Manipulation of Multi-State Magnetic Structures with Current-Induced Torques

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Spintronics devices often require the need to locally manipulate the magnetic configuration of ferromagnetic structures on sub-micron scale. In particular, when memory devices are concerned the need is for an efficient and scalable method for magnetic switching. A promising route for achieving this goal is the use of heavy metal/ferromagnetic heterostructure where current flowing through the heavy metal layer induces an interface Rashba effect and a bulk spin Hall effect which generate a field-like torque and an anti-damping like torque on the magnetic layer. In most studied cases, these current induced torques where used to switch uniform magnetic structures with perpendicular anisotropy.

Here, we study the effect of such torques on Ta/Ni00.8Fe0.2 structures with uniaxial or bi-axial anisotropy, while monitoring the magnetic state using the planar Hall effect. We note, that the magnetization in these structures is in plane and when there is more than a single easy axes the magnetization of the structure is also non-uniform. As structures with several easy axes induced by shape can be part of a magnetic memory element, the results also open the way for multi-level magnetic memory with spin-orbit torque switching.