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Influence of Pinned Layer Coupling on Magnetization Switching of Magnetic Tunnel Junction

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It is normally recognized that stray field leads to some unexpected reversal behavior of patterned magnetic elements. The influence of stray field for different thickness of pinned layer was studied through analyzing the hysteresis loops measured by focused magneto-optical Kerr effect (Focused-MOKE) magnetometry. The structure of magnetic tunneling junction (MTJ) sheet films is SiO2/ CoFe (t)/ MgO (4)/ NiFe (30)/ Ta (6), units in nanometer. The CoFe thickness (t) was changed from 0 to 7 nm to investigate the thickness effect of CoFe layer on the NiFe layer. Here, the NiFe layer is adopted as free layer and the CoFe layer is as pinned layer. In particular, the focused-MOKE is utilized to directly observe the magnetizations switching of the NiFe layer and the decay signal from the CoFe layer. The MTJ sheet films were patterned into circular disk arrays with a diameter of 500 nm by combining electron beam lithography and inductively coupled plasma reactive ion etching. In the circular disk arrays, it is found that the free layer nucleates with a vortex earlier with the increasing of the thickness of CoFe, as shown in figure 1. While the thickness of the CoFe is thicker than 5nm, the NiFe layer presents a single domain mode switching due to the large stray field caused by the bottom CoFe layer. In figure 2, it is observed that a larger stray field due to the increase of CoFe layer thickness leads to the critical magnetic field of the magnetization of NiFe layer not aligning in saturation state to move toward higher magnetic field. The stray field formed by the different thicknesses of the pinned layer results in different magnetizations switching behaviors of the free layer.

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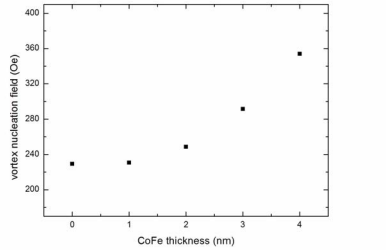

Fig. 1. Vortex nucleation field versus thickness of CoFe layer.

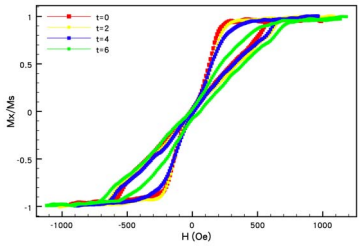

Fig. 2. Hysteresis loops of different CoFe thickness.

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