Supporting Information

Enabling Fast Formation for Lithium-ion Batteries with a Localized High-Concentration Electrolyte

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Fig. S1: XRD pattern of as-synthesized NMC811 cathode compared to R-3m reference pattern.



Fig. S2: (a) SEM images and (b) EDS maps of as-synthesized NMC811 cathode.



Fig. S3: (a) Potential versus time and (b) potential versus specific capacity curves from the formation cycles applied to LP57-containing cells in preparation for XPS.



Fig. S4: (a) Potential versus time and (b) potential versus specific capacity curves from the formation cycle applied to LHCE-containing cells in preparation for XPS.



Fig. S5: XPS spectra from LP57 samples before and after sputtering. (a) C 1s, (b) O 1s, and (c) F 1s spectra for each formation rate, with unsputtered and sputtered spectra shown in, respectively, red and green.



Fig. S6: XPS spectra from LHCE samples before and after sputtering. (a) C 1s, (b) O 1s, and (c) F 1s spectra for each formation rate, with unsputtered and sputtered spectra shown in, respectively, red and green.



Fig. S7: Fitted EIS curves from pouch full cells with (a) LP57 and (b) LHCE during cycling.



Fig. S8: Progression of charge-transfer resistance during pouch-cell cycling for cells with (a) LP57 and (b) LHCE electrolytes.



Fig. S9: Coulombic efficiency values for (a) LP57 and (b) LHCE pouch cells

Electrolyte	Formation Protocol	1 st cycle duration (h)	1 st cycle C.E. (%)	1C energy density (W h kg ⁻¹)	C/10 energy density (W h kg ⁻¹)
LP57	C/10	22.1	82.3	554	642
LP57	C/2	4.9	73.5	559	647
LP57	1C	2.9	51.3	569	653
LP57	СР	2.2	59.9	475	506
LHCE	C/10	21.4	82.2	580	675
LHCE	C/2	4.7	76.6	574	657
LHCE	1C	2.7	73.6	577	659
LHCE	СР	1.9	81.2	582	623

Table S1: First cycle durations, coulombic efficiencies, and energy densities of pouch full cells



Fig. S10: Images of graphite anodes after cycling in pouch cells with (a) LP57 and (b) LHCE electrolytes.



Fig. S11: SEM images of graphite anodes after cycling in pouch cells with (a) LP57 and (b) LHCE electrolytes.



Fig. S12: Arrhenius measurements of graphite symmetric cells from cycled pouch cell electrodes with (a) LP57 and (b) LHCE electrolytes.



Fig. S13: Postmortem half-cell potential profiles of cycled Graphite from (a) LHCE and (b) LP57 pouch cells.



Fig. S14: Images of graphite anodes from coin full cell tests after cycling in (a) LP57 and (b) LHCE with C/10 and 1C formations.