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Resonant tunneling via Dirac electron states in a topological-insulator / semiconductor junction RYUTARO YOSHIMI, University of Tokyo, ATSUSHI TSUKAZAKI, Tohoku University, KO KIKUTAKE, JOSEPH CHECKELSKY, University of Tokyo, KEI TAKAHASHI, MASASHI KAWASAKI, YOSHINORI TOKURA, RIKEN CEMS — A defining characteristic of the topological classification of solids is the existence of gapless modes at the interface of materials with unequal topological invariants. In the context of the Z_2 topological invariant, this has been verified by the spectroscopic observation of spin-polarized Dirac electron states at the interface of three-dimensional topological insulators (3D TIs) and the vacuum. By performing tunneling spectroscopy in heterojunction devices based on the TI $(Bi_{1-x}Sb_x)_2Te_3$ and band insulator InP, we report the observation of such states at the interface between a 3D TI and a topologically trivial solid. In an applied magnetic field, the tunneling conductance through these heterojunctions resonates due to the formation of Landau levels at the interface; the observed energy and angular dependence indicates these carriers are two-dimensional surface electrons obeying a Dirac-like energy dispersion. Furthermore, the composition x dependence of the deduced Fermi velocity and Dirac point energy agree with previous photoemission observations for the surface states of $(Bi_{1-x}Sb_x)_2Te_3$ with a vacuum interface. This study gives strong evidence for the existence of interface topological states in solid heterojunction, which will provide new functional devices based on TI.

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