Supporting Information

Synthesis of Molybdenum Sulfide Nanowire Arrays Using a Block Copolymer Template

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Table S1. PS and P2VP crosslink study under 254nm UV light.

Energy of UV exposure (J/cm^2)	0	0.6	1.9	3.0	Original thickness after spin coating
Thickness of P2VP (M_n=10.2k)	3.09 nm	23.65 nm	22.08 nm	19.88 nm	23.75 nm
Thickness of PS (M_n=21k)	1.29 nm	1.98 nm	9.34 nm	14.54 nm	25.51 nm

PS and P2VP were spun coated on SiO_2/Si substrates to make thin films, which were then exposed to 254 nm UV light with different amount of energy. All the films were rinsed with toluene by the same method after exposure and taken film thickness measurements, as shown in the Table S1. The degree of crosslink of the films can be qualitatively determined by the thickness of the film left. The more thickness left after the toluene rinse, the higher degree of crosslink. Both P2VP and PS were crosslinked by delivering ~3 J/cm^2 energy of UV, which was chosen to crosslink the PS-*b*-P2VP thin film.

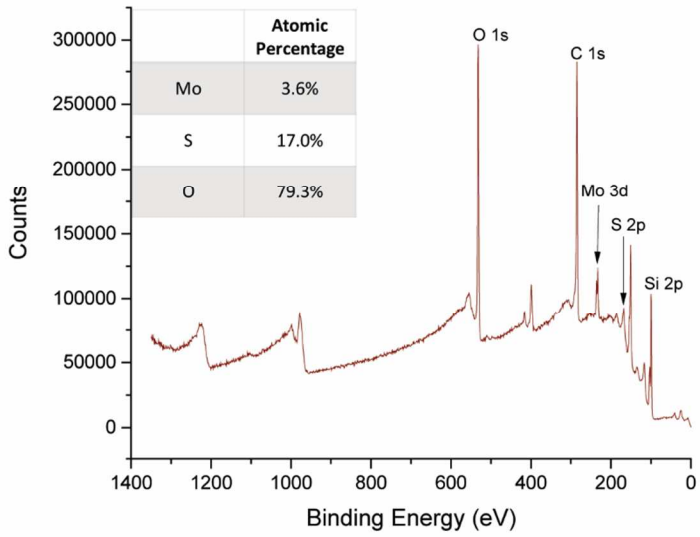

Figure S1. XPS survey scan for the sample annealed under H_2 atmosphere, corresponding to Figure 1c, with the inset showing relative atomic percentage of Mo, S, and O.

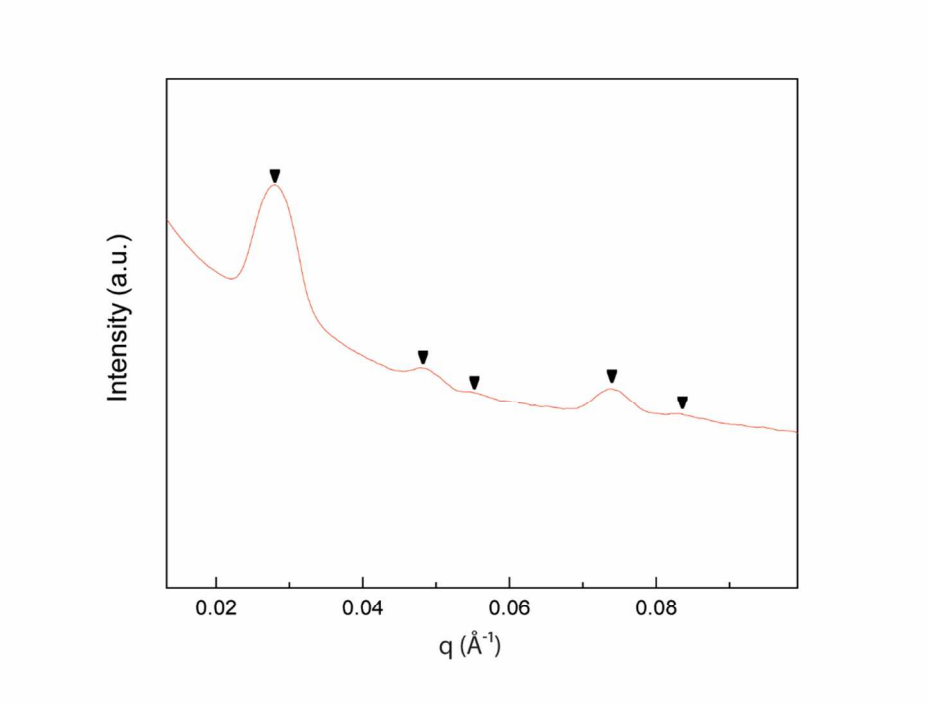

Figure S2. Small angle X-ray scattering (SAXS) data from PS-*b*-P2VP (24.6 k-10.3 k) used in this work. PS-*b*-P2VP was solvent casted and annealed at 190 ℃ for 24 hrs. Black triangles represent peak positions

for a hexagonal cylinder morphology (i.e. q^*=0.028 Å^{-1}, $\sqrt{3}q^*$, $\sqrt{4}q^*$, $\sqrt{7}q^*$, $\sqrt{9}q^*$). The center-to-center distance (25.9 nm) is determined by $D = \frac{4\pi}{\sqrt{3}q}$ for cylindrical forming block copolymers. The P2VP domain diameter (14.6 nm) is determined by $D = \frac{4\pi}{q^*}\sqrt{\frac{2f}{\sqrt{3\pi}}}$, which assumes perfect two dimensional hexagonal packing.[S1] f is volume fraction of P2VP block, which determined by nominal molecular weight (PS-*b*-P2VP, 24.6k-10.3k) and density of both blocks at room temperature (ρ(PS) = 1.05 g/cm^3; ρ(P2VP) = 1.15 g/cm^3).[S2]

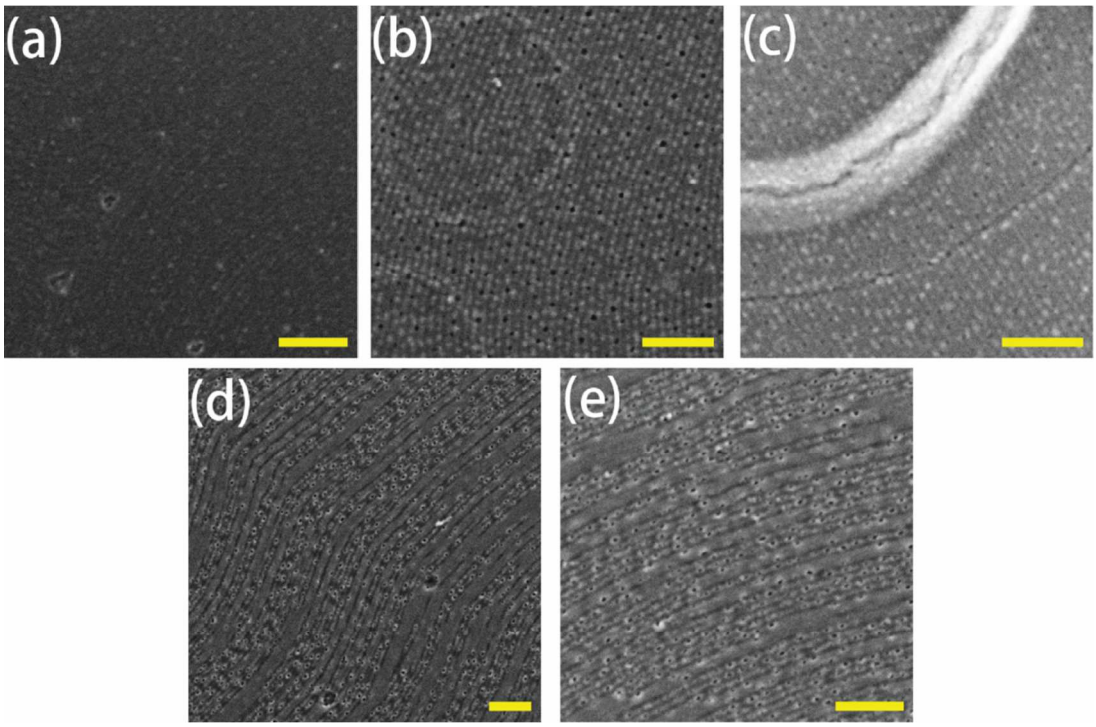

Figure S3. SEM images of PS-*b*-P2VP films (a) without protonation, (b) protonated for 3 hours at pH = 3.2, (c) pH = 2.7, (d) pH = 1.6, (e) pH = 0.56. P2VP domains fused together at lower pH. Note that the contrasts come from seeding in 0.01 M ATTM solution for 4 hours. Scale bars are 200 nm.

Preparation of X-ray diffraction sample: 10% w/w poly(2-vinyl pyridine) (P2VP) in tetrahydrofuran (THF)

was spun coated on a SiO_2/Si substrate at 2000 rpm to make a relatively thick film. The film was incorporated with the precursor in a 0.1 g/ml AHM water solution overnight. The following sulfur annealing was conducted at 700 ℃ for 1 h. Note that homo P2VP will dissolve in the pH = 3.2 condition, so the protonation step was substituted with a long incorporation (12 h) in the AHM solution which is slightly acidic (5 < pH < 6).

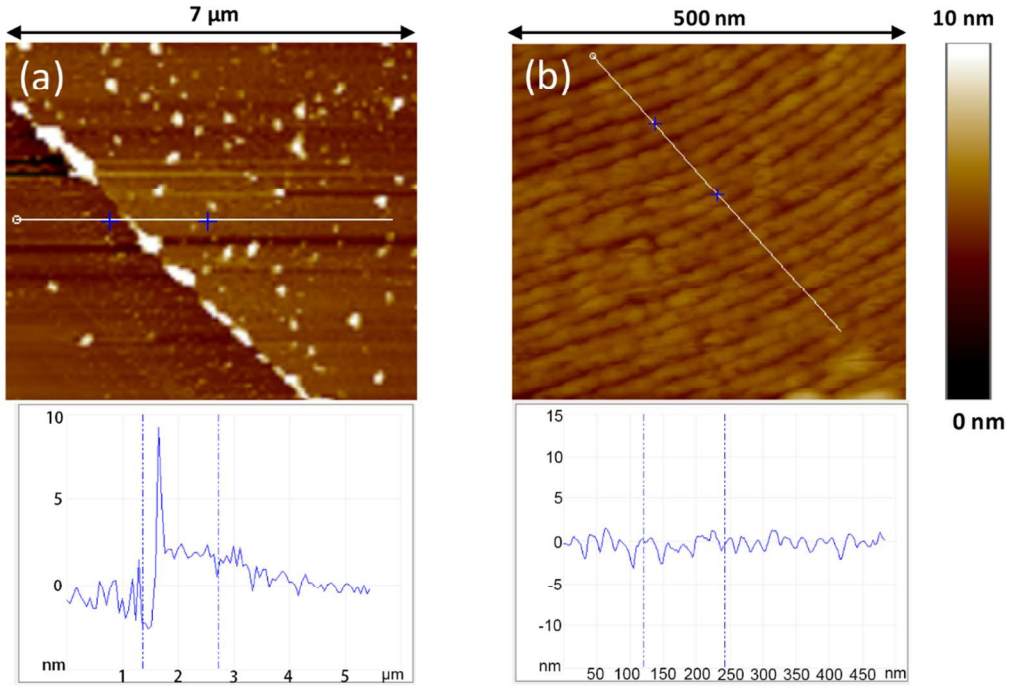

Figure S4. Atomic force microscope (AFM) images of MoS_2 nanowires annealed at 700℃. (a) Surface scratched with a razor blade to measure the height of the nanowires, which is 3-4 nm; (b) A zoom-in image of the film which confirmed the morphology of the highly packed nanowires. The surface morphology of the nanowires was imaged using a Nanoscope III Multimode atomic force microscope (Digital Instruments). Tapping mode was utilized for the AFM measurement. A triangular cantilever with an integral pyramidal Si_3N_4 tip was used. The typical imaging force was of the order of 10^{-9} N.

References:

S1. Sakurai, S.; Momii, T.; Taie, K.; Shibayama, M.; Nomura, S.; Hashimoto, T. Morphology Transition from Cylindrical to Lamellar Microdomains of Block Copolymers. *Macromolecules* **1993**, *26*, 485-491.

S2. Yu, D.; Feng, Y.; Zhu, Y.; Zhang, X.; Li, B.; Liu, H. Template Synthesis and Characterization of Molybdenum Disulfide Nanotubules. *Mater. Res. Bull.* **2011**, *46*, 1504-1509.