

Electronic Supporting Information

Accelerated Li-Ion Transport through Zwitterion-Anchored Separator for High Performance Li-S Batteries

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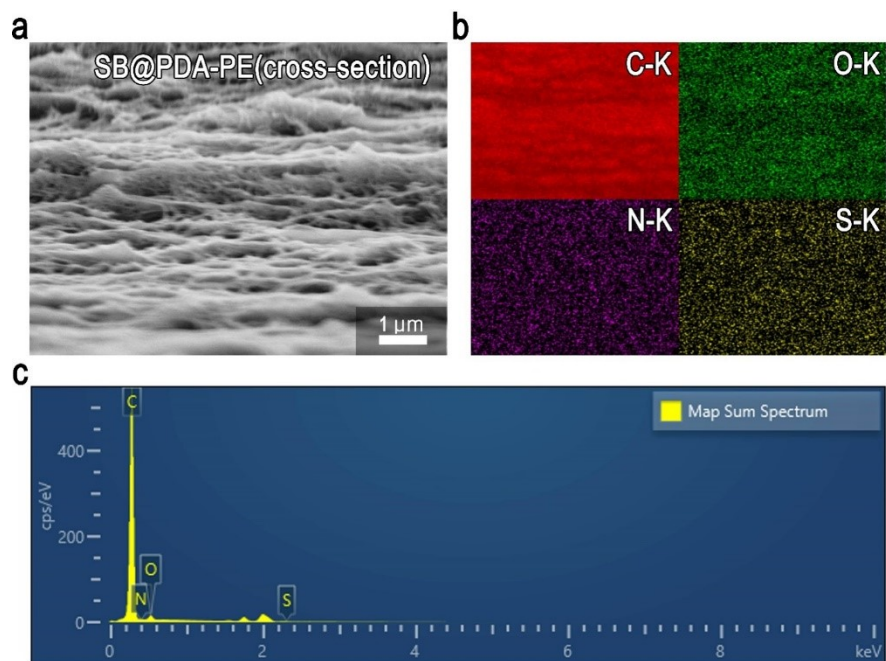


Fig. S1 (a) Cross-sectional FE-SEM image of SB@PDA-PE separator, (b) Result of SEM-EDS mapping of elemental C, O, N, S and (c) EDS spectrum of the cross-sectional image.

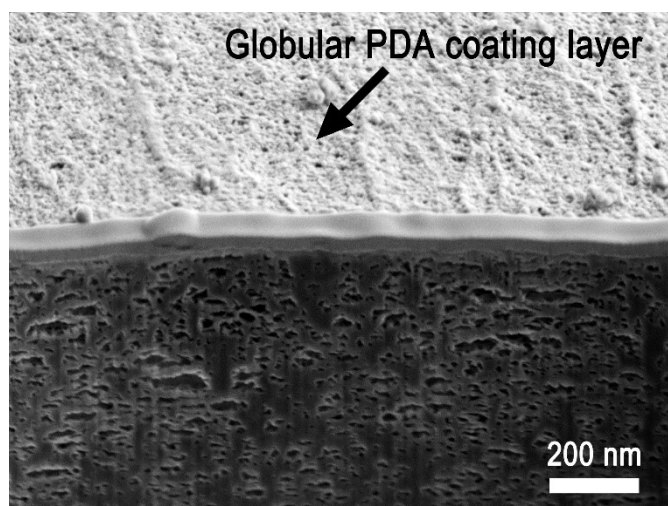


Fig. S2 Tilted observation of SB@PDA-PE using a focused ion beam combined with SEM (FIB-SEM).

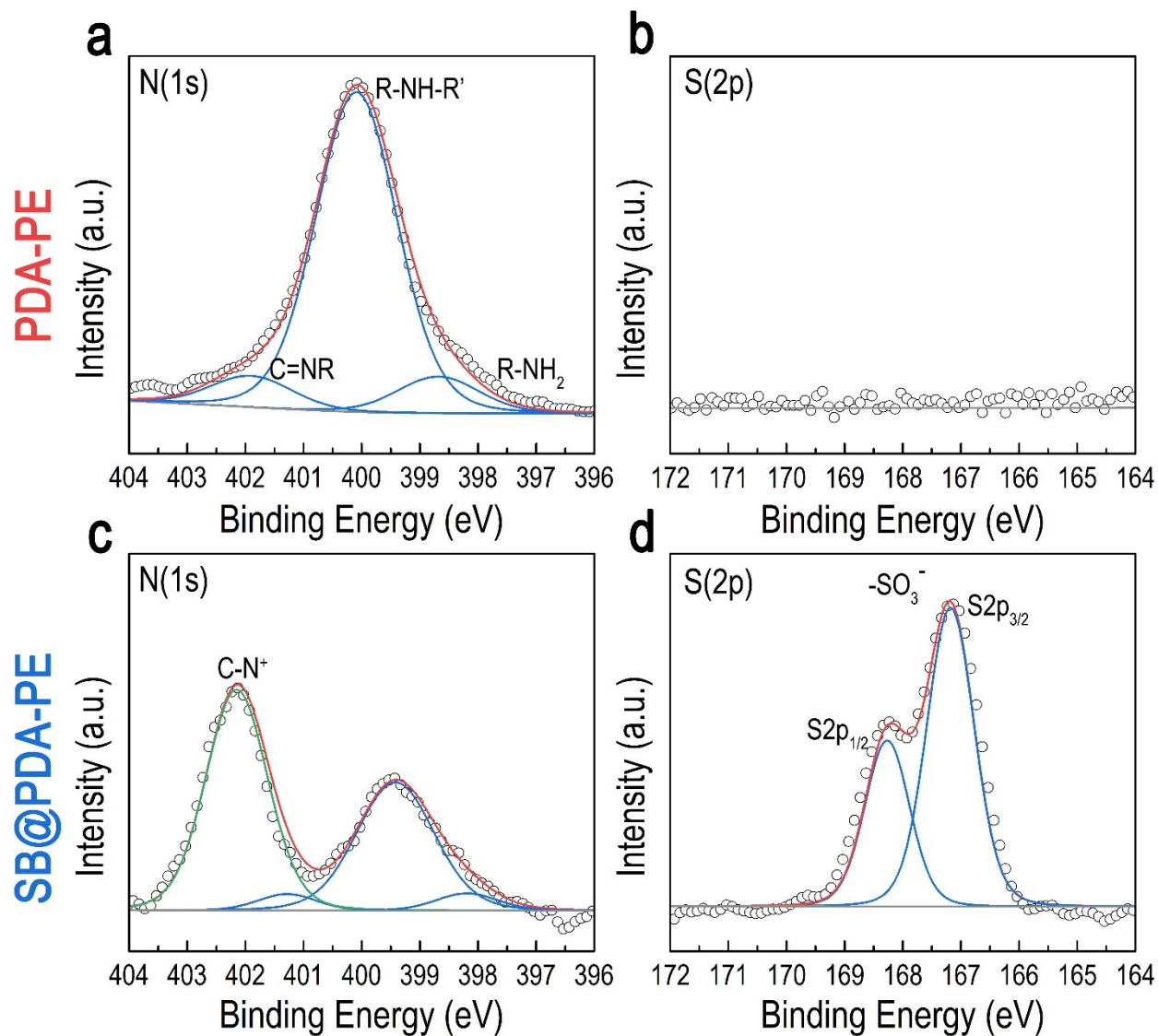


Fig. S3 (a, b) N 1s and S 2p XPS spectra of PDA-PE. (c, d) N 1s and S 2p XPS spectra of SB@PDA-PE.

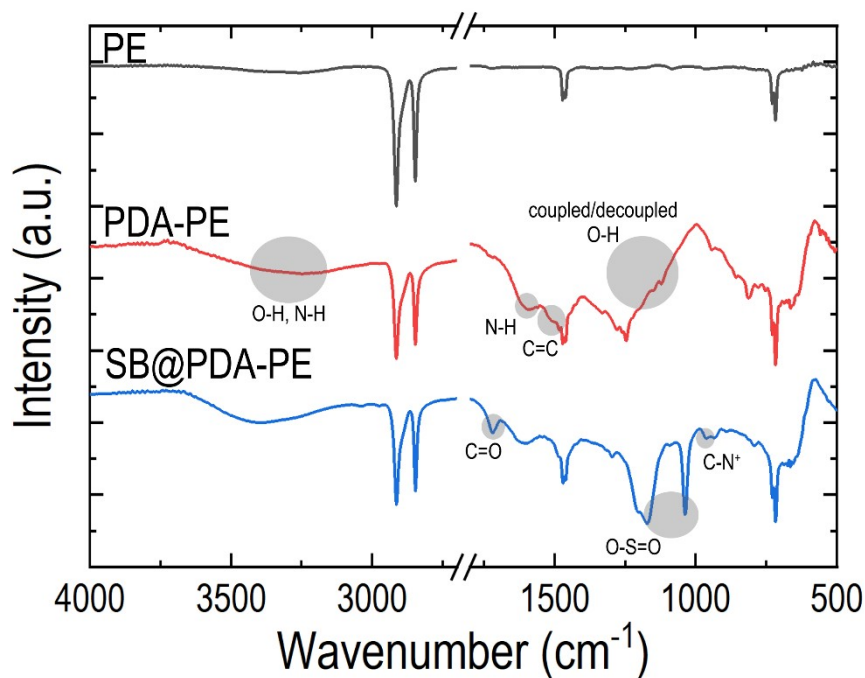


Fig. S4 FTIR spectra of PE, PDA-PE and SB@PDA-PE.

PDA-coating and SB-zwitterion-anchoring processes were additionally investigated by Fourier-transform infrared (FTIR) spectroscopy. The spectrum of the PDA-PE shows a broad peak at $\sim 3250\text{ cm}^{-1}$ assigned to O–H and N–H stretching vibrations, while the absorption peaks at 1595 and 1515 cm^{-1} correspond to N–H bending motions associated with the amine groups and C=C stretching vibrations of aromatic rings, respectively. Other peaks in the $1250\text{--}1450\text{ cm}^{-1}$ range are attributable to phenolic O–H deformations coupled/decoupled with C=C ring stretching and phenolic C=O stretching.¹ As such, these observed peaks provide evidence that the separator surface is fully PDA coated. In contrast, while the spectrum of SB@PDA-PE shows absorption peaks that correspond to PDA, the N–H stretching and bending peaks assigned to the amine groups grafted to the zwitterionic monomer are slightly shifted to higher wavenumbers. In particular, the characteristic peaks at 1036 and 1167 cm^{-1} that correspond to O–S=O stretching motions are observed due to the presence of the sulfonate group. The peak located at 963 cm^{-1} is consistent with the C–N⁺ moiety in the quaternary ammonium group, while a strong C=O peak is observed at 1719 cm^{-1} for SB@PDA-PE. As a result, the FTIR spectra support that zwitterionic SB monomers had been successfully anchored onto the amine-functional groups of the surface-coated PDA layer.

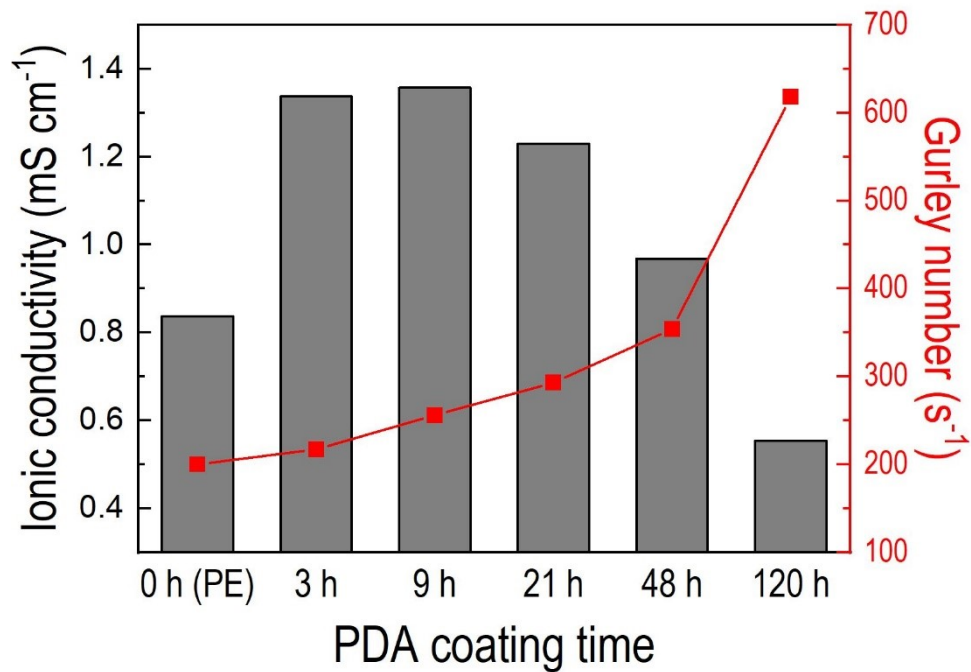


Fig. S5 Ion conductivity and Gurley number data according to PDA coating time.

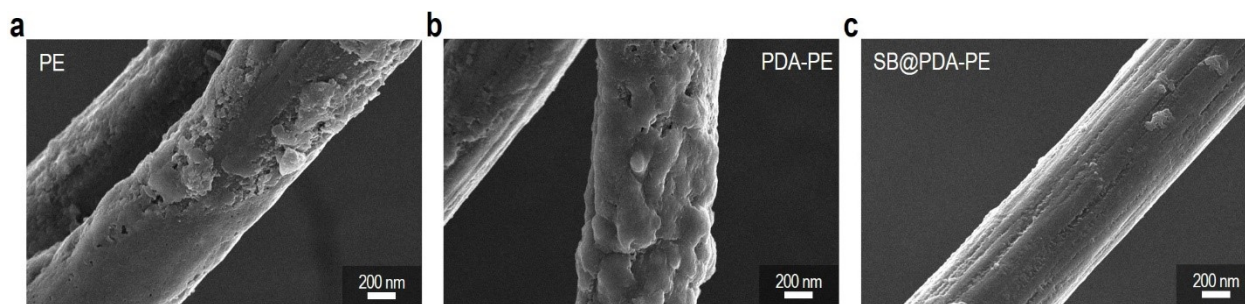


Fig. S6 SEM images of precipitated Li₂S on the carbon cloth (CC) using (a) PE, (b) PDA-PE, and (c) SB@PDA-PE separator.

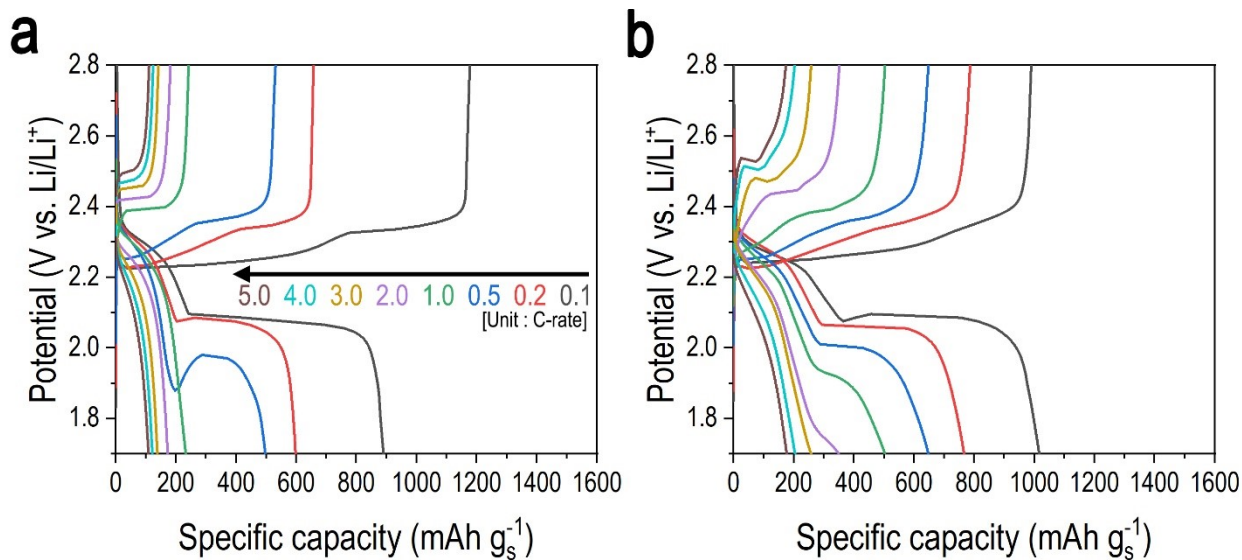


Fig. S7 Galvanostatic charge/discharge (GCD) profiles of Li-S cell with (a) PE and (b) PDA-PE at various C-rates.

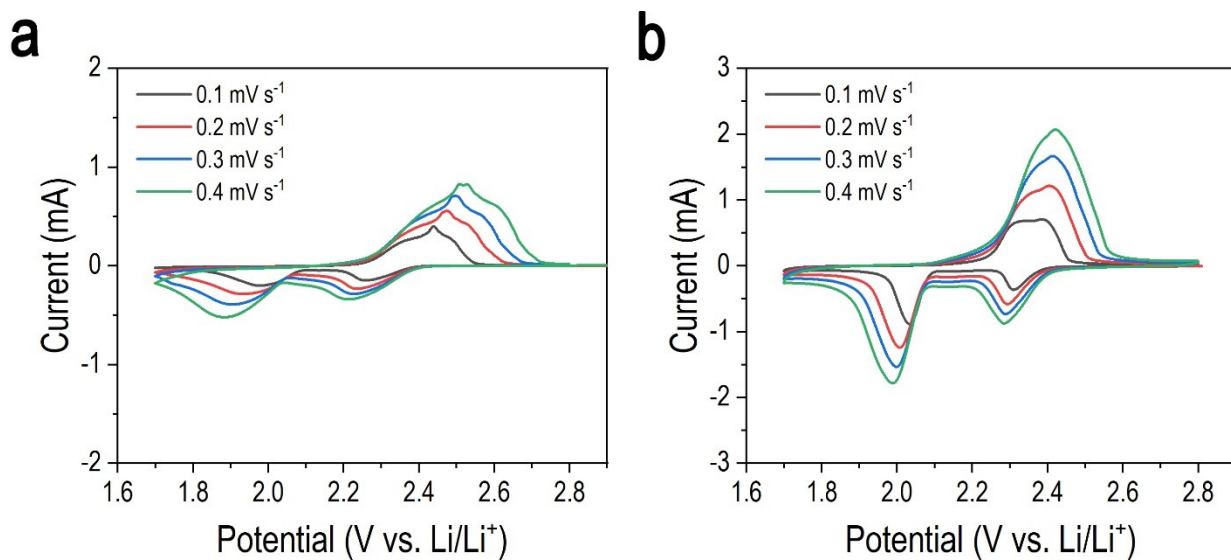


Fig. S8 CV curves of Li-S cell with (a) PE and (b) PDA-PE obtained in the range of 0.1-0.4 mV s⁻¹

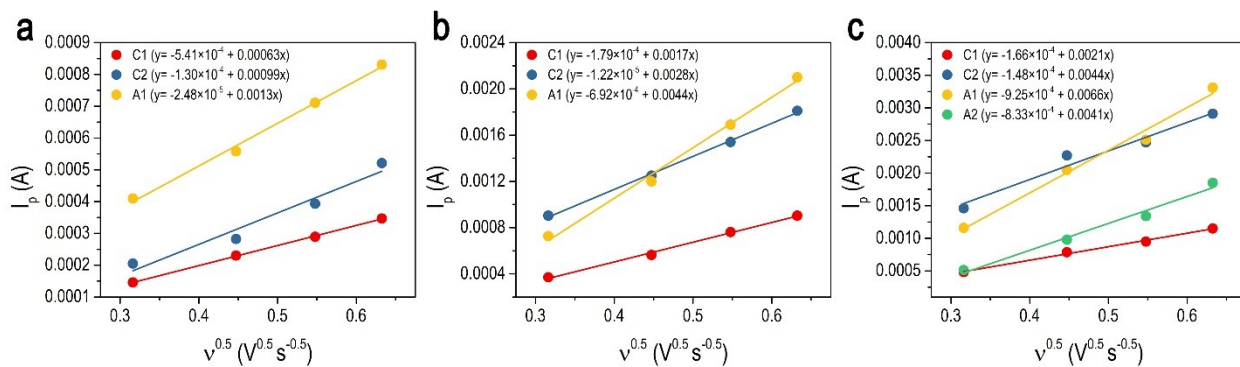


Fig. S9 Anodic and cathodic peak current versus the square root of scan rate plots of (a) PE, (b) PDA-PE and (c) SB@PDA-PE separator



Fig. S10 Digital photograph image of Li-S pouch cell with the SB@PDA-PE separator (sulfur loading mass of 4.0 mg cm^{-2})

Table S1 Comparison of the electrochemical performances of different materials modified separators for Li-S batteries.

Coating Materials	Sulfur loading (mg cm ⁻²)	Initial capacity (mAh g ⁻¹) (C-rate)	Capacity decay (%) (cycles)	E/S ratio (μL mg ⁻¹)	Ref.
Polydopamine-Zwitterionic sulfobetaine	2.0	1365.9 (0.2 C)	0.19 (150)	10	THIS WORK
		812.6 (3 C)	0.034 (1200)		
	4.0	1252.7 (0.2 C)	0.25 (100)		
Polydopamine	1.5 - 1.8	1271 (0.2 C)	-	-	S2
UiO-66-S/Nafion	1.7	1127.4 (0.1 C)	0.11 (200)	< 10	S3
UiO-66-SO ₃ Li	2.0	1020 (0.5 C)	0.056 (500)	40	S4
Porous sulfonated carbon (PSC)	~ 2.0	979 (0.5 C)	0.11 (200)	-	S5
Polystyrene sulfonate@H KUST-1	1.3	1278 (0.5 C)	0.05 (500)	20	S6
Sulfonated acetylene black	3.0	1262 (0.1 C)	0.25 (100)	7	S7
Sulfonate-ended perfluoroalkyl group	0.53	781 (1 C)	0.08 (500)	-	S8
Perfluorinated sulfonic acid ionomers	1.75	1352 (0.2)	0.31 (100)	50	S9
Polypropylene grafted with styrenesulfonate	2.0±0.5	1120 (0.05)	0.39 (40)	30	S10

Supporting References

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