Supporting Information for

Lithiophilic gel polymer electrolyte to stabilize the lithium anode for quasi-solid-state lithium-sulfur battery

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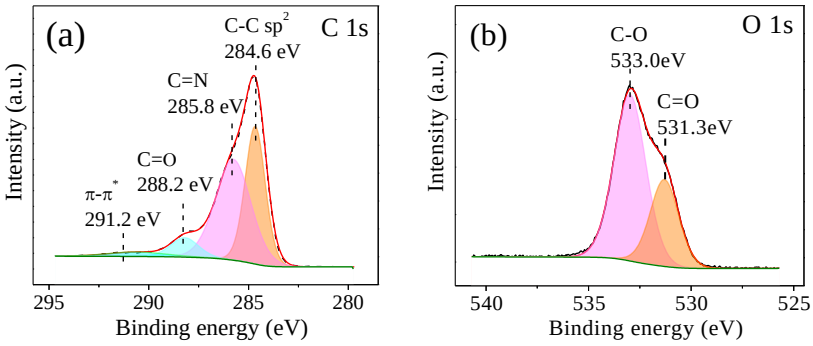

Fig. S1. XPS spectra of C 1s (a) and O 1s (b) for PDA-PVDF film.

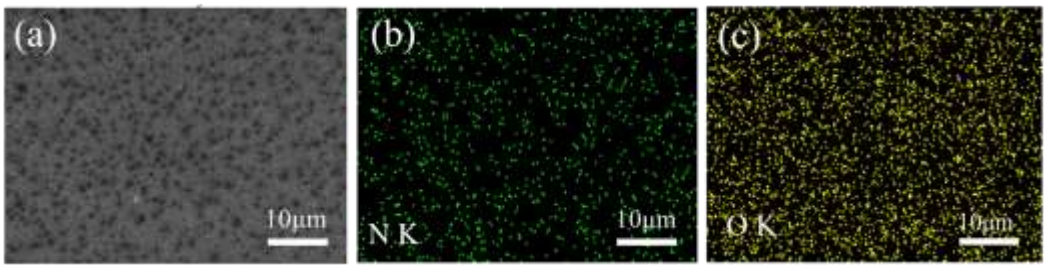

Fig. S2. SEM images of PDA-PVDF film (a) and the corresponding elements mapping of N and O (b-c).

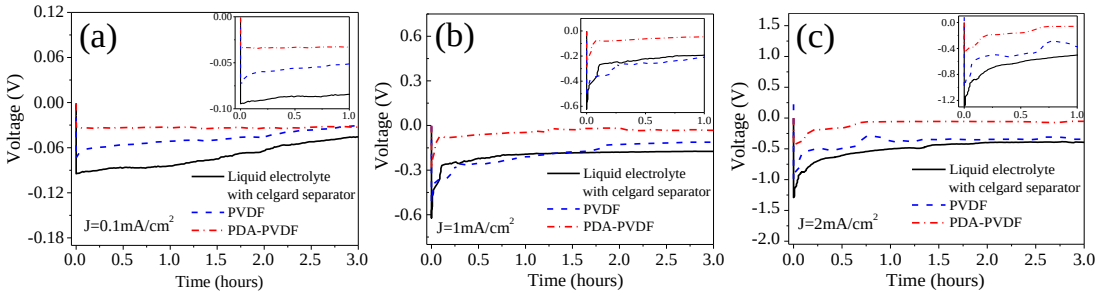

Fig. S3. The voltage-time curves during lithium nucleation stage on the lithium anode of the cells with different electrolytes at various current densities of (a) 0.1 mA cm^{-2}, (b) 1 mA cm^{-2}, (c) 2 mA cm^{-2}.

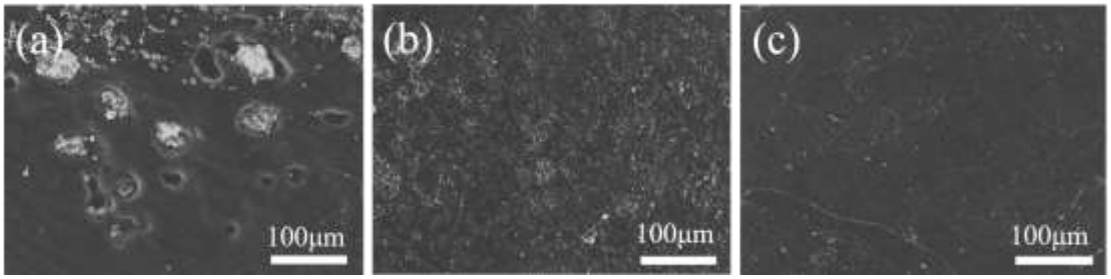

Fig. S4. SEM images of lithium in the cells using with Celgard separator (a), PVDF electrolyte (b) and PDA-PVDF electrolyte (c) after plating/stripping for 20 cycles.

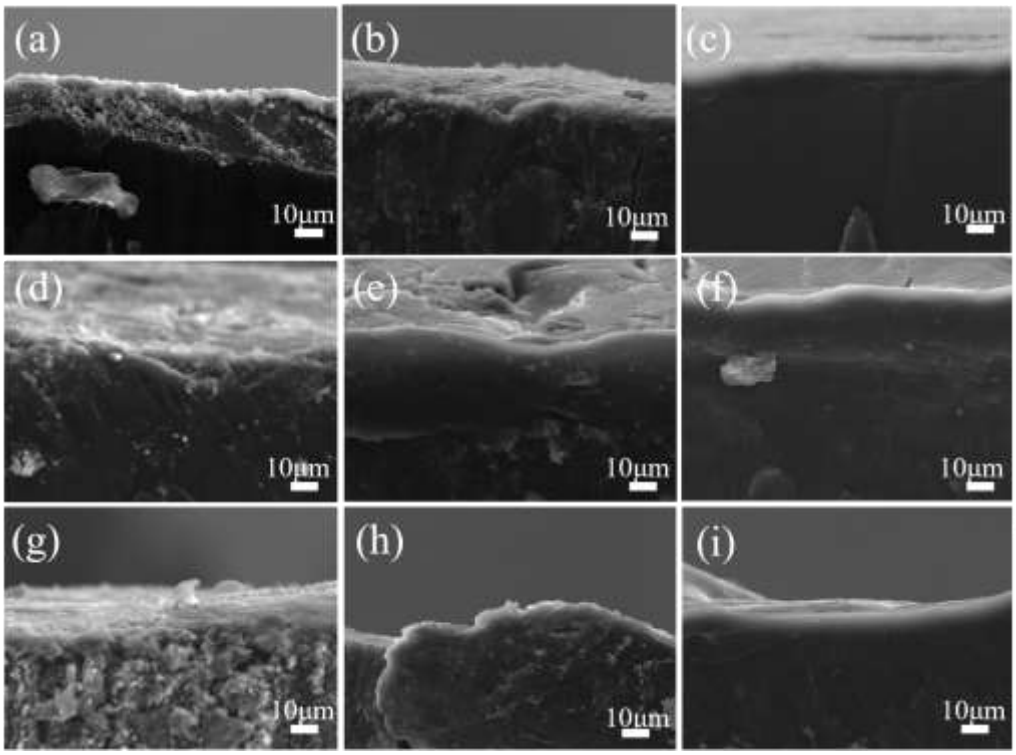

Fig. S5. SEM images of cross section of Li anodes after 10 cycles (a, b, and c), 50 cycles (d, e, and f) and 100 cycles (g, h, and i) in the testing cells with Celgard separator (a, d, and g), PVDF electrolyte (b, e, and h) and PDA-PVDF electrolyte (c, f, and i), respectively.

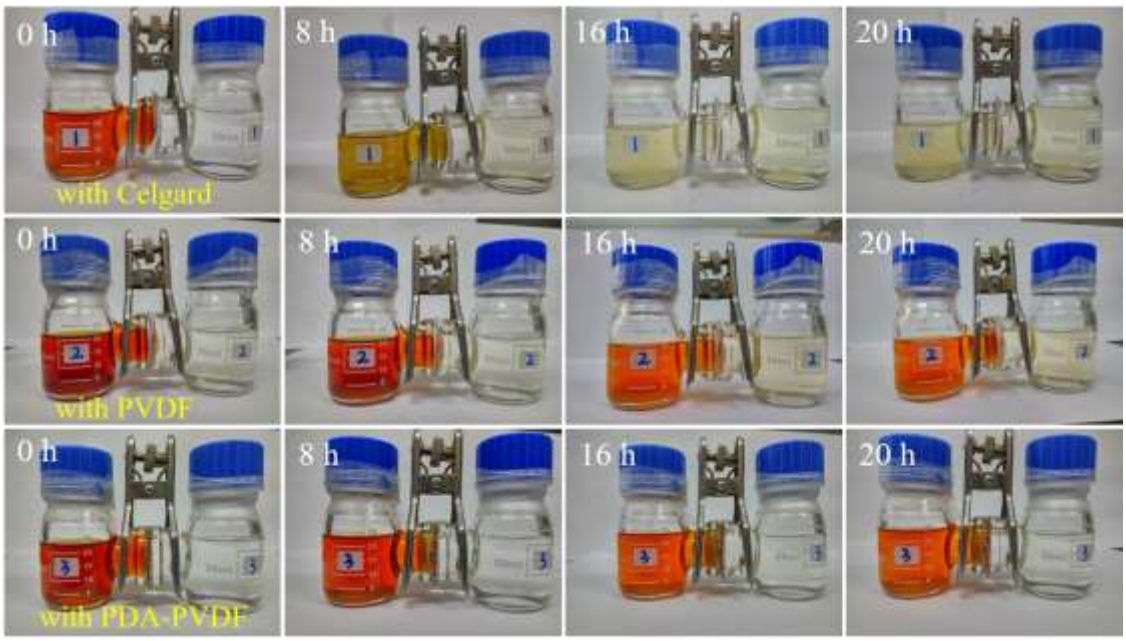

Fig. S6. The photos for the diffusion of polysulfides in the H-type cells with Celgard, PVDF and PDA-PVDF films.

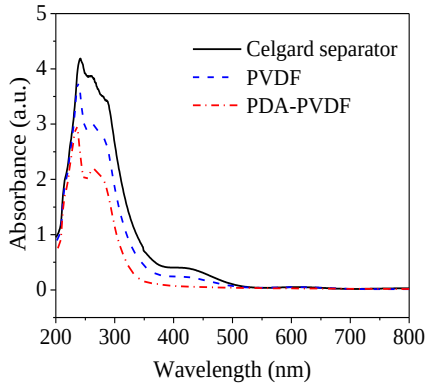

Fig. S7. UV-vis spectra of polysulfide solution after resting for 20 h with corresponding electrolytes.

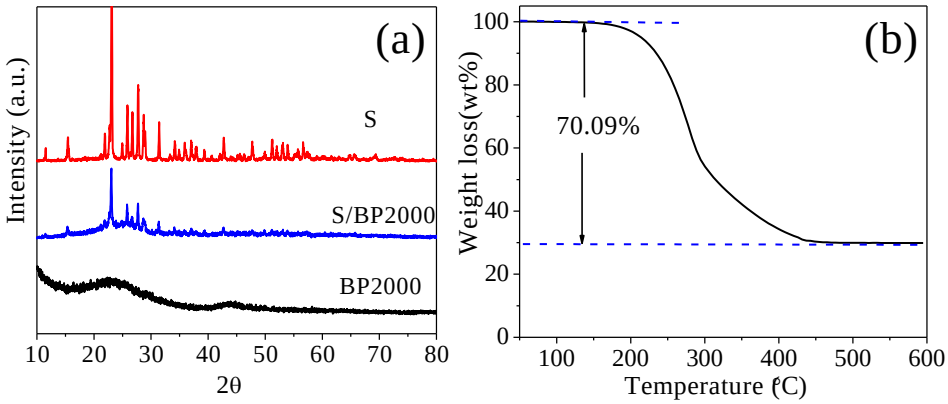

Fig. S8. (a) XRD patterns of S, BP2000 and S/BP2000 materials. (b) TG curves of S/BP2000 composite.

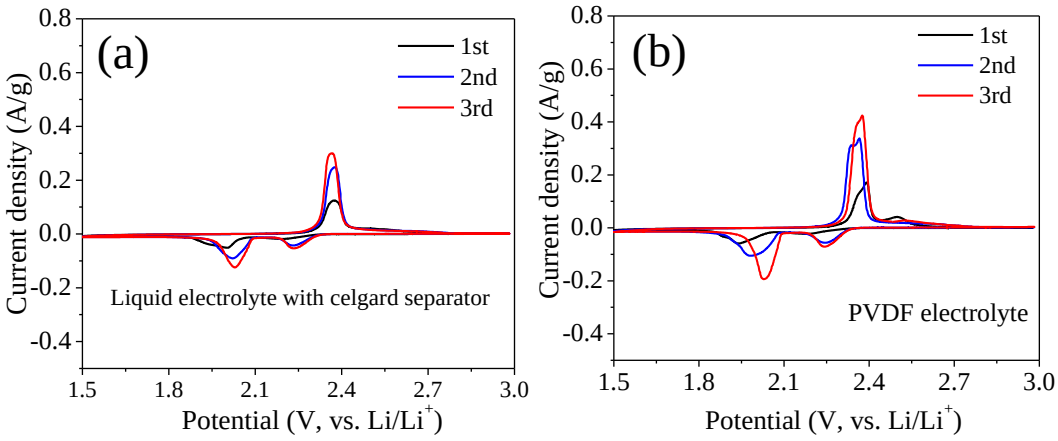

Fig. S9. CVs of the as-prepared cells with Celgard separator (a) and PVDF electrolyte (b) at the scan rate of 0.1 mV s^{-1} with the potential range of 1.5 - 3.0 V.

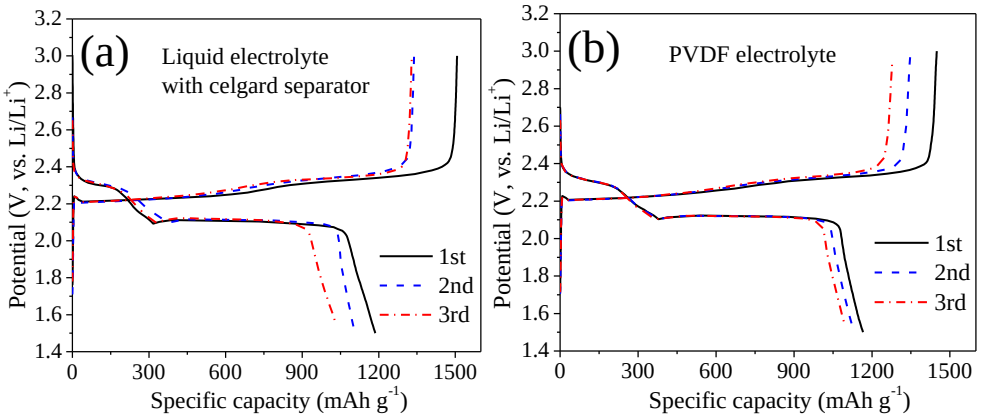

Fig. S10. The initial three discharge/charge curves of the cells with Celgard separator (a) and PVDF electrolyte (b).

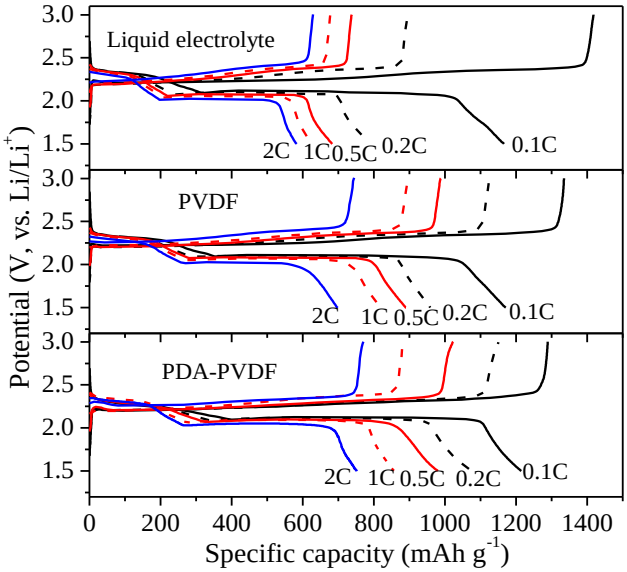

Fig. S11. The initial discharge/charge curves of the cells with different electrolytes at different rates from 0.1 C to 2 C.

Table S1. The liquid uptake of all electrolytes and the amount of liquid electrolyte in the cells with various electrolytes

Sample	M_0 (mg)	M_s (mg)	ΔM (%)	ΔV ($\mu L/mg_{(sulfur)}$)
Liquid electrolyte (with celgard separator)	2.39	5.90	146.8	--
PVDF	3.22	11.25	249.3	9
PDA-PVDF	3.33	12.74	282.8	10

The density of liquid electrolyte (ρ) is 1.174 g/mL. The amount of liquid electrolyte in the cell with Celgard is controlled at 60 $\mu L/mg_{(sulfur)}$.

Table S2. The corresponding chemical composition on Li anode in the cells with different electrolytes after 200 cycles.

Sample	C (wt.%)	O (wt.%)	F (wt.%)	S (wt.%)
Liquid electrolyte (with celgard separator)	21.77	64.23	7.01	6.99
PVDF	22.99	56.88	14.76	5.37
PDA-PVDF	24.45	49.85	22.96	2.74