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Low switching current in tungsten-based magnetic tunnel junctions with an ultrathin Hf insertion layer SHENGJIE SHI, YONGXI OU, DANIEL RALPH, ROBERT BUHRMAN, Cornell University — The discovery of a strong spin Hall effect (SHE) in certain heavy metals (HM) provides an efficient way to manipulate magnetization at the nanoscale with an in-plane electric current. Beta phase tungsten is reported to have a very large spin Hall angle (˜0.3) compared to the HMs (Pt or Ta) that have been more widely used in three terminal magnetic tunnel junctions (MTJ). However, due to difficulty in material stack development and device fabrication procedure, limited work has been done with tungsten-based MTJ systems. Here we report on our development of a reliable procedure for making tungsten-based MTJs and on the notable critical current reduction achieved by the insertion of an ultrathin Hf dusting layer between the FeCoB free layer and MgO tunnel barrier that can effectively reduce the demagnetization field by enhancing interfacial perpendicular anisotropy at the FeCoB/MgO interface. With material stack optimization we have to date obtained a critical switching current density of 6.5x10ˆ10A/mˆ2. We also report fast, ns timescale, and reliable pulse switching results of tungsten-based MTJs, which confirms low switching current and demonstrates the potential for application in energy efficient memory cells.

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