

Electronic Supplementary Information (ESI) for MoO₃ Nanowires as Electrochemical Pseudocapacitor Materials

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Experimental Section

Materials Synthesis. (NH₄)₆Mo₇O₂₄·4H₂O (Analytical pure, AR, Beijing Kebio Biotechnology Co., Ltd.) and l-Aspartic acid (>99%, Beijing Kebio Biotechnology Co., Ltd.) were used without further purification. In a typical synthesis, 23.8 mmol (NH₄)₆Mo₇O₂₄·4H₂O was dissolved in 20 ml mixed acid (1: 4 in volume) of 65-68% HNO₃ (65-68%, AR, Beijing Chemical Plant) and H₂O with stirring for 10 min and forming solution A. 9.2 mmol l-Aspartic acid was dissolved in 20 ml mixed acid (1:4 in volume) of 65-68% HNO₃ and H₂O with stirring for 10 min and forming solution B. Solution B was added into stirred solution A in 60 min at room temperature. The resulting mixture was transferred to and sealed in a Teflon-lined autoclave, heated to 240 °C and maintained at this temperature for 24 h. After the autoclave was cooled down to room temperature naturally, the products were collected via a centrifugal method washing with deionized water and ethanol for three time cycling, followed by drying at 80 °C for 4 h.

Materials Characterization. The X-ray powder diffraction measurement was carried out on a X-ray diffractometer (Druker D8 Advance) with Cu K_α radiation ($\lambda = 1.54056 \text{ \AA}$) in a 2θ range from 10° to 70°. The scanning electron microscopy (SEM) measurement was carried out on a KYKY-2000 instrument. Transmission electron microscopy (TEM) and high resolution electron microscopy (HRTEM) measurement was carried out on a JEOL JEM-2010 electron microscope, operating at 200 kV. Fourier transform infrared (FT-IR) spectra were obtained on a Nicolet 560 FT-IR spectrophotometer. Raman spectra (Renishaw, RM 1000) were measured with excitation from the 633 nm line of a He-Ne laser with a power of about 5 mW. Adsorption-desorption isotherms of nitrogen at 77 K were recorded on BET Micromeritics TriStar II 3020 equipment.

Waste water treatment experiment. In this experiment, rhodamine B (RhB) was used as organic pollutants, while the as-synthesized α -MoO₃ nanowires were used as adsorbents. RhB (1×10^{-5} mol/L, 60 mL) was mixed with the adsorbent (60 mg), respectively, and UV-vis absorption spectra (UNICO Corp., UV-2012 PC) were used to monitor the process at certain time intervals.

Electrochemical Measurement. The CV measurements were performed using a CHI 660B electrochemical analyzer interfaced to a computer system with corresponding electrochemical

software. The electrode was loaded with 5 mg of samples and tested in the potential range of 0-0.4 V. The galvanostatic charge/discharge experiments were carried out on a Newware battery testing system (Shenzhen Newware Technology Co., Ltd). and the galvanostatic charge/discharge curves were performed at current densities of 200, 400, 800 mA/g. For supercapacitor measurements, MoO₃ (5 mg) was compressed into foam nickel plates (2cm ×2 cm) under 12 Mpa pressure. Then the MoO₃ electrode was immersed into solution of 1M Na₂SO₄ solution for 8 h and then measured in a symmetric supercapacitor cells test.

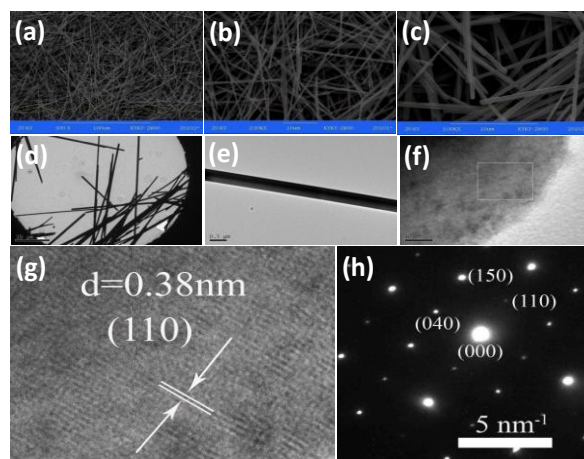


Fig. S1 SEM images of MoO₃ wires with different magnifying powers. A) Low magnification ($\times 500$) SEM image, b) mild magnification ($\times 2000$) SEM image, c) high magnification ($\times 5000$) SEM image. All these images show that the wires are uniform in size, i.e., monodisperse wires with ca. 64 μm in length and ~ 410 nm in diameter.

Fig. S1 shows the morphology of MoO₃ ultra-long wires. In the scanning electron microscopy (SEM) images, wire-like MoO₃ with diameters of ~ 410 nm (Fig. S1a–c) and lengths larger than 64 μm were observed. Furthermore, no metal particles were observed at the tip of MoO₃ wires, which is a common feature of wires which are grown catalyst-free. The crystal structures of the MoO₃ wires were further characterized by transmission electron microscopy (TEM) and high resolution transmission electron microscopy (HRTEM), as well as electron diffraction (ED) (Fig. S1d–h). According to Fig. S1e, we found the wires were smooth along the wire edge. As seen in Fig. S1f, the spacing between adjacent lattice planes stacked along the growth direction is ~ 0.38 nm, which corresponds to the distance of two (110) crystal planes. The ED pattern of the corresponding wires is shown in Fig. S1h, which demonstrates that the wires belong to a single crystal. The Brunauer–Emmett–Teller (BET) analysis based nitrogen adsorption and desorption isotherms and the corresponding Barret–Joyner–Halenda (BJH) pore-size distribution plot of the MoO₃ wires are shown in Fig. S2. The BET surface area of the MoO₃ wires was calculated from N₂ isotherms to be about 3.4077 m² g⁻¹ with an average pore size distribution of ca. 52.5 nm, which was derived from the described data. According to the adsorption isotherm of the MoO₃ wires, we can assign it as a type II isotherm, i.e., a multi-layer isotherm type of physical adsorption, which can be encountered in macroporous or non-porous powders such as oxides and carbons.

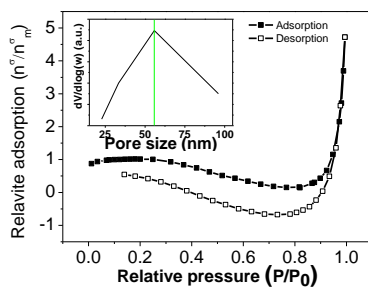


Fig S2. The N₂ adsorption-desorption isotherms for MoO₃ wires measured at 77 K. Adsorption values are shown as the ratio of the number of moles adsorbed, n^σ , to the amount required to cover the surface with a single monolayer, n^σ_m . Inset is the corresponding BJH pore size distribution curve.

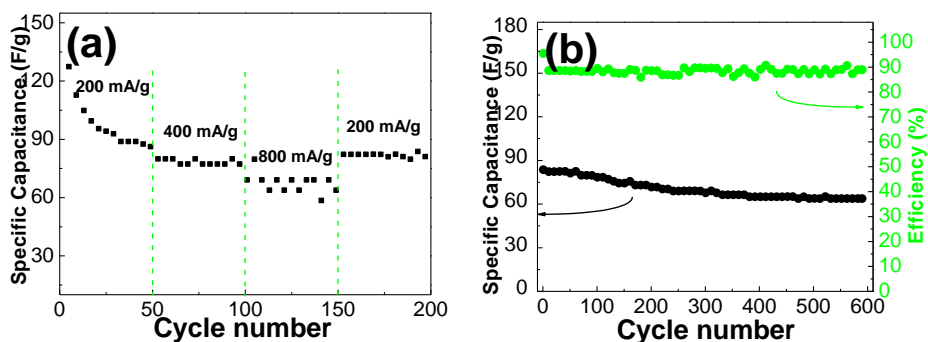


Fig S3. a) Variation of discharge specific capacitance of electrodes loaded with 5 mg of MoO₃@CNT at stepwise increasing current density of 200, 400, and 800 mA/g in the voltage from 0 to 0.3 V in 1M Na₂SO₄ aqueous solution. b) Cyclic performances of the discharge specific capacitance and efficient of electrodes loaded with 5 mg of MoO₃@CNT under current density of 200 mA/g in the voltage from 0 to 0.3 V in 1M Na₂SO₄ aqueous solution.