Electronic structure study of bulk 6*R*-TaS_2 with alternating 1*H*/1*T* layers

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Abstract
Heterostructure of two materials serves as a key approach in material engineering, enabling the combination of distinct properties or the realization of new physics at interfaces through interlayer interactions and proximity effects. Notable examples include artificial topological superconductors composed of a topological material and a superconductor [1], and two-dimensional electron gas (2DEG) formed at the interface between two oxide insulators [2]. While previous heterostructure research has primarily focused on thin films synthesized via epitaxial methods, bulk heterostructures based on transition metal dichalcogenides (TMDs) have recently gained attention. Bulk 6*R*-TaS_2 is one such TMD heterostructure, consisting of three pairs of alternating 1*H*- and 1*T*-TaS_2 layers within a unit cell (Figure 1). The constituent materials - 1*T*-TaS_2 and 2*H*-TaS_2 - are well studied, with 1*T*-TaS_2 exhibiting a Mott insulating phase with rich charge density wave (CDW) orders [3], and 2*H*-TaS_2 displaying a competition between CDW and superconductivity (SC) [4]. Interestingly, 6*R*-TaS_2 exhibits both CDW and SC phases, but with transition temperatures different from its constituent materials - T_{SC} is higher than in 2*H*-TaS_2, and T_{CDW} is lower than in 1*T*-TaS_2 - suggesting significant interlayer interactions. Here, we present an angle-resolved photoemission spectroscopy (ARPES) study of the electronic structure of bulk 6*R*-TaS_2. We discuss signatures of the aforementioned properties in its band structure, as well as potential emergent phenomena arising from the interlayer interactions. This study not only provides the knowledge on the electronic properties of a newly explored 6*R*-TaS_2, but also paves the way for future investigations into the electronic structures of bulk heterostructures.

References

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Figures

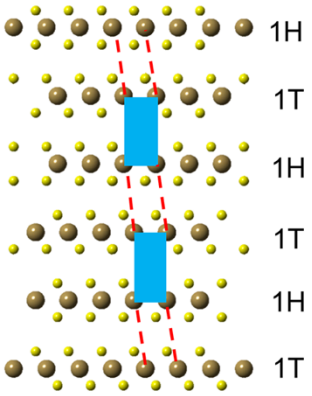

Figure 1: Crystal structure of 6*R*-TaS_2 with alternating 1*H*/1*T* TaS_2 layers. Brown and yellow spheres represent Ta and S atoms, respectively. Blue rectangles and red dashed lines highlight the displacement between 1*H*-1*T* heterolayers. Taken from Ref. [5].