Magnetic properties of ultrathin Co layers sandwiched between noble metals (Au, Pt, Ir)

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Ultrathin cobalt layers sandwiched between noble metals exhibit magnetic properties attractive for different applications. In particular in these systems relatively strong perpendicular magnetic anisotropy (PMA) can be obtained in Co thickness range of several monolayers. Moreover, for Pt/Co/Ir and Ir/Co/Pt systems strong Dzyaloshinskii-Moriya interaction (responsible for creation of skyrmions and domain walls with a given chirality) can be achieved [1]. Therefore, magnetic systems with structure X/Co/Y (X,Y = Au, Ir, Pt) are very important for applications in information technologies. We have investigated X/Co-wedge/Y (X, Y = Au, Ir, Pt) layered system deposited by magnetron sputtering on naturally oxidized Si substrate covered with Ti-4nm/Au-30nm buffer layer. The thickness of wedge shaped Co layer (tCo) was varied from 0 to 3.6 nm and the thickness of X and Y layers were 2 nm. The magnetic properties of nine systems (all combination of X/Co/Y) were characterized by measurements of magneto-optical hysteresis loops measured in polar configuration (P-MOKE) along the Co thickness gradient. On this basis we have defined tCo changes of: (i) coercive field HC(tCo); (ii) and squareness of the hysteresis loops (ratio of P-MOKE signal in remanence and saturation - ϕR/ϕS(tCo)); (iii) magnetic uniaxial anisotropy field. The Co thickness corresponding to spin reorientation transition, and volume as well as surface contributions to effective anisotropy constant were determined for each system. For selected systems the magnetic characterization was supplemented by determination of Dzyaloshinskii-Moriya interaction (using Brillouin light spectroscopy) and observation of magnetic domain structure evolution with magnetic field (using P-MOKE-microscopy).

References:

[1] A. Fert et al., Nature Materials 2 (2017), 17031.

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