Electrochemical delamination of a magnetic topological insulator

Yubing Wang, Axel Lubk, Daniel Wolf, Michael Ruck
Technische Universität Dresden, Bergstraße 66, Dresden, Deutschland
Yubing.Wang@tu-dresden.de

Magnetic topological insulators are intensively investigated for their potential application in quantum computing and spintronics. The currently most important material is $MnBi_2Te_4$ [1-3], a layered van der Waals compound that consists of magnetic septuple layers [Te-Bi-Te-Mn-Te-Bi-Te]. The surface of the materials is of special interest, since the topological and also other physical effects manifest there or originate from it [1-4]. Moreover, the antiferromagnetic coupling of the layers makes a difference between few-layer 2D crystals of $MnBi_2Te_4$ with odd or even number of layers. Up to now, all investigations were performed on mechanically exfoliated material. We now developed an up-scalable electrochemical method for liquid-phase exfoliation. Unexpectedly, we obtained nanoscrolls of $MnBi_2Te_4$, which is an unprecedented morphology for (magnetic) topological insulators. Although rolling up is a continuous transformation that in principle should not affect the topology, the breaking of symmetry, the incommensurable layers at different radii, and the probable radial magnetism are some of the aspects that immediately come to mind as fundamentally new.

References

[1] Otrokov M M, Klimovskikh I I, Bentmann H, et al. Nature **2019**, 576, 416-422
[2] Zeugner A, Nietschke F, Wolter A U B, et al., Chem. Mater. **2019**, 31, 2795-2806.
[3] Deng Y, Yu Y, Shi M, et al. Science **2020**, 367, 895-900.
[4] Feng Y, Zhu J, Lin W, et al. Nano Lett. **2022**, 22, 7606-7614.

Figures

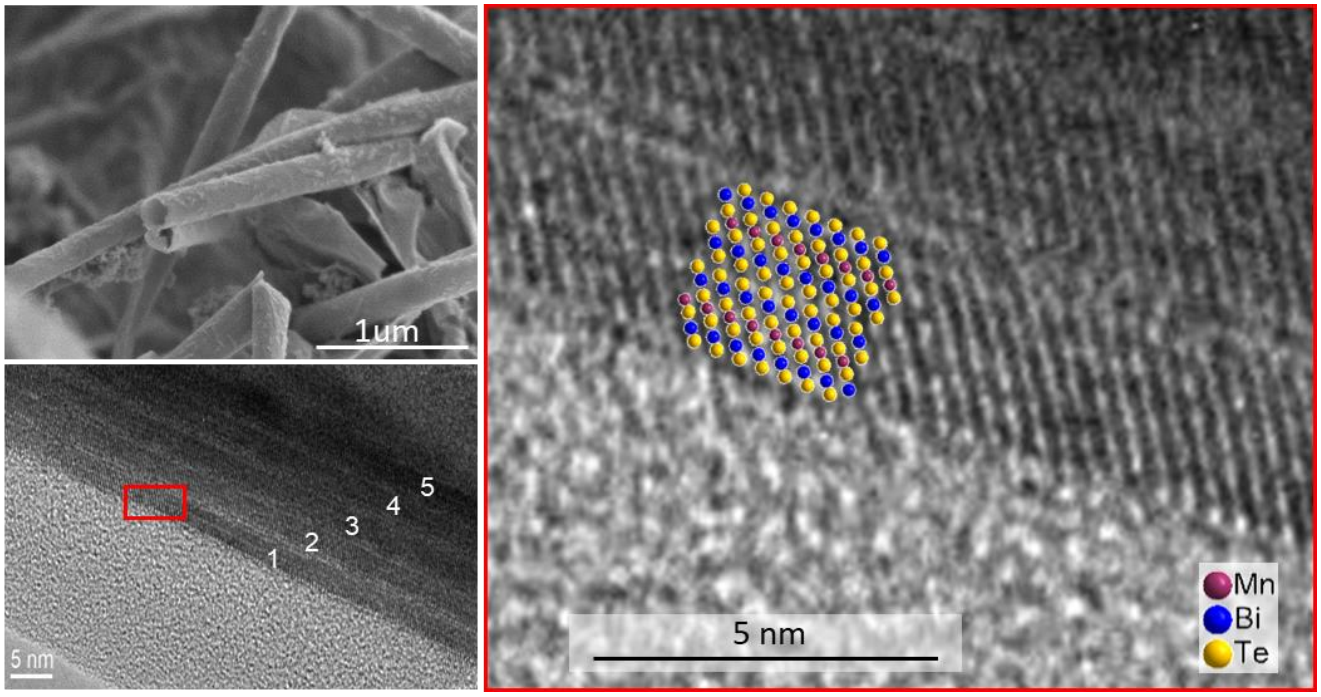

Figure 1: After applying voltage to $MnBi_2Te_4$ crystals, nanoscrolls with length up to 100 µm formed. HRTEM images reveal a rolled-up structure having a thickness of two septuple layers $MnBi_2Te_4$.