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High-conductivity 1T-MoS_2 catalysts anchored on a carbon fiber cloth for high-performance lithium-sulfur batteries

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Table S1. The weight of bare CFC, 2H-MoS_2@CFC, and 1T-MoS_2@CFC

Weight (mg)	1	2	3	4	5	6	Average weight (mg)
Bare CFC	13.89	13.59	13.83	13.75	13.93	13.74	13.79
2H-MoS_2@CFC	15.83	15.75	15.87	15.88	15.78	15.67	15.79
1T-MoS_2@CFC	15.93	15.82	15.91	15.88	15.80	15.84	15.86

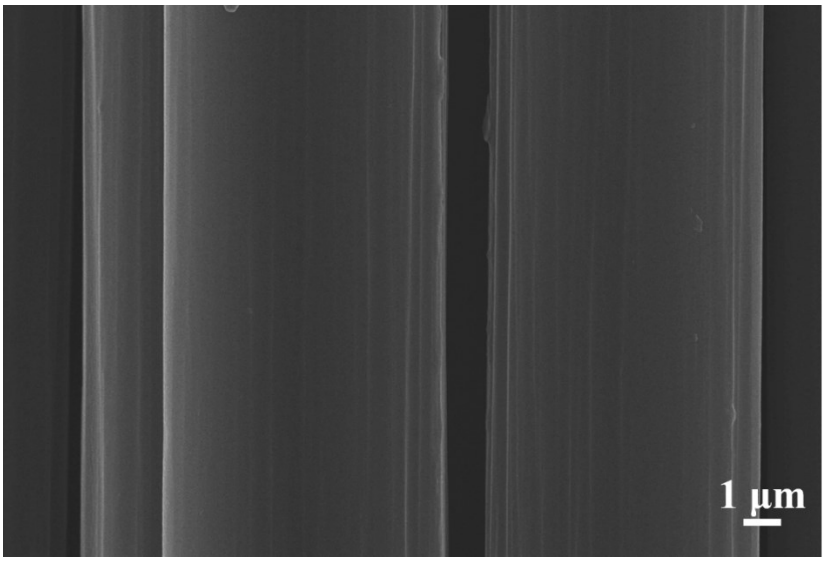

Fig. S1. SEM images of bare CFC.

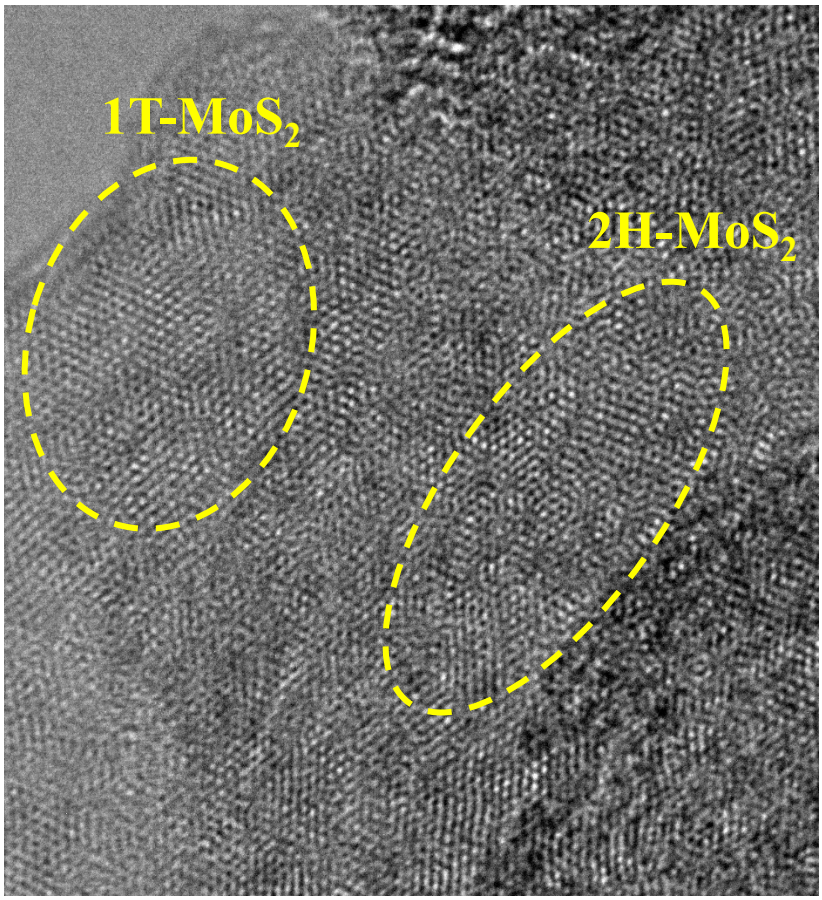

Fig. S2. HTEM images of 1T-MoS_2@CFC.

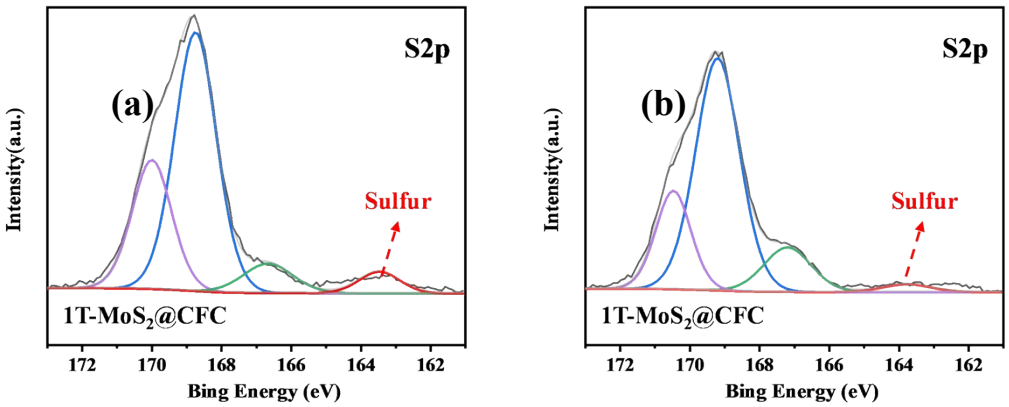

Fig. S3. XPS high-resolution spectra for S 2p of the cathodes taken out from the batteries charged to 2.8V with (a) 2H-MoS_2@CFC and (b) 1T-MoS_2@CFC

The XPS characterization of the cathodes which were charged to 2.8V and were taken out from batteries with 1T-MoS_2@CFC and 2H-MoS_2@CFC, were performed as shown in Fig S3. The peaks during 171eV to 166eV belonged to sulphate species, and the peak at 163.9eV corresponded to elemental sulfur. It was seen that the cathode facing 1T-MoS_2@CFC had more sulfur, indicating that more polysulfides were converted into S, and the reversibility was better. This was due to the fact that the surface and Mo-terminated edges of 1T MoS_2 offered stronger anchor sites for Li_2S, a lower barrier of Li–S decomposition, and faster Li^+ migration than those for the 2H phase, which demonstrated the unique catalytic property of 1T MoS_2.

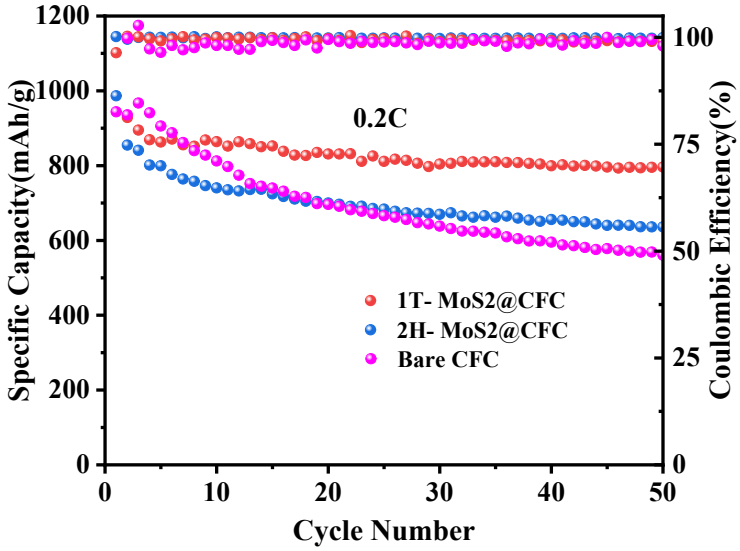

Fig. S4. Cycling performance of the Li–S batteries with Bare CFC, 2H-MoS_2@CFC and 1T-MoS_2@CFC interlayers at 0.2 C.

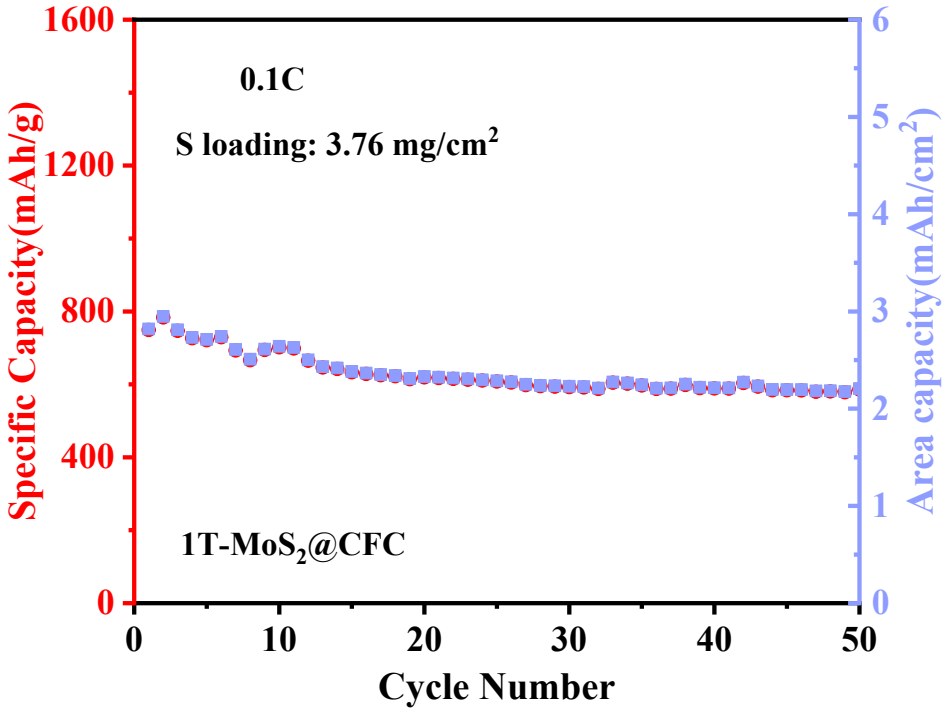

Fig. S5. Cycling performance of the Li–S batteries with 1T-MoS_2@CFC interlayer at a sulfur loading of 3.76mg/cm^2 at 0.1 C.

Battery with 1T-MoS_2@CFC interlayer still worked normally under high S loading, showing good cycling ability.

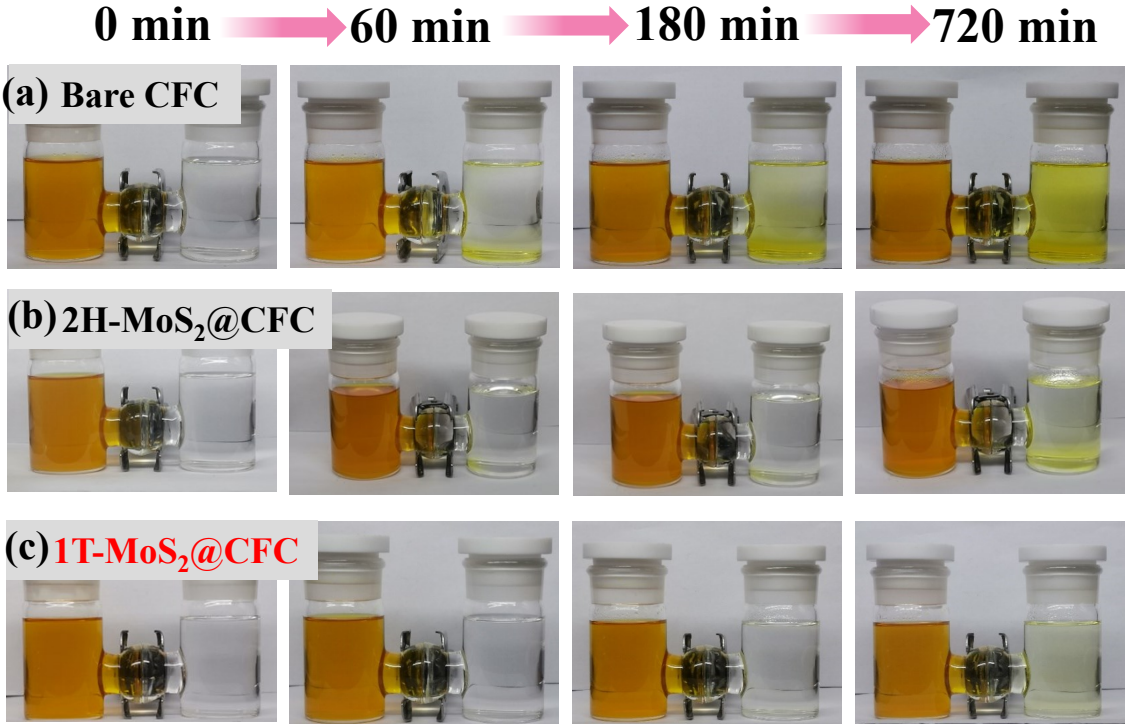

Fig. S6. Permeation test of Li_2S_6 with the (a) Bare CFC, (b) 2H-MoS_2@CFC (c) 1T-MoS_2@CFC interlayers.

In this experiment, the left side of the glass shell was the Li_2S_6 solution with a concentration of 0.05 mol L^{-1}, and the right side was the pure DOL solvent. As shown in Fig S6, the lithium polysulfides easily shuttled through the bare CFC interlayer to the right side only after 60 min, and the situation of 2H-MoS_2@CFC was better, while the other device with the 1T-MoS_2@CFC modified separator was still colorless. With the increase of time, the color of the device with CFC interlayer and 2H-MoS_2@CFC interlayer changed to dark yellow and light yellow respectively after 12 h. By contrast, the color of the device with 1T-MoS_2@CFC slightly changed, indicating that 1T-MoS_2@CFC effectively suppressed the shuttle effect of polysulfide (Fig S6).

Table S2. Comparison of the electrochemical performance of Li-S batteries with different MoS_2 systems.

Material	Synthesis method /solvent	the role of MoS_2	Specific initial capacity	Electrochemical performance	Reference
1T-MoS_2 nanosheets、WS_2、rGO	Liquid phase exfoliation /DI	Sulfur host	0.05C, 1140 mAh g^{-1}	0.5C, 300 cycles, 444.1 mAh g^{-1}	J. Colloid Interface Sci. 2019[1]
1T-MoS_2 nanodots、porous CF	Chemical Li-intercalation/n-butyllithium solution	Sulfur host	0.1C, 1156 mAh g^{-1}	0.5C, 300cycles, 620 mAh g^{-1}	J. Mater. Chem. A, 2020[2]
1T-MoS_2 nanosheets	Electrochemical exfoliation /DMF	Filter onto separator	0.2C, 1200 mAh g^{-1}	1C, 500cycles, ~670 mAh g^{-1}, CE=95%	J. Mater. Chem. A 2017[3]
2H-MoS_2 nanosheets、CNTP	Magnetron sputtering way	Self-supporting interlayer	0.5C, 1233 mAh g^{-1}	0.5C, 100cycles, 850 mAh g^{-1}	J. Electroanal. Chem.[4]
2H-MoS_2 powder	——	Coating separator	0.2C, 1246 mAh g^{-1}	0.2C, 100 cycles, ~950 mAh g^{-1}	Ceram. Int. 2019[5]
2H-MoS_2 nanoflowers、GO	Hydrothermal method/DI、annealing treatment	Coating separator	0.2A g^{-1}, 1642 mAh g^{-1}	0.2A g^{-1}, 100 cycles, 720 mAh g^{-1}	Electrochim. Acta 2017[6]
1T-MoS_2 nanoparticles、Super P	Hydrothermal method/DI	Coating separator	0.2C, 983 mAh g^{-1}	0.2C, 150 cycles, 525 mAh g^{-1}	Appl. Mater. Interfaces 2018[7]
1T-MoS_2、CFC	**Hydrothermal method/DI**	**Self-supporting interlayer**	**0.2C, 1170 mAh g^{-1}**	**0.5C, 400 cycles, 497 mAh g^{-1}, CE=100%**	**This work**

References

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