Efficient control of perpendicular magnetization through spin-orbit torques in antiferromagnet/ferromagnet/oxide structures

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Perpendicular magnetization in heavy metal (HM)/ferromagnet (FM)/oxide structures can be efficiently manipulated by in-plane current via spin–orbit torques (SOT). However, in order to achieve SOT-induced deterministic switching, an in-plane magnetic field is required, which is one of the major obstacles for device applications. To tackle such challenge, we introduce antiferromagnets (AFM) instead of HM as the source of both SOT and external magnetic field as AFM can create an effective field through exchange bias [1].

In this work, we report sizable SOT as well as in-plane exchange bias field in IrMn/CoFeB/MgO structures, which allows for purely electrical deterministic switching of perpendicular magnetization. We could further improve the switching performance by integration of an additional in-plane FM layer below the IrMn layer creating a stronger exchange bias. These results suggest that AFM is a promising material candidate in SOT-based devices because of its sizable SOT and exchange bias.

Reference

[1] Y.-W. Oh *et al.*, Nature Nanotech. (DOI: 10.1038/NNANO.2016.109)