PCP2-6

Synthesis and physical property measurements of misfit transition-metal dichalcogenide $(SbS)(TaS_2)$

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The misfit layered compound $(MS)(TX_2)_n$ (n = 1, 2, 3) has a layered crystal structure in which a MS layer (M = Bi, Pb, Sb, Sn or lanthanide) forming a square lattice is inserted between transition metal dichalcogenide TX_2 (T = Ta, Nb, Ti, V, Cr　X = S, Se) which has a triangular lattice. Because the stacking of the triangular and the square lattice breaks spatial inversion symmetry, the spin orbit interaction affects the electronic states in the misfit layered compounds. Furthermore, because of the low dimensionality of the crystal structure, the appearance of charge density wave (CDW) and superconductivity has been reported. However, understanding of the difference of the CDW and the superconducting transition temperatures between the misfit layered compounds has not been fully understood.
In one of misfit compound, $(SbS)(TaS_2)_1$, there are reports on poly crystal synthesis. However, there are no reports on single crystal synthesis and measurements of physical properties such as the CDW and the superconducting transition[1]. Furthermore, there have been no reports of real space observations of this compound so far. In this study, we investigated single crystal $(SbS)(TaS_2)_1$, whose CDW or superconducting transition has not been studied.
We found that single crystal of $(SbS)(TaS_2)_1$ can be synthesized by flux method. The structural analysis by X-ray diffraction and electric resistivity measurements down to 1.4K, and scanning tunneling microscopy measurements were performed in the single crystal. We found this material undergoes both CDW and superconducting transition, and transition temperature was 70K and 2.14K, respectively. In STM measurements, only triangular lattice layer was imaged with superlattice due to the effect of underlying square lattice layer and the CDW. In the presentation, CDW and superconducting transition temperature is compared to those of other misfit materials.

[1] Yoshito Gotoh et al. Jpn. J. Appl. Phys. **30** L1039 1991

Keywords: Superconducter, Charge Density Wave, Scanning Tunneling Microscopy, Transition metal dichalcogenide