Supporting Information

Fast Polysulfides Catalytic Conversion and Self-Repairing Ability for High Loading Lithium-Sulfur Batteries using a Permselective Coating Layer Modified Separator

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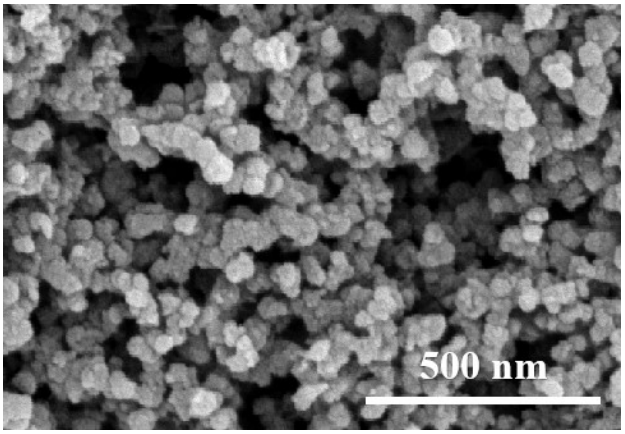

Fig. S1 SEM images of AB powder

Table S1 The specific surface areas, pore diameters and pore volumes of AB and ABPS

Material	BET surface area (m^2 g^{-1})	Pore diameter (nm)	Pore volume (mL g^{-1})
AB	55.991	12.355	0.203
ABPS	57.335	18.399	0.252

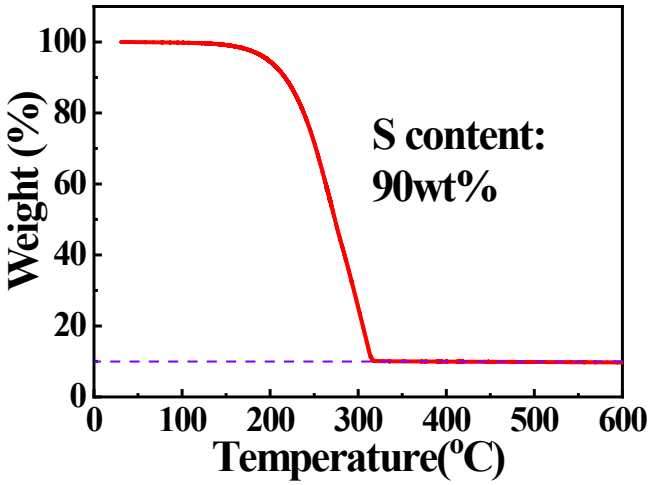

Fig. S2 The TG curves of CPS/S composites from 50 to 600℃ at a heating rate of 10 ℃ min^{-1} under a N_2 atmosphere.

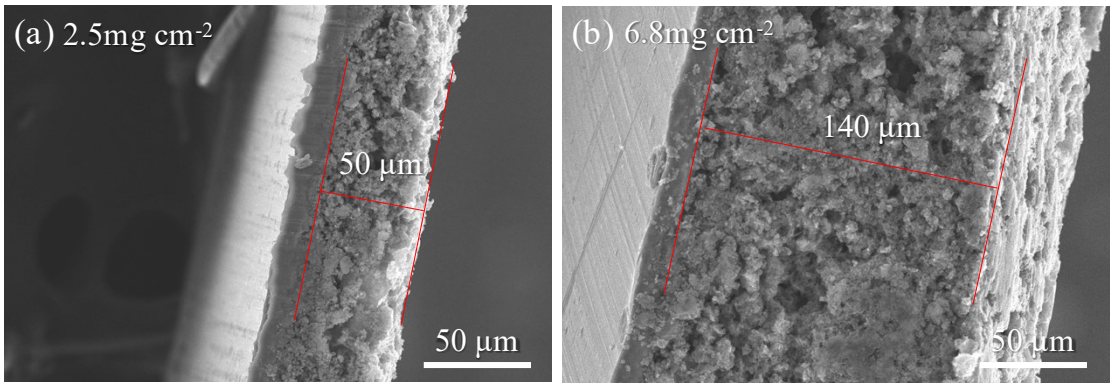

Fig. S3 The cross section SEM images of the sulfur cathodes with (a) 2.5 mg cm^{-2} and (b) 6.8 mg cm^{-2}.

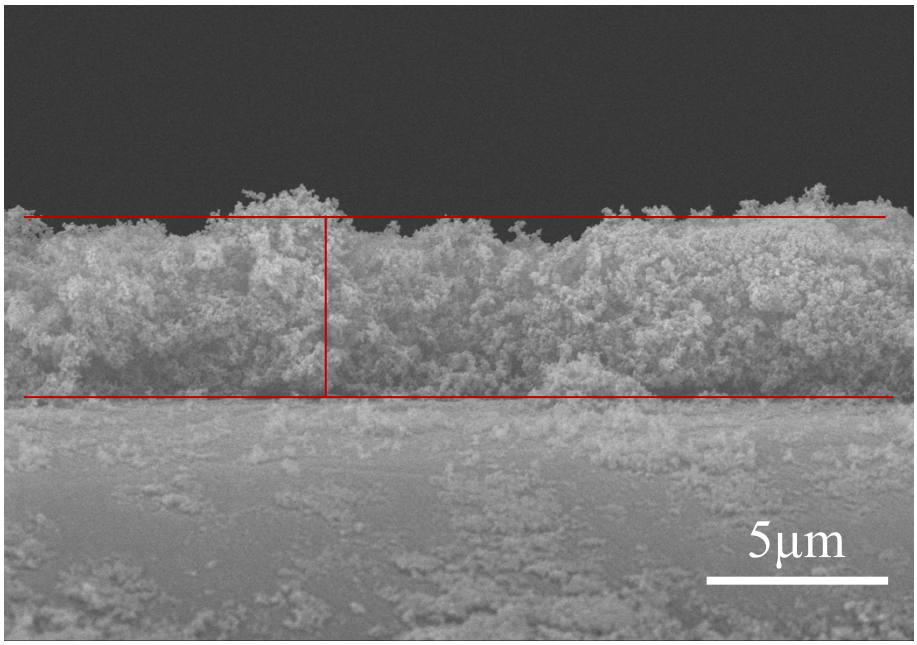

Fig. S4 The cross section SEM images of the AB modified separator

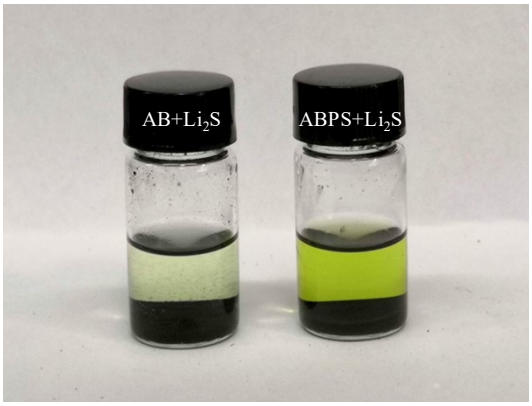

Fig. S5 Optical observation of Li_2S reaction with AB and ABPS composite in DOL/DME solution after 2 h.

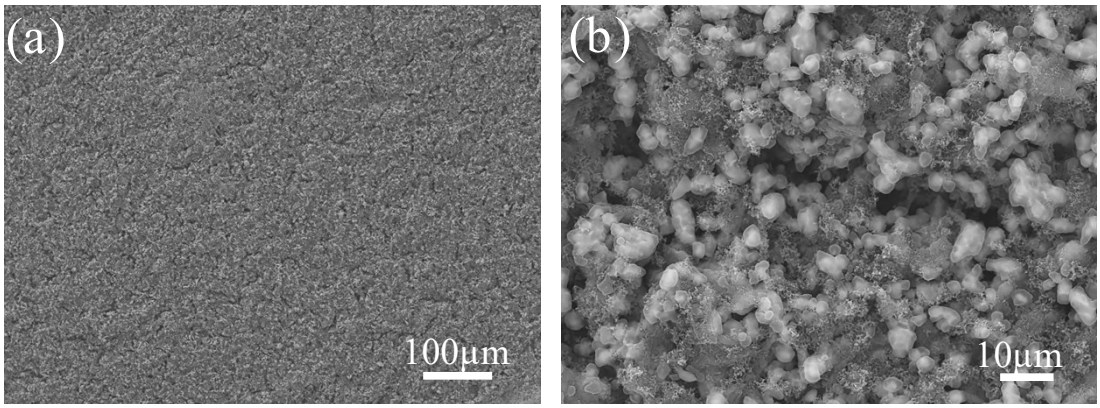

Fig. S6 The surface morphology images of the as-prepared sulfur electrodes.

Table S2 Parameters obtained for t_{Li}^{+}calculation of the symmetric coin cell.

Separator	I_s, μA	R_b, Ω	R_f, Ω	R_0, Ω	t_{Li}^{+}
Pristine Celgard separator	92.1	86.1	96.4	4.5	0.37
ABPS modified separator	310.2	25.4	27.2	2.8	0.57

Table S3 Characteristics of various high loading sulfur electrodes with or without a novel functional separator reported in the literature.

	Interlayer or Host Material Reference	Thick of the coating layer (μm)	Mass loading of the coating (mg cm^{-2})	S Percentage of Electrode/with coating (wt%)	S mass Loading (mg cm^{-2})	E/S, μL mg^{-1}	Cycle Performance mA h g^{-1} (cycle numbers)	Areal Capacity, mA h cm^{-2}	Published Date
Functional layers	g-C_3N_4/CNT[53]	12	0.45	57.6/55.6	7.2	6	787~633, (0.2C, 120)	5.67~4.56	2020
	ACC/MnO_2[54]	20	-	80/-	5 8	6.25 6.25	993~712 (0.2C, 300) 882-686 (0.1, 100)	4.96~3.56 7.06~4.49	2020
	BFO/GO/AB[55]	25	0.48	64/60.7	5.6	12	1016~ 834 (0.1C, 50)	5.1~4.3	2020
	LNPO/rGO[56]	20	0.88	80/71.6	6	8.3	700~623 (0.3C, 300)	4.2~3.7	2020
	FeTaPc@rGO[57]	13	0.23	68/65.9	5	5	1000~800 (0.2C, 200)	5~4	2021
	Ce-MOF-$_2$/CNT[36]	8	0.4	80% for composite/-	6	40 (for each cell)	993.5~886.4 (0.1C, 200)	5.96~5.32	2019
	FeP/HPC[52]	--	0.3	52.5/51.1	5.73	15	1052.9~982.5 (0.01C, 30)	6.03~5.63	2021
	CoFeCN@C[27]	15	0.5	70/65.8	5.5	15	982~818 (0.1C, 150)	5.4~4.5	2021
	Fe/Co/Ni SACs[58]	7	0.1	-/-	4.5	10	1000~892 (1.0 C, 750)	4.5~4.0	2019
	Co–N–C/AC[59]	7	0.5	56/53.1	5.09	10	1100 (0.2C, 100)	5.6	2021
Functional Host Materials	CoSA-N-C@S[60]			55.6	4.9	10.4	1061.7~871.3 (0.2C, 120)	4.63~4.21	2021
	nO2@rGO/S[61]			56	4 4	5 4	748~446 (0.2C, 200) 710~578 (0.2C, 100)	2.99~1.78 2.84~2.31	2020
	3D-S@NCoCPC[37]			62	6.15	4	1040~940 (100mA g^{-1}, 7)	6.39~5.78	2021
	S@3DVS$_4$@RGO[62]			70	5 7	10 10	1116~996 (0.2C, 100) 1030~853 (0.2C, 100)	5.80~4.98 7.21~5.97	2020
	Fe−Ni/S[63]			73.1	6.4	8	953~797 (0.1C, 100)	6.1~5.1	2021
	CNT/CNF –polysulfide[64]			68	8.64 8.64	7 4	880~400 (0.1C, 200) 620~0 (0.1C, 100)	6.9~3.45 5.35~0	2021
	S@Co−N/G [65]			67.5	6	12	1210~850 (0.2C, 100)	7.26~5.1	2019
	G-MgB_2[28]			60	9.3	6.5	850~665 (0.2C, 100)	7.9~6.18	2019
	FLPT-S[66]			59	6.8	8	1120~805 (1/30C, 75 cycles)	7.62~5.48	2019

	ABPS-coating layer[This work]	5.5	0.12	72/69.6	6.8	4	1211~886 (1.03 mA cm^{-2}, 170)	8.24~6.03	This work