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Multifunctional electronic structure in a topological insulator class SUYANG XU, ZAHID HASAN, Princeton University — The discovery of topological properties in three dimensional bulk solids have opened up many new research avenues in condensed matter physics. Only a very few compounds have been identified to be topological insulators to this date. However, none of them is proven to be suitable for the majority of experimental configurations including giant magnetoelectric and anomalous optical rotation, unusual exciton condensation, or the neutral half-fermions and interface superconductivity. In fact the realization of even any one of these proposals requires a number of multiply-connected topological compounds with modulated surface band dispersions and naturally tuned in-gap Fermi level, as well as spin variations in the presence of long life-time of the surface states. Here, using conventional and spin-sensitive probes, we report the discovery of several classes of positive band-gap high figure of merit topological insulators with critically important functional properties such as high degree of bulk resistivity and insulation, electronic structure with both in-gap Dirac point and Fermi level crossing, long surface state life-times, as well as chirality inversion through the Dirac node. The unprecedented combinations of electronic, spin, life-time and resistive bulk transport featured by the topological insulators uncovered here not only provide a new platform for research on topological quantum phenomena but also pave the way for functional devices.

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