Supporting information

Experimental Section

Ammonium heptamolybdate ($(NH_4)_6Mo_7O_4$•4HO) and thiourea (NH_2CSNH_2) were used as the Mo and S sources, respectively, to synthesize MoS_2. In a typical synthesis of MoS_2-*x* (*x* = 0, 50, 100), 0.46 g $(NH_4)_6Mo_7O_4$•$4H_2O$ and 0.6 g NH_2CSNH_2 were dissolved in 60 mL deionized water, and then *x* mg SiO_2 nanospheres were dispersed in the mixture by ultrasonication. The resulting solution was then transferred into a 100 ml Teflon-lined stainless autoclave following by reacting at 200℃ for 16 h. The resultant products were collected, washed and ultrasonic re-dispersed to etch the SiO_2 nanospheres with NaOH (1 M) and immerse in the solution for 24 h, finally collected, washed with DI water untill about PH=7,dried in 50℃ for 24 h.

The morphology and structure as-synthesized products were characterized by scanning electron microscope (SEM, Hitachi, S-4800), and further investigations were performed by the use of transmission electron microscopy (TEM, JEOL, JEM-010) and high-resolution transmission electron microscopy (HRTEM).The Raman spectra were collected on a Raman spectrometer (Labram-010) using 632 nm laser. XRD was used to to examine the crystallographic structure and phase of samples and EDX was used to detected the composite of the MoS_2-50 and MoS_2-100 after SiO_2 etching.

The electrochemical measurements were carried out using a two-electrode system with 2032 type coin cells and the lithium metal as the counter and reference electrode at the room temperature. To prepare the working electrode, active materials (70 wt%), conductivity agent (20 wt%, carbon black, Super-P-Li) and binder (10 wt%, polyvinylidene fluoride (PVDF) in NMP (N-methyl--pyrrolidone) were mixed to prepare the slurry, which was coated on copper foil by a coating machine followed by drying at 80℃in air and then at 120℃ under vacuum for 8 hours. Finally, the resultant material was cut into 1mm small round pieces after the vacuum oven was cooled down to room temperature as the working electrode. The electrolyte was 1 M $LiPF_6$ dissolved in mixture of ethylene carbonate (EC): dimethyl carbonate (DMC): diethyl carbonate (DEC) =1:1:1 by volume. The working electrode, electrolyte, counter electrode, separator (Celgard 400) were assembled in an Argon-filled gloved box (Mikrouna, Super-MK100) with the concentration of oxygen and moisture below 1.0 and 0.1 ppm. Cyclic voltammetry (CV) profiles (0.01−3.0 V, 0.2 mV/s) were obtained on an electrochemical workstation (Metrohm-Autolab BV, Utrecht, The Netherlands). Galvanostatic charge/discharge cycles of the cells were conducted between 0.01 and 3.00 V *vs* Li/Li^+ on a LAND CT-001 Abattery cycler (Wuhan, China) at room temperature, Electrochemical impedance spectroscopy (EIS) was measured on an electrochemical workstation (Metrohm-Autolab BV, Utrecht, The Netherlands) over the frequency range of 100 kHz to 0.01 Hz.

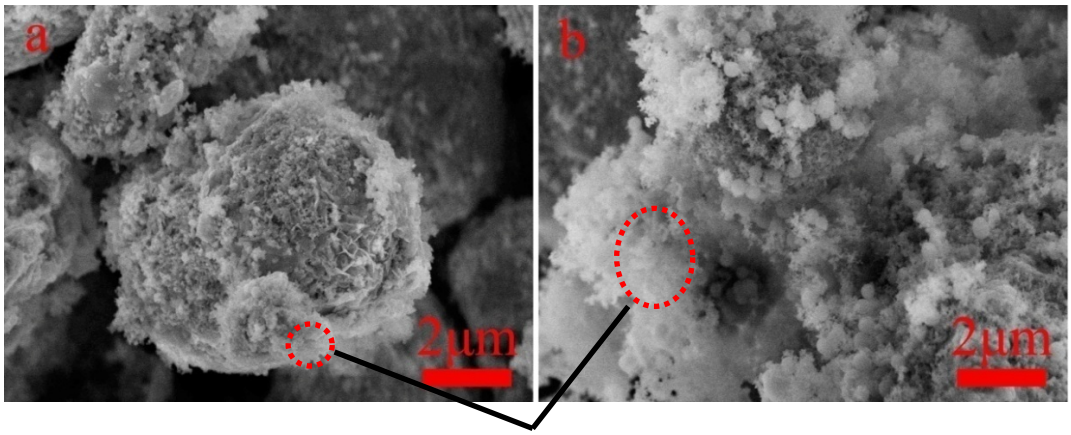

Figure S1 SEM images of as-prepared MoS_2-50 (a) and MoS_2-100 (b) before SiO_2 etching.

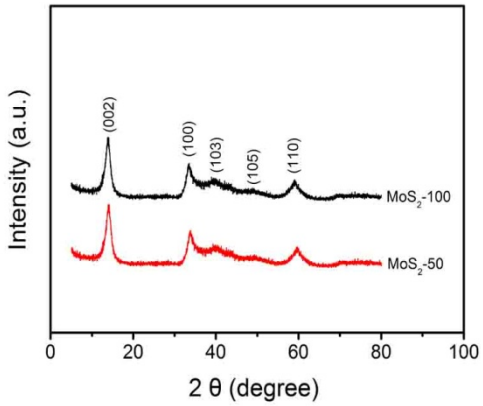

Figure S2 XRD patterns of MoS_2-50 and MoS_2-100

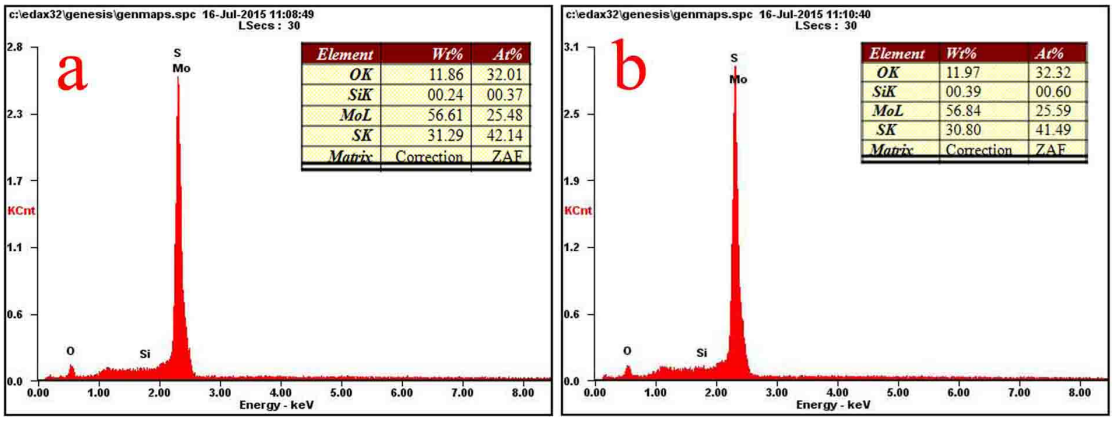

Figure S3 EDX images of as-prepared (a) MoS_2-50 and (b) MoS_2-100 after SiO_2 etching.

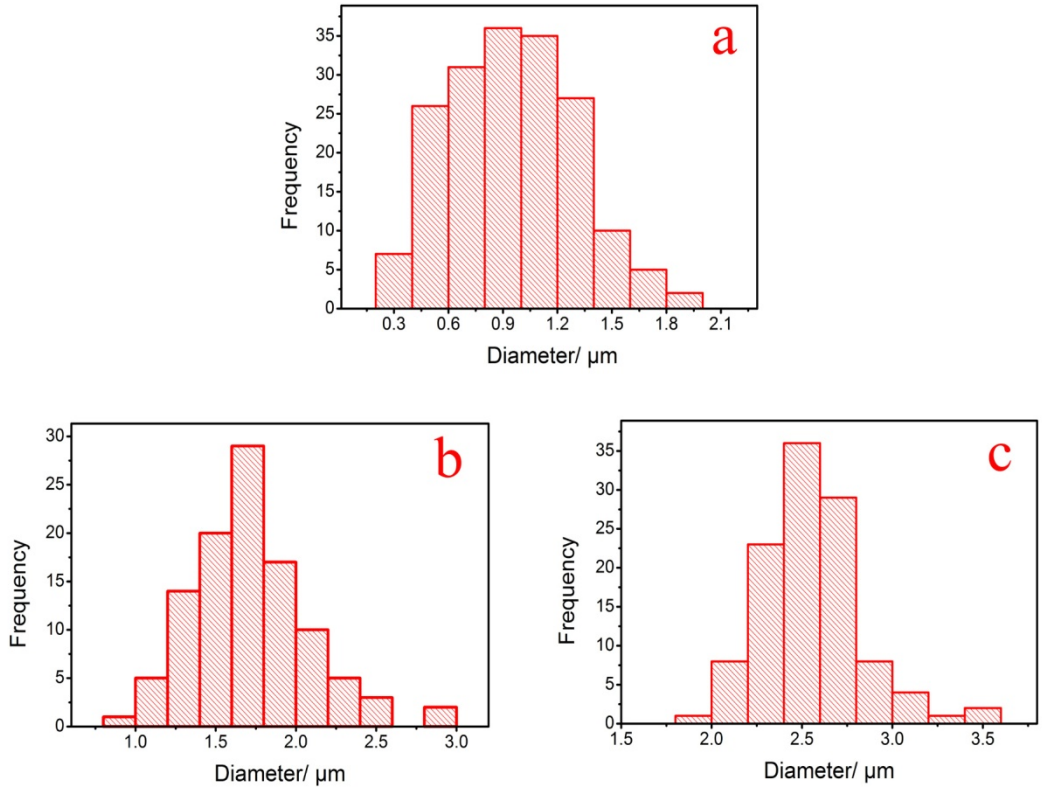

Figure S4 Histogram of the diameter distribution of MoS_2-0 (a), MoS_2-50 (b) and MoS_2-100 (c).

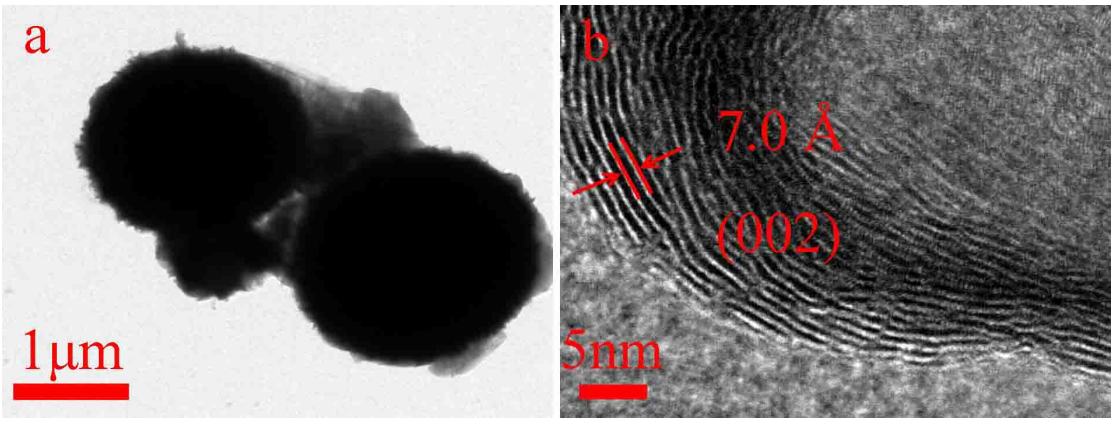

Figure S5 (a) TEM and (b) HRTEM of MoS_2-100

Method	First charge capacity (mAh/g)	First discharge capacity (mAh/g)	Reversible capacity after (*x*) cycles	Current density (mA/g)	Reference
SiO_2 assisted	**1065**	**1312**	**987 (100)**	**134**	**This work**
NaOH assisted	980	900	957 (50)	100	20
Carbon spheres template	-	-	750 (50)	100	22
Nanosheets self assemble	907	1236	902 (80)	100	19
MoS_2/Polyaniline	893	1127	801.2 (50)	100	21
polystyrene microsphere assisted	791	1160	672 (50)	100	31

Table S1 Performance comparison of different hierarchical MoS_2 in this paper and previously reported references.

Materials	First charge capacity mAh/g	First discharge capacity mAh/g	Reversible capacity after (*x*) cycles	Current density(mA/g)	Reference
MoS_2-50	**1065**	**1312**	**987 (100)**	**134 (0.2C)**	**This work**
MoS_2-50	**894.9**	**950.1**	**675.3 (100)**	**670 (1C)**	**This work**
Co_3O_4@Graphene	941	-	740 (60)	200 (0.2C)	32
SnO_2-RGO	-	1680	776 (70)	100	33
Cr_2O_3/carbon	-	812.6	465.5(150)	100	34
Graphene-Wrapped Fe_3O_4	770	-	580	700	35

Table S2 Performance comparison of MoS_2 in this paper and some other oxides based composite materials previously reported.