Synthetic antiferromagnetic ordering induced by interlayer exchange coupling in ultrathin Co/(Re, Pt)/Co structures

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The creation of synthetic antiferromagnets with large Dzyaloshinskii–Moriya interaction (DMI) is important and demanding task. Our previous studies revealed large DMI in Re/Co/Pt trilayer [1]. In this work, the interlayer exchange coupling in epitaxial systems containing two Co layers separated by a single layer (Re or Pt) or double layers Re/Pt are presented. The orthogonal wedged samples were deposited by molecular beam epitaxy on $Al_2O_3(0001)$ substrate with 40 nm Pt buffer with a following scheme: Re buffer with thickness d_{ReB}, bottom Co wedge along y-axis; Re, Pt, or Pt/Re(d_{Re}=1nm) spacer wedge along x-axis; top Co wedge along y-axis; 4 nm of Pt as capping layer.

A polar magneto-optical Kerr effect (PMOKE) setup was used to record remanence maps, local magnetization loops and magnetic anisotropy measurements. The measured minor hysteresis loops were employed to determine the interlayer exchange coupling field H_{IEC} used to estimate the interlayer exchange coupling strength per unit area J.

The structures with a single Re wedge spacer exhibit an oscillatory character of the interlayer coupling and 3 antiferromagnetic (AF) remanence states were observed, depending on d_{ReB} thickness. The RKKY model well describes the observed coupling; in the case of d_{ReB}=0 the dependence $J(d_{Re})$ can be fitted RKKY model with maximal observable coupling strength of -1 mJ/m^2 and period 0.9 nm. In the structures with Pt spacer the remanence AF state was observed in $1.3 < d_{Pt} < 2.6$ nm region with double peak for d_{Pt}=1.5 and 1.8 nm. Previously AF state for Pt spacer was not reported. While introducing Pt/Re(1 nm) buffer, the d_{Pt} region for remanence AF coupling became slightly wider and smaller strength.

The results obtained in this studies can be used for design skyrmion-based nanostructures using synthetic AF with large DMI [2].

References:

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