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**Surface-to-surface scattering in three-dimensional (3D) topological insulator (TI) thin films** GEN YIN, DARSHANA WICKRAMARATNE, ROGER LAKE, Department of Electrical Engineering, University of California, Riverside — When the thickness of a 3D TI material is reduced below approximately 6nm, hybridization of the opposite surfaces states can result in inter-surface tunneling. Due to the rotational symmetry of the thin film, the k-s locking relation on opposite surfaces also has opposite chirality. Thus, in this inter-surface scattering mechanism, back-scattering is allowed without the flip of the spin. This effect breaks the protection of TI surface states against back-scattering. To investigate the influence of the inter-surface scattering mechanism, we study different near-elastic scattering mechanisms in the surface state transport using Boltzmann transport equations within the relaxation time approximation. The effect of screened Coulomb impurities, low-energy acoustic phonons and surface magnetic impurities on the TI surface states will be discussed. The response of the inter-surface scattering of TI states to various external stimuli such as a Rashba-like splitting and the orientation of the impurity magnetic moments will also be presented. Using our simulation results, we propose possible experimental methods to modulate the back-scatter protection of TI surface states in thin film TI materials.

Gen Yin
Department of Electrical Engineering, University of California, Riverside

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