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Incoherent Domain Configuration Along Wire Width in Permally Nanowires

Kyoung-Woong Moon[1], Jae-Chul Lee[1,2], Kyung-Ho Shin[2], and Sug-Bong Choe[1]*

[1]Department of Physics and Astronomy, Seoul National University, 599 Gwanak-ro, Gwanak-gu, Seoul, Korea
[2]Spintronics Research Center, Korea Inst. of Science & Technology, 5 Wolsong-gil, Seongbuk-gu, Seoul, Korea

*Corresponding author: Sug-Bong Choe, e-mail: sugbong@snu.ac.kr

Magnetization reversal processes in ferromagnetic nanowires are investigated with respect to the angle of sweeping magnetic field. Nanowires with 600 nm in width are formed on 20-nm-thick Permalloy film by means of electron beam lithography followed by ion milling. Due to the narrow width of the nanowires, the magnetization is expected to exhibit to rotate coherently [1]. Such a coherent rotation are observed in the HR measurement for the angle smaller than 74° as shown in Fig. 1(a)-(b). In this case, the whole magnetization turns to an angle balanced between the strengths of the external field and the internal anisotropy, followed by a sudden jump of the switching at a threshold field. However, on the other hand, it is interesting to see that above 74° the HR curve exhibits two distinct jumps as shown in Fig. 2(c)-(e). To clarify the origin of the two jumps, we carried out micromagnetic prediction by use of OOMMF [2]. A typical result for 80° is illustrated in Fig. 2. Based on the simulation results, it is revealed that at the first jumps the magnetization forms a curved domain configuration consisting of reversed magnetization at the central region as shown in Fig. 2(B-E). The second jump restores the quasi-coherent magnetization. Due to the formation of the curved domain configuration, the coherent model fails to preidict the switching field quantitatively. The discordance is experimentally confirmed to persist even in 130-nm nanowires.

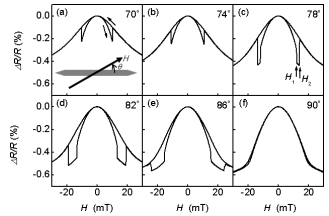

Fig. 1. HR curves with different angle of external field.

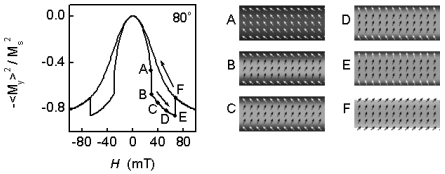

Fig. 2. Simulation results at 80 degree.

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