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Inter-band Tunneling between Doped Topological Insulator Surface States GEN YIN, DARSHANA WICKRAMARATNE, ROGER LAKE, University of California Riverside — Thin films of 3D topological insulators (TIs) have been experimentally synthesized recently. Impurity doping of the TI surface has been reported to modify the position of the Fermi level and generate Rashba-like splitting of the surface band structure. Our research uses a Non-Equilibrium Green's Function (NEGF) method to simulate inter-surface transport properties for TI thin films. A tight-binding model is established by discretizing a 4 x 4 k.p Hamiltonian for 3D TIs. Because of confinement, thin TI slabs of several nanometers allows inter-surface tunneling at quantum number matching states. The tunneling intensity can be tuned by surface Coulomb impurity doping or applying an external bias. Unlike regular topologically trivial surface states, inter-band tunneling between TI surfaces presents a conduction minimum when the dispersions of the two surfaces align perfectly over each other. The suppression of transport originates from the momentum coupling with time reversal symmetry, leading to significant non-linear I-V properties for the P-N tunneling at forward bias. This leads to a NDR current minimum when an external bias completely compensates the built-in potential. The study on inter-surface tunneling in TI thin films benefits the understanding of the transport behavior of TI surface states, which calls for further experimental investigations in the future.

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