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Robust topological interface states in a lateral magnetic-topological heterostructure

Introducing uniform magnetic order in two-dimensional topological insulators (2D TIs) by constructing heterostructures of TI and magnet is a promising way to realize the high-temperature Quantum Anomalous Hall effect. However, the topological properties of 2D materials are susceptible to several factors that make them difficult to maintain, and whether topological interface states (TISs) can exist at magnetic-topological heterostructure interfaces is largely unknown. Here, we experimentally show that TISs in a lateral heterostructure of CrTe2/Bi(110) are robust against disorder, defects, high magnetic fields (time-reversal symmetry-breaking perturbations), and elevated temperature (77 K). The lateral heterostructure is realized by lateral epitaxial growth of bilayer (BL) Bi to monolayer CrTe2 grown on graphite. Scanning Tunneling Microscopy and non-contact Atomic Force Microscopy demonstrate a black phosphorus-like structure with low atomic buckling (less than 0.1 Å) of the BL Bi(110), indicating the presence of its topological properties. Scanning tunneling spectroscopy and energy-dependent dI/dV mapping further confirm the existence of topologically induced one-dimensional in-gap states localized at the interface. These results demonstrate the robustness of TISs in lateral magnetic-topological heterostructures, which is competitive with those in vertically stacked magnetic-topological heterostructures, and provides a promising route for constructing planar high-density non-dissipative devices using TISs.

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