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Interplay between Spin-Orbit Torque and Unidirectional Magnetoresistance in Modulation-Doped Topological Insulators[1] YABIN FAN, QIMING SHAO, LEI PAN, XIAOYU CHE, QINGLIN HE, GEN YIN, KANG L. WANG, Electrical Engineering Department, University of California, Los Angeles, DEVICE RESEARCH LABORATORY TEAM — We study the current-induced spin-orbit torque (SOT) and unidirectional magnetoresistance (UMR) in modulation-doped topological insulators (TIs). In the bilayer structures composed of TI and Cr-doped TI (Cr-TI, for short), both the SOT and UMR are very large with the values orders of magnitudes greater than those reported in traditional materials, such as the heavy metal-based magnetic structures or the doped diluted magnetic semiconductors. Furthermore, both the SOT and UMR are consistent with the current-induced spin polarization on the TI surface arising from the spin-momentum locking feature of the topological surface states. On the other hand, in the TI/Cr-TI/TI trilayer structures where the Cr-TI layer is in the middle, both the SOT and UMR values become significantly smaller. Through modulation doping and structure engineering, we reveal that the giant SOT and UMR in TI/Cr-TI bilayers originate in the topological spin-momentum locked Dirac Fermions on the TI surface, and they exhibit a strong correlation to each other.

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Yabin Fan
Electrical Engineering Department, University of California, Los Angeles

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