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[814] Spin-orbit torque induced domain switching in antiferromagnet/ferromagnet heterostructures

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Recently, current-induced spin-orbit torques (SOT) switching have been demonstrated in ferromagnet (FM) / antiferromagnet (AFM) multilayers with perpendicular anisotropy [1,2]. The use of an AFM results in multiple nonvolatile (memristive) states, akin to neural networks [3]. Past experiments suggest that the non-uniform exchange bias from the AFM causes separate switching of domains, leading to this behavior [4]. This description differs from conventional SOT switching in FM/nonmagnet (NM) cases [5]. A deeper understanding of the switching in FM/AFM structures is thus relevant for SOT research and for AFM applications in spintronic devices. Here we use x-ray photoemission electron microscopy to image the FM domains of [Co/Ni]₂/PtMn layers, at intermediate switching states with injected currents. We find that the Co/Ni domains are shaped irregularly and are of the order of 300 nm. Sequential current pulses gradually switch domains by nucleation & expansion, reproducibly; commensurate with electrical measurements. As a 1st visualization of field-free SOT switching, this opens new avenues to understand and optimize this behavior for FM/AFM spintronic devices.

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