by dc sputtering with the external magnetic field (H_d) of 300 Oe to get in-plane unidirectional anisotropy. Both NiO and NiFe film were patterned using the metal mask with 1 mm width, as shown in Figure 1. Three kinds of domain walls, namely, (A) ***head-to-head*** zig-zag and (B) ***tail-to-tail*** zig-zag Block walls and (C) straight Neel walls were found at specific edges of the unidirectional biased NiO(30 nm)/NiFe(10 nm) bilayer having the exchange biasing field (H_{ex}) of 21 Oe. The zig-zag walls appeared at the edges perpendicular to H_d. The *head-to-head* and the *tail-to-tail* walls appeared at the top and bottom edges respectively, as derived from the MFM contrast, and consistent with the direction of the exchange bias field. The Neel walls appeared at the edges parallel with H_d. The zig-zag walls are nearly a factor of three wider than the Neel wall. More importantly, no walls were observed for the strong exchange-biased bilayer (60 nm NiO , H_{ex} = 75 Oe), while the amplitude of the zig-zag domain increased with decreasing exchange biasing. Similarly, the coercivity of the zig-zag walls decreased with decreasing exchange bias, as evidenced by wall movement due to the MFM tip. This may be explained by mutual restraint between H_{ex} and the demagnetization field of edge (H_{De}): if H_{ex} is stronger than H_{De}, the magnetization of NiFe film will be saturated due to exchange biasing, and the walls at the edge will not be generated and vice verza. We similarly investigated the magnetization reversal process, the subsequent motion of the walls and identified the pinning and nucleation sites during reversal. These results and analysis will be presented in the paper.

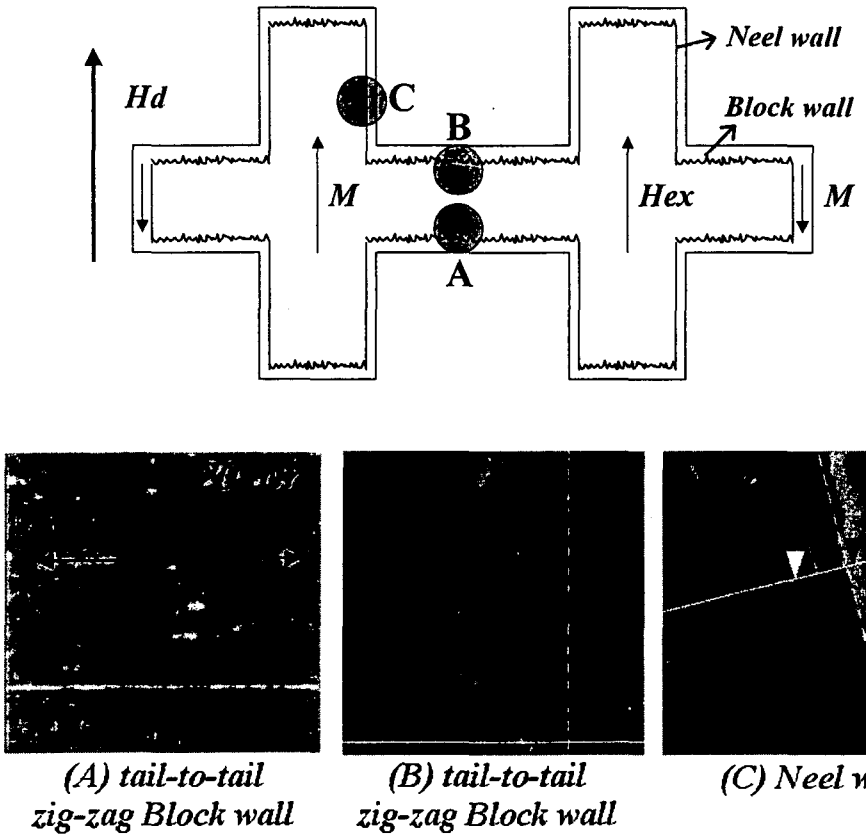

Figure 1. Three kinds of domain walls in the different edges of A, B, and C