Supporting Information

PVP-assisted synthesis of MoS_2 nanosheets with improved lithium storage properties

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Experimental section

Materials synthesis. All chemicals used in our experiments are of analytical purity and used as received without further purification. The MoS_2 materials were synthesized using a modified hydrothermal reaction similar to the approach developed by Tian et al.[1] To prepared the single layer MoS_2 nanosheets, 0.4318 g molybdic oxide (MoO_3), 0.7289g potassium thiocyanate (KSCN) and 0.1 g Polyvinylpyrrolidone (PVP) were added into 30 mL of deionized water with actively magnetic stirring at room temperature. After 30 min, the as-obtained suspension was transferred to a 50 mL Polyphenylene (PPL) autoclave and kept in an electrical oven at 210 ^{o}C for 24 h. After cooling down naturally, the black precipitates were collected by centrifugation and washed with deionized water and anhydrous ethanol several times, following by drying at 60 ^{o}C overnight and the MoS_2 precursor obtained. The as-prepared MoS_2 precursor was annealed in a conventional tube furnace at 500 ^{o}C for 4 h in an Ar atmosphere and the as-prepared MoS_2 nanosheets are designated as MSP. The MoS_2 micro-flowers were also prepared by a similar synthetic process but without adding the Polyvinylpyrrolidone (PVP), the as-synthesized MoS_2 micro-flowers are designated as MS.

Materials characterization. Thermogravimetric Analysis (TGA) instrument (SDT, Q600) was used to study the evolution of the as-prepared MoS_2 precursor in Ar atmosphere at a ramping rate of 10 ^{o}C min^{-1}. The phase purity of the as-prepared products were studied by X-ray power diffraction (XRD, Rigaku D/max2500 XRD with Cu Kα radiation, λ=1.54178 Å). The morphologies and sizes of the as-prepared products were characterized by scanning electron microscopy (SEM, FEI Nova NanoSEM 230) and transmission electron microscopy (TEM, JEOL JEM-2100F). High-resolution transmission electron microscope (HRTEM) analysis was performed on the JEOL JEM-2100F transmission electron microscope.

Electrochemical measurements. The electrochemical properties were carried out by assembly of coin cells (2025 type coin cell). The cathode slurry was prepared by dispersing the as-prepared products, acetylene black, and polyvinylidene fluoride (PVDF) binder in a weight ratio of 80 : 10 : 10 in a N-methyl-2-pyrrolidone (NMP) solution. The slurry was coated on copper foil and dried in a vacuum oven at 90 ^{o}C overnight prior to coin-cell assembly. The Li/MoS_2 coin cells, containing cathode electrode, metallic lithium, polypropylene separator, and electrolyte of 1 M solution of $LiPF_6$ in ethylene carbonate/dimethyl carbonate (EC/DMC) (1 : 1, vol.%), were assembled in a glove box (Mbraun, Germany). The galvanostatic charge/discharge performances of the electrodes were evaluated at room temperature using an Land Battery Tester (Land CT 2001A, Wuhan, China) within the voltage range of 0.01 V- 3 V (vs. Li/Li^+). The loading of the MoS_2 cathode material is about 1-2 mg in a diameter of 1 cm. Cyclic voltammetry (CV) was tested with an electrochemical workstation (CHI660C, China) at a scan rate of 0.1 mV s^{-1} in the voltage range of 0.01 V- 3 V (vs. Li/Li^+). The electrochemical impedan ce spectrometry (EIS) was performed on a ZAHNER-IM6ex electrochemical workstation (ZAHNER Co., Germany).

1. Y. Tian, Y. He and Y. Zhu, *Mater. Chem. Phys.*, 2004, **87**, 87.

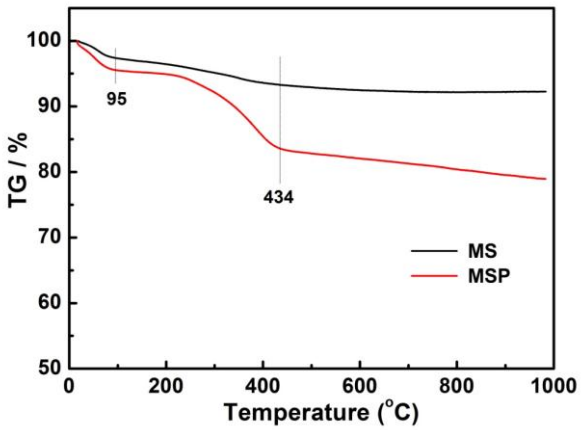

Figure S1. TG results of the as-prepared MoS_2 precursors calcined in Ar atmosphere at a ramping rate of 10 $^{o}C\ min^{-1}$.

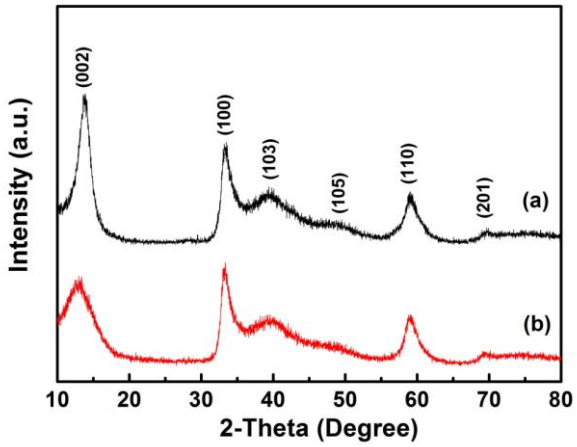

Figure S2. XRD patterns of the as-prepared MoS_2 precursors of MS (a) and MSP (b).

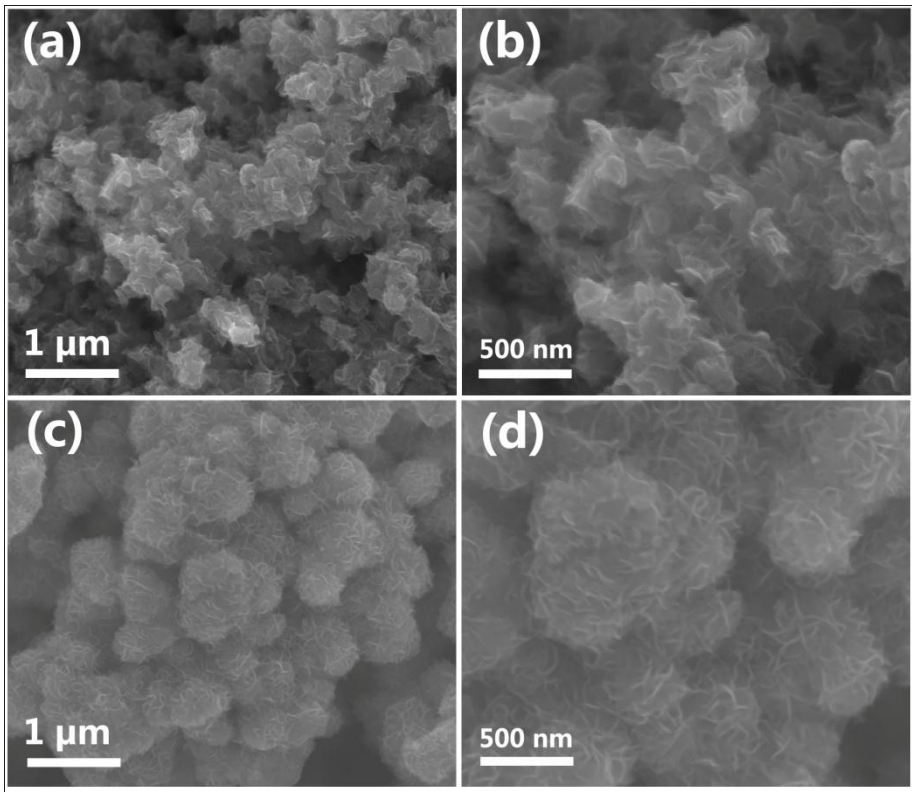

Figure S3. SEM images with different magnifications for the as-prepared MoS_2 precursors of MSP (a, b) and (c, d) MS.

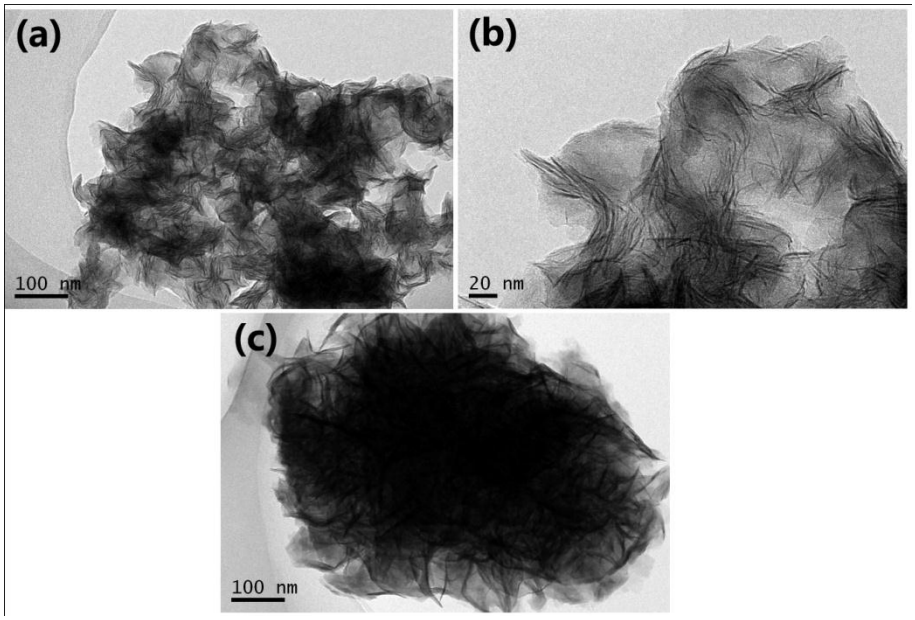

Figure S4. TEM images with different magnifications of MSP precursor (a, b) and TEM image of MS precursor (c).

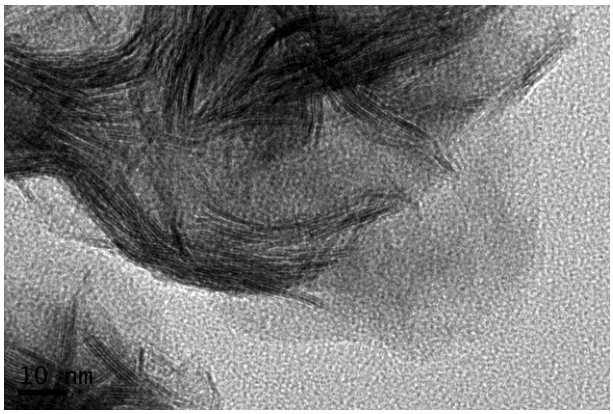

Figure S5. TEM image of MSP sample synthesized at 500 ^{o}C for 4 h in Ar atmosphere.

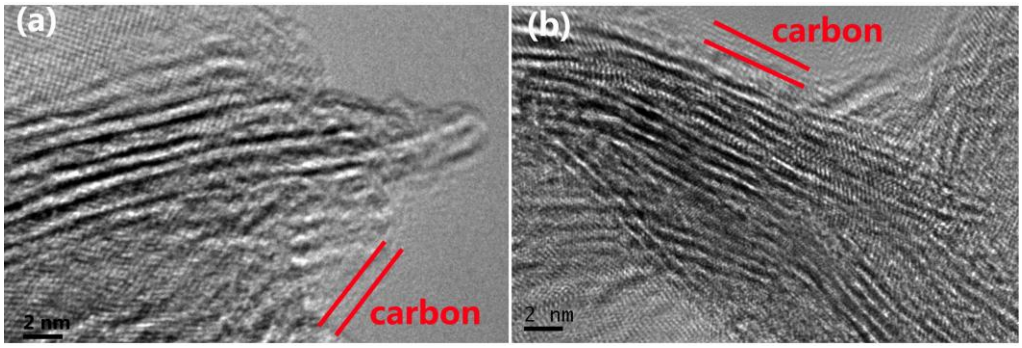

Figure S6. HR-TEM images of MSP precursor (a); MSP sample (b).

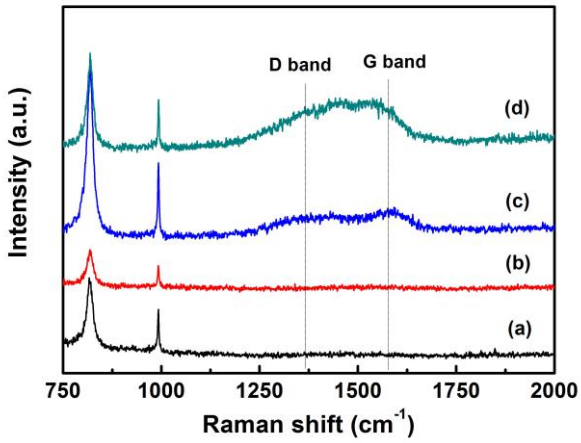

Figure S7. Raman spectrums of MS precursor (a); MS sample (b); MSP precursor (c); MSP sample (d).

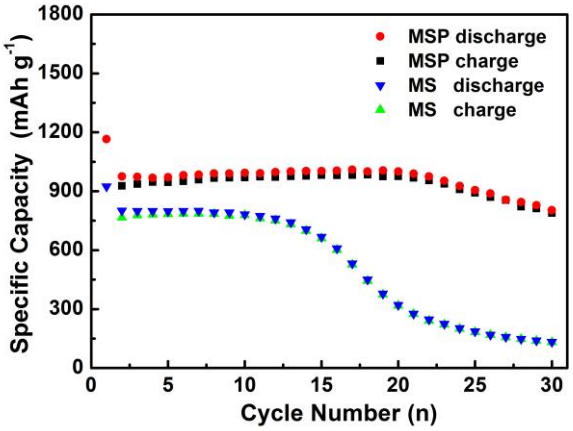

Figure S8. Cycling performances of the annealed products at 100 mA g^{-1}.

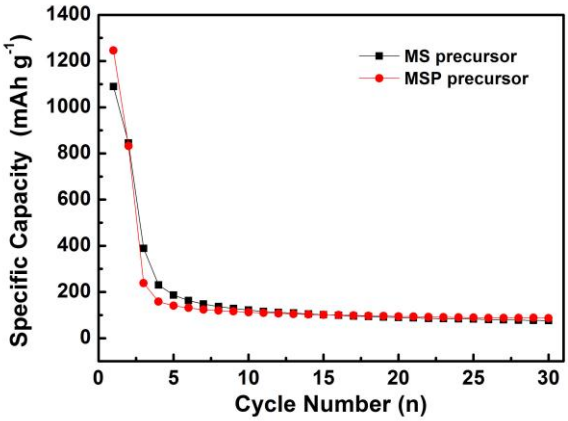

Figure S9 Cycling performance for MoS_2 products without sintering at 100 mA g^{-1}.