NCNR SEMINAR: APRIL 5, 2024. 10:45 AM (EST)

Low-Damping and Sizeable Spin-Orbit Torques in Vertically Graded Fe-Ni Alloys

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Energy-efficient spintronic devices require a large spin-orbit torque (SOT) and low damping to excite magnetic precession. In conventional devices based on heavy-metal/ferromagnet bilayers, reducing the ferromagnet thickness to ~1 nm enhances the SOT -- but at the detriment of high damping. Here, we investigate an alternative approach based on a 10-nm-thick single-layer ferromagnet to attain both low damping *and* a sizable SOT. Instead of relying on a single interface, we continuously break the bulk inversion symmetry with a vertical compositional gradient of two ferromagnetic elements: Fe with low intrinsic damping and Ni with sizable spin-orbit coupling. We find low effective damping parameters of $< 5\times10^{-3}$ in the FeNi alloy films, despite the steep compositional gradients. Moreover, we also reveal a sizable anti-damping SOT efficiency of up to ~0.1, even *without* an intentional compositional gradient. Through depth-resolved x-ray diffraction, we identify a lattice strain gradient as the key source of symmetry breaking, which can produce a greater SOT than compositional asymmetry. Our findings provide fresh insights into damping and SOTs in single-layer ferromagnets for power-efficient spintronic devices.

Friday, April 5, 2024
10:45 AM (UTC-05:00) Eastern Time (US & Canada) | Hybrid format
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