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Elemental topological Dirac semimetal: α-Sn on InSb(111) CAIZHI XU, PENG CHEN, XIAO-XIONG WANG, MAN-HONG WONG, JOSEPH HLEVYACK, TAI-CHANG CHIANG, Department of Physics, University of Illinois at Urbana-Champaign, YANG-HAO CHAN, MEI-YIN CHOU, Institute of Atomic and Molecular Sciences, Academia Sinica, YIGE CHEN, HAE-YOUNG KEE, Department of Physics, University of Toronto, HYEJIN RYU, NOBUMICHI TAMURA, ZAHID HUSSAIN, SUNG-KWAN MO, Advanced Light Source, Lawrence Berkeley National Laboratory, CATHERINE DEJOIE, Structure of Materials Group, ESRF-The European Synchrotron — Three-dimensional (3D) topological Dirac semimetals (TDSs) feature 3D Dirac fermions associated with bulk states and nontrivial surface states near the Fermi level. With their unique electronic structure, 3D TDSs show a number of exotic electronic properties and provide a versatile platform for realizing other novel electronic phases and exploring topological phase transitions. While previously discovered 3D TDSs have complicated chemical structures, here we report the first realization of such phase in an elemental form, α-Sn films epitaxially-grown on InSb(111). Using angle-resolved photoemission spectroscopy (ARPES), we have observed 3D Dirac cones in this system. As the film thickness is reduced the character of the Dirac cone changes from 3D to 2D. The epitaxial strain in our α-Sn films is key to the formation of the observed TDS phase as shown by first-principles calculations. Our results suggest ample opportunities for engineering the electronic and topological properties of thin films through thickness and strain control.

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