Magnetism meets Topology:
Electronic structure of the candidate FM-TI $Mn_{1+x}Sb_{2-x}Te_4$ by ARPES

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Abstract

The observation of the quantum anomalous Hall (QAHE) effect in Cr- & V-doped thin topological insulators (TI's) [1] gave access to dissipationless edge states without the need for an external magnetic field, in principle paving the way for developing low-power consumption topological quantum electronic and spintronic devices. This striking effect is fundamentally caused by the opening of an inverted gap in the topological surface states of the TI, given by the out of plane magnetization of the magnetic dopants (see **Figure 1**). Unfortunately, the disorder from the magnetic dopants confined these states to ultralow temperatures (few mK) hindering any possible applications.

Intrinsically magnetic topological insulators have been proven to be an excellent platform to combine magnetism and topology at high temperatures, allowing the observation of the QAHE [2] and further magnetic topological phases at record-high temperatures [3]. Recently, Angle Resolved Photoemission Spectroscopy (ARPES) measurements of MBE-grown films of Mn-rich $Mn_1Sb_2Te_4$[4] were argued to support it being a ferromagnetic topological insulator with – as yet - the highest Curie temperature T_C=45K.

In this talk, I present our latest ARPES data from Mn-rich $Mn_{1+x}Sb_{2-x}Te_4$ single crystals with T_C as high as 70K (**Figure 2**). I will discuss the pro's and con's of using single crystals in the chase for a ferromagnetic topological insulator with very high transition (Curie) temperature, and introduce surface decoration with alkali metals and the use of circular dichroism in ARPES as powerful methods beyond conventional ARPES to sharpen the determination of the topology of these materials.

References

[1] Chang et al, Science, 340 (2013) 6129
[2] Haiming et al, Nat Physics,17 (2021) 36
[3] Otrokov et al, Nature, 575 (2019) 416
[4] Wimmer et al, Adv Materials, 33 (2021) 2102935

Figures

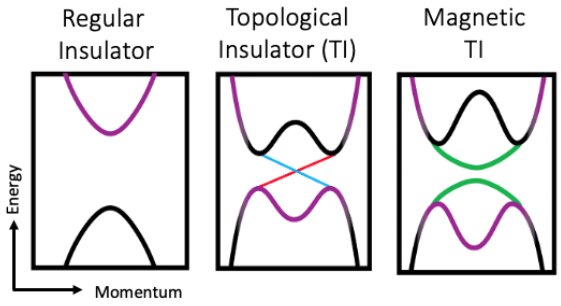

Figure 1: Opening of a magnetic gap within the topological surface states.

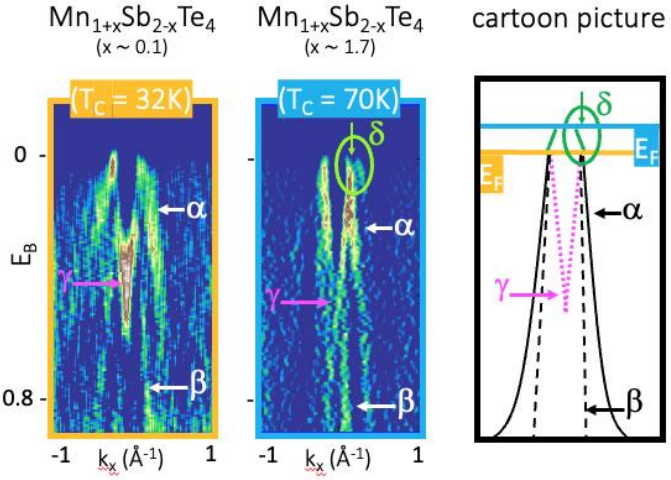

Figure 2: Our ARPES data in $Mn_{1+x}Sb_{2-x}Te_4$ single crystals & current picture of the system.