Magnetic ordering in epitaxial ultrathin Co layers surrounded by Pt and W covers

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The magnetic properties of epitaxial layered structures $Pt(d_{Pt1})/W(d_{W1})/Co(d_{Co})/Pt(d_{Pt2})/W(d_{W2})$ substantially depend on the thicknesses of the component W bottom layer and Co magnetic film. Using the polar magnetooptical Kerr effect PMOKE based magnetometry and microscopy, magnetic force microscopy and Brillouin Light Scattering (BLS) spectrometry the following features have been investigated: (i) the magnetic anisotropy and magnitude of Dzyaloshinskii-Moriya interaction (DMI) and (ii) magnetic domain structure evolution driven by magnetic field. Conditions (arrangement and thickness of the component layers) for perpendicular magnetic anisotropy (PMA) occurrence were determined. Studies of the samples with different thicknesses d_{W1}, d_{Co} (and selected d_{Pt1}= 10 nm, d_{Pt2}= 3 nm, d_{W2}= 0 nm) revealed: (i) existence of large DMI characterized by effective coefficient D_{eff} as high as 1.5 mJ/m^2; (ii) possibility of creation the bubble/skyrmion lattices while approaching the transition region (driven by increasing d_{W1} or decreasing d_{Co}) from PMA to superparamagnetic state. Small domain creation was observed also while approaching spin reorientation transition driven by d_{Co} increase or d_{W1} decrease. The micromagnetic simulations (using experimentally determined magnetic anisotropy field and D_{eff} constant) reproduced the magnetic domain structures and magnetization processes observed experimentally.

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