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Optimizing proximity induced anomalous Hall effect in $(Bi_xSb_{1-x})_2Te_3$/YIG heterostructures ZILONG JIANG, CHI TANG, JING SHI, UC Riverside, CUIZU CHANG, PENG WEI, JAGADEESH S. MOODERA, MIT — The spontaneously broken time reversal symmetry leads to an energy gap in the Dirac spectrum of the surface states of a topological insulator (TI) which gives rise to the quantized anomalous Hall effect (QAHE). QAHE has been observed in TI doped with Cr. Here we explore an alternative route by coupling the surface states of TI with yttrium iron garnet (YIG) ferrimagnetic insulator (FI). Just as in Cr-doped TI, a major challenge is to reduce the bulk conduction which overwhelms the surface state contribution. We have successfully grown 5 quintuple layer thick ternary TI $(Bi_xSb_{1-x})_2Te_3$ on atomically flat YIG films, in which the Fermi level of TI can be controlled by the Bi:Sb ratio. We have observed the anomalous Hall effect (AHE) in TI/YIG heterostructure over a wide range of carrier density and in both electron and hole types induced by varying the Bi:Sb ratio from 0:1 to 1:0. Both R_{xx} and R_{AH} undergo systematic and dramatic changes as the Bi:Sb ratio is varied. The maximum R_{AH} occurs near the p-n cross-over region at Bi:Sb ratio ˜0.2:0.8, which is nearly two orders of magnitude greater than the minimum value at Bi:Sb ratio ˜1:0. As the Bi:Sb ratio is varied, we find that R_{AH} scales quadratically with R_{xx}, indicating the scattering rate independent AHE. The electric field effect study further demonstrates the existence of robust AHE while the Fermi level of TI is tuned. This research was supported by UC Lab fees program and a DOE/BES award at UCR, and by NSF/DMR at MIT.

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