Proximity-Induced Ferromagnetism on a Topological Insulator Surface: Bi2Se3/EuS Heterostructures

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Topological insulators (TIs) are unique materials with novel quantum properties that arise from the existence of completely gapless surface states containing linear Dirac electronic dispersion. These states exhibit spin-momentum locking that is robust against non-magnetic disorder and structural lattice impurities (even in the presence of a strong external magnetic field) due to strong bulk spin-orbit interaction and time reversal symmetry. Short-range exchange interactions between TI surface states and ferromagnetic insulators create a gap in the energy band structure that is useful in a variety of fundamental physical studies (such as exotic quasiparticle behavior). The goal of this project is to determine the nature of n-type and p-type TIs after creating a TI/ferromagnetic insulator bilayer, specifically by observing heterojunctions between Bi2Se3 and EuS. Voltage gating was used to vary the density of states (DOS) within the bilayer, tuning the Fermi level across the surface Dirac point. Our results include structural analysis and unique non-ohmic transport data that suggest an induced ferromagnetic phase within the TI films, making the Bi2Se3/EuS heterostructure an ideal candidate for future research.