TOKUMOTO LAB.

Physical properties of layered materials

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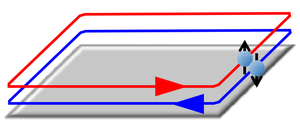
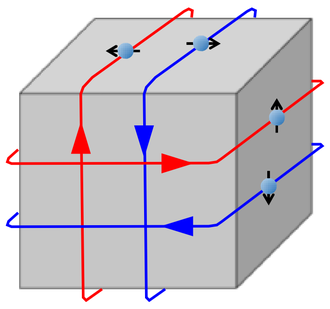
◆Topological insulator

Topological insulators are quantum materials that have a bulk band gap as an ordinary insulator but have protected metallic conducting states on their edge/surface. Topological insulators were first predicted in 2005, and have been experimentally verified in 2007.



2D topological insulator



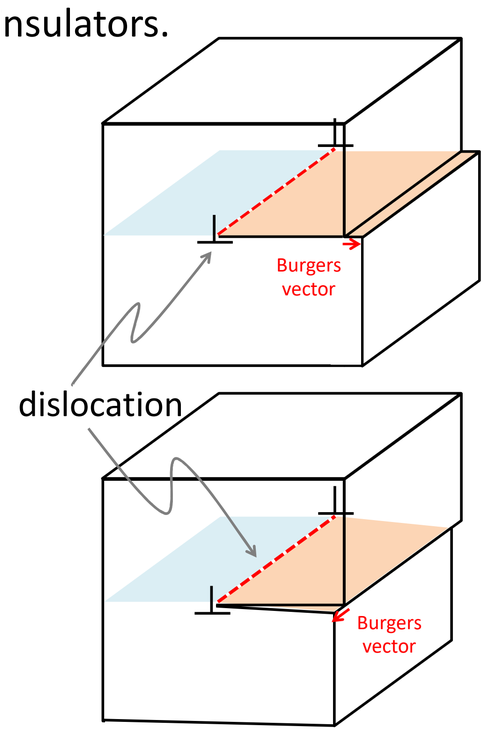
3D topological insulator

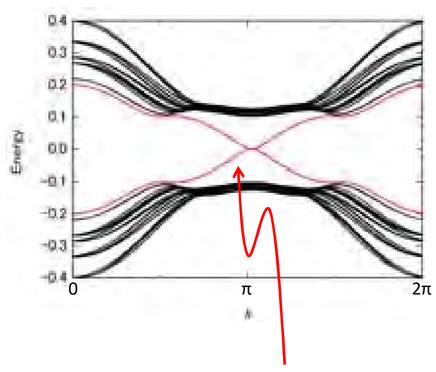
Metallic edge/surface states

- helically spin-polarized
- massless Dirac fermions
- robust against nonmagnetic disorder

◆Dislocations in topological insulators

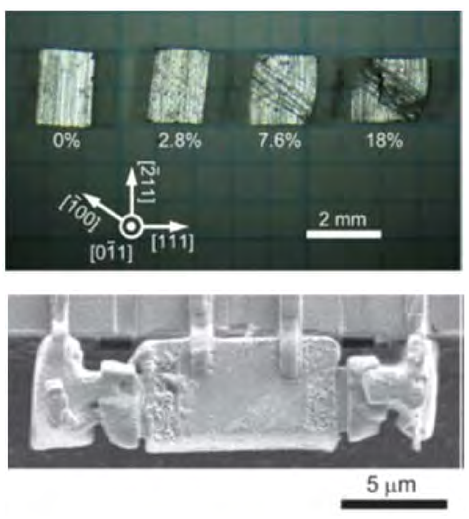
In 2009, it has been theoretically predicted that the metallic states also occur along dislocations in 3D topological insulators.

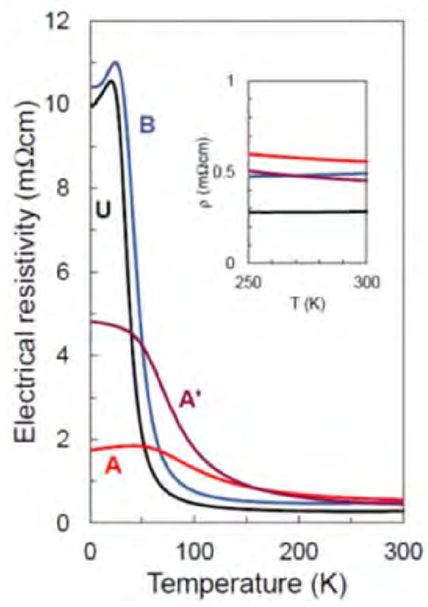




Metallic states localized along dislocations in topological insulators

Experimental verification of dislocation conduction in Bi-Sb topological insulator



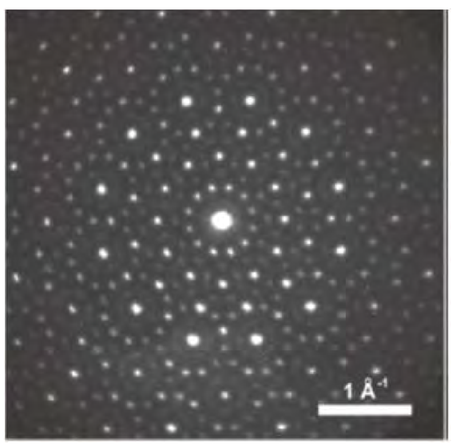


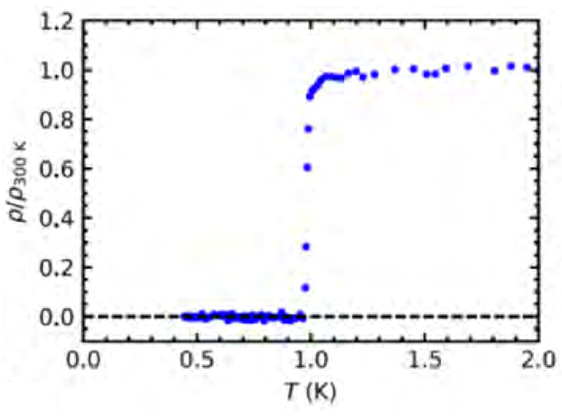
H. Hamasaki *et al.*, *J. Phys. Soc. Jpn.*, **89** (2020) 023703.

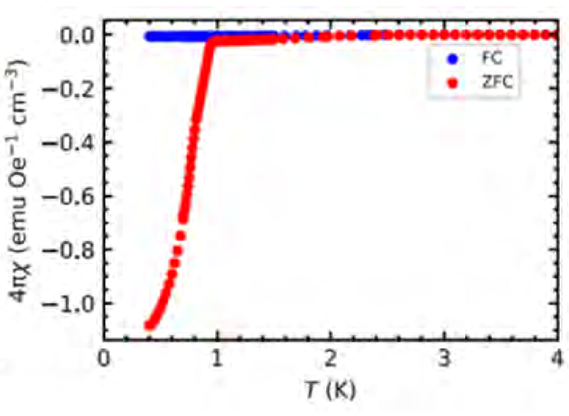
◆Van der Waals layered quasicrystal

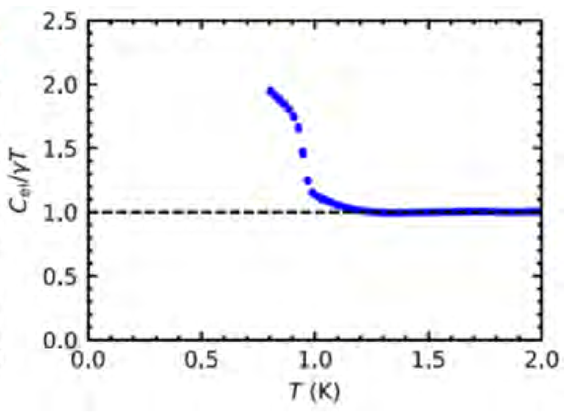
Van der Waals layered materials are drawing significant attention owing to their unique physical properties that reflect the two-dimensional nature of their structures.

we discovered superconductivity in a van der Waals layered quasicrystal of $Ta_{1.6}Te$. This discovery can promote new research on assessing the physical properties of novel van der Waals layered quasicrystals as well as two-dimensional quasicrystals. Moreover, it paves the way toward new frontiers of superconductivity in thermodynamically stable quasicrystals.









Y. Tokumoto *et al.*, *Nat. Commun.*, **15** (2024) 1529.