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Topological Crystalline Insulators[1]

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Topological crystalline insulators (TCI) are new phases of matter in which nontrivial band topology and crystal symmetry unite to protect metallic states on the boundary. Remarkably, TCIs have been predicted and observed in the conveniently simple rocksalt SnTe class of IV-VI semiconductors. Despite the simple crystal structure, the interplay between topology and crystal symmetry in these materials have led to a rich variety of new phenomena, including the coexistence of massless and massive Dirac fermions arising from ferroelectric distortion and strain-induced flat band superconductivity. These new physical mechanisms are not only of intrinsic interest but may also find application in new transistor devices. After discussing the topological nature and potential uses of IV-VI family TCIs, I will present recent predictions of TCIs in several anti-perovskite materials. The origin of TCI in this new class of materials is strikingly different and involves the band inversion of two J = 3/2 quartets of Dirac fermions, which together form a "Dirac octet." As interactions play a significant role in many anti-perovskites, this prediction serves as first step toward realizing TCIs in strongly correlated systems.

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