

# Wafer Scale MoS<sub>2</sub> Thin Layers Prepared by MoO<sub>3</sub> Sulfurization

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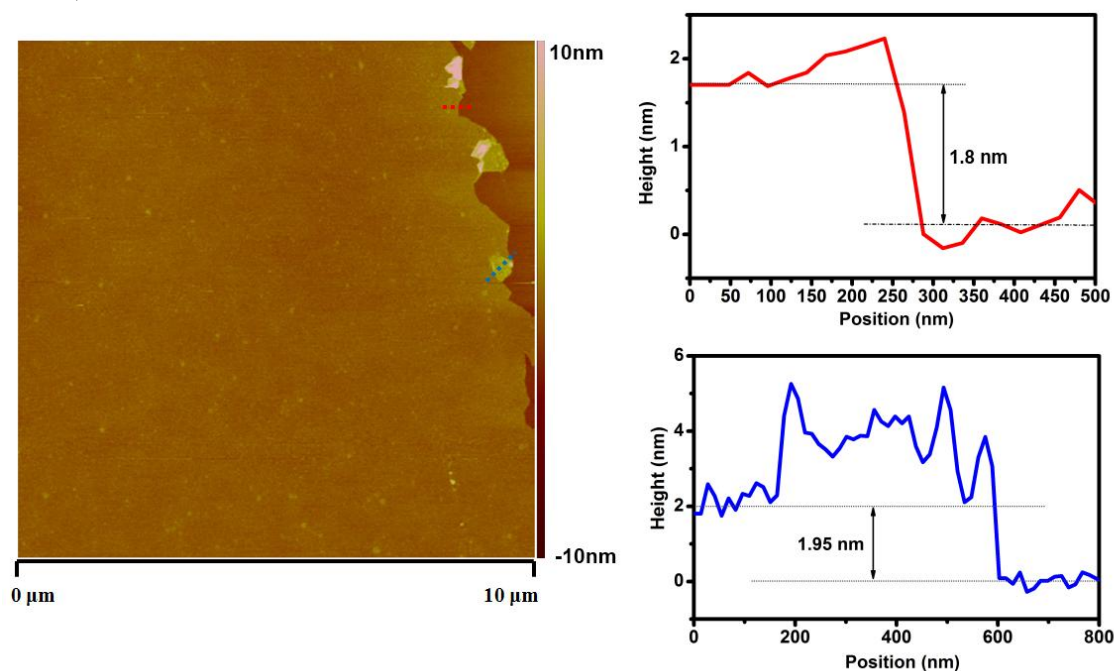
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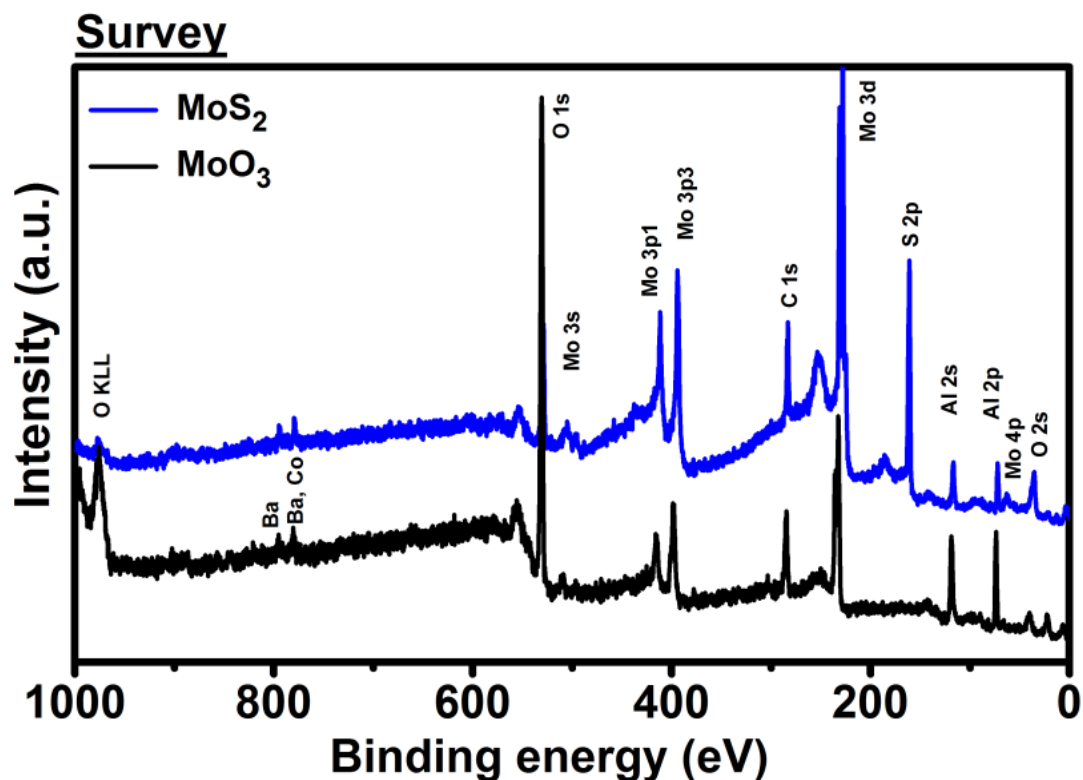
<sup>d</sup> Research Center for Applied Sciences, Academia Sinica, Taipei, 11529, Taiwan

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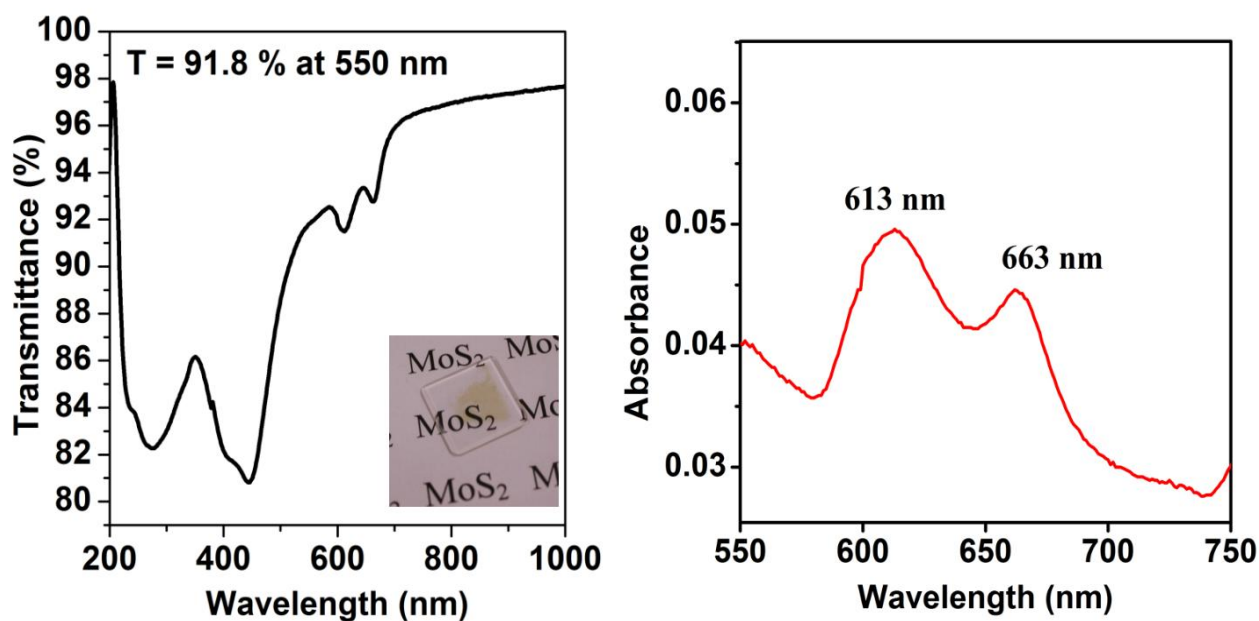
**Figure S1.** Addition AFM image showing that the cross-sectional height is ~ 1.8nm (trilayer MoS<sub>2</sub>)



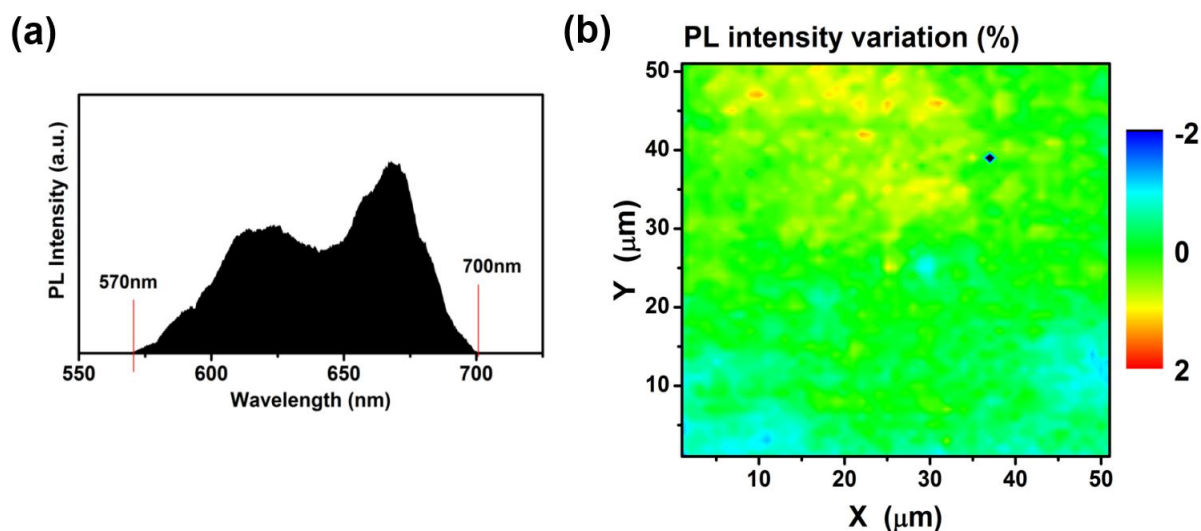
**Figure S2.** The X-ray photoemission spectroscopy (XPS) survey scans for the Mo and S binding energies of the MoO<sub>3</sub> layer before and after sulfurization.



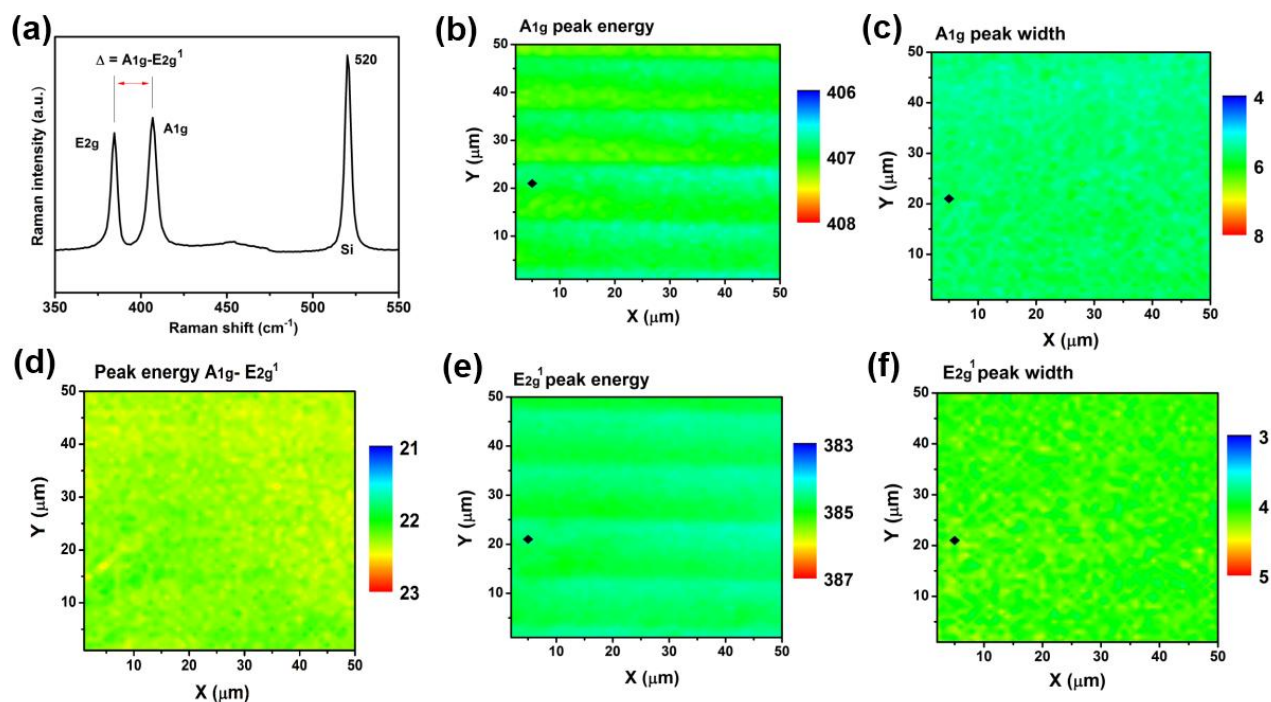
**Figure S3.** (a) Transmittance and (b) Absorption spectrum for the MoS<sub>2</sub> layer.



**Figure S4.** (a) PL spectrum of the MoS<sub>2</sub> trilayer. (b) The PL intensity percentage variations vs. the area number, where the PL intensity is calculated by integrating the peak area from 570 to 700 nm and the PL intensity percentage variation is relative to the average PL intensity values for all points in the mapping.

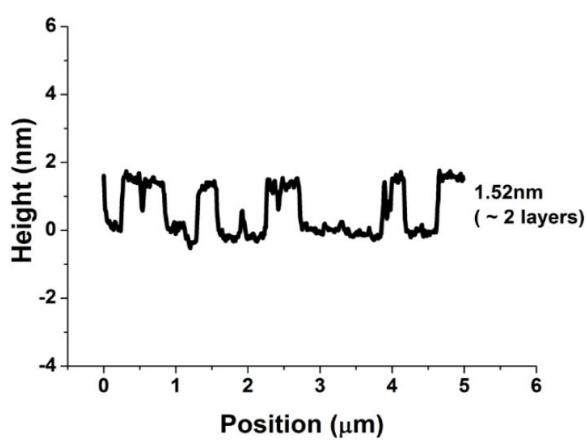
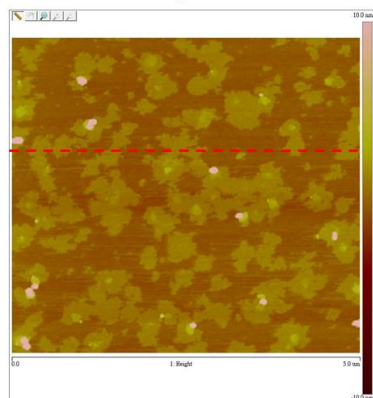


**Figure S5.** (a) Single Raman spectra for the MoS<sub>2</sub> trilayer. Raman mappings for (b) A<sub>1g</sub> peak energy, (c) A<sub>1g</sub> peak width, (d)  $\Delta$  value, (e) E<sub>2g</sub><sup>1</sup> peak energy and (f) E<sub>2g</sub><sup>1</sup> peak width of the MoS<sub>2</sub> trilayer.

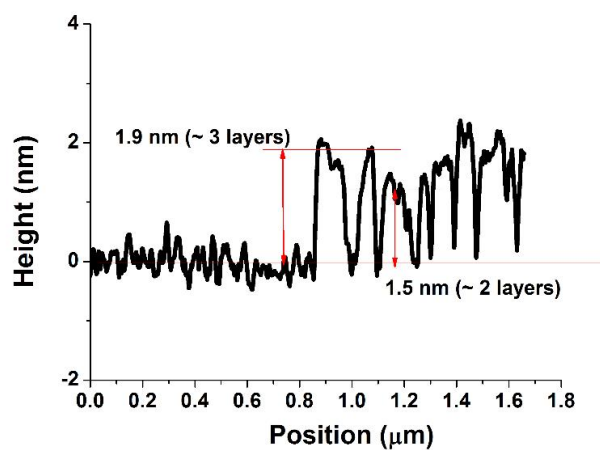
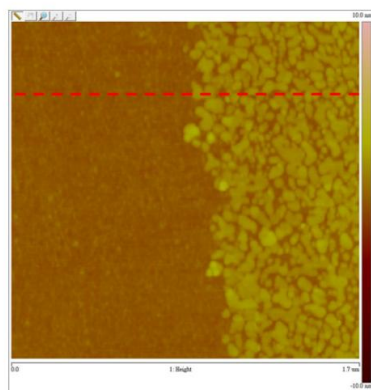


**Figure S6.** AFM images for the MoS<sub>2</sub> flakes obtained after sulfurization of the MoO<sub>3</sub> layers with various thicknesses.

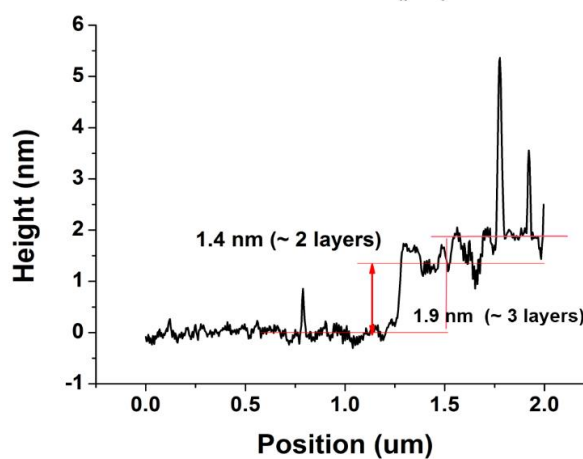
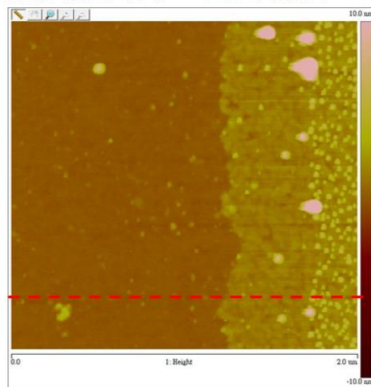
**(a) Initial MoO<sub>3</sub> = 0.8 nm**



**(b) Initial MoO<sub>3</sub> = 1.5 nm**



**(c) Initial MoO<sub>3</sub> = 2.2 nm**



**Figure S7.** (a) The Raman D value, and (b) PL B1 peak position for the MoS<sub>2</sub> films or flakes as a function of initial MoO<sub>3</sub> thicknesses.

