Spin-orbit torque in sputtered $Bi_{1-x}Te_x$/CoFeB bilayers

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Electrical control of magnetization of ferromagnet is the core in spintronics application for realizing low-energy-consumption magnetic memory devices. Spin-orbit torques (SOT) in normal metals/ferromagnet heterostructures has attracted particular attention for its high potential in manipulating the magnetization of a ferromagnet at nano-scale. Though large SOT has been observed in different materials, the effective method of tuning the strength of SOT is still absent. Bismuth has been predicted to be a good spin current source due to the strong spin-orbit coupling. The carrier concentration of bismuth can be controlled because of the semimetallic property. Therefore, bismuth has also been proposed as a possible playground with tunable spin Hall conductance by carrier doping in theory [1]. Recently, giant room temperature SOT has been confirmed in $Bi_{1-x}Sb_x$ alloy [2,3]. Thus, investigation of tunable SOT in bismuth with carrier doping may be realizable and important for practical application.

In this work, we systematically studied the SOT of sputtered $Bi_{1-x}Te_x$/CoFeB bilayers with different Te concentration x under different temperature by using the second harmonic Hall resistance technique. Bi phase dominates in light Te-doped sample according to x-ray diffraction spectra results and Te works for electron doping. The spin Hall efficiency of a $Bi_{0.89}Te_{0.11}$ sample increases by a factor of two from 10 K to 300 K. The strength of spin Hall conductance in $Bi_{1-x}Te_x$ decreases rapidly and monotonically by increasing the Te concentration x. The details of the results will be discussed in the presentation.

Reference

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