

## Supporting Information

# Negative Differential Resistance Observed on the Charge Density Wave of a Transition Metal Dichalcogenide

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KEYWORDS: Charge Density Wave, Scanning Tunneling Microscopy, Negative Differential Resistance, Transition Metal Dichalcogenides

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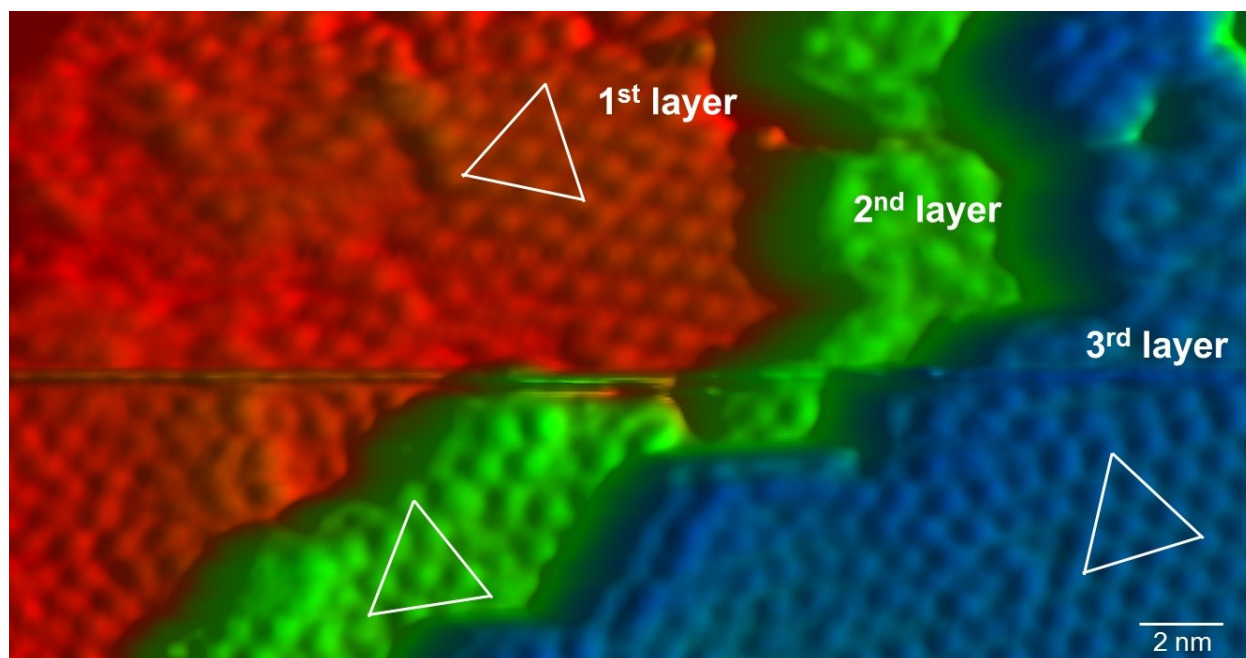
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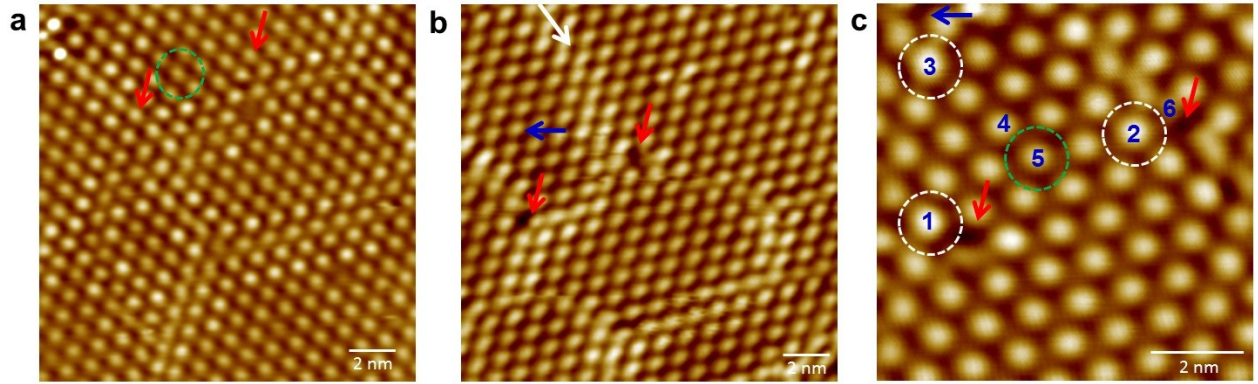
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### S1. Stacking or CDW in adjacent 1T-TaS<sub>2</sub> layers



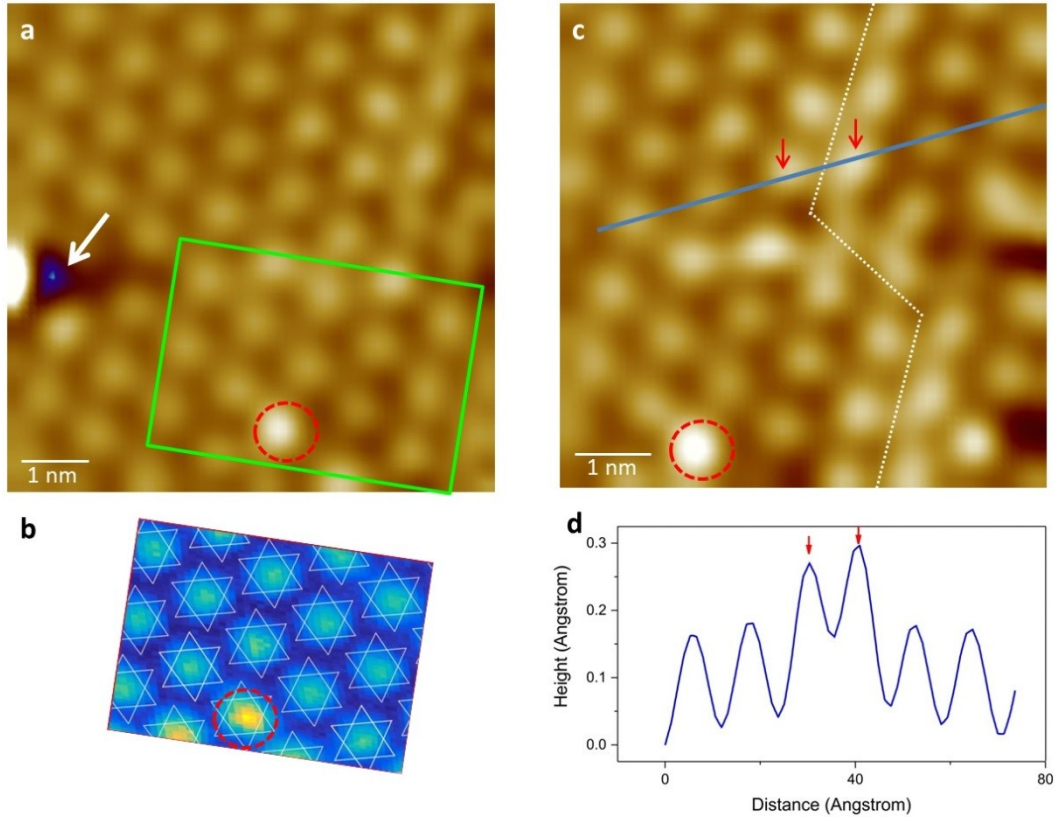
**Figure S1.** STM image of 1T-TaS<sub>2</sub> multi-layers acquired at the edge of the sample shows CDW domains. The triangles indicate different ordering [Imaging parameters:  $V_t = 1\text{V}$ ,  $I_t = 1\text{ nA}$ ].

## S2. Creation of tip-induced local defects



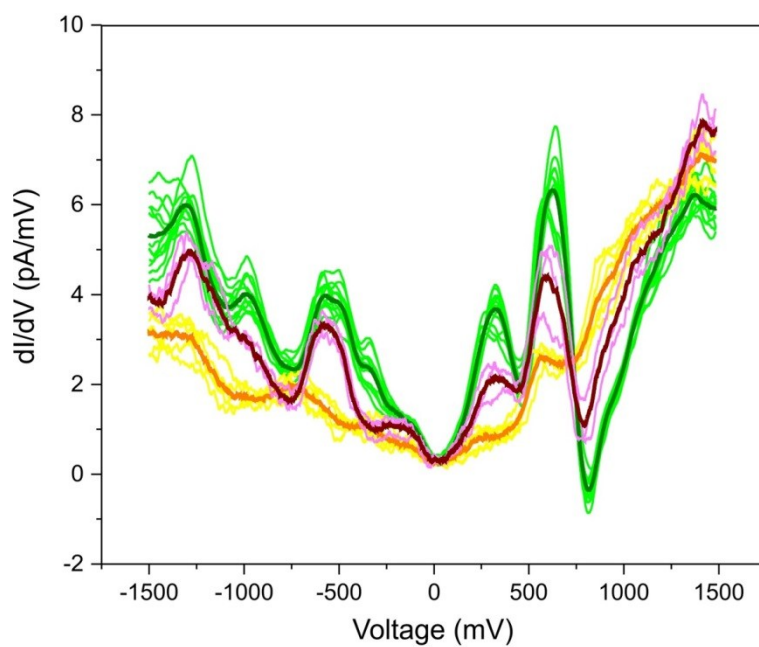
**Figure S2.** ***a***, An STM image of a 1T-TaS<sub>2</sub> with the CDW lattice. ***b***, The STM image after creating two point defects at the place shown with red arrows in '*a*'. The brighter regions (indicated with a white arrow) are stacking faults caused by the manipulation. ***c***, A zoom in STM image after creating another defect at the blue arrow location in '*b*'. White ovals indicate the changes in electronic structure of the CDW top sites that exhibit NDR. The green oval in '*a*' and '*c*' indicate the same CDW top site before and after manipulation where the  $dI/dV$  spectra shown in Fig. 3b are acquired. [Imaging parameters:  $V_t = 1V$ ,  $I_t = 0.2$  nA].

### S3. 1T-TaS<sub>2</sub> region of the dI/dV movie



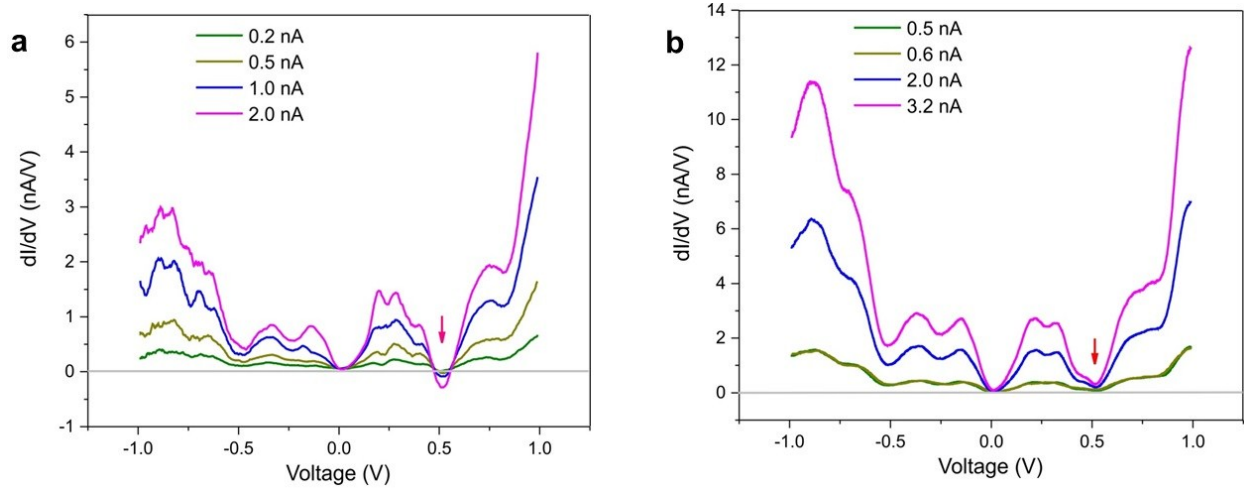
**Figure S3.** **a**, An STM image of 1T-TaS<sub>2</sub> region after tip sample mechanical contact at left (indicated with the white arrow). **b**, dI/dV maps are acquired at the green rectangle region. **c**, An STM image of the same 1T-TaS<sub>2</sub> region where a CDW domain is indicated with the white dashed line. **d**, A line profile across the blue line in 'c' shows a height difference appeared at the domain wall (indicated with red arrows in 'c' and 'd'). The red oval in 'a', 'b' and 'c' marks the position of a bright protrusion (electronic defect) used here as a landmark. [Imaging parameters:  $V_t = 1V$ ,  $I_t = 1\text{ nA}$ ]

#### S4. $dI/dV$ spectroscopy of individual atoms



**Figure S4.**  $dI/dV$  spectra acquired over the 'a' (green), 'b' (pink) and 'c' (yellow) atom sites of the Star-of-David structure. The average spectrum of each atom type; green for 'a', brown for 'b' and orange for 'c' atoms.

### S5. Tip height dependent $dI/dV$ spectroscopy



**Figure S5.**  $dI/dV$  spectroscopic data measured at different set-currents at a fixed bias of 1V. The increase in tunnelling current represents an approaching tip towards the surface. **a**,  $dI/dV$  curves measured at the different set tunnelling currents on the CDW top site (a defect site as shown in Fig. 2a) reveal an increasing NDR at  $\sim 0.5$  V (indicated with a red arrow) by reducing the tip height. **b**,  $dI/dV$  curves measured at a CDW top site that does not show NDR. Here, the  $dI/dV$  curves remain at positive values at  $\sim 0.5$  V by approaching the tip to the surface (red arrow location).