Supporting Information

Ultrasmall few-layered MoS₂ nanosheets anchored on flower-like hierarchical carbon as a long-life electrode for lithium storage

Xiongwei Wang[1], Ludan Zhang[2], Peiyi Wu[1]*

[1]State Key Laboratory of Molecular Engineering of Polymers, Department of Macromolecular Science, Fudan University, Shanghai 200433, China

[2]Department of Chemistry, Laboratory for Advanced Materials, Fudan University, Shanghai 200438, P. R. China
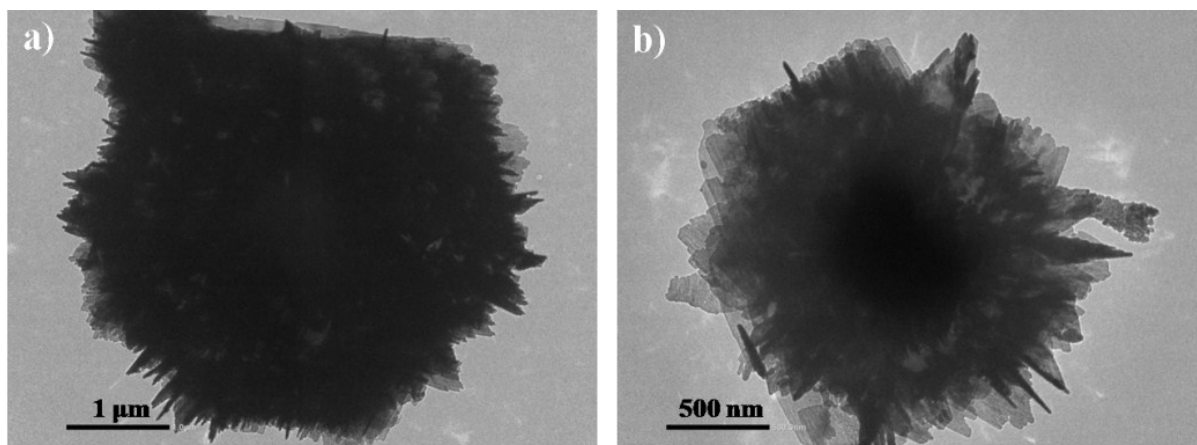
E-mail：peiyiwu@fudan.edu.cn

1

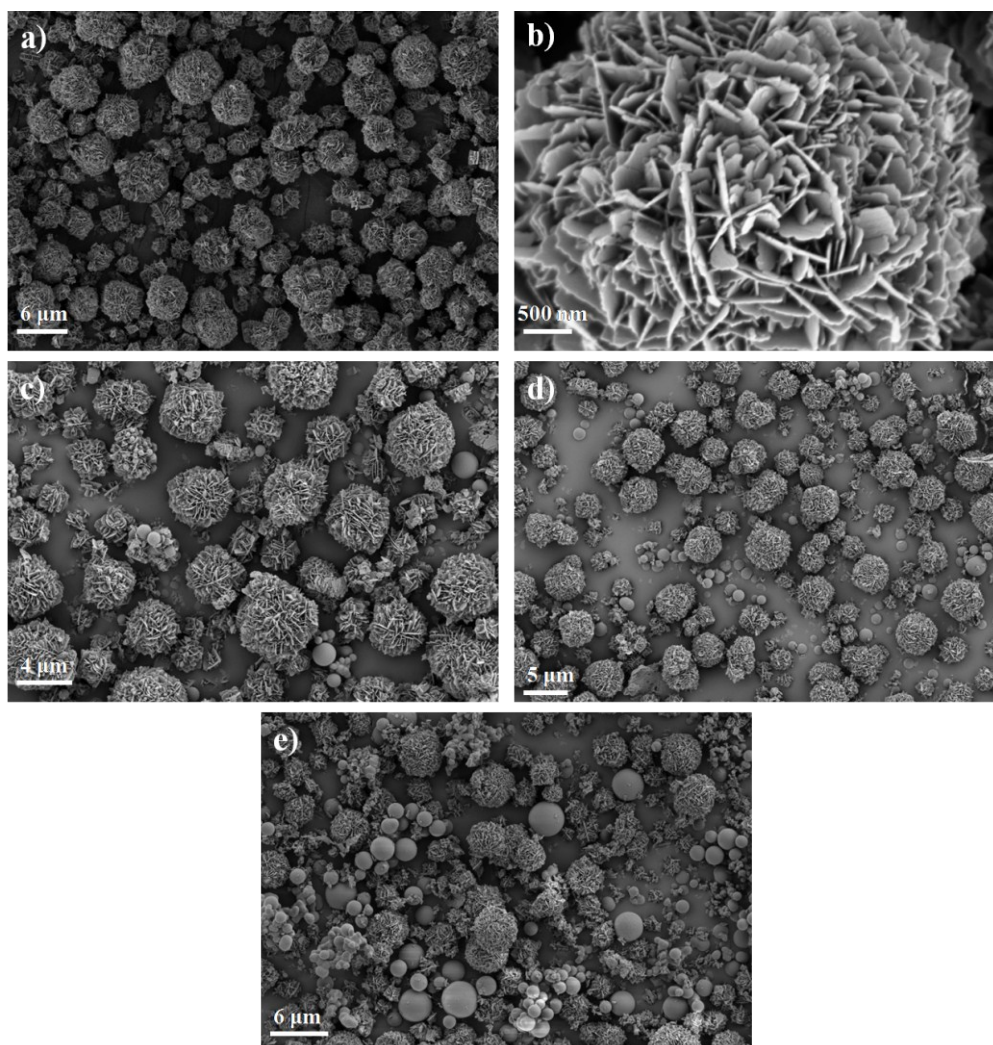**Fig. S1** TEM images of ZnO (a) and ZnO@HTC carbon (b)

Fig. S2 SEM images of ZnO@HTC carbon prepared by hydrothermal treatment of the mixture with different ratio of ZnO to glucose: (a,b) 1:1, (c) 1:1.5, (d) 1:2, (e) 1:2.5
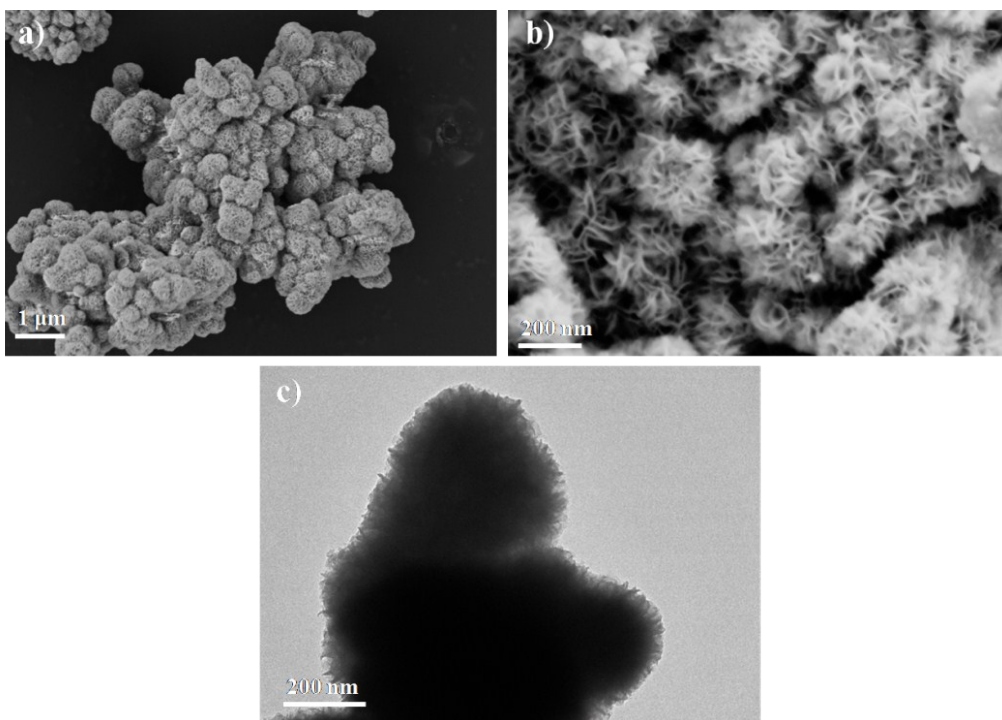
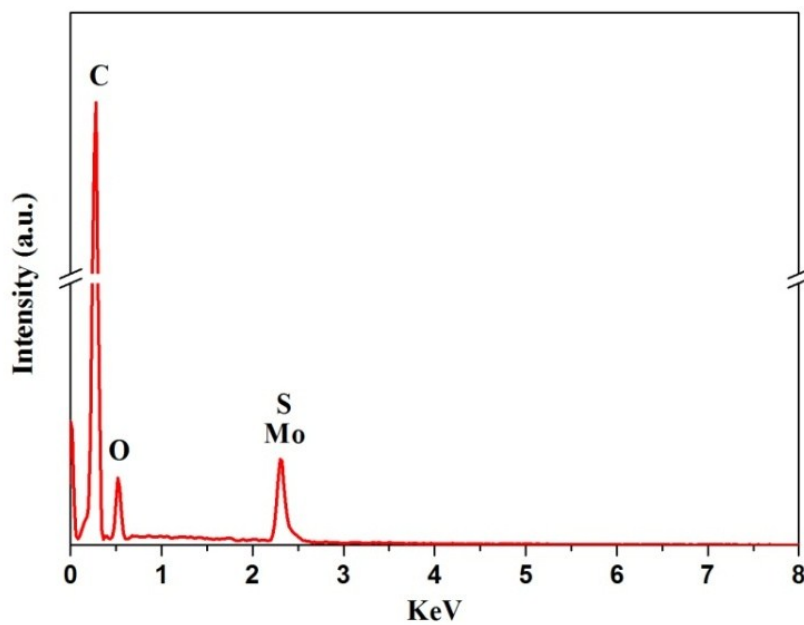**Fig. S3** SEM images (a,b) and TEM image (c) of bare MoS$_2$ nanosphere

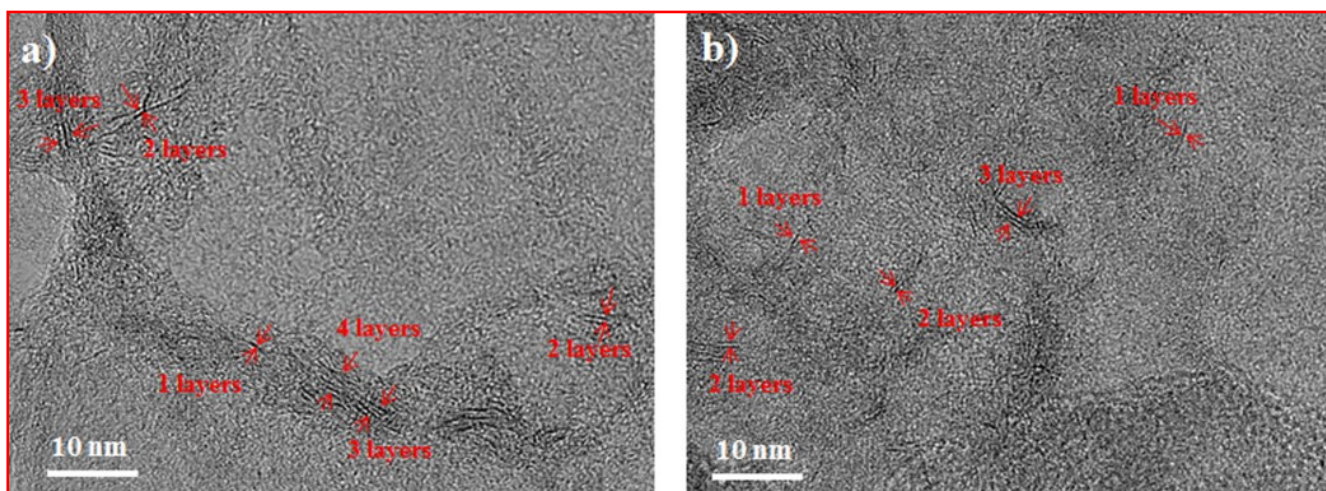**Fig. S4** Energy dispersive X-ray spectroscopy (EDX) of FC-22MoS$_2$ hybrid

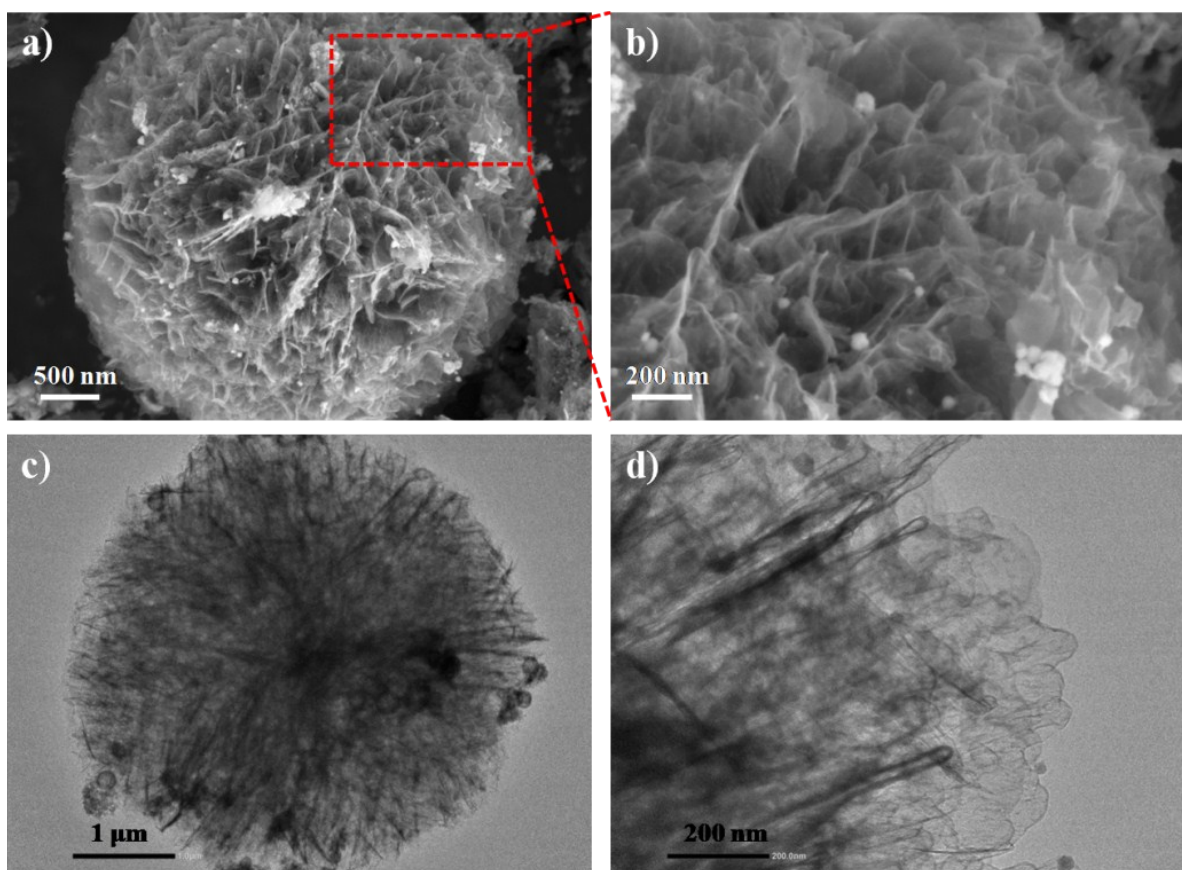**Fig.S5** High-resolution TEM images of FC-22MoS$_2$ hybrid

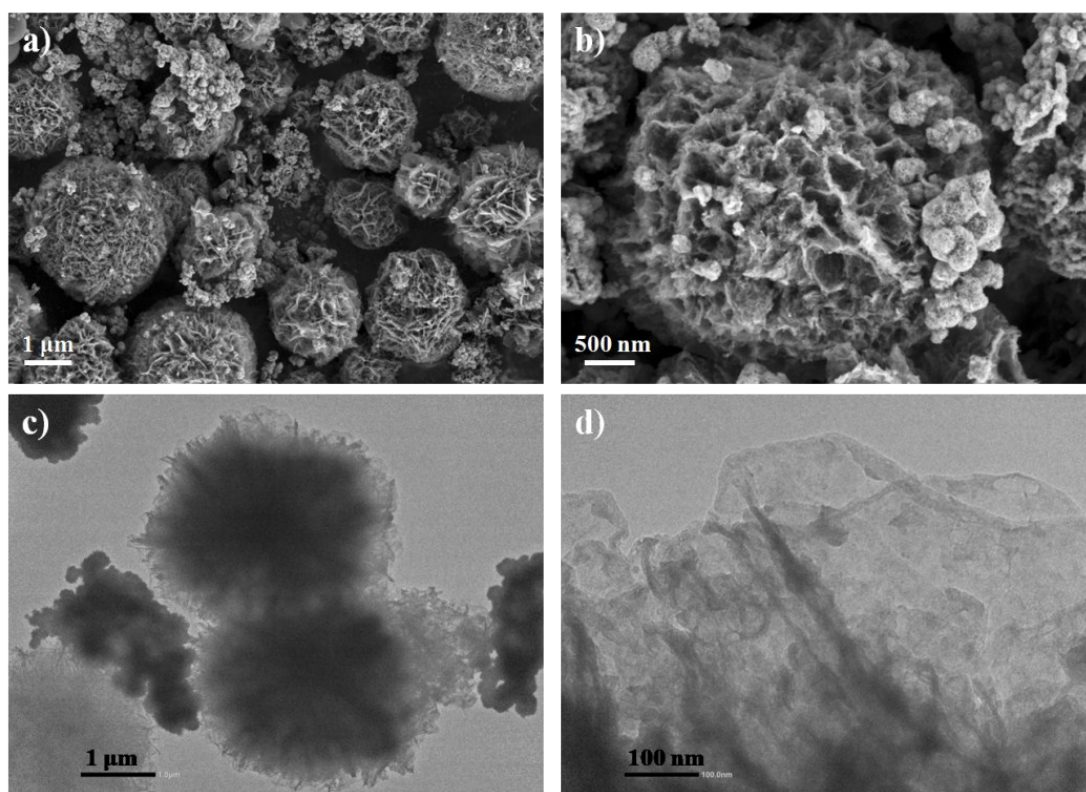**Fig. S6** SEM images (a,b) and TEM images (c,d) of FC-10MoS$_2$ hybrid

Fig. S7 SEM images (a,b) and TEM images (c,d) of FC-40MoS$_2$ hybrid

Table S1. MoS$_2$ percentage in FC-MoS$_2$ hybrids measured by ICP

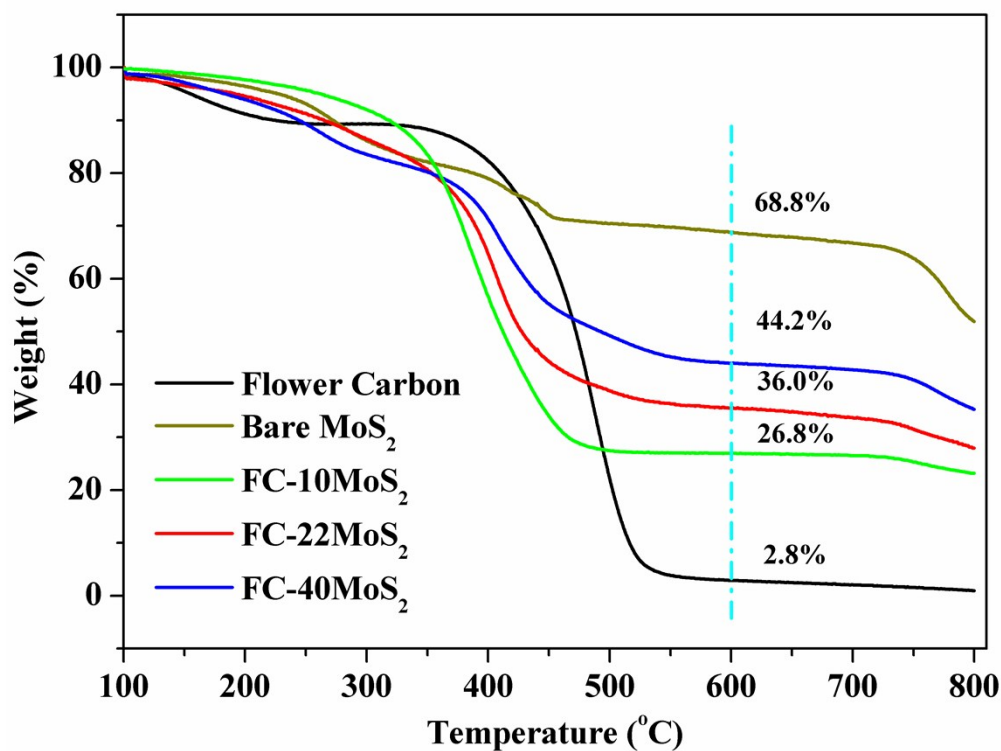| Sample ID	Sample mass (mg)	Concentration of Mo element (250 ml) (mg/L)	MoS$_2$ percentage (wt%)
FC-10MoS$_2$	30.3	23.1	31.8
FC-22MoS$_2$	30.0	35.6	49.4
FC-40MoS$_2$	31.5	45.5	60.1

Fig. S8 TGA curves of pure FC, bare MoS_2 nanosphere, FC-10MoS_2, FC-22MoS_2 and FC-40MoS_2
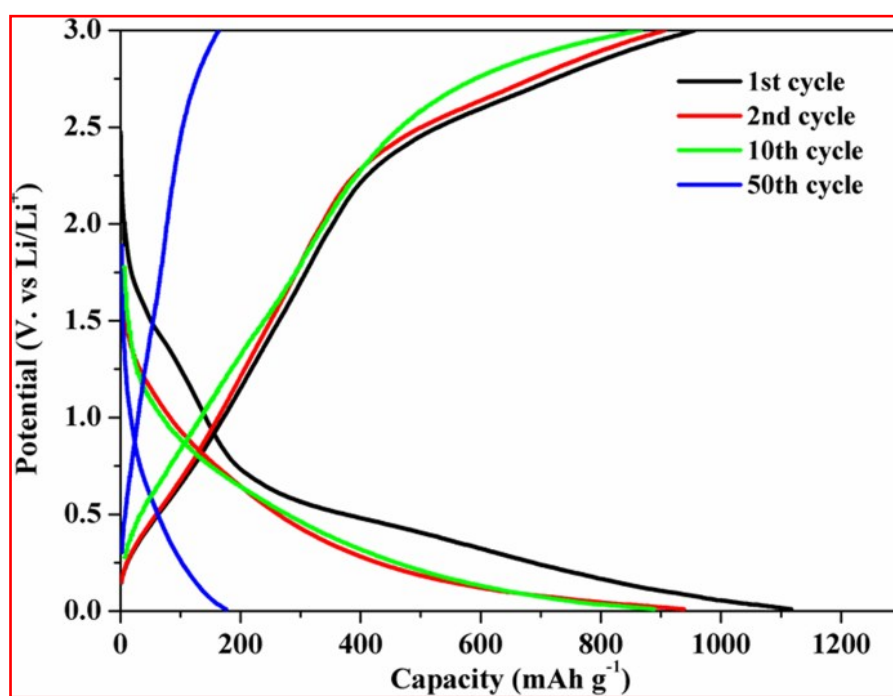

Fig. S9 Discharge-charge profiles of 1 st, 2 nd, 10th and 50th cycle of bare MoS_2 NPs.
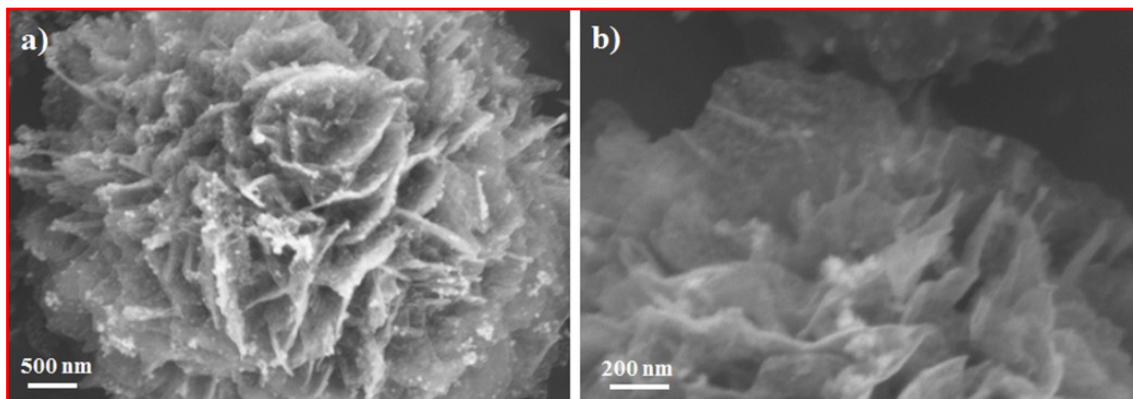
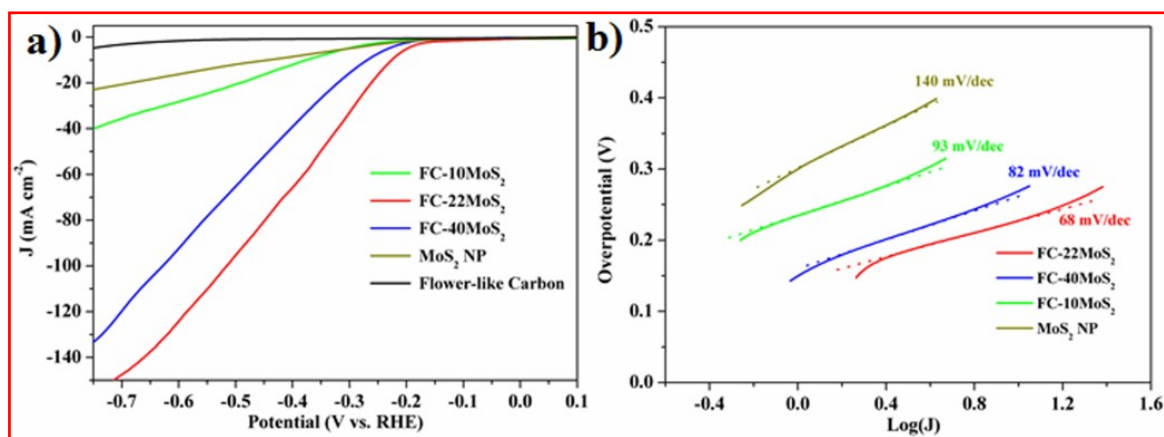**Fig. S10** FESEM images of the FC-22MoS$_2$ anode after 50 cycles at 200 mA g^{-1}.

Fig. S11 (a) LSV polarization curves of FC, MoS$_2$ NPs, FC-10MoS$_2$, FC-22MoS$_2$ and FC-40MoS$_2$ hybrids and (b) corresponding Tafel curves.
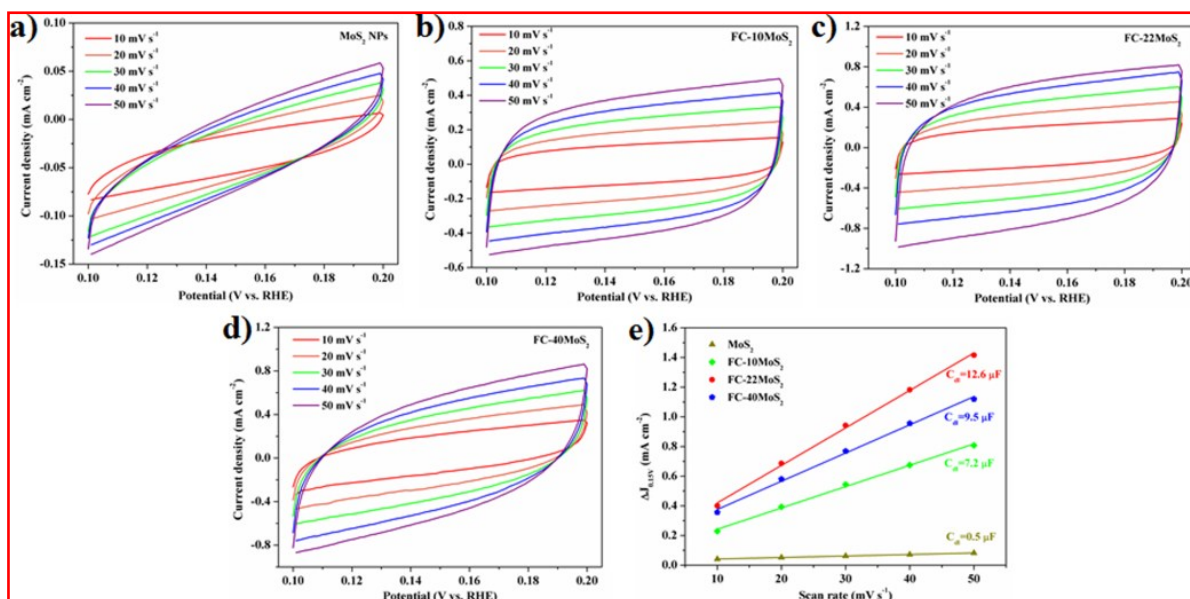
Fig. S12 Cyclic voltammograms of MoS_2 NPs (a), FC-10MoS_2 (b), FC-22MoS_2 (c) and FC-40MoS_2 (d) modified GCE at various scan rates from 10 to 50 mV s^{-1}. (e) Linear fitting for the capacitive current Δ_J at 0.15 V vs scan rates.

Table S2. Summary of representative MoS_2 based nanocomposites for HER performance in acidic media

| Typical examples	Onset potential (mV)	Tafel slope (mV/dec)	Reference
MoS_2/3D flower-like carbon	~110	65	**This work**
MoS_2/carbon nanofiber foam	~120	44	**[1]**
MoS_2/graphene aerogel	107	86.3	**[2]**
MoS_2 nanosheets/CNTs	90	44.6	**[3]**
MoS_2 nanoflowers/rGO paper	~190	95	**[4]**
MoS_2 /N-doped carbon nanofiber	108	61	**[5]**
MoS_2/nanoporous metal	125	41	**[6]**
MoS_2/N-doped graphene	~115	45	**[7]**
MoS_2/N-doped carbon nanoboxes	~100	55	**[8]**
MoS_2/graphene	~130	41	**[9]**
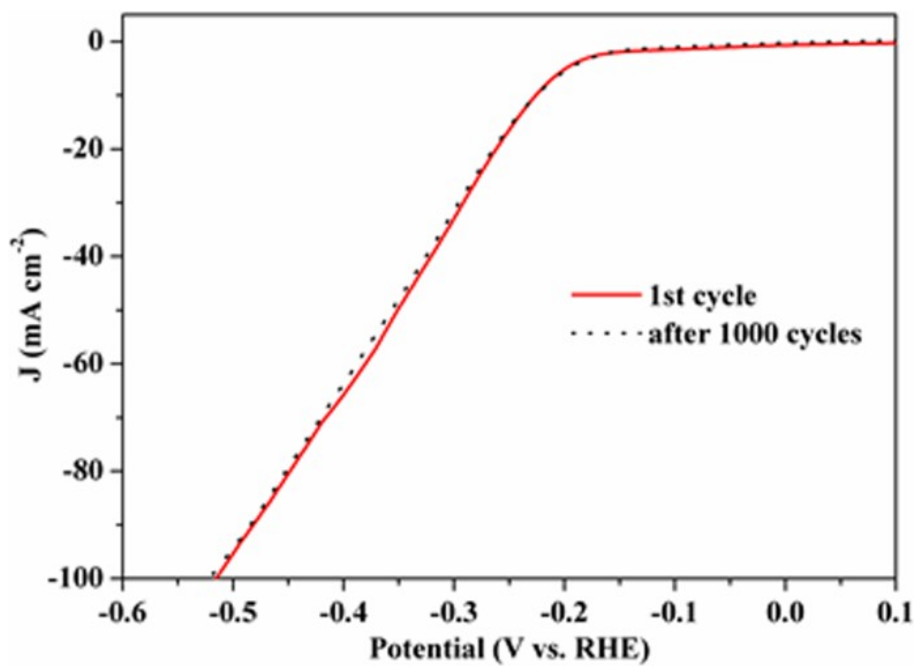
Fig. S13 HER polarization curves before and after 1000 cycles for FC-22MoS$_2$.
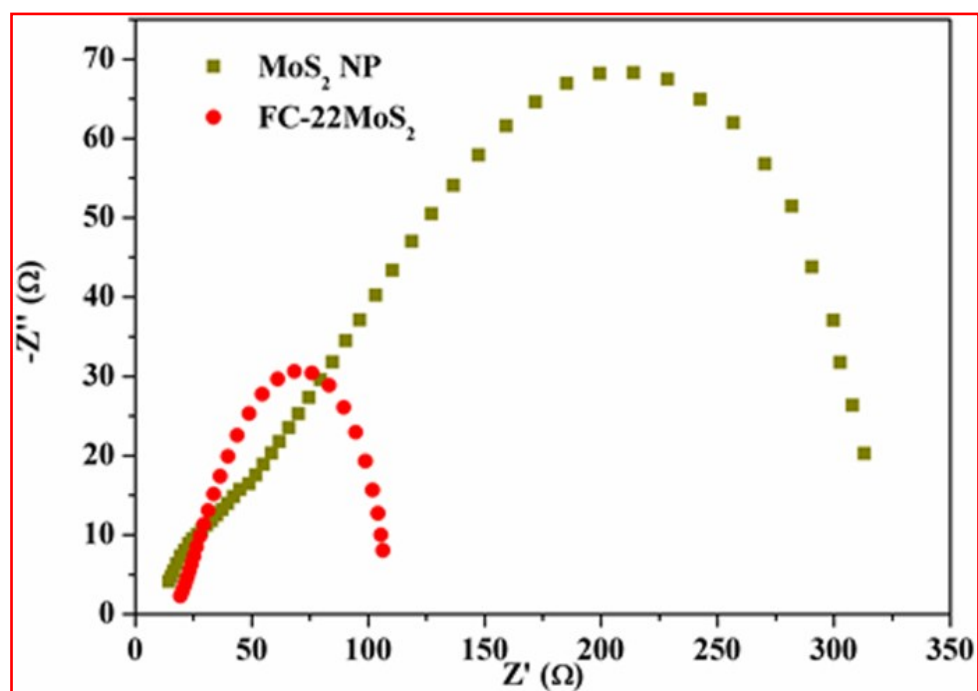

Fig. S14 AC impedance spectroscopy of MoS$_2$ NPs and FC-22MoS$_2$ hybrid at an overpotential of 0.35 V.

Reference

1. Guo, X.; Cao, G.-l.; Ding, F.; Li, X.; Zhen, S.; Xue, Y.-f.; Yan, Y.-m.; Liu, T.; Sun, K.-n., J. Mater. Chem. A, 2015, 3, 5041-5046.

2. Zhou, W.; Zhou, K.; Hou, D.; Liu, X.; Li, G.; Sang, Y.; Liu, H.; Li, L.; Chen, S., ACS Appl. Mater. Interfaces, 2014, 6, 21534-21540.

3. Yan, Y.; Ge, X.; Liu, Z.; Wang, J.-Y.; Lee, J.-M.; Wang, X., Nanoscale, 2013, 5, 7768-7771.

4. Ma, C.-B.; Qi, X.; Chen, B.; Bao, S.; Yin, Z.; Wu, X.-J.; Luo, Z.; Wei, J.; Zhang, H.-L.; Zhang, H., Nanoscale, 2014, 6, 5624-5629.

5. Lai, F.; Miao, Y.-E.; Huang, Y.; Zhang, Y.; Liu, T., ACS Appl. Mater. Interfaces, 2015, 8, 3558-3566.

6. Ge, X.; Chen, L.; Zhang, L.; Wen, Y.; Hirata, A.; Chen, M., Adv. Mater., 2014, 26, 3100-3104.

7. Dai, X.; Li, Z.; Du, K.; Sun, H.; Yang, Y.; Zhang, X.; Ma, X.; Wang, J., Electrochim. Acta, 2015, 171, 72-80.

8. Yu, X.-Y.; Hu, H.; Wang, Y.; Chen, H.; Lou, X. W., Angew. Chem. Int. Ed., 2015, 54, 7395-7398.

9. Zheng, X.; Xu, J.; Yan, K.; Wang, H.; Wang, Z.; Yang, S., Chem. Mater., 2014, 26, 2344-2353.