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The diverse properties of two-dimensional topological semimetal WTe_2[1]

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Semimetals have recently received renewed attention as hosts of topological band structure features such as Dirac and Weyl points. Many have van der Waals layered structures and can readily be exfoliated. In the case of WTe_2 we have found a surprising range of phenomena in monolayer and few-layer samples. The edges of a monolayer conduct electricity in a manner consistent with the existence of protected helical boundary modes on a 2D topological insulator, while the internal conductivity ranges between insulating, metallic and superconducting behavior as a function of temperature and gate voltage. Signs of a Fermi surface persist down to the level of a bilayer. Finally, two- or three-layer WTe_2 is spontaneously polarized in the stacking direction and can switched by an external electric field, that is, it is ferrolectric. We speculate that electron-hole correlations connect all these phenomena.

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