Supporting information

Novel Li_xSiS_y/Nafion as Artificial SEI Film to enable Dendrite-Free Li metal anodes and High Stability Li-S batteries

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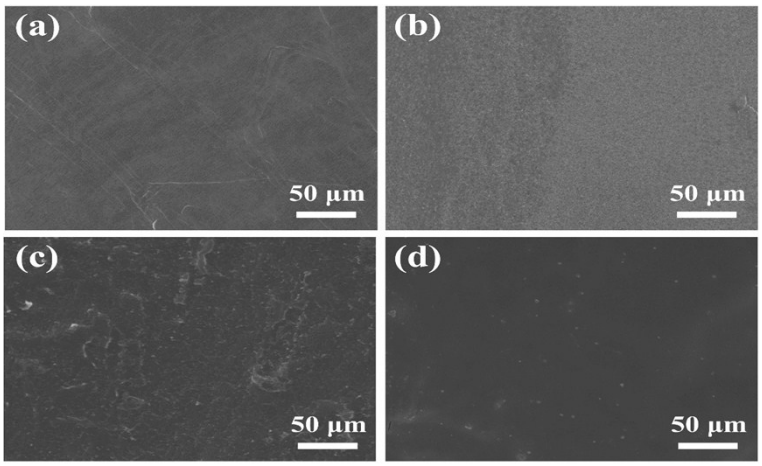

Fig. S1. SEM images of a (a) Li electrode, (b) Li electrode after reaction with Li_2S_8, (c) Li-Li_xSiS_y electrode, and (d) Li-LNF electrode.

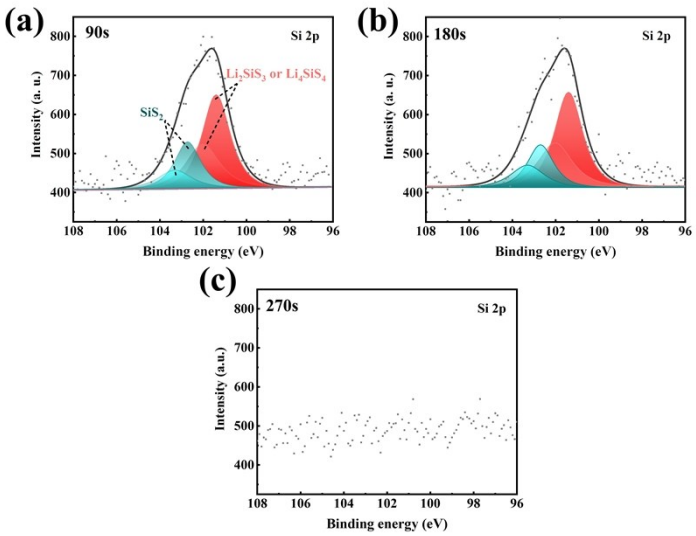

Fig. S2. (a-c) High-resolution XPS spectra of Si 2p for the Li_xSiS_y thin film at different sputtering times.

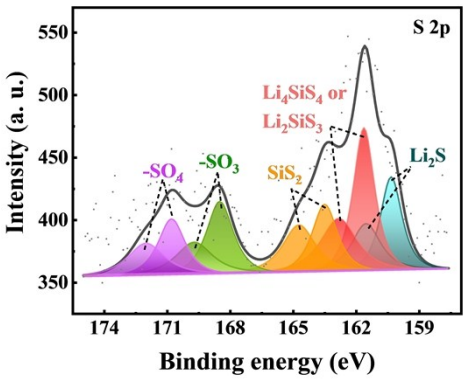

Fig. S3. High-resolution XPS spectra of S 2p for the Li_xSiS_y thin film.

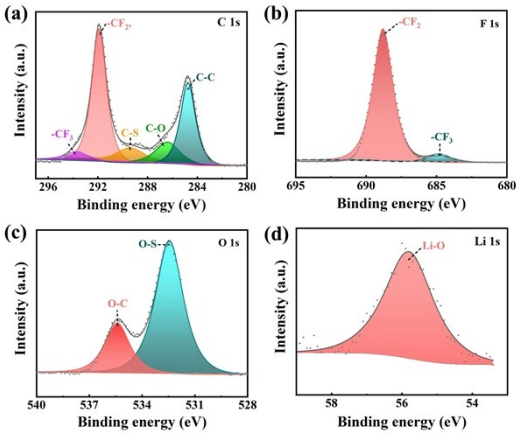

Fig. S4. High-resolution XPS spectra of C 1s, F 1s, O 1s and Li1s for the lithiated Nafion layer on the Li-LNF electrode.

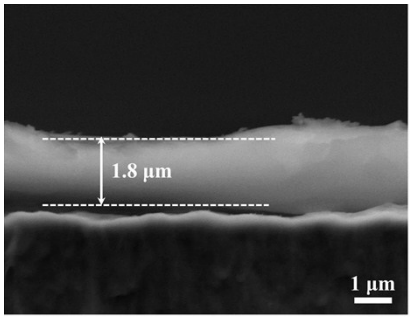

Fig. S5. Cross-sectional SEM image of the Li-LNF electrode.

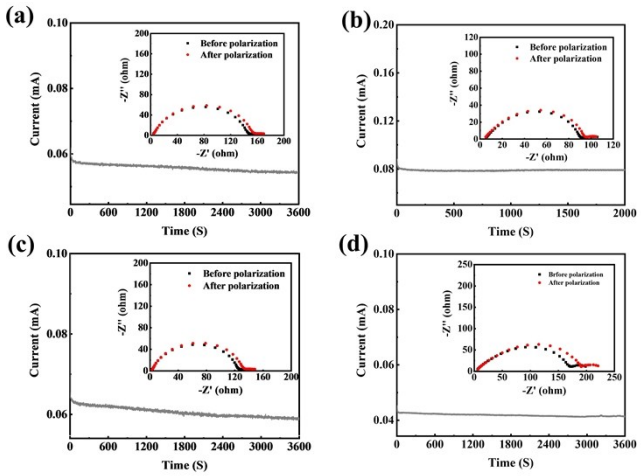

Fig. S6. Current-time plots of (a) Li, (b) Li-Li_xSiS_y, (c) Li-Nafion and (d) Li-LNF symmetric cells, using standard electrolyte after the application of a constant potential (10 mV). The inserts are the electrochemical impedance spectra before and after polarization.

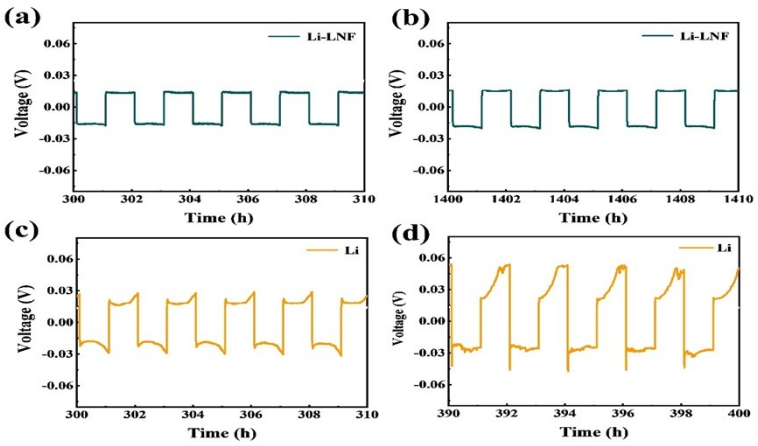

Fig. S7. The voltage-time profiles of symmetric cells for (a), (b) Li-LNF electrodes and (c), (d) Li electrodes at a current density of 1 mA cm^{-2} during different cycling stages.

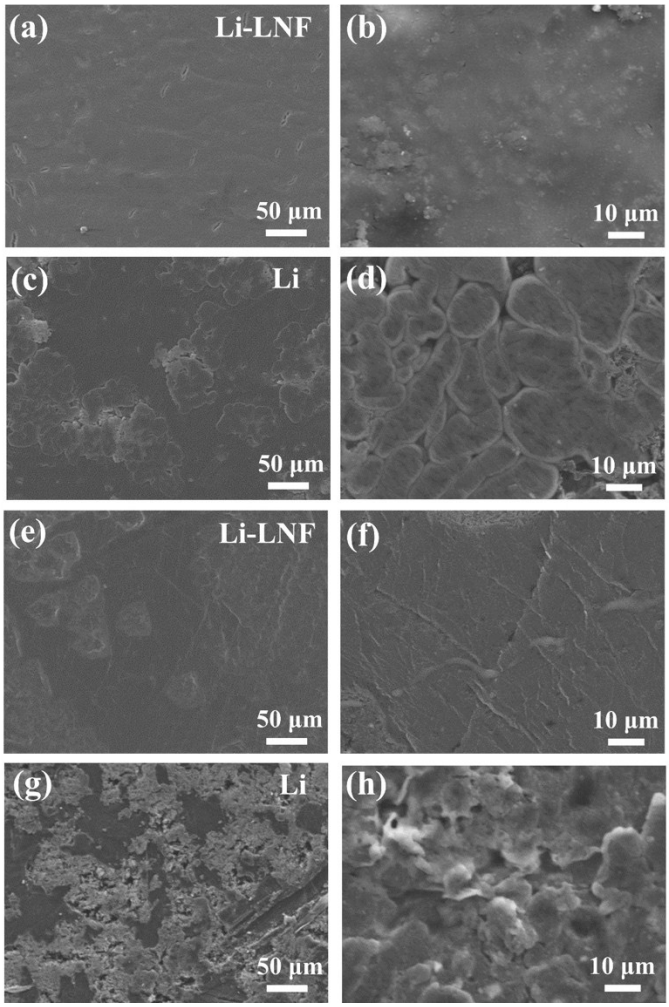

Fig. S8. SEM images of a deposited Li (1.0 mAh cm^{-2}) on (a) the Li-LNF electrode and (c) the Li electrode after 5 cycles; (b and d) the corresponding magnified SEM images from (a and c). SEM images of a stripped Li (1.0 mAh cm^{-2}) on (e) the Li-LNF electrode and (g) the Li electrode after 5 cycles; (f and h) the corresponding magnified SEM images from (e and g).

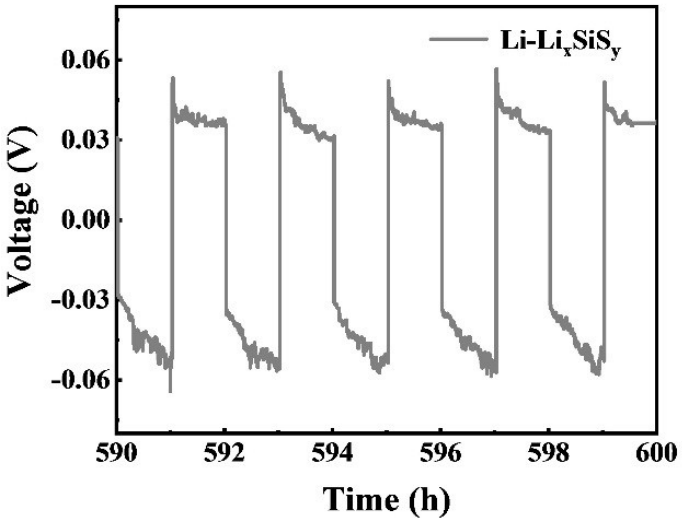

Fig. S9. The voltage-time profile of symmetric cells for Li-Li_xSiS_y electrodes at a current density of 1 mA cm^{-2} during different cycling stages.

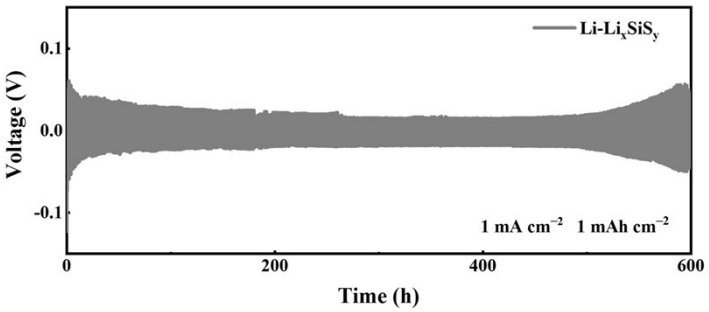

Fig. S10. The voltage-time profile of Li-Li_xSiS_y symmetric cell at current density of 1 mA cm^{-2} and a capacity of 1 mAh cm^{-2}.

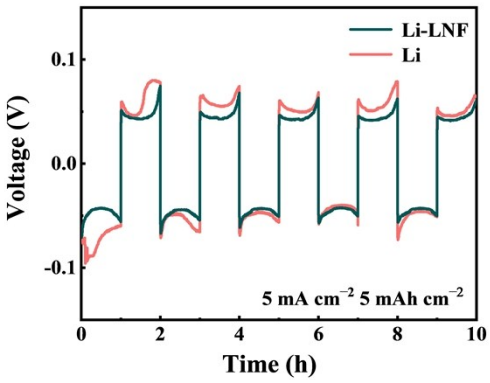

Fig. S11. The voltage-time profiles of Li-LNF and Li symmetric cells at current density of 5 mA cm^{-2}, capacity of 5 mAh cm^{-2}.

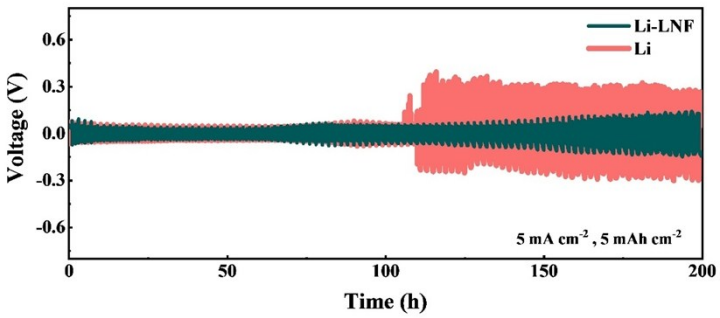

Fig. S12. The voltage-time profile of symmetric cells for the Li-LNF electrodes at a current density of 5 mA cm^{-2} and a capacity of 5 mAh cm^{-2}.

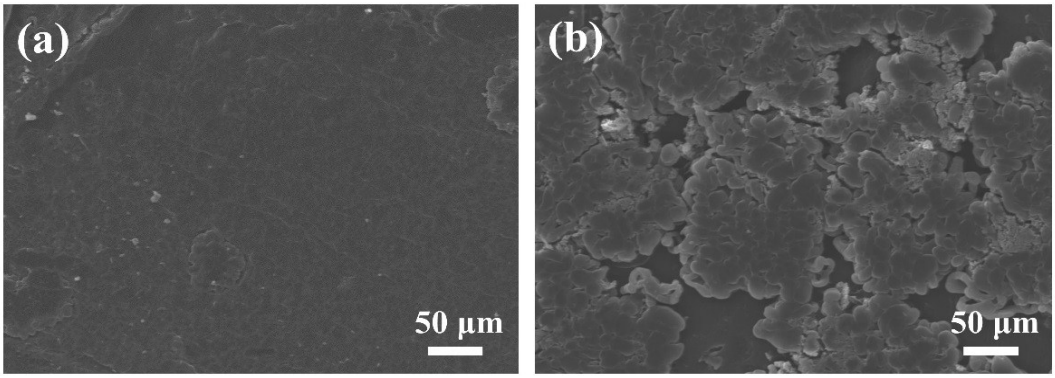

Fig. S13. SEM images of plated Li (5.0 mAh cm^{-2}) on (a) the Li-LNF electrode and (b) the Li electrode.

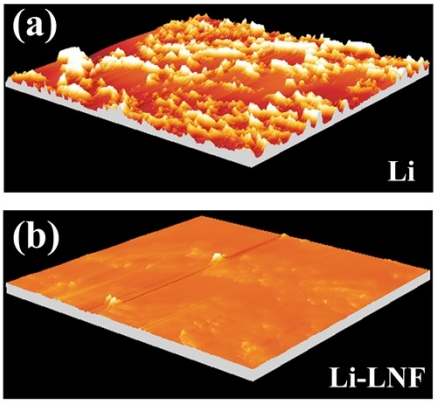

Fig. S14. AFM images of a deposited Li (5.0 mAh cm^{-2}) on (a) Li electrode and (b) Li-LNF electrode.

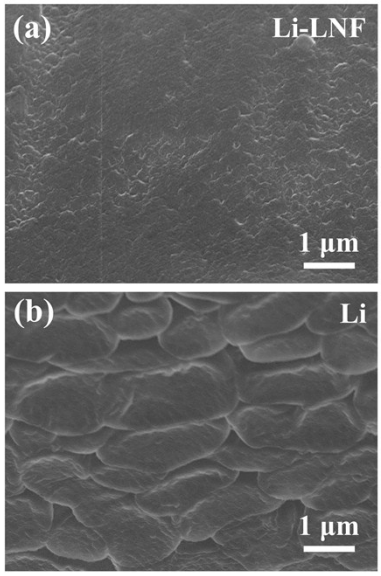

Fig. S15. Magnified cross-sectional SEM images of a deposited Li (5.0 mAh cm^{-2}) on (a) Li-LNF electrode and (b) Li electrode.

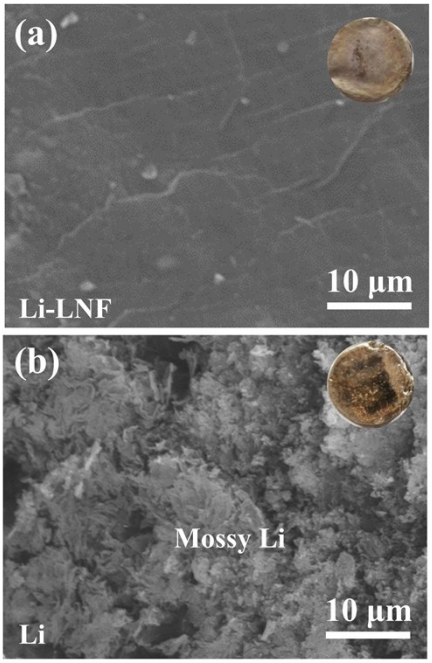

Fig. S16. SEM images of a stripped Li (5.0 mAh cm^{-2}) on (a) Li-LNF electrode and (b) Li electrode. The inserts are corresponding optical photos of the Li-LNF electrode and Li electrode, respectively.

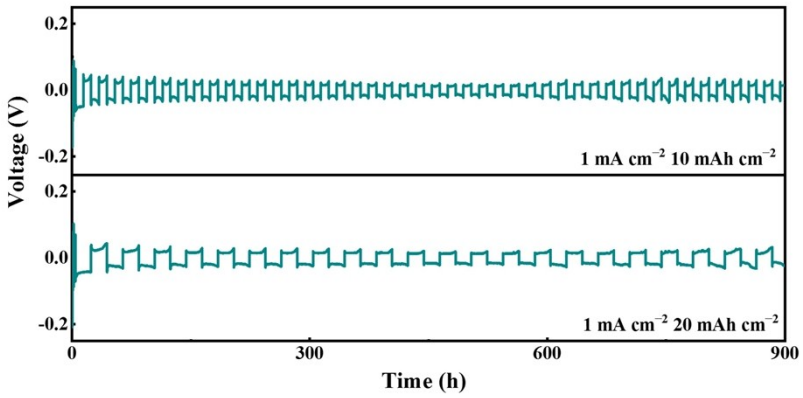

Fig. S17. The voltage-time profiles of Li-LNF symmetric cells at current density of 1 mA cm^{-2}, capacity of 10 mAh cm^{-2} and 20 mAh cm^{-2}.

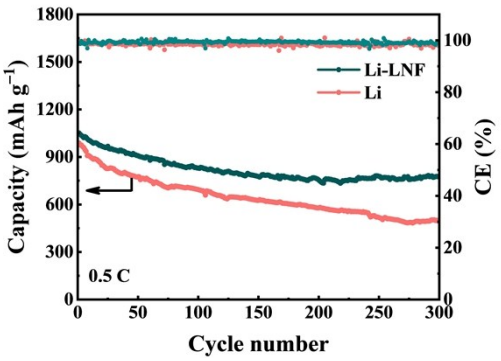

Fig. S18. Cycling performances of Li–S cells-II for the Li-LNF and Li anodes at 0.5 C.

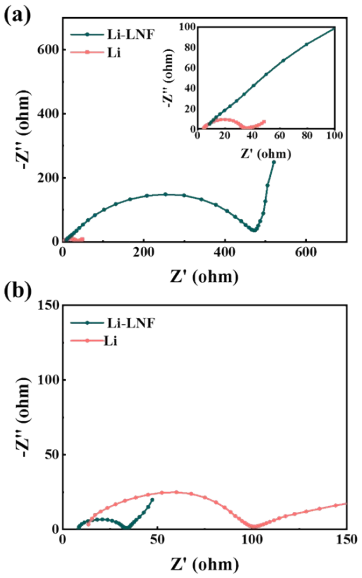

Fig. S19. EIS plots of Li–S cells for the Li-LNF and Li anodes (a) before cycling, (b) after 20 cycles. The inters is an enlarged EIS plot.

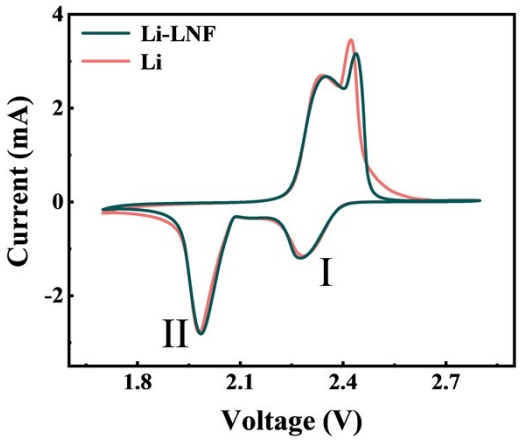

Fig. S20. CV curves of Li–S cells-II for the Li and Li-LNF anodes.

Table S1. The etching time and etching depth of Li-Li_xSiS_y electrode

Etching number	1	2	3
Etching Time（S）	90	180	270
Etching Depth (nm)	67	134	200

Table S2. The currents and resistances obtained before/after polarization for the calculation of Li transference number

	I_0 (mA)	I_S （mA）	R_0 （Ω）	R_S （Ω）	t_{Li+}
Li	**0.062**	**0.055**	**145.3**	**153.6**	**0.63**
Li-Li_xSiS_y	**0.088**	**0.079**	**84.7**	**89.5**	**0.89**
Li-Nafion	**0.065**	**0.059**	**124.7**	**133.4**	**0.80**
Li-LNF	**0.045**	**0.042**	**173**	**190**	**0.86**