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Ambipolar quantum transport in Cd_3As_2 field effect transistors

SHINICHI NISHIHAYA, MASAKI UCHIDA, YUSUKE NAKAZAWA, University of Tokyo, MARKUS KRIENER, RIKEN Center for emergent Matter Science (CEMS), YUSUKE KOZUKA, University of Tokyo, YASUJIRO TAGUCHI, RIKEN Center for emergent Matter Science (CEMS), MASHASHI KAWASAKI, University of Tokyo, RIKEN Center for emergent Matter Science (CEMS) — Cd_3As_2 with ultra-high electron mobility, has recently been discovered to be a Dirac semimetal with a pair of doubly degenerate Weyl points, which can lead to emergent transport phenomena such as chiral anomaly. Experimental materialization of the Dirac semimetal has triggered intensive research on unveiling the new topological state. In many cases, however, defect-induced high carrier density of Cd_3As_2 makes Fermi energy far above Weyl points, hindering such attempts. Here we report systematic control of carrier density of Cd_3As_2 in a thin film form. Electric field effect with use of $SrTiO_3$ substrate as back-gating dielectric as well as chemical doping effect of Zn are employed to achieve carrier type inversion from n-type to p-type with Fermi energy crossing the charge neutral Weyl points. Quantum transport properties are examined with changing the Fermi energy position and band inversion energy for systematic understanding of the electronic structures.

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