Supporting Information

Deterioration mechanism of $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$/Graphite-$SiO_x$ power batteries under high temperature and discharge cycling

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Table S1. Detailed parameters of the assembled full cells

Battery type	Cathode	Anode	Electrolyte
NCA/liquid electrolyte/ (graphite-SiO_x)	91 wt% $LiNi_{0.85}Co_{0.15}Al_{0.05}O_2$; 1 wt% CNT; 4 wt% Super-P; 4 wt% PVDF	93 wt % graphite-SiO_x ; 1.6 wt % CMC; 3 wt % Super-P; 2.4 wt % SBR;	Liquid electrolyte: 1M $LiPF_6$ solution dissolved in ethylene carbonate (EC)/diethyl carbonate (DEC)/ethyl methyl carbonate (EMC) (volume ratio of EC:DEC:EMC = 1:1:1)

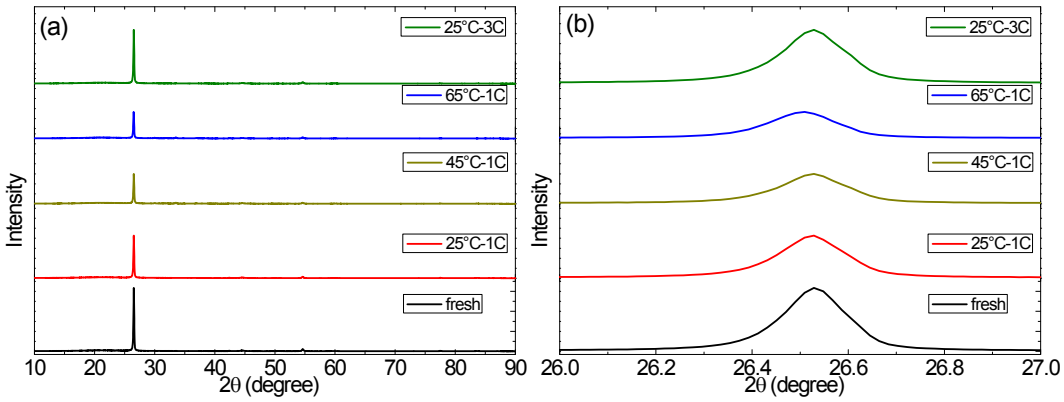

Fig. S1. XRD patterns of fresh and aged graphite-SiO_x electrodes at different cycling conditions: (a) full patterns, (b) main peaks.

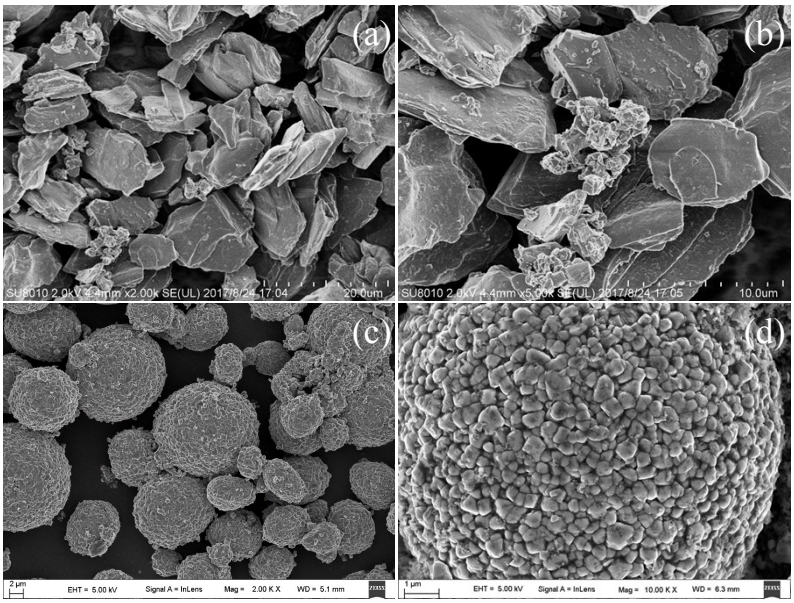

Fig. S2. SEM images of graphite-SiO_x (a, b) and NCA (c, d) powder.

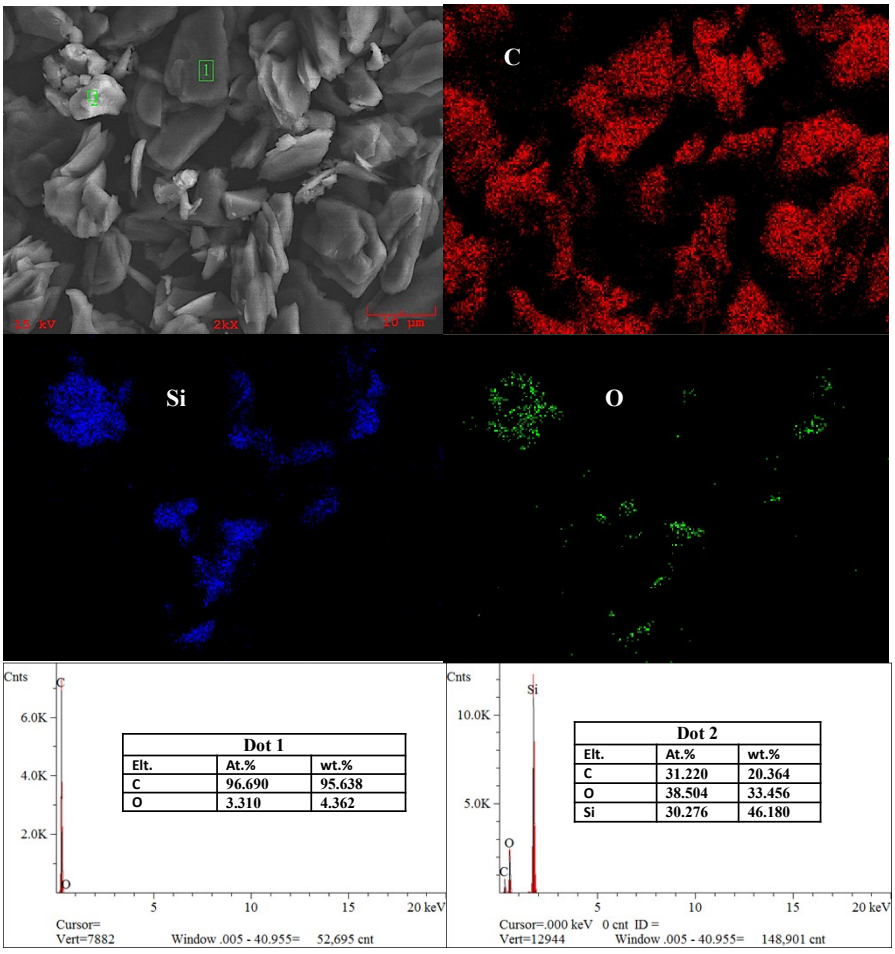

Fig. S3. Mapping and EDS of graphite-SiO_x raw powder material.

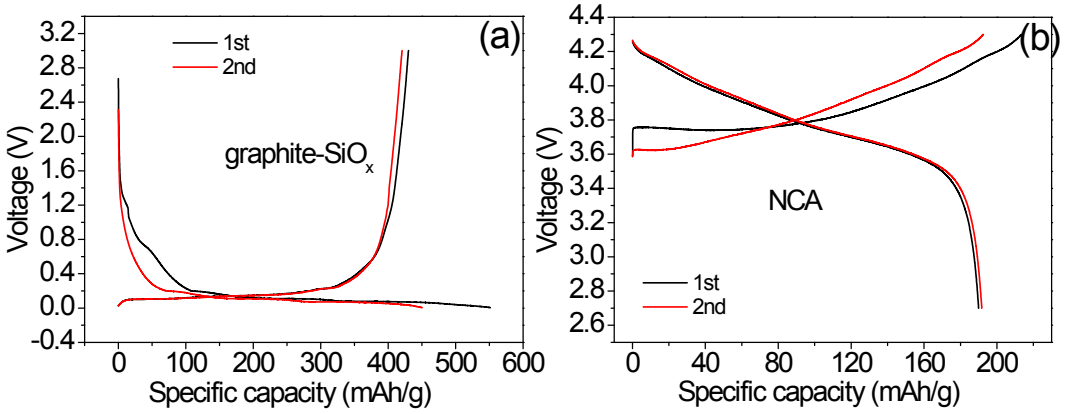

Fig. S4. Basic electrochamical characterization of graphite-SiO_x (a) and NCA (b).

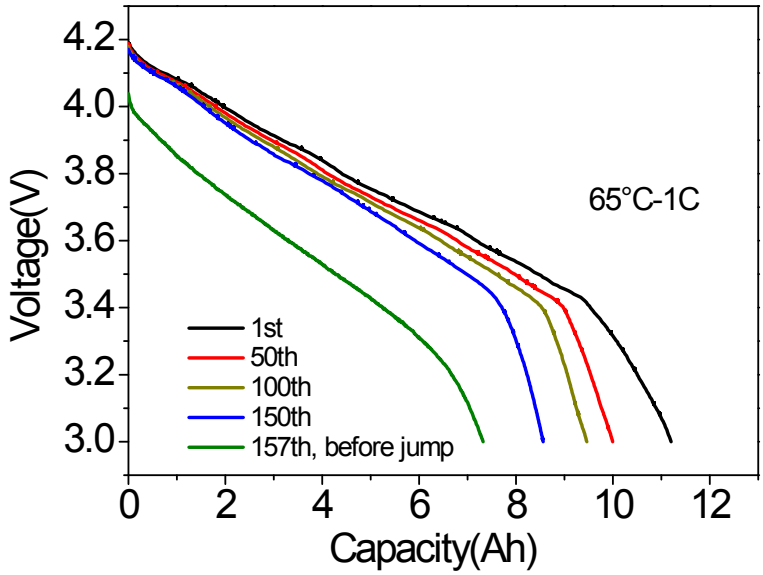

Fig. S5. (a) different cycles of voltage profiles for 65°C cycle, (b, c, d) different charge curves at 0.04C and the charge curves at 0.5C in the following.

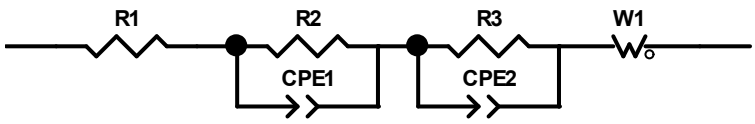

Fig. S6. Equivalent circuit model in the electrochemical impedance spectra (EIS) measure

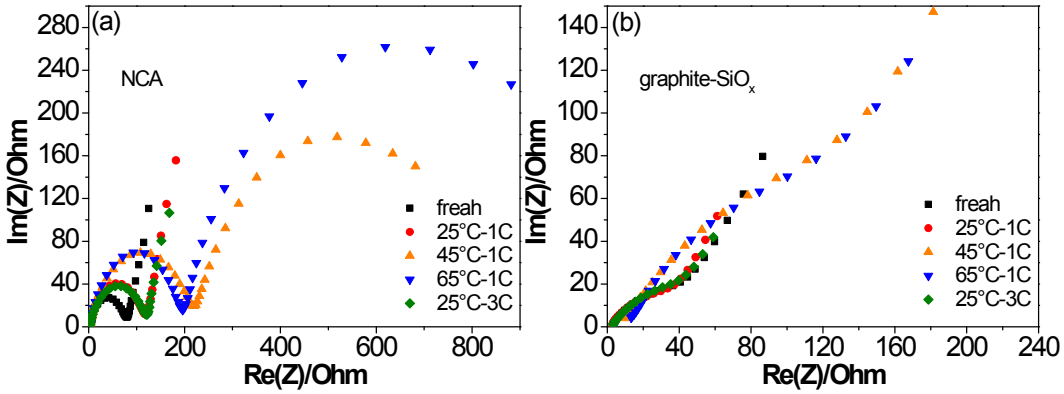

Fig. S7. EIS curves of coin cells for (a) NCA and (b) graphite-SiO_x electrodes obtained from fresh and cycled batteries. The measurement is performed at 25°C and in the fully discharged state.

Table S2. Simulated results from EIS curves in **Fig. 2** by Z-view software

	fresh	25°C-1C	45°C-1C	65°C-1C	25°C-3C
R_b (mΩ)	14.76	16.2	33.8	43.7	14.51
R_{sei} (mΩ)	5.21	2.97	5.84	29.11	3.49
R_{ct} (mΩ)			5.72	16.85	
R_{total} (mΩ)	19.97	19.17	45.36	89.66	18

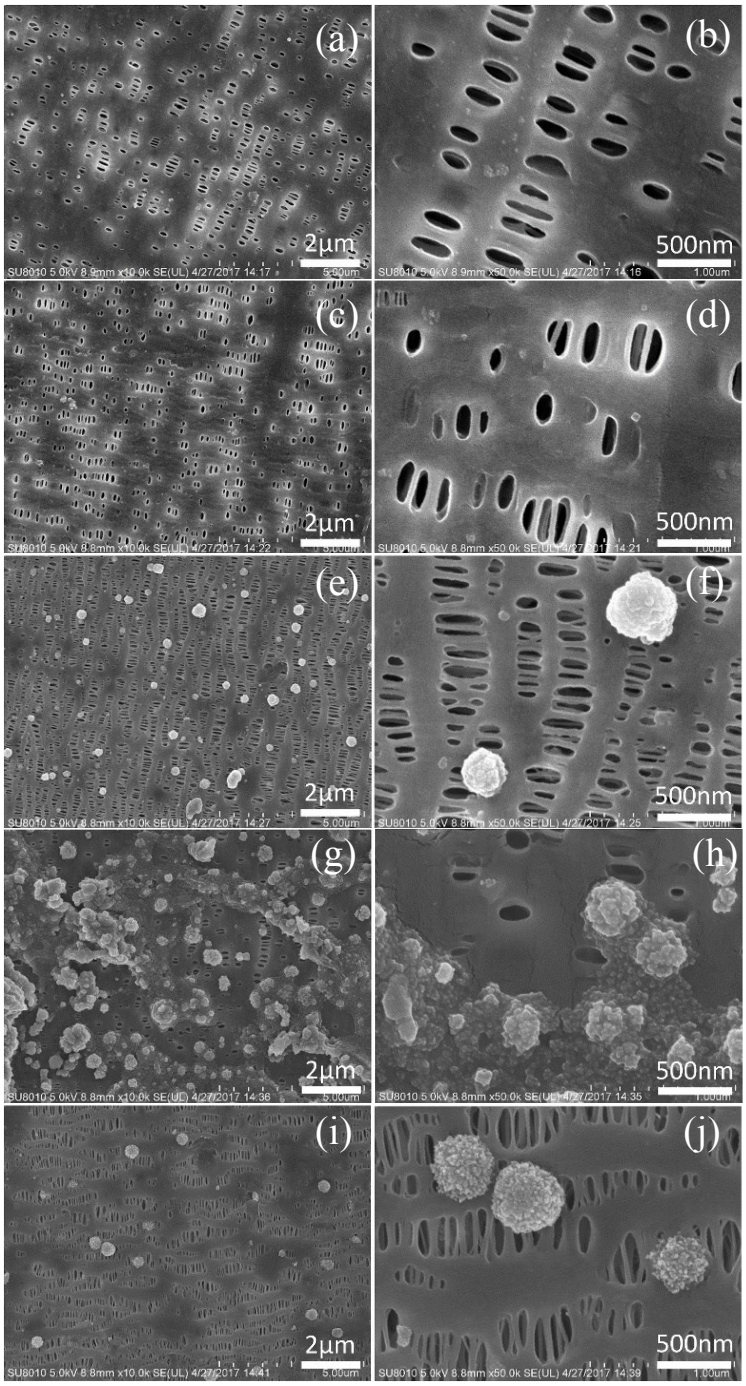

Fig. S8. SEM images of separator surface after different cycling conditions: fresh (a, b), 25°C-1C (c, d), 45°C-1C (e, f), 65°C-1C (g, h) and 25°C-3C (i, j).

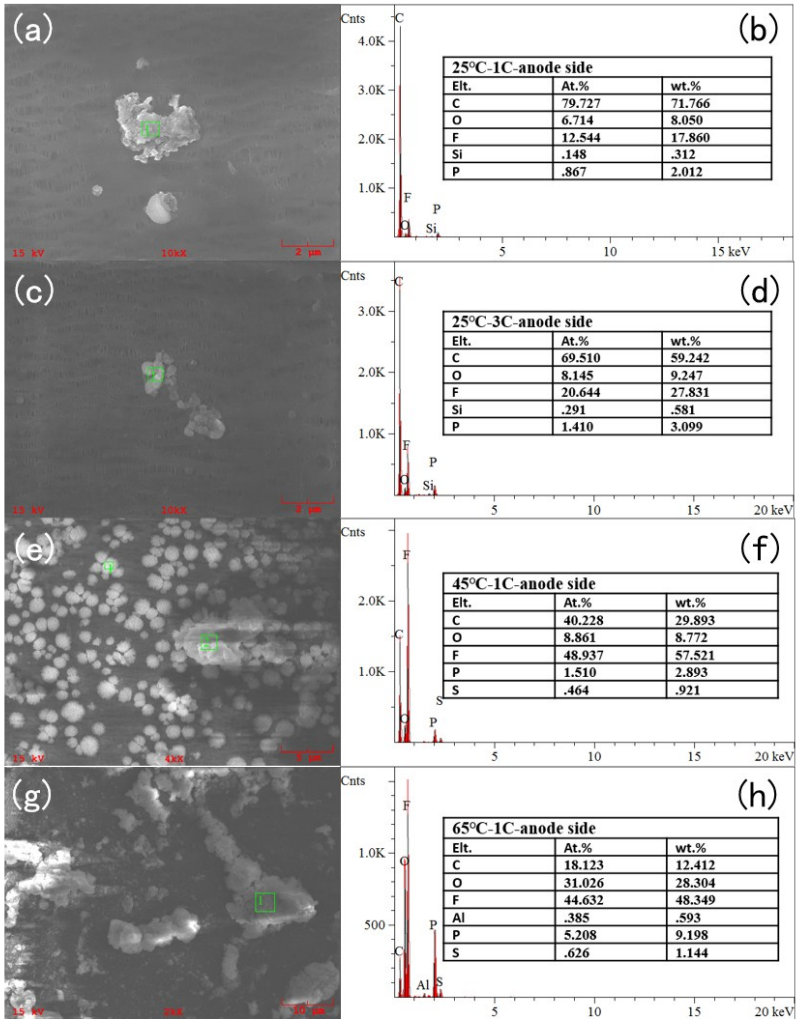

Fig. S9. SEM images and EDS of separator surface on the anode surface: 25°C-1C (a, d), 25°C-3C (c, d), 45°C-1C (e, f) and 65°C-1C (g, h)

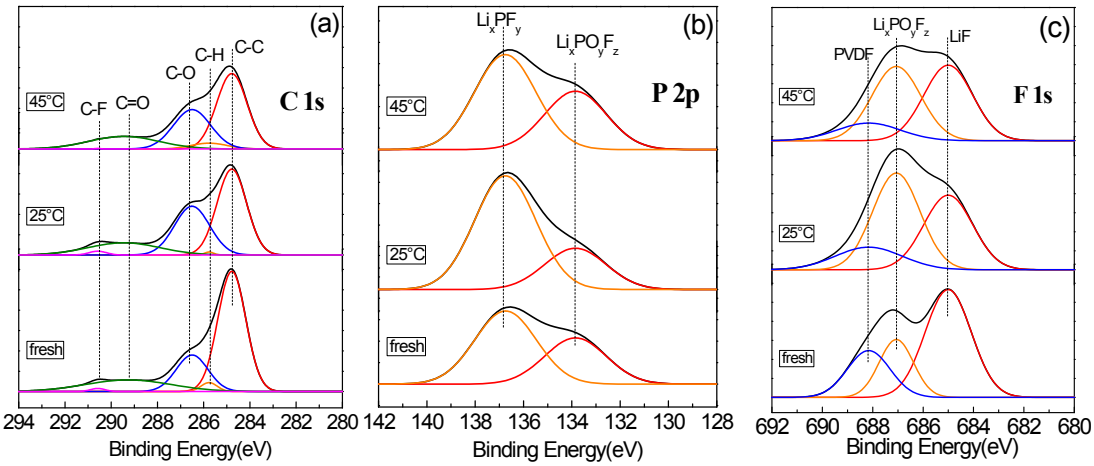

Fig. S10. XPS of C 1s, P 2p and F 1s spectra of fresh and aged NCA electrodes.

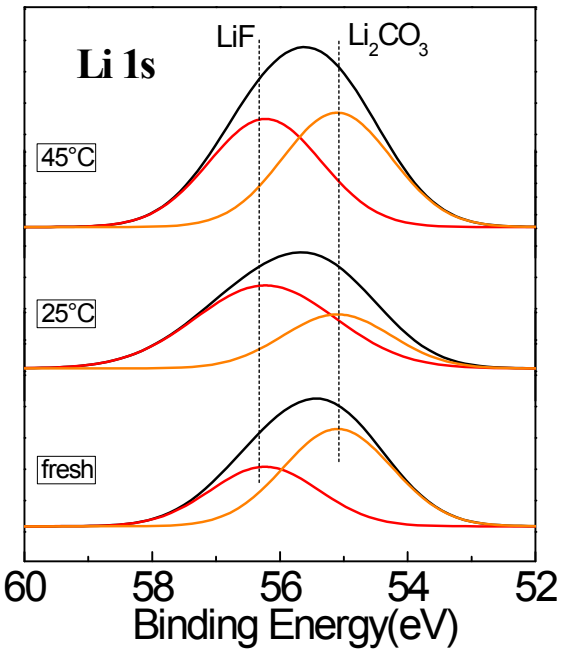

Fig. S11. XPS of Li 1s nd Ni 2p spectra of fresh and aged graphite-SiO_x electrodes.