Interlayer Dzyaloshinskii– Moriya interactions in epitaxial Co/Ir/Co/Pt multilayers

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The Dzyaloshinskii–Moriya interaction (DMI) is an antisymmetric exchange interaction that arises in systems lacking inversion symmetry. Initially demonstrated in ferromagnetic (FM) thin films, DMI describes the coupling between spins mediated by an adjacent paramagnetic heavy metal layer. As DMI favors a specific rotational sense of spin alignment within the FM layer, is inherently chiral in nature. More recently, theoretical predictions [1] and experimental studies [2] have confirmed the presence of a significant interlayer DMI between neighboring FM layers separated by a non-magnetic spacer. This type of interlayer DMI opens up new avenues for tailoring magnetic textures and improving the functional capabilities of magnetic multilayer structures.

In this study, we investigated the magnetic properties of epitaxial Co(3 nm)/Ir(d_{Ir})/Co(d_{Co})/Pt multilayers grown by molecular beam epitaxy on MgO(111). The top FM layer exhibited in-plane magnetization, while variation of the d_{Co} enabled control of perpendicular magnetic anisotropy in the bottom Co layer. For a specific range of Co layer thickness and Ir spacer thickness, where strong antiferromagnetic RKKY interaction is expected, we observed unique magnetic behavior of the bottom Co layer that is sensitive to the magnetic state of the top Co film. Polar magneto-optic Kerr effect (PMOKE) microscopy measurements, performed after demagnetizing the sample with an in-plane magnetic field to induce the formation of in-plane magnetic domains in the top Co layer, indicate that PMOKE hysteresis loops measured in regions corresponding to antiparallel in-plane domains are shifted in opposite directions, providing clear evidence of interlayer Dzyaloshinskii–Moriya interaction in the system. Moreover, both the magnitude and the sign of the exchange bias (EB) exhibit an oscillatory dependence on d_{Ir}. In my presentation, I will demonstrate how the magnetic properties of Co(3nm)/Ir(d_{Ir})/Co(d_{Co})/Pt multilayers evolve with changes in d_{Ir} and d_{Co}.

References:

[1] E. Y. Vedmedenko et al., Phys. Rev. Lett. 122, 257202 (2019)

[2] A. Fernández-Pacheco et al., Nature Mater. 18, 679–684 (2019)