Characterization of WTe2 multilayer grown by CVT

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Tungsten ditelluride (WTe_2) is a transition metal dichalcogenides (TMD) [1]. It is considered a 2D material since it shows a multi-layer structure compose by layer W atoms sandwiched between two Te atoms. The layers are implied buy Van der Waals interaction. WTe2 differs from the others TMDs since it present a distorted orthorhombic unit cell where the central W atoms are displaced from the center and form a zig-zag W chain. This distorted crystal and the high SOC made the WTe2 band structure particularity attracting for studying new topological phases. Theoretical studies have predicted that WTe_2 multi-layer could be a type II Weyls semimetal [2]. Whereas a WTe_2 monolayer is a 2D topological insulator at temperature lower (T<100K). ARPES measurements show the opening of a gap [3] and transport studies demonstrate the presence of quantum spin hall effect [4].

In this work we present a complete characterization of the crystal and electronic band structure of a multi-layer WTe_2 crystal growth by Chemical Vapor Transport. X-Ray Diffraction and Raman spectroscopy have been used to characterize the crystal structure. Raman spectroscopy has been performed along all the main crystallographic axes showing a high anisotropic behaviour of the scattering peaks. The combination of the two techniques allows us to demonstrate the high crystal structure of our crystals. In-situ exfoliation allowed us to perform X-Ray photoemission spectroscopy (XPS) and angle resolved photoemission spectroscopy (ARPES) on a non-oxidized WTe_2 crystal. XPS measurements confirm the lack of oxidation. The shape, area and position of the XPS peaks allow us to confirm the presence of the expected electrical bounds between W and Te. Our ARPES measurements on the multilayer sample are in accord with the literature and shown the presence of a semimetallic band structure, i.e. the presence of electron and hole pockets. No evidence of type II Weyls semimetal band structure has been found.

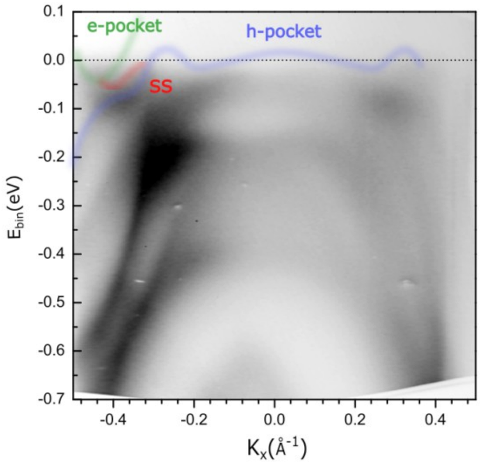

Fig.1 ARPES data along the Γ–Y direction

Those characterizations allow us to confirm the high quality of our crystals and the possibility to use it in heterostructures with magnetic material and study the proximity effect and the presence of quantum anomalous hall effect.

References

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