Exploring the Zoo of Layered Quantum Materials

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Abstract

There has been a recent rush of predictions of a variety of astonishing phenomena and functionalities that can be discovered in layered quantum materials, from topological superconductivity or disipationless conductivity at the boundaries of 2D topological insulators, to emergent particles with fractional charge and statistics or exotic collective behaviours that arise from strong interactions.
A suitable combination of experimental techniques: STM/STS, Helium Atom Scattering and spin-resolved ARPES will be used to characterize the properties of both single crystals, such as a type-II Dirac semimetal (1T-$PtTe_2$(100) [1]), a predicted topological superconductor (1T-$PdTe_2$(100) [2]) or an antiferromagnetic Topological Insulator ($MnBi_2Te_4$ (001) [3]) and epitaxial monolayers, such as 2D topological semiconductors (2H-$MoTe_2$/gr/ Ir(111)) or Quantum Spin Hall Insulators (1T-$MoTe_2$/gr/ Ir(111) [4]).

References

[1] G. Anemone et al, 2D Mater. **7**, 025007 (2020)
[2] G. Anemone et al, npj 2D Materials and Applications (2021) 5:25
[3] M. Garnica et al, npj Quantum Materials (2022) 7:7
[4] M. Garnica et al, (submitted)

Figures

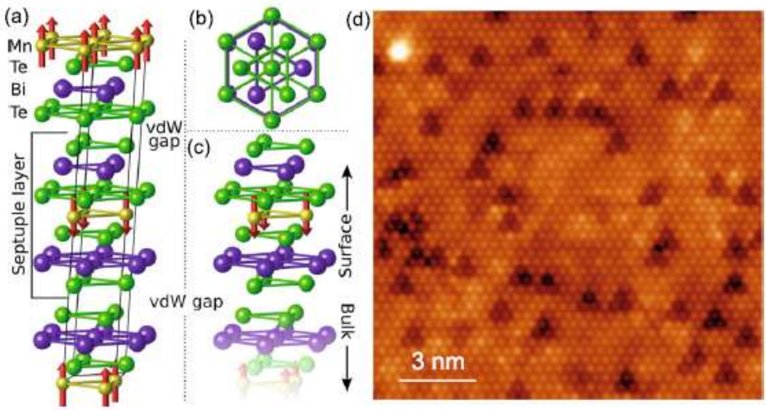

Figure 1: **$MnBi_2Te_4$ bulk and surface structure**. **a)** Side view of the bulk crystalline structure of $MnBi_2Te_4$ with red arrows showing the interlayer AntiFerroMagnetic order. The crystal cleavage in this layered compound takes place at the van der Waals gap, thus exposing a Te layer of a Septuple Layer at the surface. **b**) Top and **c)** side views of the surface crystal structure. **d)** Atomically-resolved STM image of the surface of the cleaved sample (1 V and 0.3 nA) showing the hexagonal aarray of Te atoms and some defects (dark triangular depressions and a bright circular protrusion).