Structural and electronic characterization of sulfur depleted monolayer VS_2 synthesized on Au(111)

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Studies on bulk transition metal dichalcogenides (TMDCs) show a variety of electronic properties based on the specific combination of metal and chalcogen elements. Since it is possible to exfoliate or synthesize stable 2D versions of many TMDCs, they have attracted great attention for the opportunity to study reduced dimensionality in a variety of electronic systems. In this aspect, many 2D TMDC surfaces provide a rich playground to explore the emergence and interplay of quantum phenomena.

VS_2 is of particular interest, as it has not yet been synthesized in monolayer form, and its magnetic ground state is unclear. Here, we present an investigation with low temperature scanning tunneling microscopy/spectroscopy (STM/STS) on the structural and electronic properties of sulfur-depleted single layer VS_2 on Au(111). Upon annealing as-grown 1T monolayer VS_2, there is a structural phase transition to a sulfur depleted phase: The depletion of sulfur from the surface layer is manifested in a reconstructed surface which exhibits chain like structures. Our results shed light on the atomic structure of single layer VS_2 as well as reveal a complex Fermi surface of striped phase. STS mapping at low temperature indicates the emergence of non-dispersive electronic ordering close to the Fermi level.