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Electrical Probing of Inherent Spin Polarization in a Topological Insulator with Electrical Gating[1] JOON SUE LEE, ANTHONY RICHARDELLA, NITIN SAMARTH, Pennsylvania State Univ — The hallmark of a time-reversal symmetry protected three-dimensional topological insulator is the helically spin-textured surface state. Although electrical detection of spin polarization in topological insulators has been demonstrated very recently, there have not been any electrical measurements to demonstrate the entire mapping of the spin polarization throughout the surface state. We report the electrical probing of the spin-polarized surface state using a magnetic tunnel junction as a spin detector while the chemical potential of a topological insulator $(Bi,Sb)_2Te_3$ is tuned by back gating. Hysteretic spin signals were observed as the magnetization of the detector ferromagnet (permalloy) switches with in-plane magnetic field. Changing the direction of bias current through the topological insulator channel flips the direction of the spin polarization, resulting in the reverse of sign of the detected spin signals. We demonstrate the control of the Fermi energy, which has importance not only in further understanding of the spin-momentum locking in the surface state but also in possible electrical tuning of the spin polarization for potential spin-based devices.

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