Supporting Information

Performances Enhanced High-nickel Lithium Metal Batteries through Stabling Cathode and Anode Electrolyte Interfaces

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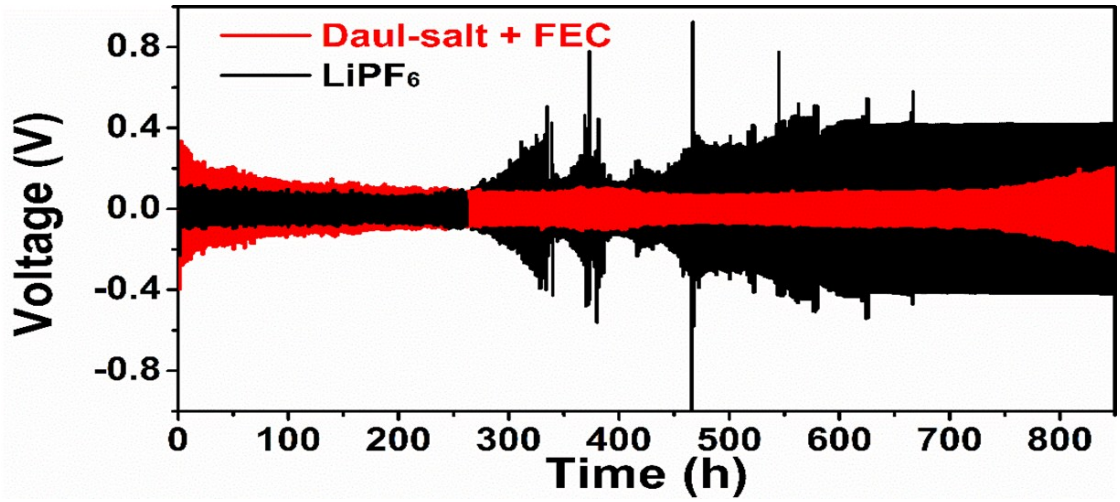

Figure S1 Cycling performances of Li||Li cells, tested at 0.5 mA cm^{-2} and a charge/discharge capacity of 0.5 mAh cm^{-2} using the $LiPF_6$ baseline electrolyte and Dual-salt + FEC electrolyte, respectively.

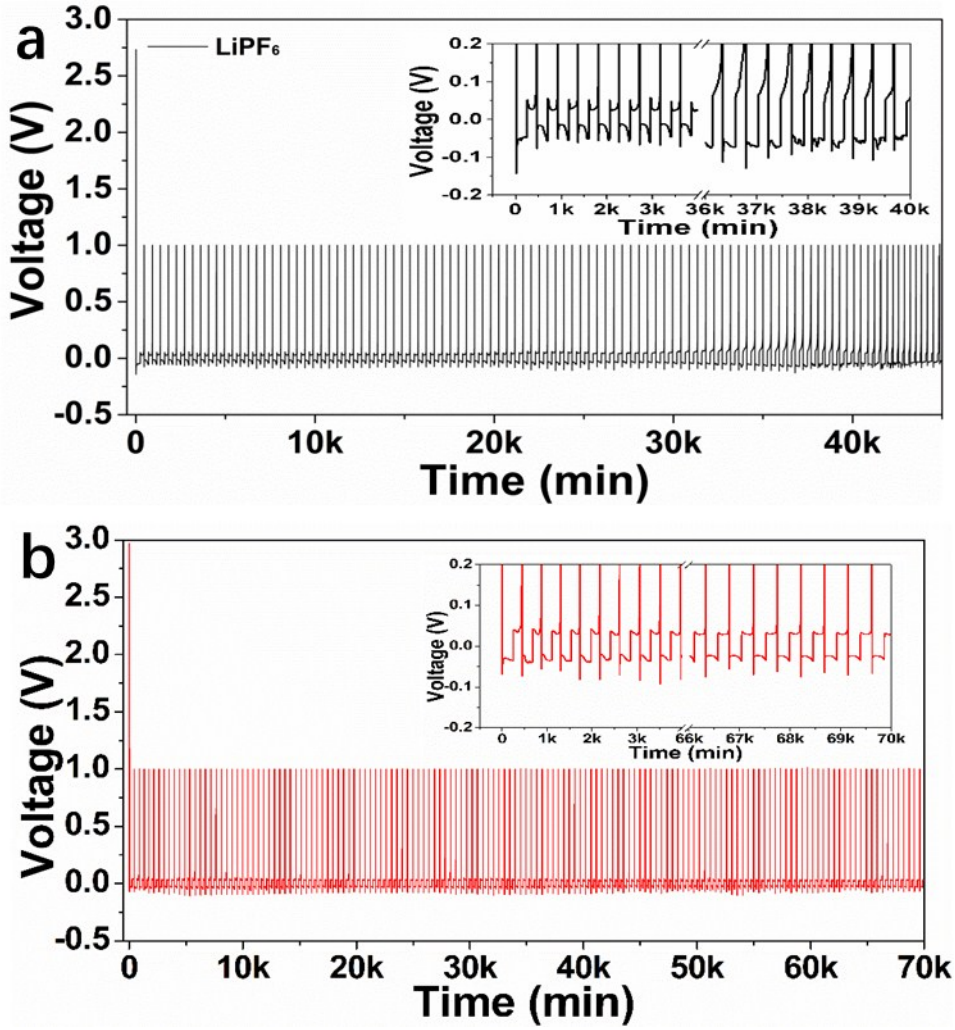

Figure S2(a), (b) Voltage *vs.* time curves for the Li||Cu cells, with insets showing selected enlarged curves, tested at 0.25 mA cm^{-2} with a deposited capacity of 1.0 mAh cm^{-2} using the $LiPF_6$ baseline electrolyte and Dual-salt + FEC electrolyte, respectively.

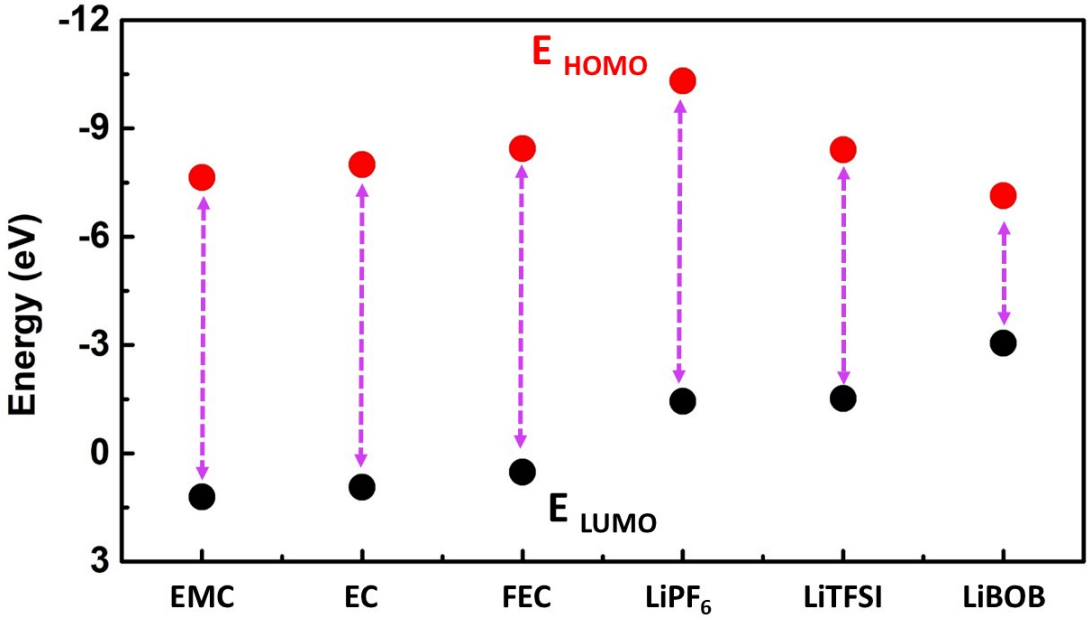

Figure S3 Calculated HOMO and LUMO values for EMC, EC, FEC, $LiPF_6$, LiTFSI and LiBOB.

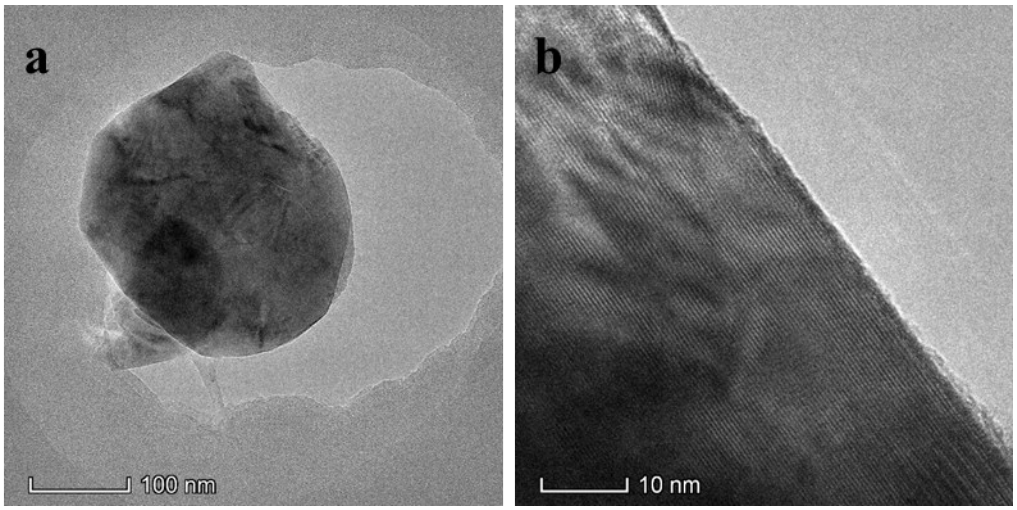

Figure S4(a)-(b) HRTEM images of the fresh pristine high nickel NCM.

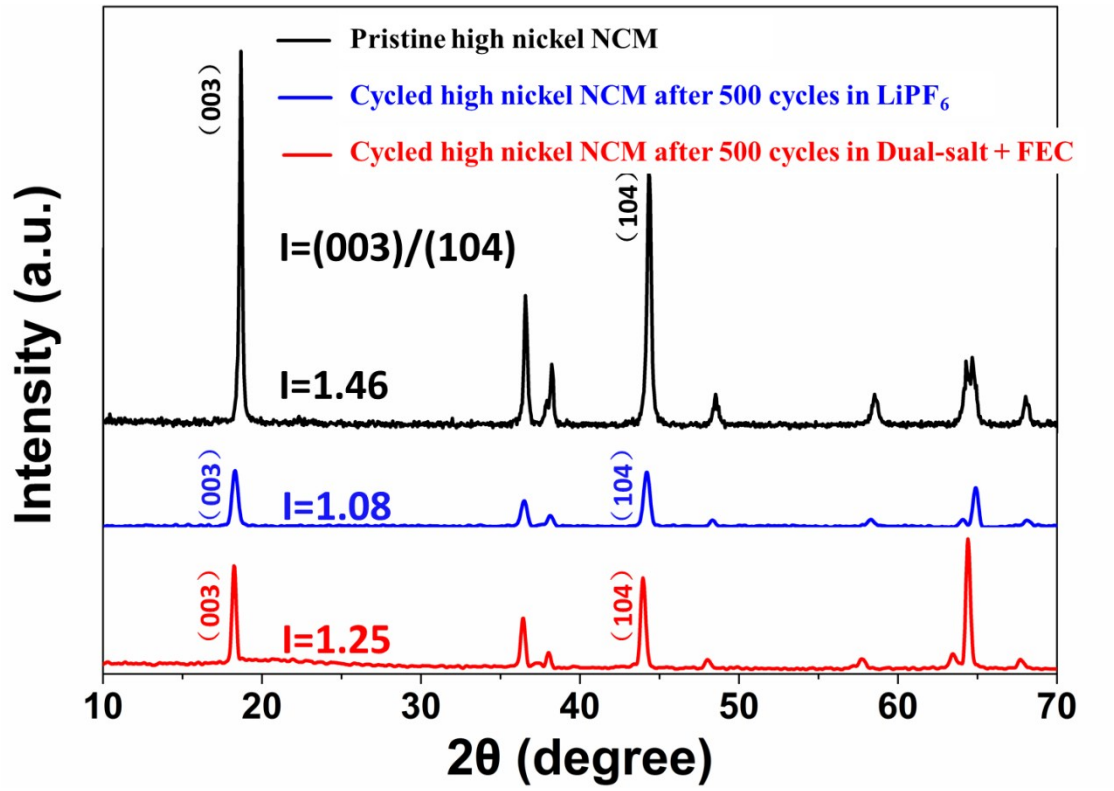

Figure S5 X-ray diffraction patterns of the pristine high nickel NCM, cycled high nickel NCM after 500 cycles in $LiPF_6$ and Dual-salt + FEC electrolyte, respectively.

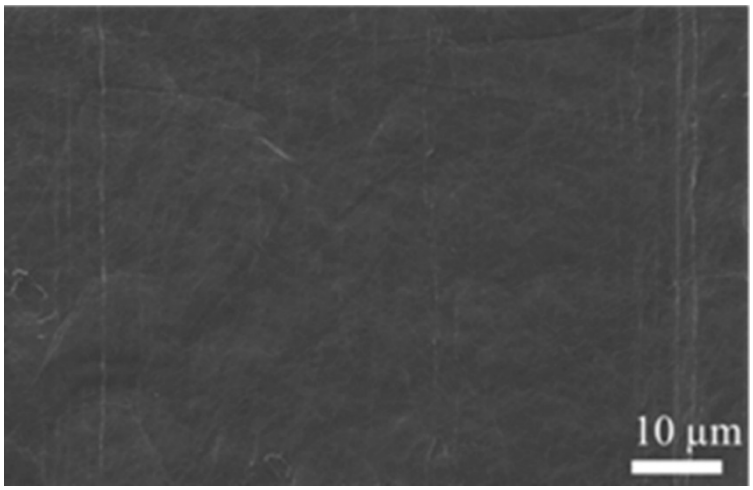

Figure S6 Top view SEM image of the Li metal anode before cycling.

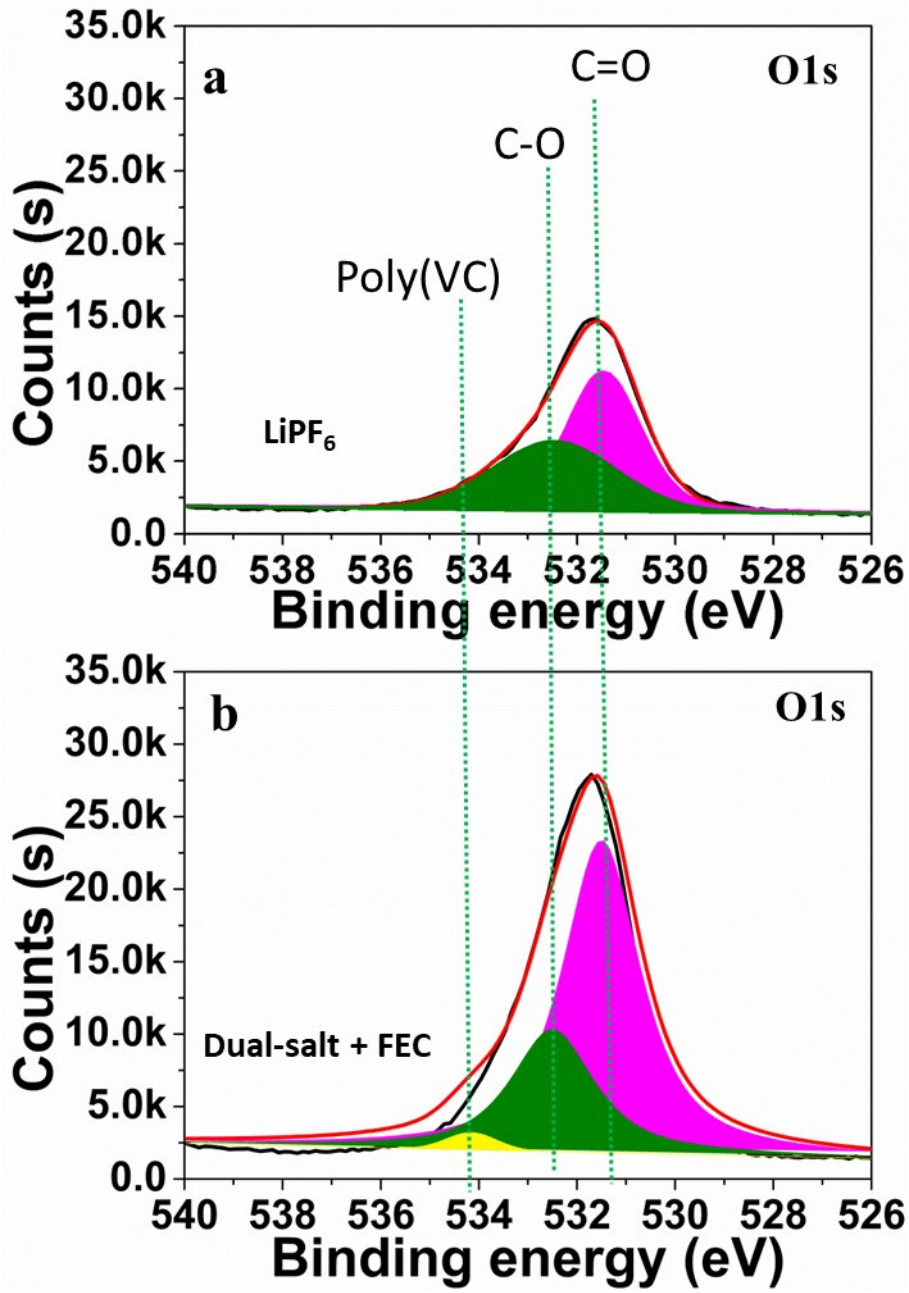

Figure S7(a)-(b) High resolution XPS spectra of O1s for the Li metal anode after 500 cycles in the baseline $LiPF_6$ electrolyte and Dual-salt + FEC electrolyte, respectively.

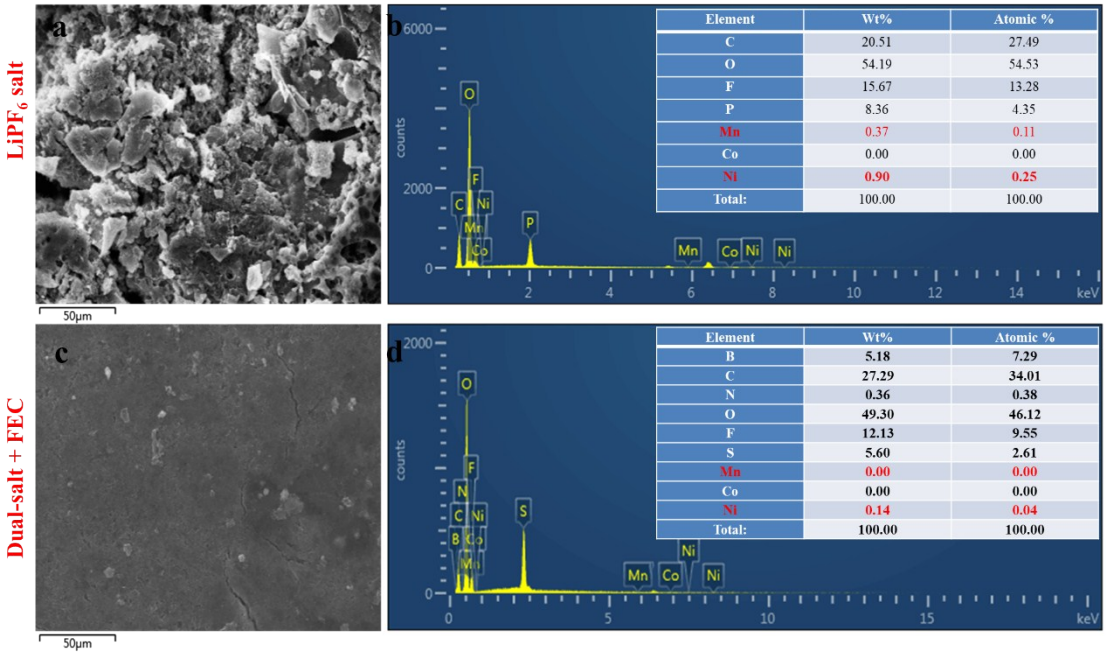

Figure S8 (a)-(b) and (c)-(d) SEM images and the corresponding EDS elements compositions in the SEI for the Li metal anode after 500 cycles in $LiPF_6$ electrolyte and Dual-salt + FEC electrolyte, respectively.

Table S1 EDS elements compositions of the amorphous phase region as shown in Figure 4(a).

Element	Atomic Fraction （%）	Atomic Error (%)	Mass Fraction (%)	Mass Error (%）	Fit Error （%）
C	75.49	5.78	68.24	3.38	2.04
O	10.71	2.28	13.13	2.69	0.47
F	12.97	2.77	16.89	3.46	0.53
P	0.84	0.17	1.74	0.34	1.45

Table S2 EDS elements compositions of the amorphous phase region as shown in Figure 4(e).

Element	Atomic Fraction （%）	Atomic Error (%)	Mass Fraction (%)	Mass Error (%）	Fit Error （%）
C	22.32	6.25	17.30	2.99	6.60
N	0.00	0.04	0.00	0.04	0.00
O	75.22	25.47	79.06	20.31	2.25
F	1.37	0.47	1.53	0.41	6.74
S	1.08	0.36	2.12	0.52	2.55