SUPPLEMENTARY INFORMATION FOR

Electrical properties of collapsed MoS_2 nanotubes

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SI1. Relative difference in conductivity between elevated and depressed parts

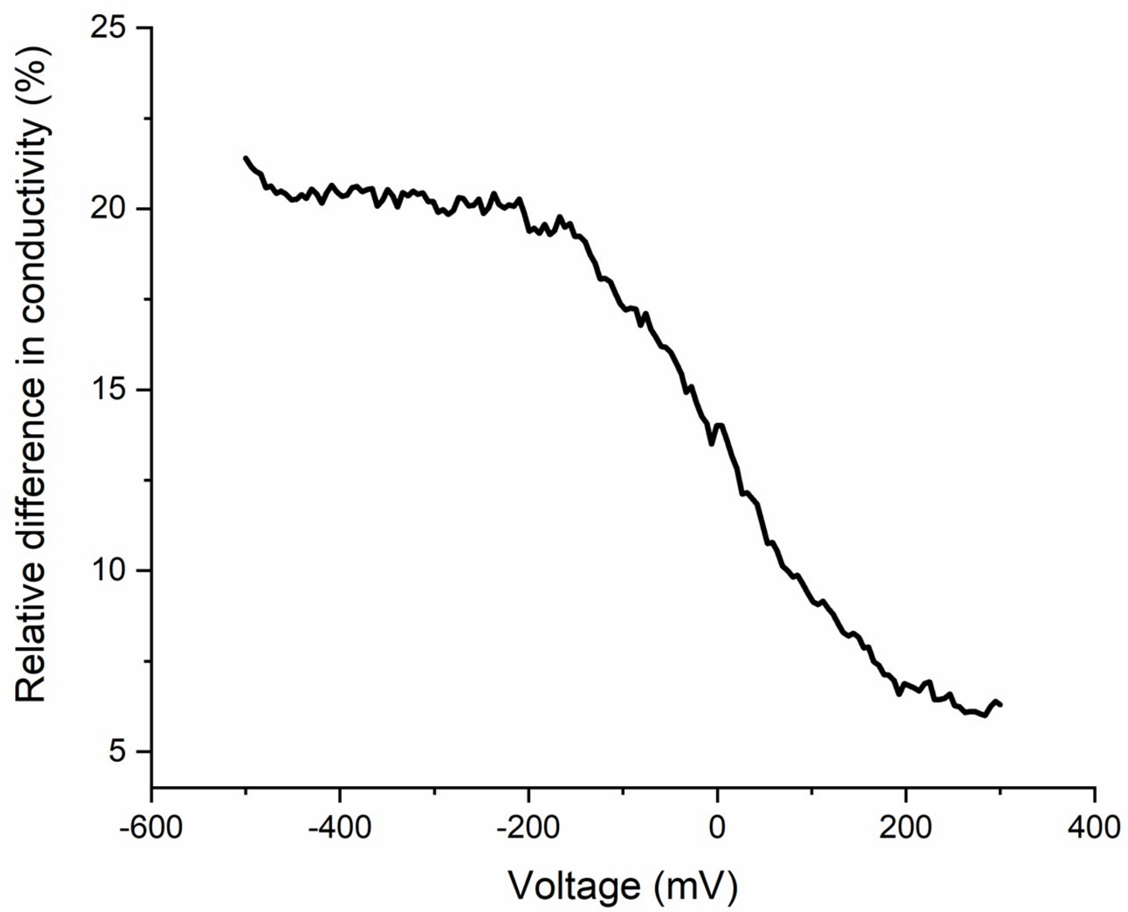

Fig. SI1 Relative difference in conductivity between depressed and elevated parts. Difference in conductivity is more pronounced at voltages lower than -150 mV, where elevated regions exhibit 20 % greater conductivity compared to the depleted areas. With increasing voltage from -150 mV to 250 mV, the relative difference in conductivity is linearly decreased from 21 % at -150 mV to 6 % at 250 mV.

SI2. Bright elevated dots (bulbs) found on the surface of a MoS_2 NR

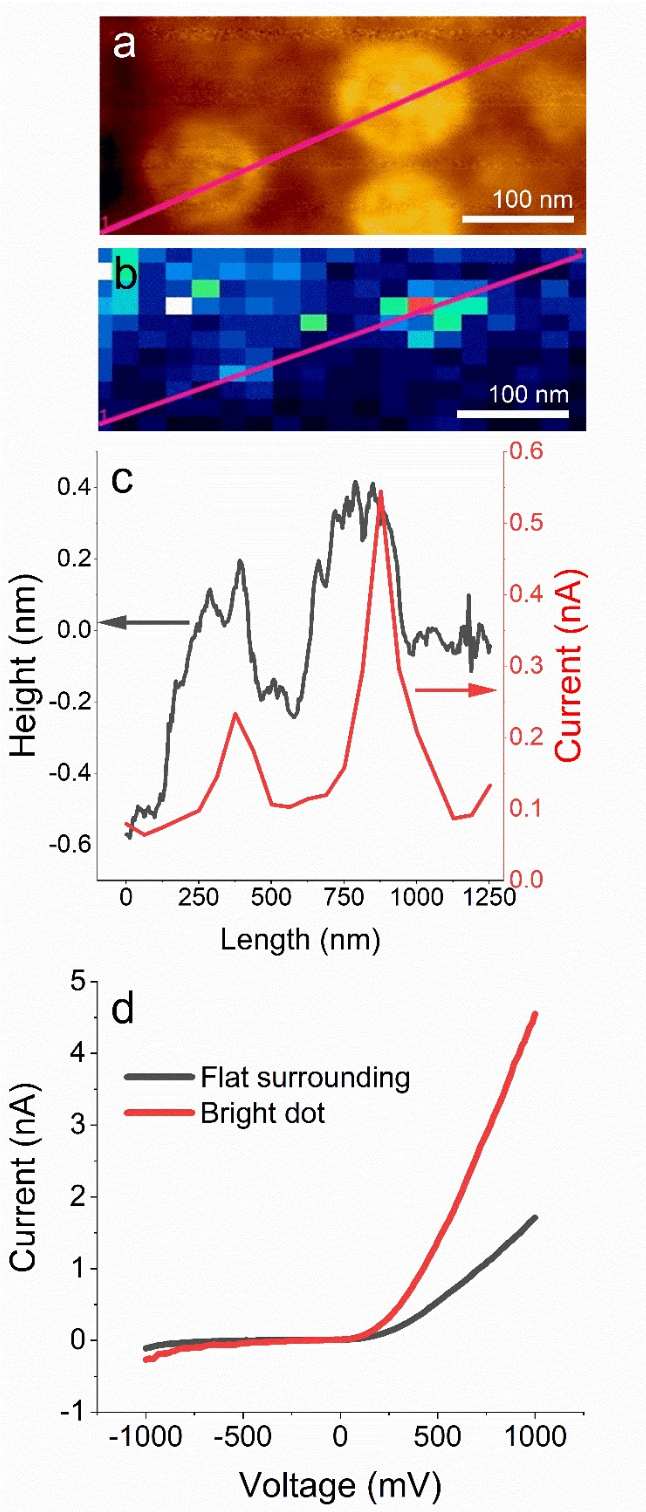

Fig. SI2 Conductivity measurements on a MoS_2 NR surface with some present bulbs: (a) Topography. (b) CITS current image taken at +195 mV. (c) Extracted cross-section profiles: topography (black), conductivity at +0.195 V (red). (d) Averaged I-V spectra from bright dot (red) and flat surroundings (black).

SI3. Injection of electrons

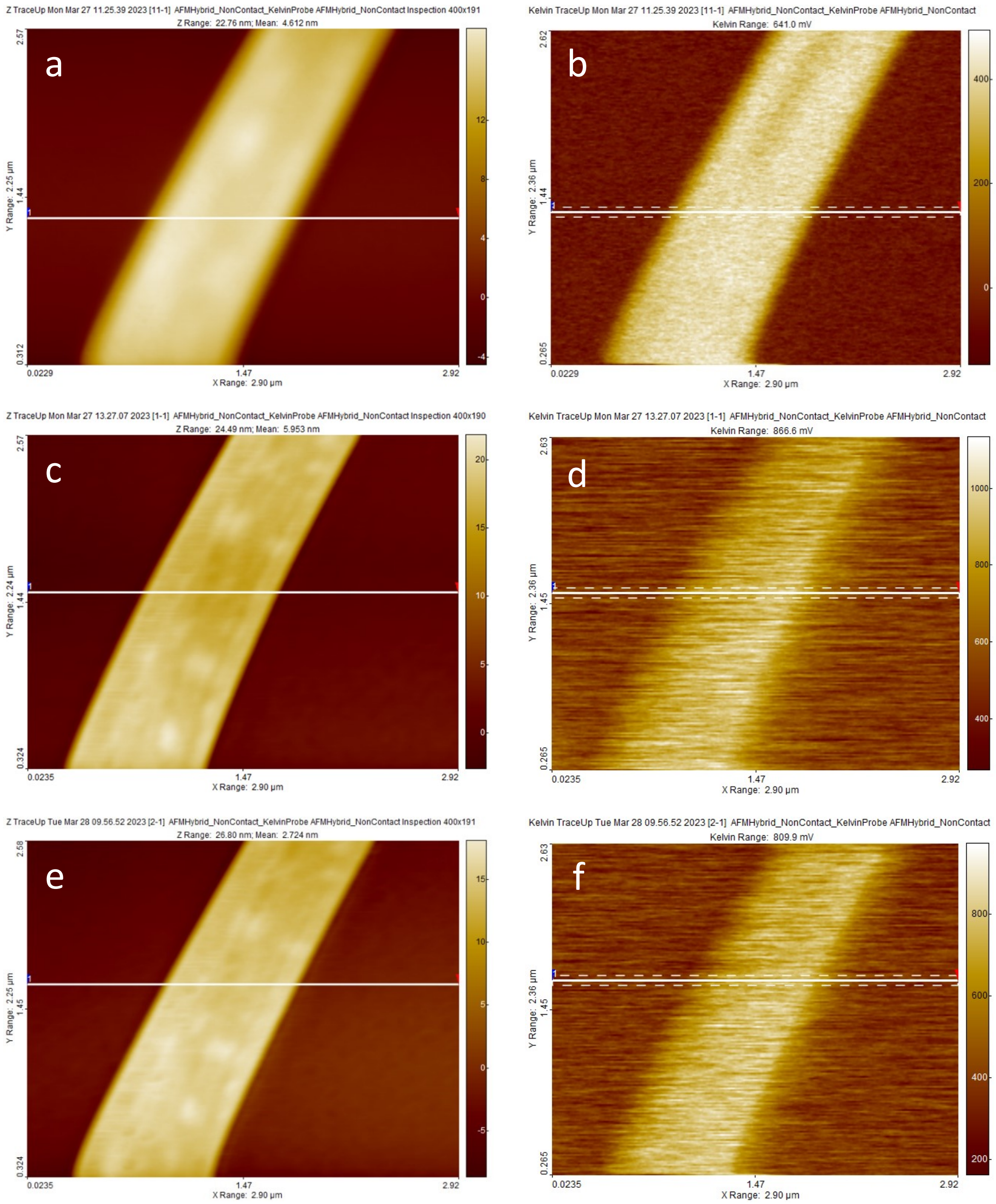

Fig. SI3 Topographical (left) and Kelvin images (right). (a, b) before first injection of electrons. (c, d) immediately after the last injection at -V. (e, f) 24h after the last injection.

SI4. Injection of holes

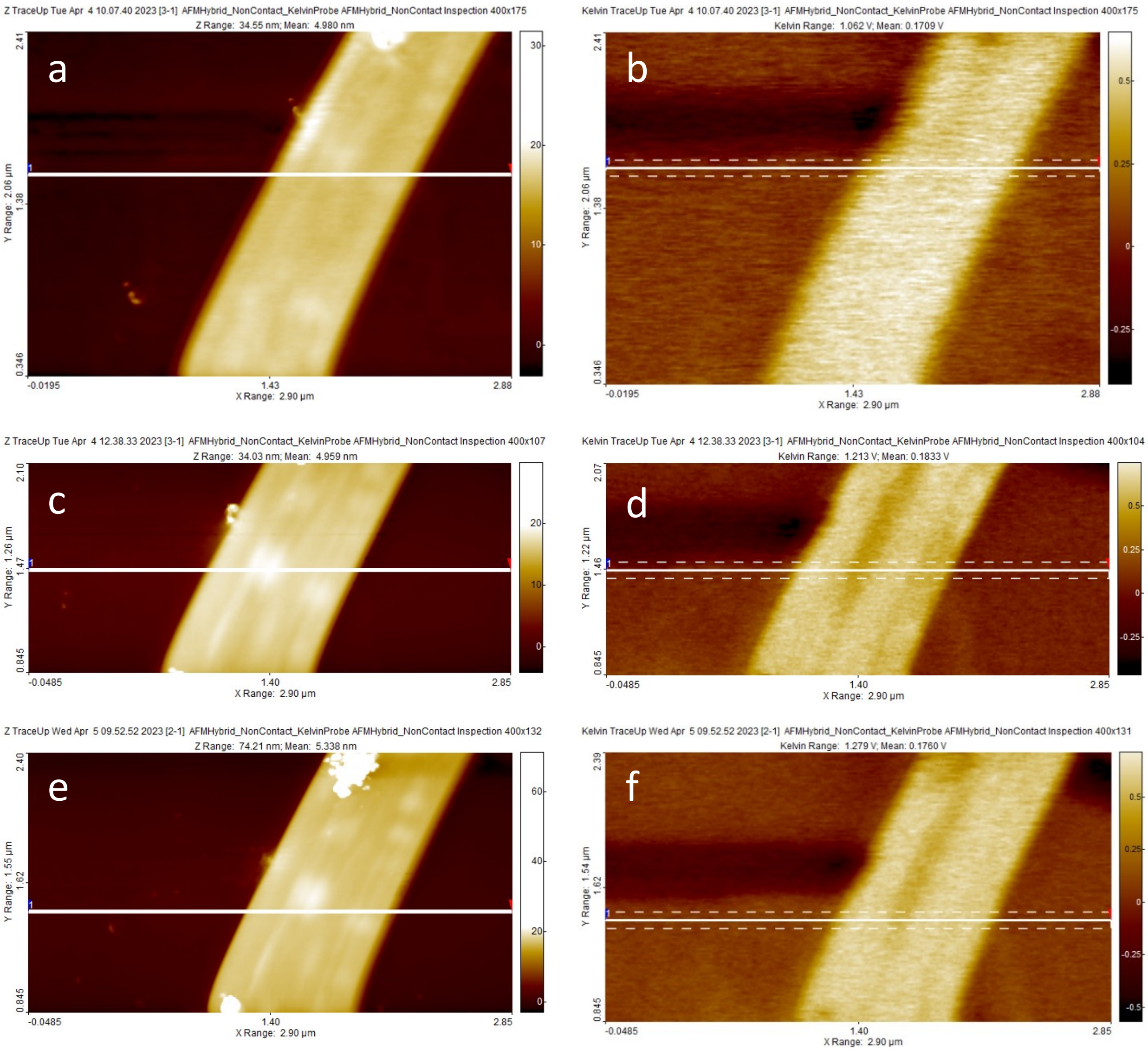

Fig. SI4 Topographical (left) and Kelvin images (right). (a, b) Before first injection of holes. (c, d) Immediately after the last injection at +8 V. (e, f) 24h after the last injection.

SI5. Charge density calculation, charge-charge distance, and Coulombic repulsion after charge injection

The charge density, charge-charge distance and Coulombic repulsion for the case of injection of electrons, as presented in the main article, were estimated under the assumption that the change in contact potential difference (ΔV_{CPD}) is solely due to the surface charge on the nanoribbon (NR) and that this charge is evenly distributed. During injection, some charges become trapped at the MoS_2 NR – SiO_2 substrate interface. However, since the NR is 17 nm thick - corresponding to 26 layers between the substrate and the top surface - and given that such a thick MoS_2 effectively screen charges from the MoS_2-SiO_2 interface [SI_1], this trapped charge at the interface doesn't influence the CPD values measured on the NR's surface.

The charge density was estimated based on the change in the CPD of the NR before and after charge injection: [SI_2]:

$$\sigma = \frac{\Delta V_{NR} \cdot \varepsilon_0 \cdot \varepsilon_{NR}}{t_{NR}} = \frac{0.1 \cdot 8.85 \cdot 10^{-12} \cdot 4}{17 \cdot 10^{-9}} = 0{,}21\ mC/m^2, \qquad \text{(SI5-1)}$$

where $\Delta V_{NR} = 0.1\ V$ represents the change in the CPD values of the NR before charge injection (Fig. 7, Initial; 450 mV) and after the last electron injection (Fig. 7, -8V(3); 350 mV); $\varepsilon_0 = 8.85 \cdot 10^{-12}\ F/m$ is the vacuum dielectric constant, $\varepsilon_{NR} = 4$ is the dielectric constant of the MoS_2 [SI_3] and the $t_{NR} = 17 \cdot 10^{-9}\ m$ is the thickness of the NR (Fig. 7). The electron density is:

$$\rho_e = \frac{\sigma}{e_0} = \frac{0{,}21 \cdot 10^{-3}}{1{,}6 \cdot 10^{-19}} = 1{,}31 \cdot 10^{15} \frac{electrons}{m^2}, \qquad \text{(SI5-2)}$$

where $\sigma = 0{,}21\ mC/m^2$ is the charge density from eq. SI5-1 and the $e_0 = 1{,}6 \cdot 10^{-19}\ C$ is the elementary charge. From this, the charge-charge distance is:

$$d_{charge-charge} = \frac{1}{\sqrt{\rho_e}} = \frac{1}{\sqrt{1{,}31 \cdot 10^{15} \frac{electrons}{m^2}}} = \frac{1}{3{,}62 \cdot 10^{7} \frac{electrons}{m}} = 27{,}6\ nm \qquad \text{(SI5-3)}$$

The Coulombic force between two adjacent electrons is given by:

$$F_{charge-charge} = \frac{1}{4 \cdot \pi \cdot \varepsilon_0} \frac{q_1 \cdot q_2}{d^2} = \frac{1}{4 \cdot \pi \cdot 8.85 \cdot 10^{-12}} \frac{1{,}6 \cdot 10^{-19^2}}{27.6 \cdot 10^{-9^2}} = 3 \cdot 10^{-13}\ N \qquad \text{(SI5-4)}$$

The potential energy of a single electron can be calculated as:

$$E = F_{charge-charge} \cdot d_{charge-charge} = 3 \cdot 10^{-13}\ N \cdot 27.6 \cdot 10^{-9}\ m = 8{,}28 \cdot 10^{-21}\ Nm = 0.05\ eV \qquad \text{(SI5-5)}$$

References:

[SI_1] A. Castellanos-Gomez, E. Cappelluti, R. Roldán, N. Agraït, F. Guinea and G. Rubio-Bollinger, *Adv. Mater.*, 2013, **25**, 899-903.

[SI_2] I. Bdikina, D. K. Sharmaa, G. Otero-Iruruetaa, M. J. Hortigüelaa, P. K. Tyagi, V. Netoa and M. K. Singh, *Appl. Mater. Today*, 2017, **8**, 18-25.

[SI_3] E. J. G. Santos and E. Kaxiras, *ACS Nano*, 2013, **7**, 10741–10746.