Realization of fractional-layer transition metal dichalcogenides

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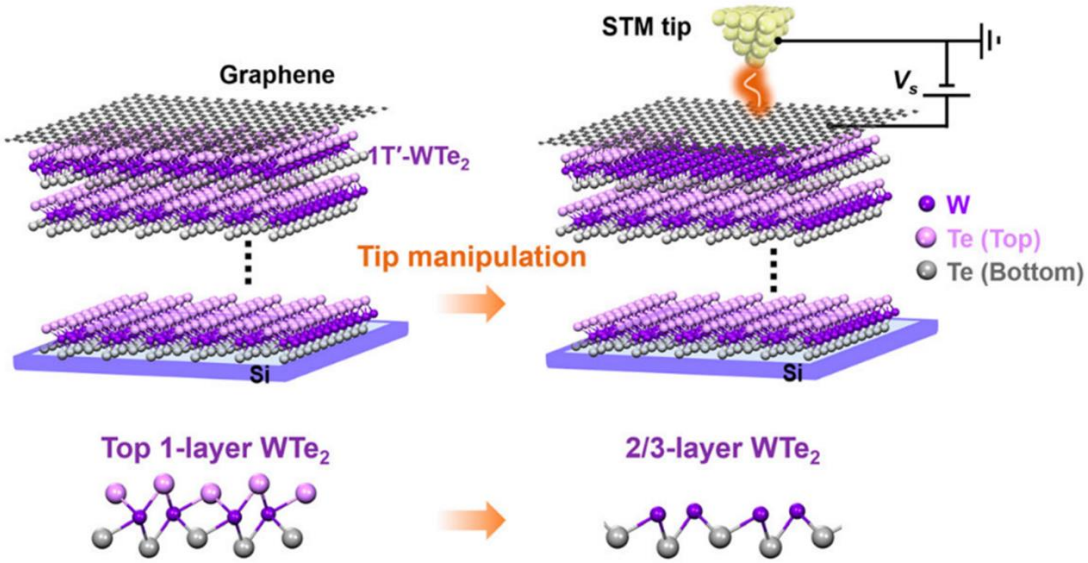
Abstract: Layered van der Waals transition metal dichalcogenides (TMDCs), generally composed of three atomic X-M-X planes in each layer (M = transition metal, X = chalcogen), provide versatile platforms for exploring diverse quantum phenomena. In each MX_2 layer, the M-X bonds are predominantly covalent in nature and, as a result, the cleavage of TMDC crystals normally occurs between the layers. Here we report the controllable realization of fractional-layer WTe_2 via an in-situ scanning tunneling microscopy (STM) tip manipulation technique. By applying STM tip pulses, hundreds of the topmost Te atoms are removed to form a nanoscale monolayer Te pit in the 1T′-WTe_2, thus realizing a 2/3-layer WTe_2 film. Such a configuration undergoes a spontaneous atomic reconstruction, yielding a unidirectional charge density redistribution with the wavevector and geometry quite distinct from that of pristine 1T′-WTe_2. Our results expand the conventional understanding of the TMDCs and are expected to stimulate further research on the structure and properties of fractional-layer TMDCs [1].



Pic.1 Structural schematic of 2/3-layer WTe_2.

Bibliography

[1] Ya-Xin Zhao, Heng Jin, Zi-Yi Han, Xinlei Zhao, Ya-Ning Ren, Ruo-Han Zhang, Xiao-Feng Zhou, Wenhui Duan, Bing Huang, *Yu Zhang, *Lin He. Realization of fractional-layer transition metal dichalcogenides. *Nat Commun* **16**, 3659 (2025).