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Title of the Presentation: Electronic structure of multi-layer VTe_2 thin film studied by ARPES

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Short Biography:

Tappei Kawakami is studying the electronic states of atomically thin transition-metal dichalcogenides by using MBE and high-resolution ARPES. His recent interest is to search for novel physical properties of functional 2D materials.

Abstract:

The discovery of Dirac electrons in monolayer graphite (graphene) has initiated the search for new functional two-dimensional (2D) materials which exhibit the novel physical properties different from the bulk counterpart. Recently, monolayer transition-metal dichalcogenides (TMDs) are attracting particular attention since they are a promising candidate to explore exotic physical phenomena which are absent in bulk. Amongst TMDs, bulk vanadium ditelluride (VTe_2) has been reported to exhibit one-dimensional structural phase transition from the octahedral 1*T* structure to the distorted octahedral 1*T*" structure, which is called double-zigzag chain structure at below 482 K [1]. Recently, our group have succeeded in fabricating a monolayer (1ML) VTe_2 thin film on bilayer graphene / SiC by using molecular-beam-epitaxy (MBE) method, and elucidate the electronic structure originated from the 1*T* structure with angle-resolved photoemission spectroscopy (ARPES) [2]. On the other hands, the origin of different crystal structures between monolayer and bulk has not been understood yet.

To approach this issue, we performed ARPES measurement for multilayer VTe_2 thin film grown by MBE [3]. Figure 1 shows the ARPES results for 1ML (left) and 6ML (right) VTe_2 films along the ΓM direction of first Brillouin zone with 1*T* structure. For 1ML VTe_2, one can immediately recognize that the relatively flat band and the dispersive hole-like band exist below the Fermi level (E_F), which are assigned as to the V 3*d* and Te 5*p* orbitals by comparing with the first-principle calculation, respectively. However, for 6ML VTe_2, the slightly dispersive flat band corresponding to V3d orbitals apparently crosses E_F, indicating a metallic nature in 6ML VTe_2.

In this presentation, we will present the electronic states of multi-layer VTe_2 thin films in more details and discuss the crystal structure transition related with a charge-density wave (CDW) in VTe_2.

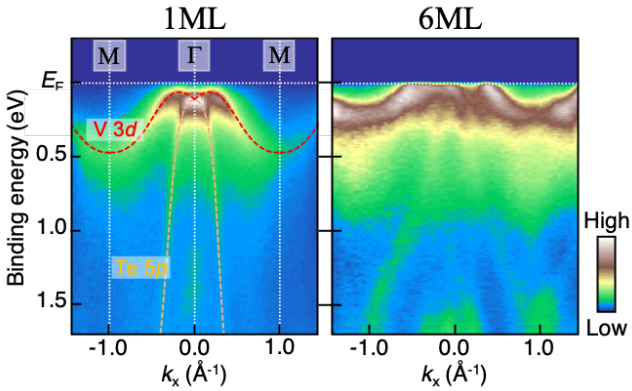

Fig. 1. ARPES intensity plots for 1ML (left) and 6ML (right) VTe_2 thin films grown on bilayer graphene/SiC. The red and yellow dotted lines represent the V 3*d* and Te 5*p* band, respectively.

[1] T. Ohtani *et al.*, Solid State Commun. **40**, 629 (1981).
[2] K. Sugawara *et al.*, Phys. Rev. B **99**, 241404(R) (2019).
[3] T. Kawakami *et al.*, submitted.