Evidence for Perpendicular Interfacial Magnetization in Ta/Py Bilayers Induced by the Dzyaloshinskii-Moriya Interaction

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Ta/Py bilayers are typically considered purely in-plane magnetic anisotropy (IMA) systems. We show that this assumption breaks down at the *interface*: transport measurements reveal a small *perpendicular interfacial magnetization* at the Ta/Py boundary, electrically accessed via an *antisymmetric planar Hall effect* (APHE). Using reciprocity-based lead swapping, we separate the symmetric PHE from APHE and find that the APHE signal (i) is sinusoidal in the in-plane magnetization angle, (ii) is independent of current amplitude and polarity (excluding Joule-heating and spin–orbit-torque artifacts), and (iii) is insensitive to field magnitude once the film is magnetically saturated. The APHE amplitude and phase vary systematically with seed layer (SiO_2, MgO, Al_2O_3) and post-deposition annealing, implicating interfacial strain which is confirmed from grazing incident X-ray diffraction. Taken together, the results are consistent with a strain-modulated interfacial Dzyaloshinskii–Moriya interaction (DMI) that couples the bulk in-plane magnetization to a small perpendicular interfacial moment.
Because the signal is governed by interfacial physics, we expect this previously unrecognized magnetic degree of freedom to extend beyond Ta/Py to a broader class of heavy-metal/ferromagnet heterostructures. The ability to electrically probe and program an interfacial M_z in nominally IMA stacks opens a route to interface-engineered spintronic functionalities, including device concepts that exploit coexisting in-plane and out-of-plane components for multistate, higher-density memory.

References:

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