2D $NbSe_2$ with Star-of-David CDW Superlattice--- A Versatile Platform for Exploring Quantum Phenomena

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Abstract

The charge density wave (CDW) is a superstructure due to lattice distortion and results in the modulation of electronic states. In recent years, the study of CDW in two-dimensional systems has attracted more and more research attention. We dive into this exciting area by starting with the Mottness, spin, and CDW properties of single-layer $NbSe_2$, then we continue to use molecular beam epitaxy to build a variety of CDW superstructures (including bilayer homojunction/heterojunction, one-dimensional CDW reconstruction, chiral domains). We have used scanning tunneling microscopy/spectroscopy to measure these superstructures with high spatial, temporal, and energy resolution, and observed a variety of novel effects such as spin states in a hexagonal lattice, metal-insulator transition, CDW lateral size effect, one-dimensional band bending, and reversible switching of chiral domains[1-7]. These works provide novel insights for the understanding and potential application of low-dimensional CDW-based quantum materials in nanoelectronics.

Keywords: 2D materials，CDW，$NbSe_2$，STM，Heterojunctions

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