Effects of interface structure on induced perpendicular magnetic anisotropy in heavy metal/ferromagnetic layered structures

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Abstract

Perpendicular magnetic anisotropy (PMA) is known as key for the success of the modern high-density magnetic recording technologies. The PMA of ferromagnetic (FM) films is achieved by applying noble metal (such as Pt, Pd) films through enhanced spin-orbital coupling at the noble metal/FM interface. Currently, theorists have proposed that heavy metal (such as Pb, Bi) with much larger value of spin-orbital constant could be good candidates for generating higher strength of PMA [1]. In this work, we examine this potential through experimental aspects by investigating the Pb, Pd/Co/Ni systems. The results of magnetic-optical Kerr effects show that the PMA of Co/Ni films can be triggered when the coverage of the Pb (t_{Pb}) film is larger than 0.5 ML. The PMA of Pb/Co/Ni films reaches a maximum strength when t_{Pb} is close to 2 ML. Meanwhile, X-ray magnetic circular dichroism with sum-rule analysis shows a strongly enhanced orbital/spin moments ratio of the interfacial Co layer compared with the value in conventional Co thin film [2]; this indicates a strong spin-orbital coupling effects at the Pb/Co interface. However, the PMA of Pb/Co/Ni films is significantly reduced when t_{Pb} is larger than 2 ML. According to our magnetic properties and structure/growth analyses, an nonlinear evolution of PMA in the Pb/Co/Ni systems with a variation of t_{Pb} is found to be strongly correlated with an island growth (SK) mode of Pb grown on Co/Ni films, caused by large difference of surface free energy [3] and lattice mismatch.

Keywords: Heavy metal, Pb, perpendicular magnetic anisotropy

Reference:

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