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Driving a uniform magnetization to a metastable, mixed state by Spin Hall Effect Spin Torque DEBANJAN BHOWMIK, MARK NOWAKOWSKI, LONG YOU, Department of Electrical Engineering and Computer Sciences, University of California Berkeley, DAVID KEATING, MARK WONG, University of California Berkeley, JEFFREY BOKOR, SAYEEF SALAHUDDIN, Department of Electrical Engineering and Computer Sciences, University of California Berkeley — Spin Hall effect based magnetic switching and domain wall motion have recently attracted a lot of attention both from a fundamental and an application perspective [1,2,3]. In that context it is important to understand how spin Hall current acts on a uniform magnetization in the absence of external magnetic field. We observe that in Hall bars made from a thin film stack of Ta (10 nm)/CoFeB (1 nm)/MgO (1 nm)/Ta (10 nm) a current pulse of magnitude $5x10^6$ A/sq. cm. drives a uniformly polarized magnet to a metastable mixed state of up and down polarized domains. We have experimentally confirmed the mixed state through anomalous Hall effect measurement and magneto-optic Kerr effect imaging. The magnet breaks into domains due to nucleation of domain walls followed by free domain wall motion as a result of depinning of the domain walls from defects by the spin Hall torque.

[1] Liu, L. *et al. Science* **336,** 555-558 (2012).
[2] Bhowmik, D. *et al.* Nature Nanotechnology (2013), DOI:10.1038/nnano.2013.241.
[3] Emori, S. *et al.* Nature Materials **12**, 611-616 (2013).

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