Modulation of electronic properties in two-dimensional platinum chalcogenides

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Among layered materials, platinum chalcogenides have received great attention due to their peculiar physical properties. The strong layer-dependent electronic properties cause a band gap opening in monolayer $PtTe_2$, while the system otherwise is (semi)metallic.[1] Here we show that starting with $PtTe_2$ films, other compositions such as Pt_3Te_4 and Pt_2Te_2 can be obtained by a postgrowth desorption of tellurium or vapor-deposited Pt atoms.[2] The experiments combined with DFT calculations provide insights into these transformation mechanisms and the stabilization of the new phases. The partially converted monolayer flakes exhibit $PtTe_2$-Pt_2Te_2 heterojunctions, which enable the formation of the in-plane semiconductor-metal interface.[3] We further studied the electronic structure of edges and point defects in $PtSe_2$ monolayer where metallic 1D states with spin-polarized bands were found.[4] In addition to stoichiometry, combining different Pt-chalcogenides in vertical heterostructures provides an additional degree of engineering of materials properties.[5] Our results showed the variation of the interlayer interaction within the moiré structure locally modulates the electronic structure of $PtSe_2$/$PtTe_2$ heterostructures.

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