

ARPES Investigation of the Altermagnetic Electronic Structure of Epitaxial α -MnTe

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Altermagnets are an exciting new class of magnetic materials combining zero net magnetization with symmetry-enforced momentum-dependent spin-split electronic bands, enabling spin-polarized electronic states without stray magnetic fields. Realization of altermagnetism in thin films is essential for both fundamental studies and device integration. Hexagonal α -MnTe has recently emerged as a prototypical altermagnet, demonstrated by lifted Kramers spin degeneracy without inversion-symmetry breaking nor net magnetization [1]. The material exhibits intrinsic p-type conductivity due to hole doping, placing the Fermi level near or within the valence band.

Here we present ARPES measurements of 150 - 300 nm thick MnTe samples grown on InP(111)A substrates by molecular beam epitaxy. In situ RHEED as well as XRD and LEED measurements confirm the high crystalline quality of the epilayers. ARPES experiments were performed at the SOLARIS synchrotron using photon energies between 21 and 90 eV with linear and circular polarization at temperatures of 90 and 250 K. The results show good agreement with recently published works [1,2].

Most importantly, we observe pronounced anisotropic band splitting characteristic of altermagnetism on the order of 150 meV in Γ -M direction, as well as snowflake-shaped constant-energy contours in the antiferromagnetic state, directly visualized in ARPES maps. Circular-dichroism ARPES measurements reveal a strong circular-polarization-dependent intensity asymmetry, predominantly related with the excitation geometry. Furthermore, on- and off- Mn 3p \rightarrow 3d resonant difference spectrum shows enhanced Mn-3d spectral weight around 3.5 eV binding energy and a weaker charge transferred state contribution around 2 eV. Compared to zinc-blende MnTe, the satellite feature in NiAs-type MnTe appears shifted toward lower binding energy, consistent with more effective electronic screening.

References:

- [1] J. Krempaský et al., Nature 626 (2024) 517-522
- [2] M. Hajlaoui et al., Adv. Mater. 36 (2024) e2314076