Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Electronic Supplementary Information

Self-assembly of MoO_3-decorated carbon nanofiber interlayer for high-performance lithium–sulfur batteries

Huilan Li, Xiaofei Wang, Chu Qi, Chengcheng Zhao, Cuimei Fu, Lina Wang* and Tianxi Liu

State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Innovation Center for Textile Science and Technology, Donghua University, Shanghai 201620, China

Corresponding Author

*E-mail: linawang@dhu.edu.cn

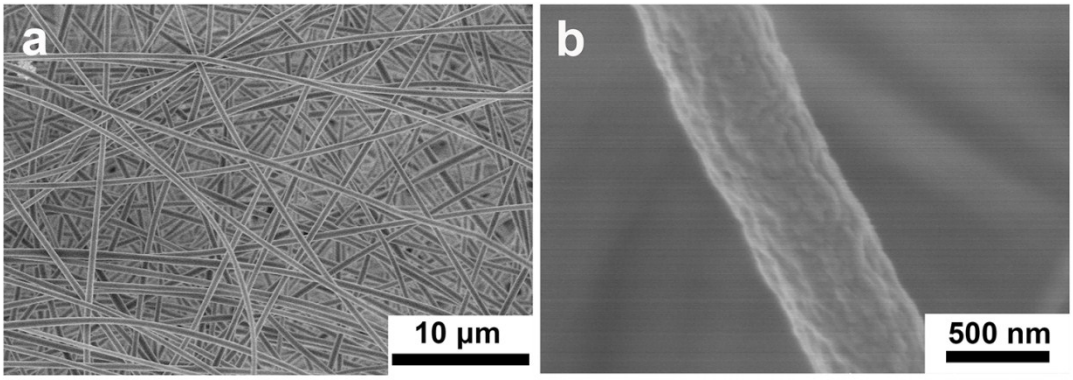

Fig. S1 SEM images of PAN nanofibers at (a) low and (b) high magnifications.

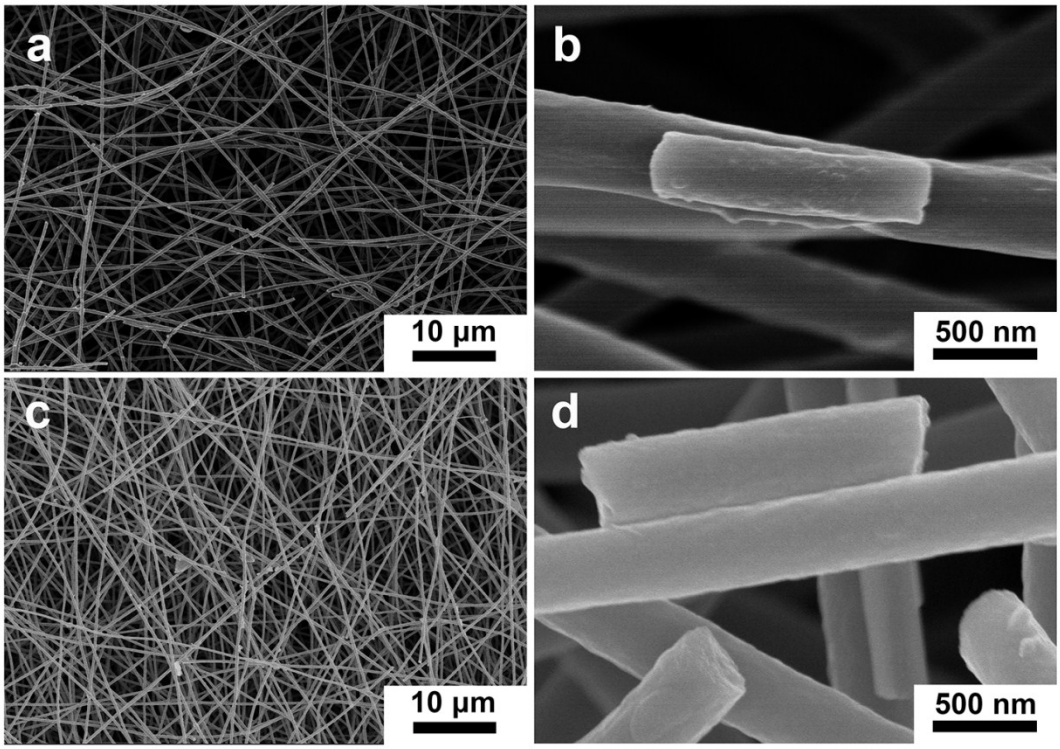

Fig. S2 SEM images of (a, b) MoO_3/CNF-1 and (c, d) MoO_3/CNF-3 membranes.

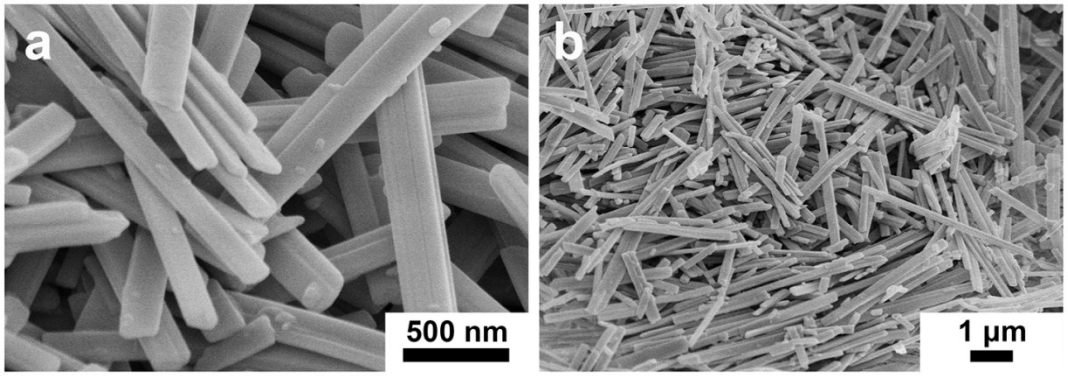

Fig. S3 SEM images of pure MoO_3 nanorods at (a) low and (b) high magnifications.

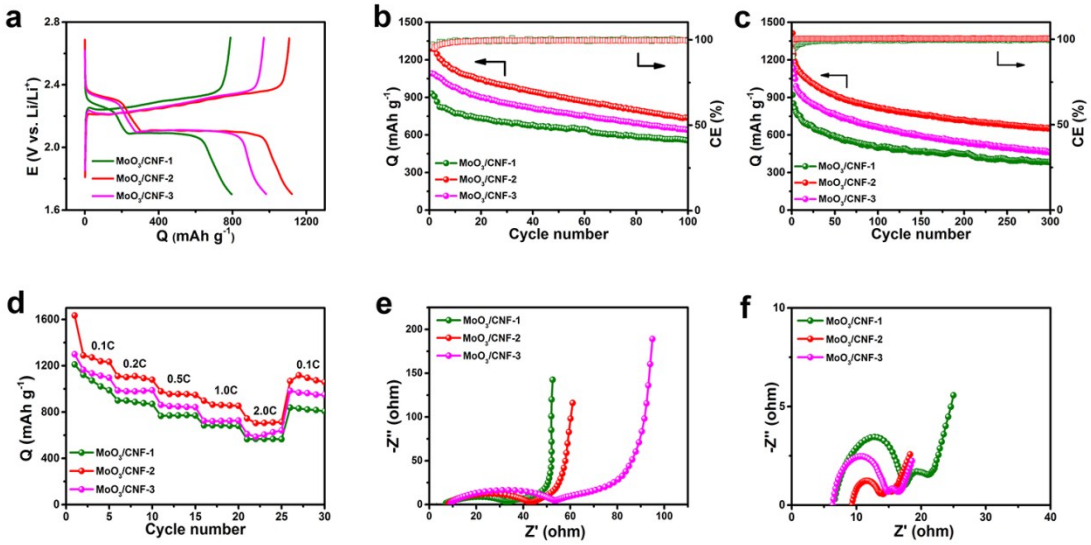

Fig. S4 Electrochemical properties of Li–S batteries with MoO_3/CNF-1, MoO_3/CNF-2, and MoO_3/CNF-3 interlayer. (a) Typical galvanostatic discharge–charge profiles upon the 10th cycle at 0.2 C. (b) Cycling performance at 0.2 C. (c) Cycling performance at 0.5 C. (d) Rate performance. EIS spectra of the cells (e) before cycling and (f) after 500 cycles at 1 C.

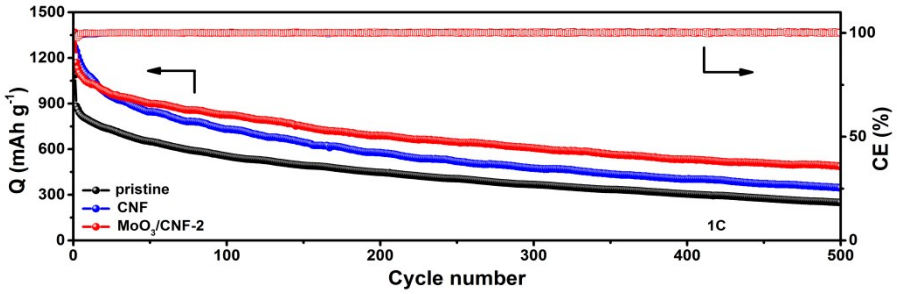

Fig. S5 Cycling performance of cells without interlayer, with a CNF or MoO_3/CNF-2 interlayer at 1 C.

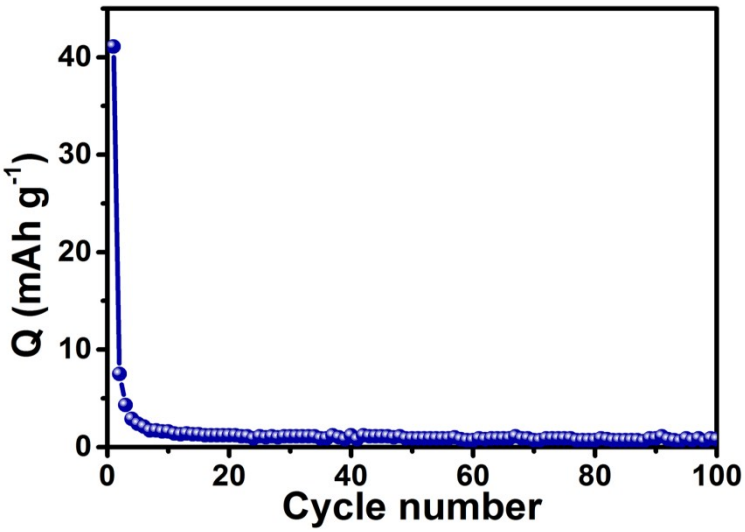

Fig. S6. Cycling performance of the cell using the MoO_3/CNF-2 membrane as the cathode and a Li-metal anode.

Table S1. EIS fitted parameters of fresh Li−S cells without interlayer, with a CNF or MoO_3/CNF-2 interlayer.

Fresh Li−S cells	**pristine**	**CNF**	**MoO_3/CNF-2**
R_e (Ω)	4.10	5.31	7.81
CPE_{ct} (F cm^{-2} s^{n-1})	$2.51*10^{-5}$	$3.81*10^{-5}$	$1.86*10^{-5}$
n	0.68	0.68	0.79
R_{ct} (Ω)	47.38	35.86	35.20

R_e is the Ohmic resistance of the electrolyte. R_{ct} stands for the interfacial charge transfer resistance. CPE (constant phase element) denotes the capacitance of the component. n is the CPE exponent. When n = 1, the CPE becomes a pure capacitance. When n < 1, it represents a leaking (non ideal) capacitor. CPE_{ct} arises from the double-layer capacitance.

Table S2. EIS fitted parameters of Li−S cells without interlayer, with a CNF or MoO_3/CNF-2 interlayer after 500 cycles.

Cycled Li−S cells	**pristine**	**CNF**	**MoO_3/CNF-2**
R_e (Ω)	12.21	9.15	9.12
CPE_{ct} (F cm^{-2} s^{n-1})	$3.78*10^{-5}$	$1.25*10^{-4}$	$1.89*10^{-4}$
n	0.76	0.64	0.66
R_{ct} (Ω)	8.99	8.74	4.68
CPE_f (F cm^{-2} s^{n-1})	0.014	0.025	0.030
n	0.46	0.48	0.43
R_f (Ω)	17.26	5.97	4.17

R_e, R_{ct}, and R_f stand for the Ohmic resistance of the electrolyte, the interfacial charge transfer resistance, and the Li-diffusion resistance in the surface film, respectively. CPE_{ct} arises from the double-layer capacitance. CPE_f represents the capacitance on the surface film.

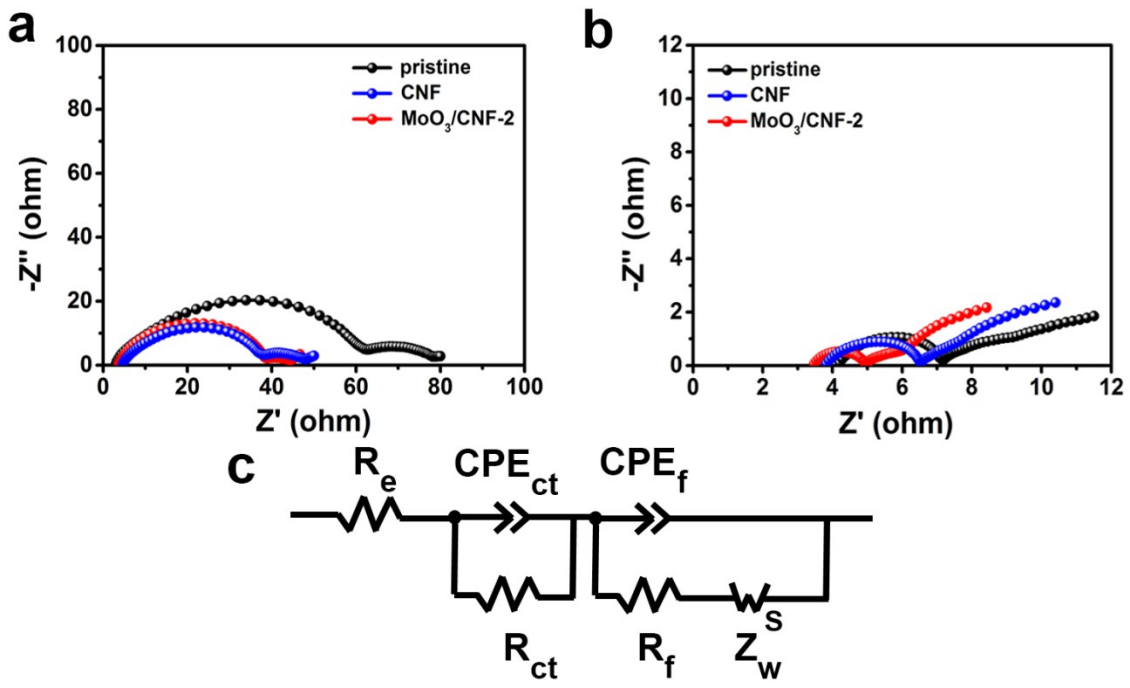

Fig. S7. EIS spectra of Li|Li symmetric cells with/without interlayer (a) before and (b) after cycling for 400 h at 0.5 mA cm^{-2}, 1 mAh cm^{-2}. (c) The equivalent circuit used to simulate EIS curves.

Table S3. EIS fitted parameters of fresh symmetric Li|Li cells without interlayer, with a CNF or MoO_3/CNF-2 interlayer.

Fresh Li|Li cells	**pristine**	**CNF**	**MoO_3/CNF-2**
R_e (Ω)	2.79	4.56	3.75
CPE_{ct} (F cm^{-2} s^{n-1})	$1.23*10^{-5}$	$1.87*10^{-5}$	$1.02*10^{-5}$
n	0.74	0.75	0.83
R_{ct} (Ω)	60.96	34.65	35.01
CPE_f (F cm^{-2} s^{n-1})	$3.19*10^{-3}$	$4.42*10^{-3}$	$1.05*10^{-2}$
n	0.59	0.54	0.44
R_f (Ω)	23.80	16.78	13.05

The meaning of each component is mentioned above.

Table S4. EIS fitted parameters of cycled symmetric Li|Li cells without interlayer, with a CNF or MoO_3/CNF-2 interlayer.

Cycled Li|Li cells	**pristine**	**CNF**	**MoO_3/CNF-2**
R_e (Ω)	4.25	3.89	3.52
CPE_{ct} (F cm^{-2} s^{n-1})	$7.15*10^{-5}$	$1.71*10^{-4}$	$1.18*10^{-4}$
n	0.83	0.78	0.85
R_{ct} (Ω)	2.92	2.69	1.44
CPE_f (F cm^{-2} s^{n-1})	0.089	0.19	0.17
n	0.59	0.60	0.57
R_f (Ω)	4.16	4.07	2.23

The meaning of each component is mentioned above.