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Strain engineering of topological phase transition in elemental gray tin: Dirac semimetal phase in the missing half of strain spectrum[1]
HUAQING HUANG, FENG LIU, Univ of Utah — Gray tin was previously found to be a strong topological insulator under compressive uniaxial strain. Here, based on effective $k.p$ analysis and first-principles calculations, we discover that gray tin becomes a Dirac semimetal in the other missing half of strain spectrum, under tensile uniaxial strain. In this newly found Dirac semimetal state, two Dirac points which are tunable by tensile [001] strains, lie in the k_z axis and Fermi arcs appear in the (100) surface. A large negative magnetoresistance is anticipated in this half of strain spectrum, which shows as a strong signature of the chiral anomaly effect. Comparing to other Dirac semimetal materials, the proposed Dirac semimetal state in the nontoxic elemental gray tin can be more easily manipulated and accurately controlled. We envision that gray tin provides a perfect platform for strain engineering of topological phase transitions by sweeping through the strain spectrum from positive to negative and vice versa.

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