Charge density waves in 2D Transition Metal Dichalcogenide heterostructures probed by STM

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Two-dimensional (2D) materials exhibit a fascinating variety of exotic electronic states, including charge density waves (CDWs) observed in transition metal dichalcogenides (TMDs). While the Peierls distortion explains well CDWs in one dimension, understanding their origin in higher dimensions remains a challenge. Beside the question of the physical origin, the control and manipulation of CDW in TMDs offers a rich playground for fundamental physics and possible applications. The modification and manipulation of CDW can be achieved by intercalation or local excitation as revealed by scanning tunneling microscopy [1,2].

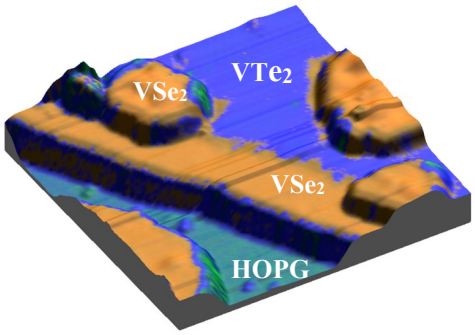

Figure:
STM image of VSe_2/VTe_2 heterostructure on graphite color coded by the conductance map at 1.3 V.

In CDWs heterostructures, the interaction between two materials with different electronic ground-state is full of promises for the emergence of new electronic phases. We present the investigation of VX_2 heterojunctions grown by successive deposition of TMDs and characterize their electronic properties using scanning tunneling microscopy and spectroscopy (STM/STS). We observe that the charge density wave symmetry of VSe_2 on top of a vertical VSe_2/VTe_2 heterostructure closely resembles the (4 × 4) CDW of bulk VSe_2. In lateral heterostructures, the ML VSe_2 recovers the expected ($\sqrt{3} \times \sqrt{7}$) CDWs. Spectroscopic measurements on VSe_2/VTe_2 islands is different from spectra measured on ML-VSe_2. At the periphery of VSe_2 islands and at the boundary of lateral heterostructures, an edged state appears in the STS that is absent inside single layers.

REFERENCES

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