Supporting Information

Vertically Standing MoS$_2$/MoO$_x$ Heterojunction Nanosheets for Enhanced Visible-Light Photocatalytic Active and Photostability

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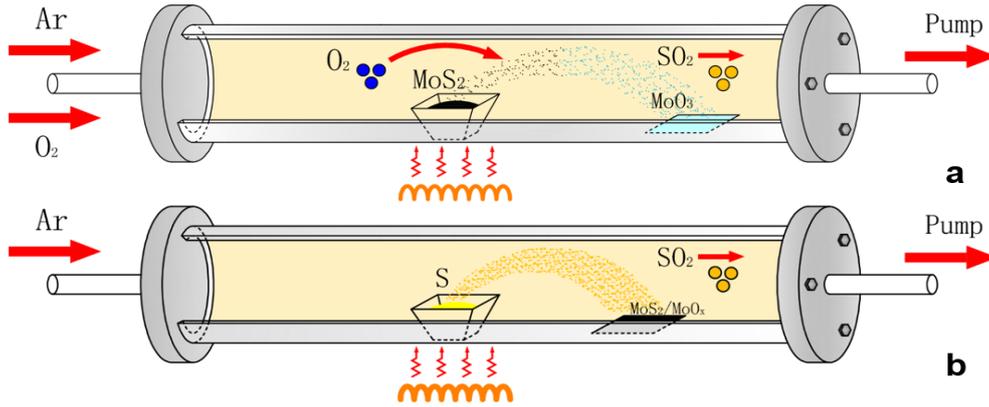
Fig. S1 Schematic illustration for the two–step CVD process: (a) the synthesis of MoO$_3$ nanosheets and (b) the assembly of MoS$_2$ coverage by sulfurizing MoO$_3$ templates.

The vertically oriented MoO$_3$ nanosheets were synthesized by chemical vapor deposition (CVD), then the core–shell heterostructured nanosheets were obtained by sulfidizing MoO$_3$ templates. For the high temperature CVD method, the metallic source was evaporated at the high temperature region and then drifted to deposit onto a substrate at the lower temperature region under flowing argon/oxygen gas. Herein, the growth mechanism of the vertical MoO$_3$ nanosheets may be based on the vapor–solid (VS) mechanism.[1] In the VS mechanism, the size of MoO$_3$ nanosheets is proportional to time and growth rate which depend on evaporation rate and system pressure. Theoretically, the formation of wire/belt-like nanostructures can be explained by the kinetics of crystal growth via the 2D nucleation probability,[2] which is expressed as $P_N = B\exp\left(-\dfrac{\pi\sigma^2}{k^2 T^2 \ln(\alpha)}\right)$, where P_N is a nucleation probability, B is a constant, σ is the surface energy of the solid whisker, k is the Boltzmann constant, T is the absolute temperature, and α is the supersaturation ratio defined as $\alpha = p/p_0$,

where p and p_0 is respectively vapor pressure and equilibrium vapor pressure corresponding to temperature T. A higher temperature and larger supersaturation ratio induce the sheet-like structure. By comparison, lower temperature and smaller supersaturation ratio facilitate the growth of a wire/rod-like structure. The evaporation rate and the system pressure could have effect on the growth via the vapor pressure in terms of the supersaturation ratio as seen in the 2D nucleation probability equation.
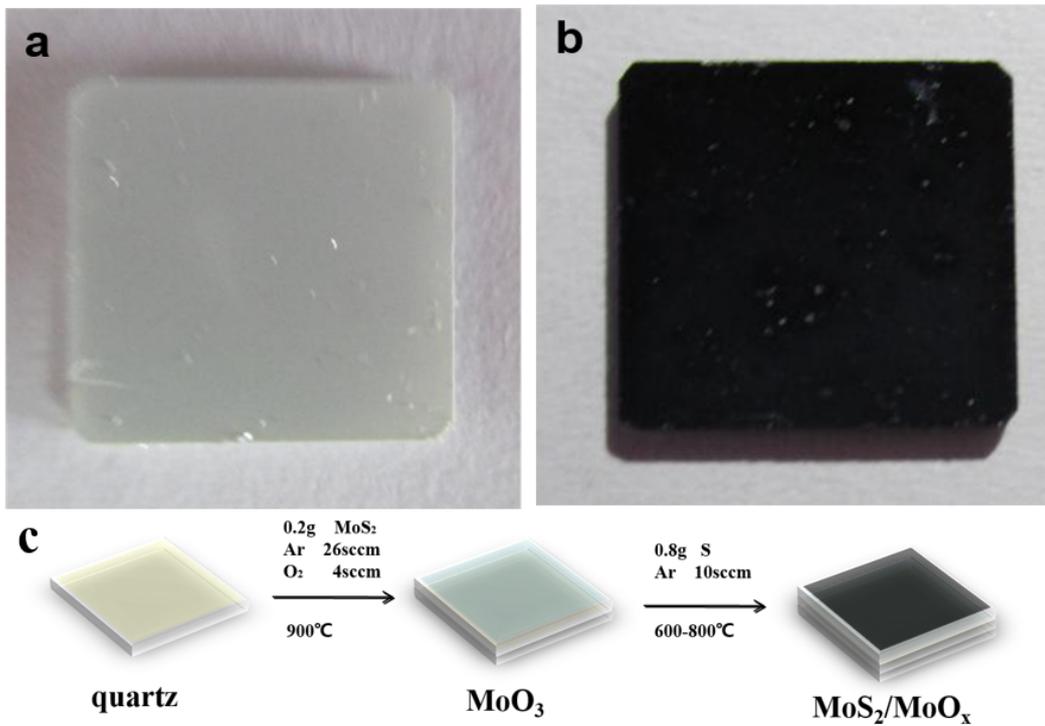
Fig. S2 Digital photographs of (a) MoO_3 and (b) MSO1 before and after the sulfidization. (c) Schematic illustration for the construction of MSO heterojunction.
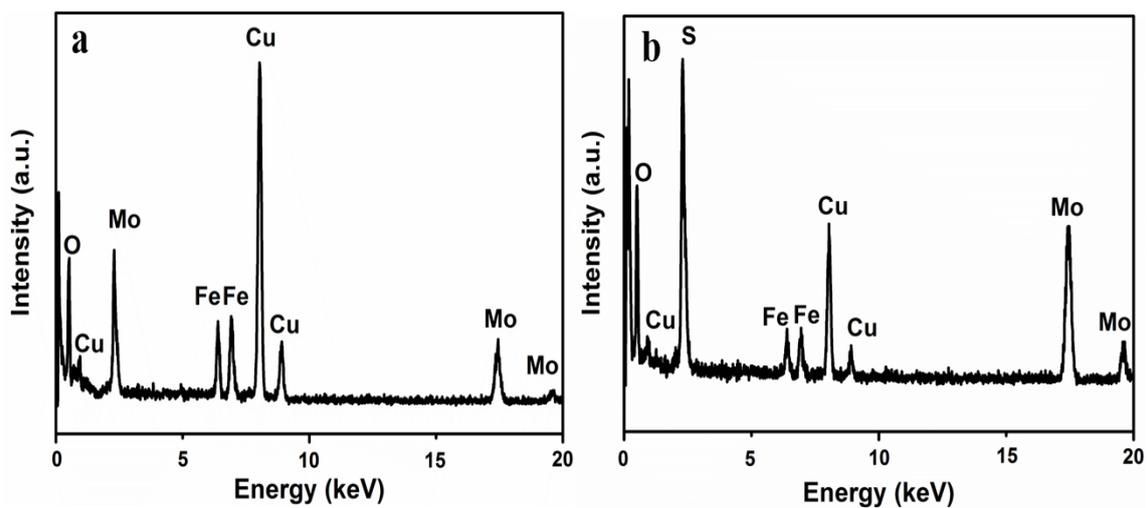
Fig. S3 EDS spectra acquired from the whole area of (a) MoO_3 and (b) MSO1 before

and after the sulfidization.
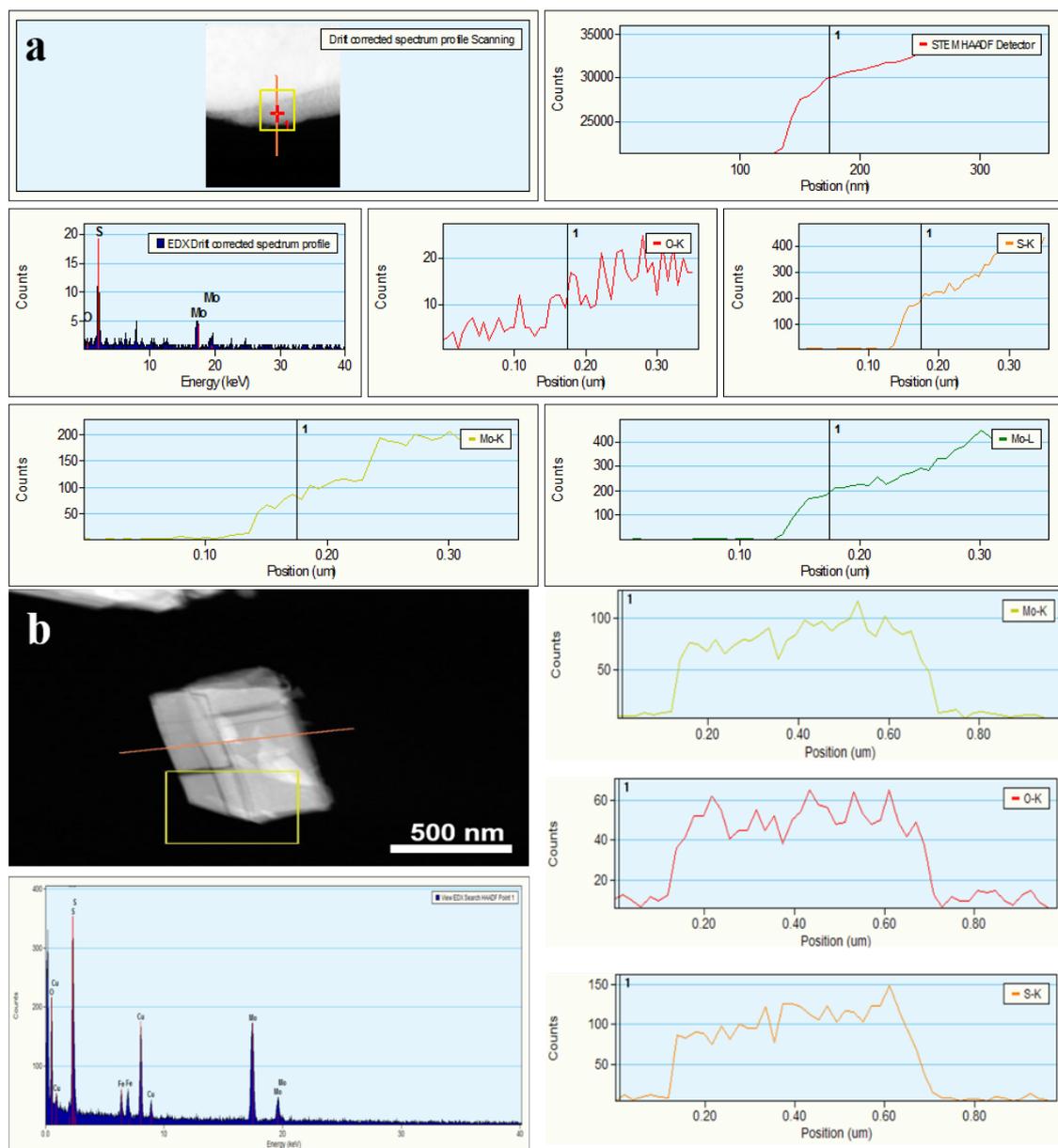
Fig. S4 The line-sweeping EDS spectra acquired from (a) the edge and (b) the surface areas of MSO1 after the sulfidization.

Time (min) \ PH=7	MoO₃	MSO₁	MSO₂	MSO₃	TiO₂	Blank
0	0.356	0.356	0.356	0.356	0.356	0.356
30	0.289	0.091	0.108	0.117	0.301	0.352
60	0.231	0.035	0.049	0.061	0.264	0.350
90	0.203	0.021	0.035	0.041	0.227	0.349
120	0.184	0.011	0.021	0.028	0.211	0.349

Table S1 The absorbance intensities of RhB aqueous solution at its typical wavelength of 553 nm with the illumination time for different photocatalysts.

a

PH Time（min）	2	5	7	9	12
0	0.317	0.334	0.356	0.378	0.393
30	0.310	0.294	0.289	0.347	0.379
60	0.274	0.251	0.231	0.321	0.367
90	0.249	0.227	0.203	0.314	0.351
120	0.247	0.224	0.184	0.308	0.349

b

PH Time（min）	2	5	7	9	12
0	0.317	0.334	0.356	0.378	0.393
30	0.126	0.117	0.091	0.197	0.214
60	0.097	0.090	0.035	0.149	0.171
90	0.058	0.051	0.021	0.109	0.121
120	0.031	0.025	0.011	0.087	0.119

Table S2 The absorbance intensities of RhB aqueous solution at its typical wavelength of 553 nm with the illumination time at different PH values for (a) MoO_3 and (b) MSO1 before and after the sulfidization.

Repeat times Time（min）	0	1	2	3	4
120	0.011	0.018	0.020	0.033	0.038

Table S3 The absorbance intensities of RhB aqueous solution at its typical wavelength of 553 nm after the illumination of 120 min in five sequential recycles for MSO1 after the sulfidization.

Reference

1 S. Phadungdhitidhada, P. Mangkorntong, S. Choopun, N. Mangkorntong and D. Wongratanaphisan, *Mater. Lett.* 2011, **65**, 568.

2 Z. R. Dai, Z. W. Pan and Z. L. Wang, *Adv. Funct. Mater.* 2003, **13**, 9.