Room temperature perpendicular magnetization switching through giant spin-orbit torque from sputtered $Bi_xSe_{(1-x)}$ film

M. DC[1], R. Grassi[2], JY Chen[2], M. Jamali[2], D. Hickey[3], D. Zhang[2], Z. Zhao[2], H. Li[3], P. Quarterman[2], Y. Lv[2], M. Li[2], K. Mkhoyan[3], T. Low[2], and JP Wang[2,1,3,*]

[1]*School of Physics and Astronomy, University of Minnesota, MN 55455*
[2]*Department of Electrical and Computer Engineering, University of Minnesota, MN 55455*
[3]*Department of Chemical Engineering and Material Science, University of Minnesota, MN 55455*

The spin-orbit torque (SOT) arising from materials with large spin-orbit coupling promises a path for ultra-low power and fast magnetic-based storage and computational devices. We investigated the SOT from magnetron-sputtered $Bi_xSe_{(1-x)}$ thin films in $Bi_xSe_{(1-x)}$/CoFeB heterostructures by using dc planar Hall and spin-torque ferromagnetic resonance (ST-FMR) methods. Remarkably, the spin Hall angle (SHA) was determined to be as large as 18.62 ± 0.13 and 8.67 ± 1.08 using dc planar Hall and ST-FMR methods, respectively. Moreover, switching of perpendicular CoFeB multilayer using SOT from the $Bi_xSe_{(1-x)}$ has been observed at room temperature (RT) with the lowest-ever switching current density reported in a bilayer system 4.3×10^5 A/cm^2. The demonstrated giant SHA, ease of growth of the films on silicon substrate, successful growth and switching of a perpendicular CoFeB multilayer on $Bi_xSe_{(1-x)}$ film opens a path for use of $Bi_xSe_{(1-x)}$ topological insulator (TI) as a spin-current generator in SOT-based memory and logic devices.

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