Magnetic Anisotropy in [Pt/Co_5Ni_5] multilayers structure

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Perpendicular magnetic anisotropy base magnetic tunnel junctions(p-MTJ) have attracted a lot of research interests. Because they have several advantages to realize high density magnetic random access memory(MRAM) over in-plane MTJ. Many perpendicular magnetic anisotropy(PMA) systems have researched, for examples, $[Co/Pt]_n$ multilayers, $[Co/Pd]_n$ multilayers, $L1_0$ compounds(CoPt, FePt). Particularly, [Co/NM]n multilayers structure is a promising candidate because of a controllable saturation magnetization(M_s) and a high anisotropy energy density. In order to make a commercial MRAM, however, a low switching current is needed for a low power consumption, in this reason, low M_s should be satisfied. In this respect, CoNi which has a low M_s is considered in this study.

The structure of Ta / Pt / Ru / $[Co_5Ni_5(t_{CoNi})/Pt(t_{Pt})]_6$ / Ru was fabricated on a Si/SiO_2 substrate using a DC magnetron sputtering system. The base pressure was 7×10^{-8} Torr while working pressure was fixed at 2×10^{-3} Torr. Post annealing was conducted in various temperature 300°C～500°C and magnetic properties were measured by a vibrating sample magnetometer.

It is well-known that PMA comes from the surface between top Co layer and bottom Pt layer, and recently many multilayers structures have a thinner Pt layer than a Co layer.[1] As shown in figure 1, however, only samples containing a thick Pt layer show PMA, though a thin Pt layer is favorable for a strong PMA. In figure 2, thick Pt and Co layer show PMA after annealing over 400°C, however PMA of [0.5 nm/ 0.5 nm]$_6$ structure disappeared after post annealing at 500°C In terms of M_s, post annealing at 500°C reduced the values of M_s especially for thin Co layer samples.

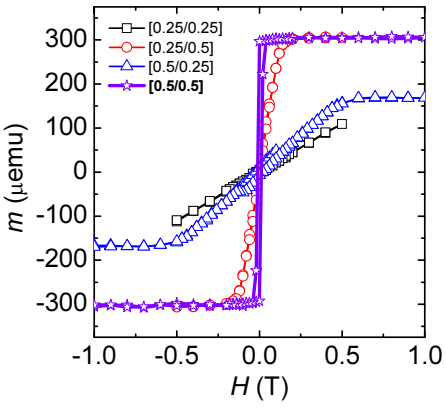

Figure 1. Hysteresis loop of out of plane for [Pt/CoNi]$_6$ structure before post annealing

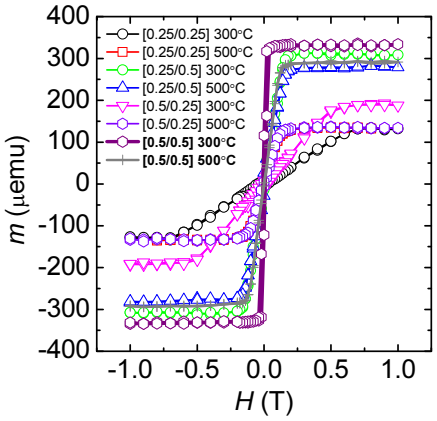

Figure 2. Hysteresis loop of out of plane for [Pt/CoNi]$_6$ structure after post annealing

References

[1] T. Y. Lee *et* al., J. Appl. Phys. **113**, 216102 (2013)