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Generating Dirac mass by local symmetry breaking in SnTe topological crystalline insulator

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Topological phases of matter are exciting field of research and may be a key to future electronic devices. In a topological insulator, metallic electronic surface states are protected by time reversal symmetry. Topological crystalline insulators (TCIs) are a new class of topological materials, at which electronic surface states are topologically protected along certain crystallographic directions by crystal symmetry. Breaking global crystal symmetry causes the surface states to become gapped and non-metallic. But what happens when crystal symmetry is broken locally?

Tin telluride (SnTe) shows a gapless surface states (Dirac fermions) for (001) and (111) surfaces and is understood to be a TCI. Our density functional calculations provide a detailed picture of how local symmetry breaking on SnTe (001) surfaces greatly suppresses topological surface states. We expect that in such regions, locally massive Dirac fermions are created. STM measurements on SnTe show that defects in the form of dislocations, vacancies, step edges and pits do exist. By combining theory and experiment, we explain that it is possible to host both massive and massless Dirac Fermions on a single surface.