Supporting Information

Synergistic mediation for sulfur conversion in lithium-sulfur batteries by Gerber tree-like interlayer with multiple components

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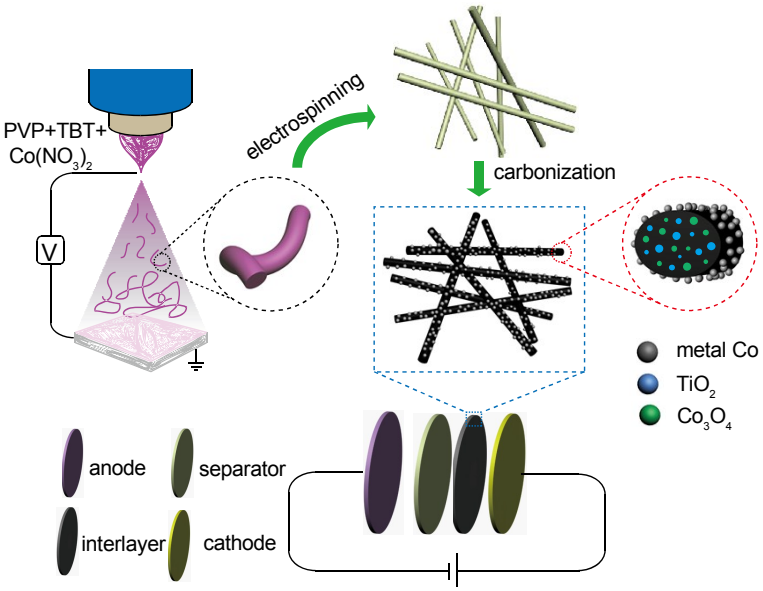

Fig. S1 The preparation process of multifunctional interlayer and the corresponding cell configuration.

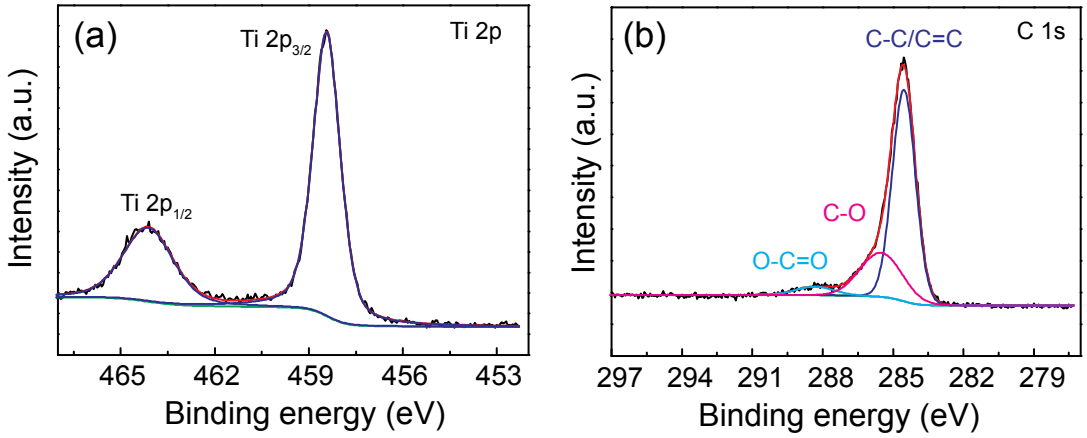

Fig. S2 (a) Ti 2p and (b) C 1s spectrum of the interlayer before cycle.

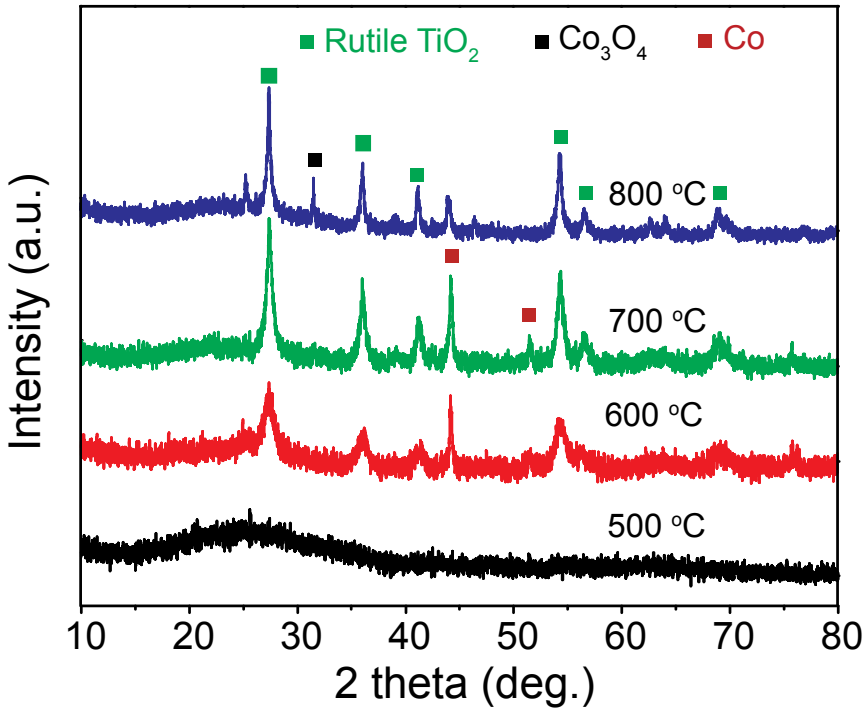

Fig. S3 The XRD patterns of the interlayers carbonized at different temperatures.

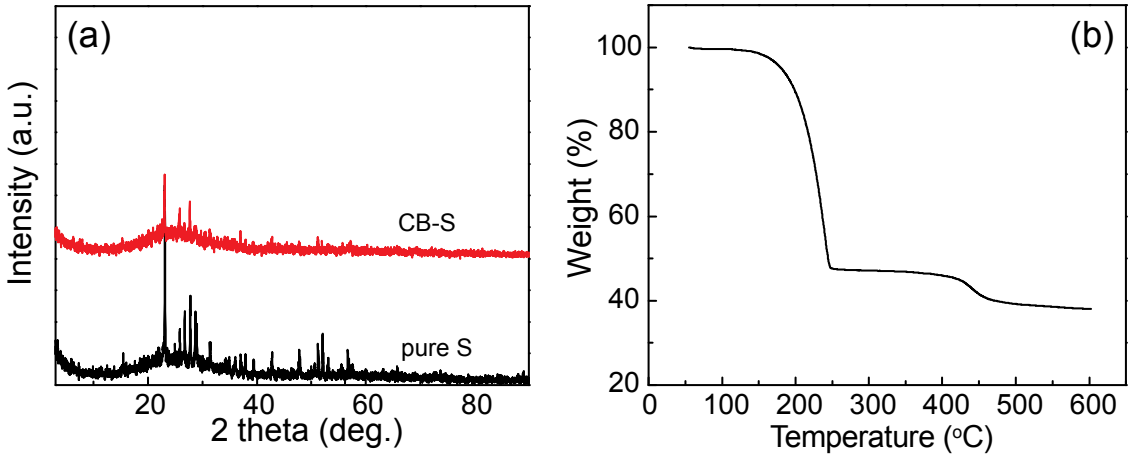

Fig. S4 (a) XRD pattern of the CB-S cathode. (b) TGA result of the CB-S cathode.

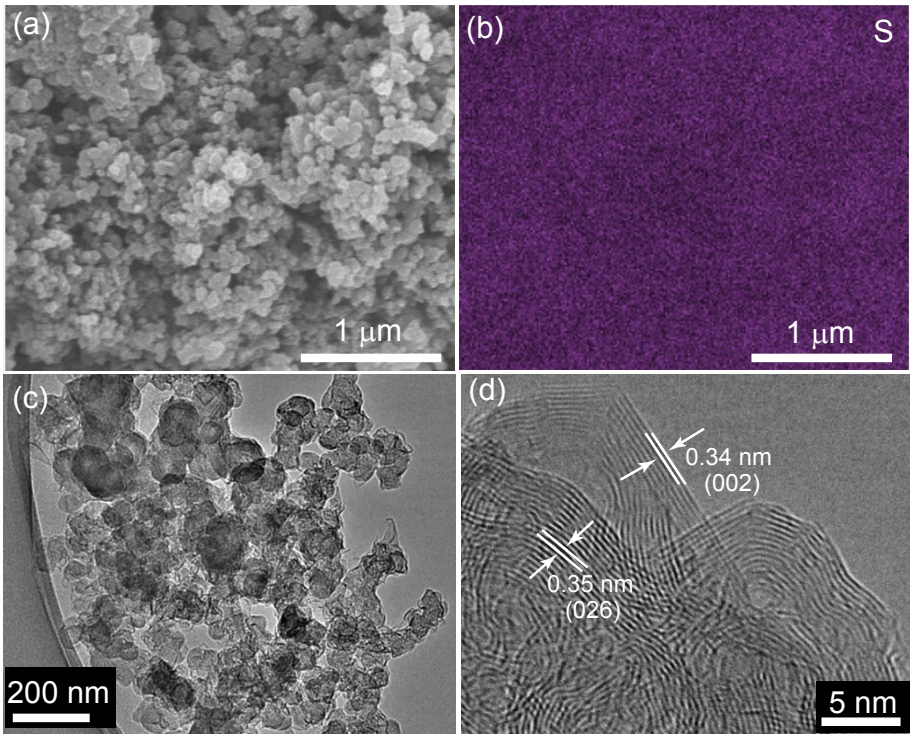

Fig. S5 The morphology characterization of the CB-S composite. (a) SEM image (b) Elemental mapping of sulfur (c) TEM and (d) HRTEM images.

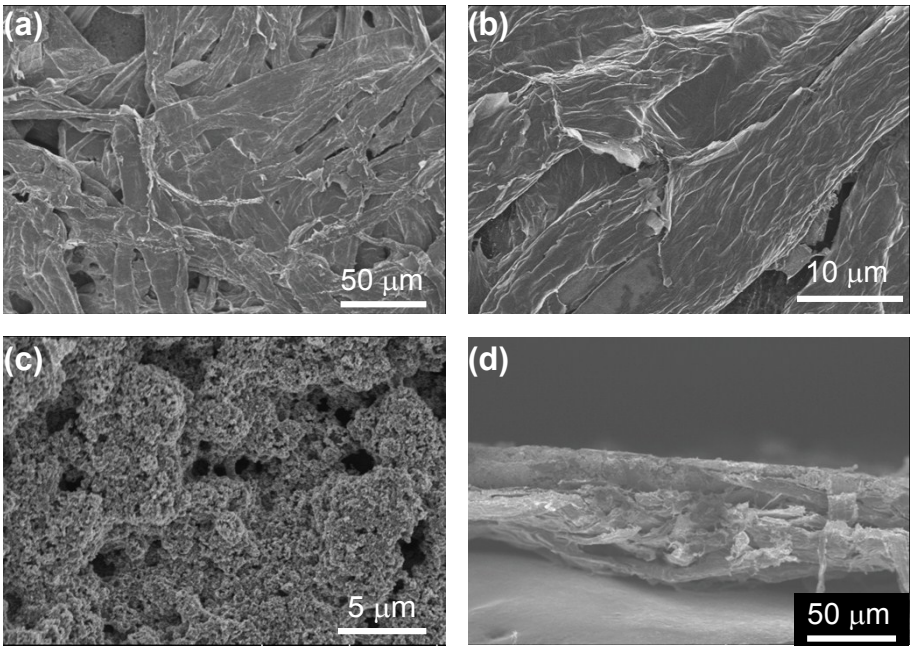

Fig. S6 (a) Low- and (b) high-resolution SEM images of the current collector. (c) The front and (d) cross-sectional SEM image of the current collector with active materials coating (The inserted images are the photos of the cathode slice).

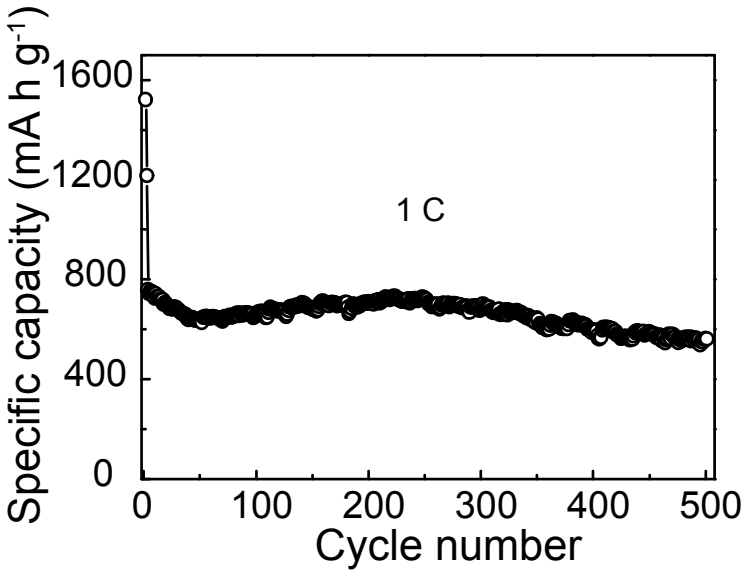

Fig. S7 The long cycle performance of the cell with interlayer at 1 C.

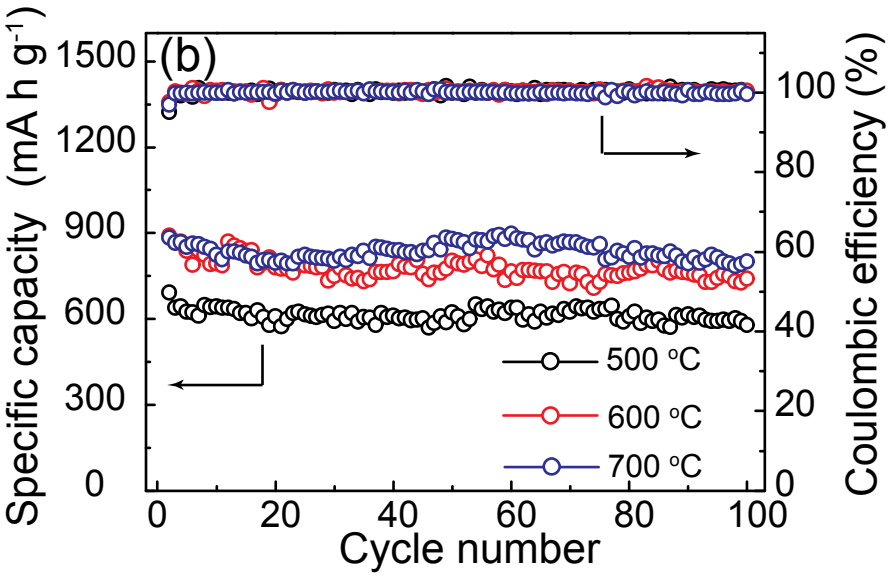

Fig. S8. The comparison of the cycle performances at 0.5 C for the cell with interlayers obtained at different carbonization temperatures.

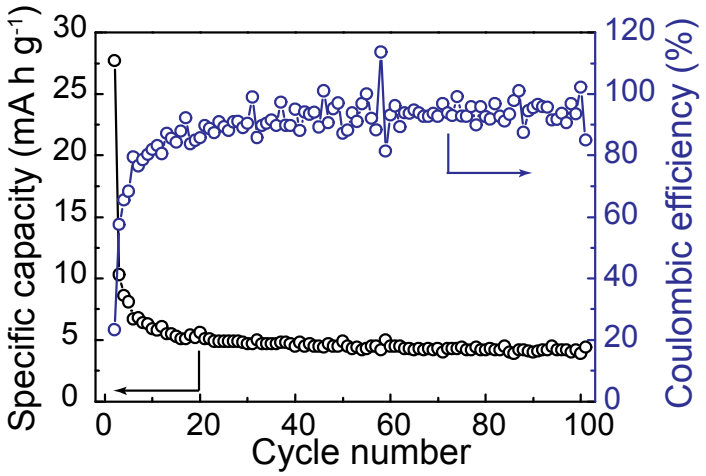

Fig. S9 The cycle performance of the cell with individual interlayer.

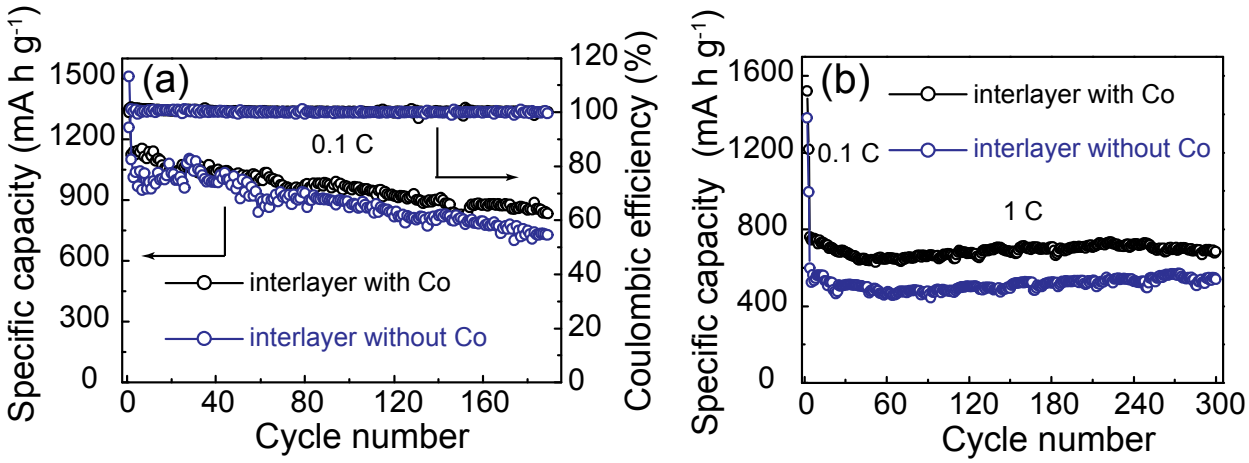

Fig. S10 The comparison of the electrochemical performance for the cell with and without Co in the interlayer. (a) The cycle performance at 0.1 C. (b) The cycle at the high current density of 1 C.

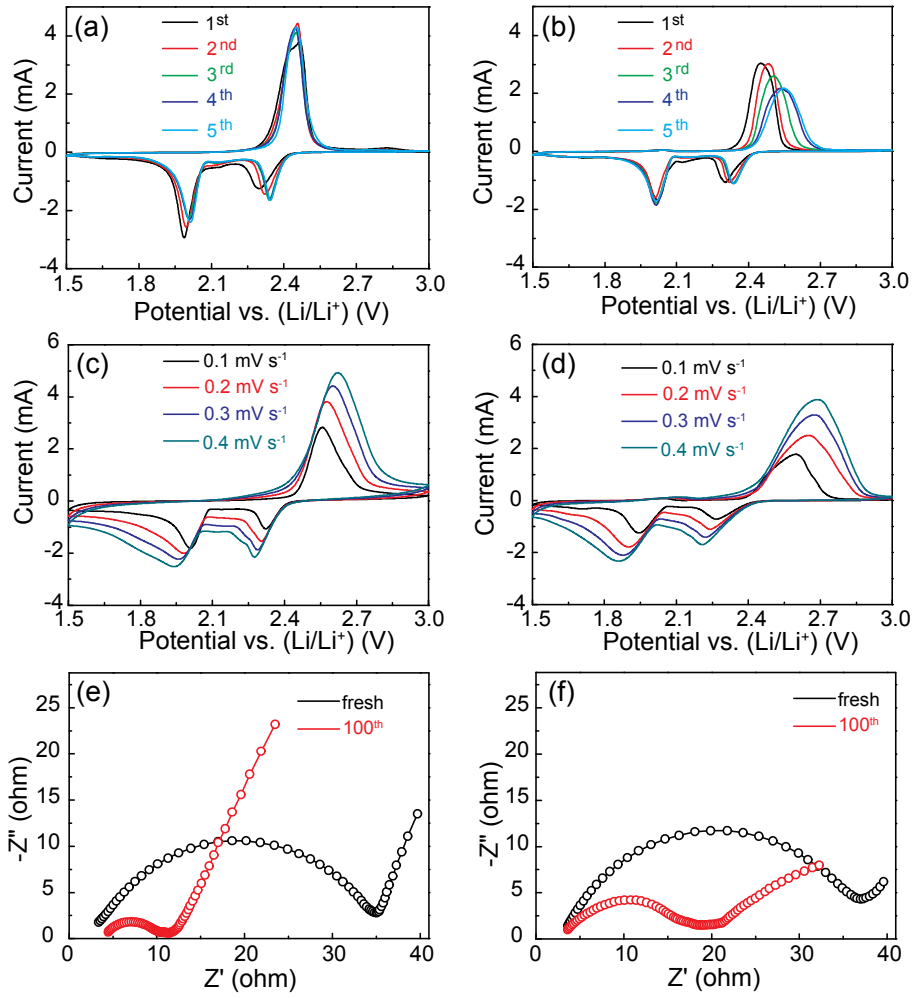

Fig. S11 The comparison of the electrochemical characterization for the cell with (left side) and without Co (right side) in the interlayer. (a, b) CV for different cycles at 0.1 mV s^{-1} (c, d) CV curves at different scan rates (e, f) EIS results at different cycles.

Table S1. The comparison of electrochemical performance and relevant parameters of this work with other similar reports in the literatures about the inserted block layers between cathode and separator (containing the interlayer and the coating layer on separator or cathode).

Composite of the Inserted block Layer	Sulfur loading on the cathode (mg cm^{-2})	Sulfur content on the cathode	Mass loading of layer (mg cm^{-2})	Current rate (1C=1675 mA g^{-1})	Reversible capacity (mA h g^{-1})	Cycle number	Capacity retention	Published date
Gerber tree-like interlayer with multicomponents (this work)	1.5	54%	0.65	0.1C 0.5C 1C	968 802 684	100 100 300	85.3% 89.6% 90%	
graphene oxide on separator[1]	1.0-1.5	63%	0.12	0.1C	708	100	77%	2015
freestanding bilayer C-S cathode[2]	3	40%	0.92	1C	750	300	83.4%	2016
Carbonized non-woven fabric film as interlayer[3]	2	70%	-	0.1C	858	100	57.7%	2015
Active carbon nanofiber-filter coated separator[4]	2.1-2.3	70%	0.35	0.2C	819	100	74%	2015
N-doped porous hollow carbon sphere coated separator[5]	1.6	60%	0.28	1C	542	500	44.5%	2015
S-doped microporous carbon as interlayer[6]	1.5	60%	3.7-4.3	0.2C	976	200	63.2%	2016
B-doped redox graphene oxides coated separator[7]	1.45-1.56	56%	0.2-0.3	0.1C	663.6	300	54%	2016
graphene embedded carbon fiber as interlayer[8]	1.2	60%	-	1C	698	300	61.3%	2015
PANIF-MCNT coated separator[9]	1.4	60%	0.01	0.2C	709	100	70%	2015
COF-net on CNF-net interlayer[10]	1.1	75%	2.08	2C	630	300	84%	2016
Nafion nanoweb coated on sulfur electrode[11]	2.4	60%	0.84	0.5C	695	200	65.8%	2016
V_2O_5 decorated CNF as interlayer[12]	2	70%	1	0.3C	889	100	87%	2017
SiO_2 nanoparticle decorated separator[13]	1.2-1.4	48%	-	0.2C	603.5	200	64%	2017
RuO_2 nanoparticle-embedded mesoporous carbon coated separator[14]	2	70%	0.3	0.5C	665	300	-	2016
PAN-SiO_2 nanofiber membrane with MCNT[15]	1-1.2	70%	3.44	0.2C	741	100	62.7%	2016
trilayer graphene-separator-Al_2O_3[16]	0.75	60%	1.23	0.2C	804.4	100	75%	2016
Few layered- Ti_3C_2 coated separator[17]	1.9	70%	0.2-0.32	0.3C	721	100	88%	2016

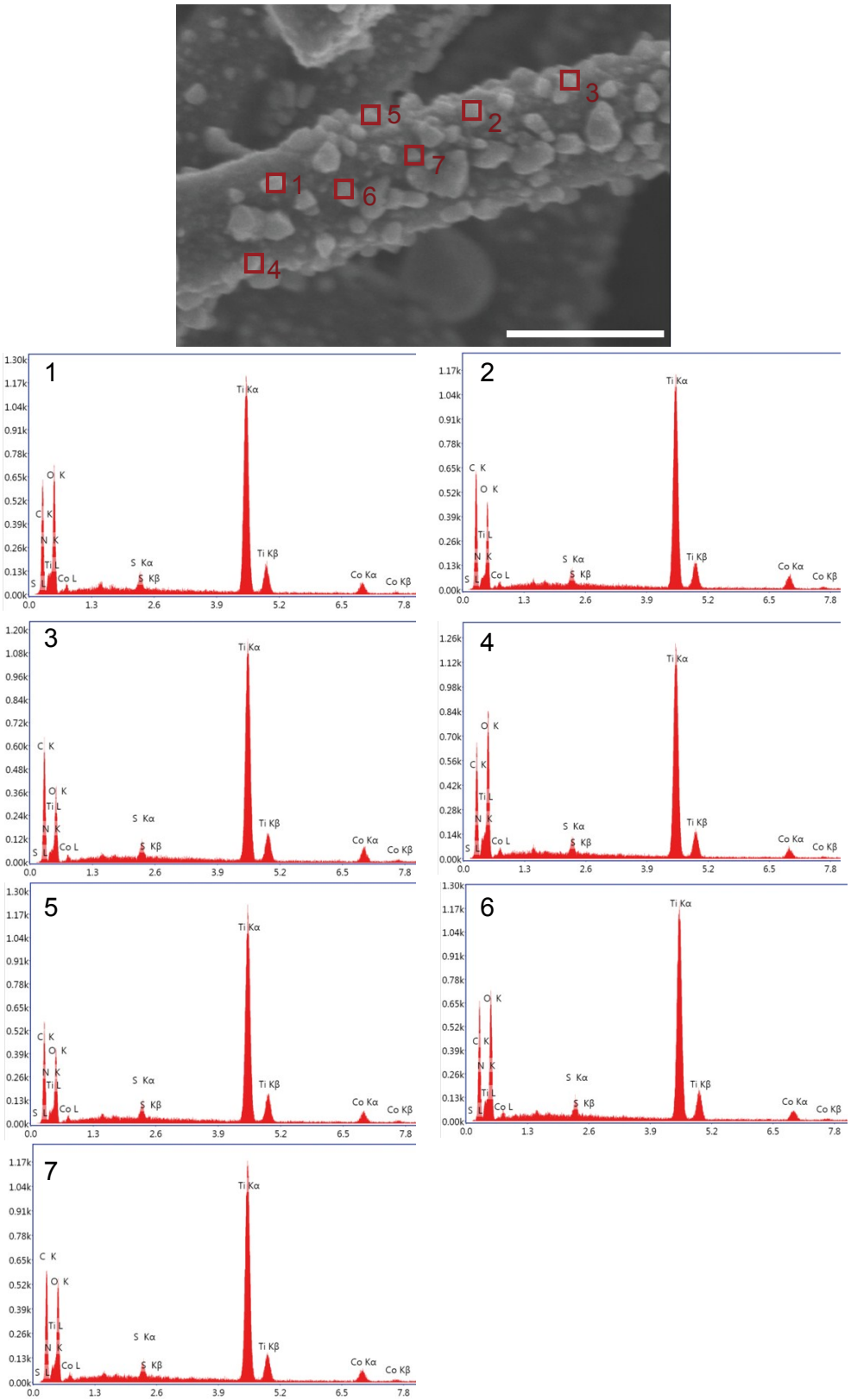

Fig. S12 EDX spectra analysis aimed at seven nanoparticles on the nanofibers, respectively.

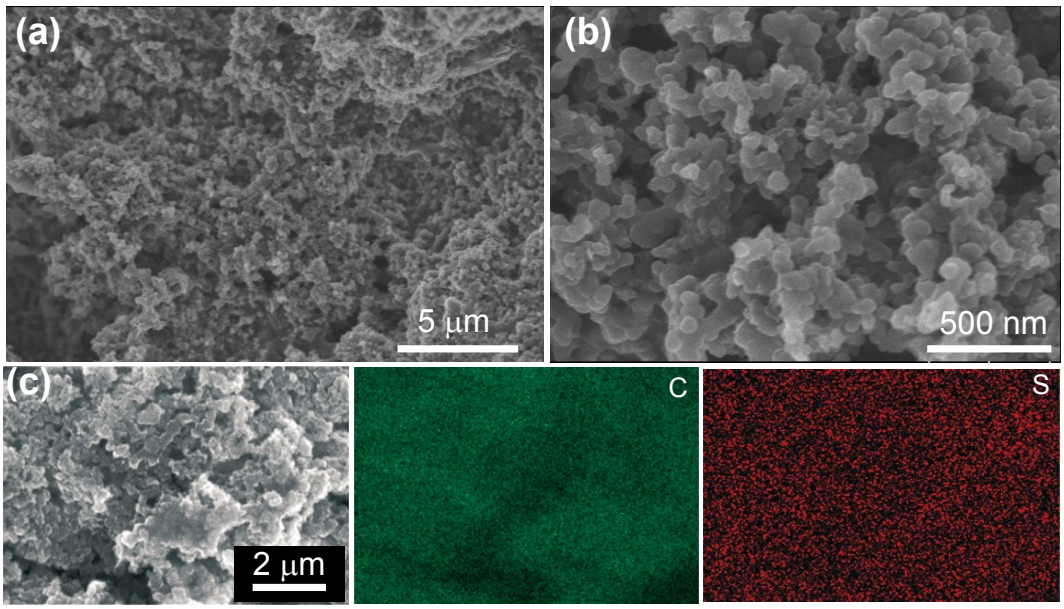

Fig. S13 The morphology characterization of the cathode after 100 cycles. (a) Low- and (b) high-resolution SEM images of the cathode. EDX mapping of element C and S corresponding to Figure (c).

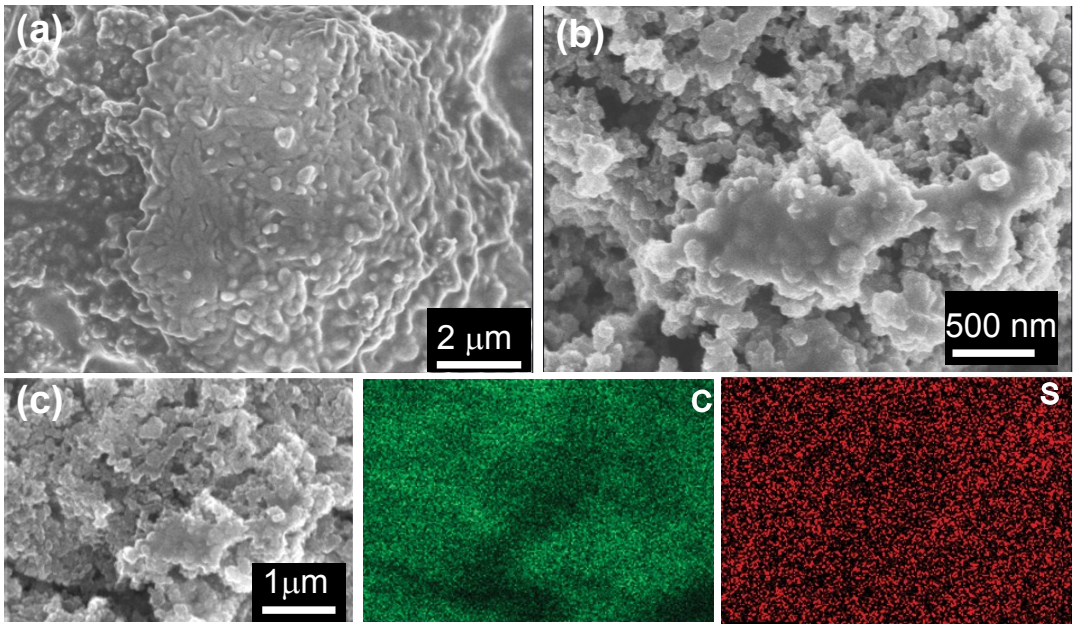

Fig. S14 The morphology characterization of the cathode for cell without interlayer after cycles. (a) Low- and (b) high-resolution SEM images of the cathode. EDX mapping of the cathode corresponding to Figure (c).

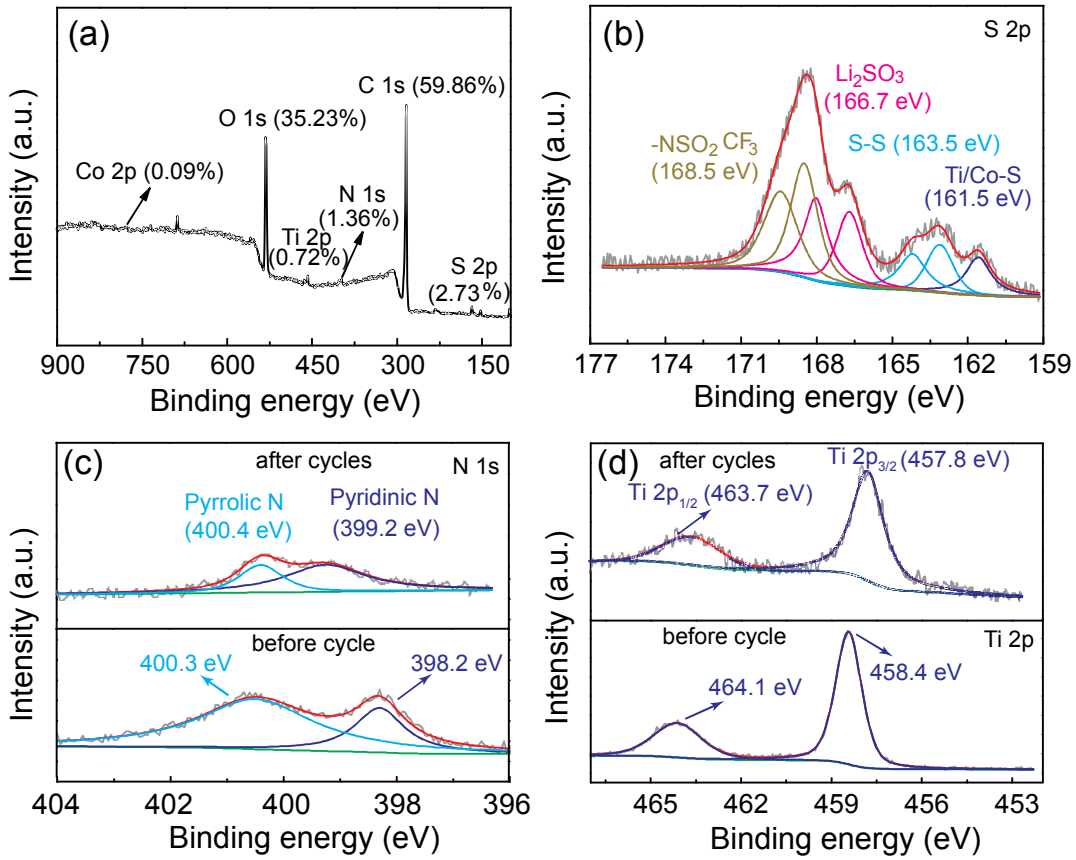

Fig. S15 XPS characterization of the interlayer after cycles compared with that before cycle. (a) Survey spectrum (b) S 2p spectrum (c) N 1s spectrum (d) Ti 2p spectrum.

Table S2. EDS results (at%) of the nanoparticles marked by red boxes on the fibers in Figure S5 after 100 cycles.

	C	N	O	S	Ti	Co
1	38.1%	5.5%	47.4%	0.4%	7.8%	0.7%
2	46.1%	3.3%	40.1%	0.4%	8.9%	1.1%
3	47.5%	2.4%	38.7%	0.5%	9.7%	0.7%
4	35.4%	6.6%	49.7%	0.4%	7.2%	0.6%
5	43.3%	4.1%	41.0%	0.6%	9.9%	1.1%
6	37.8%	5.9%	47.5%	0.4%	7.6%	0.7%
7	41.2%	5.0%	43.9%	0.4%	8.5%	0.9%

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