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Scanning Tunneling Spectroscopy Investigations of Surface States in Three Dimensional Topological Insulators and Topological Crystalline Insulators

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Three dimensional topological insulators (TIs) are a new class of material possessing topologically protected spin-polarized Dirac fermions on their surface. This new material has gathered much attention because of its great potential for realizing novel phenomena that are important for both fundamentals and applications. 3D topological insulators have been extensively probed by surface sensitive tools such as ARPES and spectroscopic imaging scanning tunneling microscopy (STM). In this talk, we will especially focus on STM measurements of $Pb_{1-x}Sn_xSe$. This material belongs to a recently discovered new category of topological insulators called topological crystalline insulators (TCIs). In TCIs, topology and crystal symmetry intertwine to create surface states with a unique set of characteristics different from conventional 3D TIs. We have discovered broken mirror symmetry driven states that coexist with massless Dirac electrons in different regions of momentum space. Our findings experimentally demonstrate the unique tunability of surface Dirac electrons which is promising for the future realization of novel electronic states within TCIs.

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