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Surface state driven spin-torque in topological-insulator / ferromagnetic-metal bilayers MARK H. FISCHER, ABOLHASSAN VAEZI, Cornell University, AURELIEN MANCHON, King Abdullah University of Science and Technology (KAUST), EUN-AH KIM, Cornell University — A hallmark of surface states in strong 3D topological insulators (TI) is the helical spin texture. While there have been proposals on exploiting this spin texture for spintronics applications, they focused on TI/ferromagnetic-insulator (FI) structures predicting field-like torque due to spin accumulation. Motivated by recent spin-torque experiments on Pt/ferromagnetic-metal(FM) structures, we consider a TI/FM bilayer, where the magnetic moment as well as the current driven through the system are in plane. While existing TIs have a conducting bulk, recent transport experiments showed that the main contribution to the current in Bi_2Se_3 thin films comes from two distinct surface states: the topological Dirac surface state and an additional 2D electron gas with Rashba spin-orbit coupling. We thus consider spin torque in the TI/FM structure due to these two surface states. We find that each surface state leads to out-of-plane (field-like) torque due to current driven spin accumulation. Moreover, we find an in-plane torque due to spin diffusion into the FM, an effect absent in TI/FI structures. Interestingly, the two surface states contribute with opposite sign to the spin density. This allows for the experimental identification of the dominant state based on its sign.

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