Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

Understanding on the constant-voltage fast charging process using a high-rate Ni-rich cathode material for lithium ion battery

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Figure S1. Annealed NCM811 powders acquired from 5 kg of USP precursors.

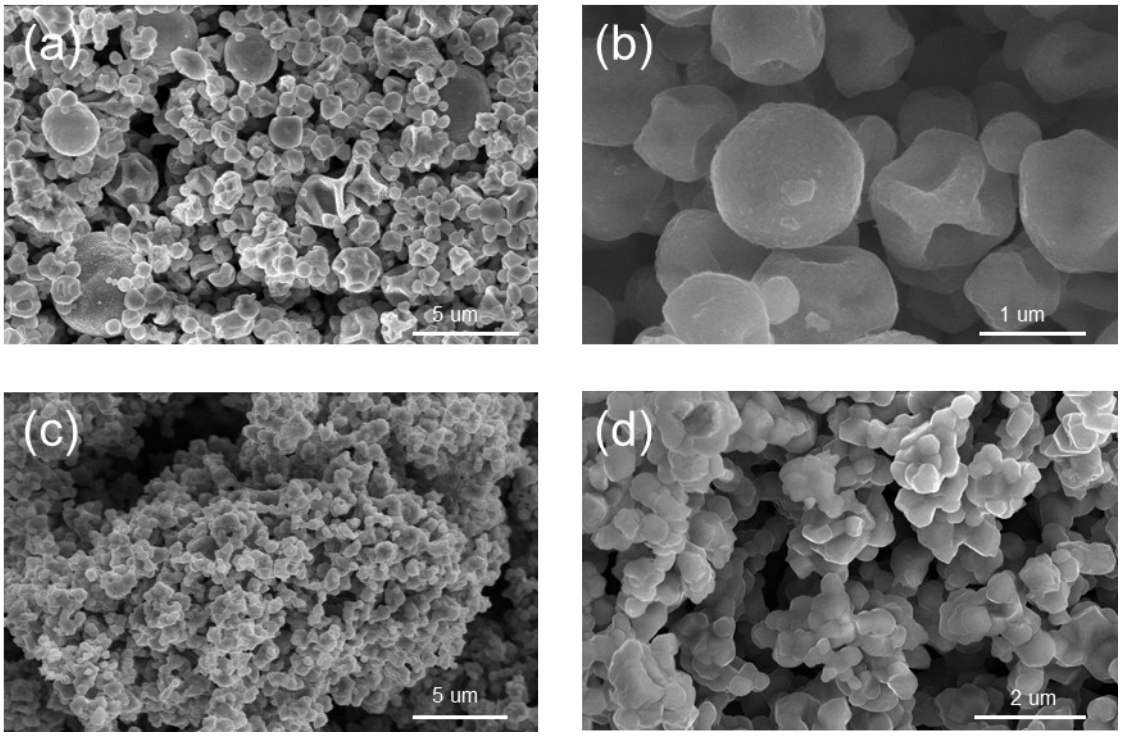


Figure S2. SEM images of (a,b) USP precursor and (c,d) annealed powders.

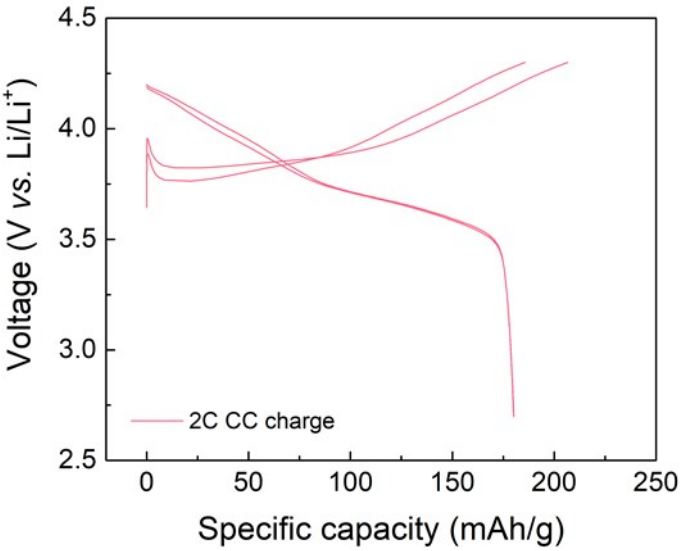


Figure S3. Voltage profile of NCM811 under 2C CC charging protocol.

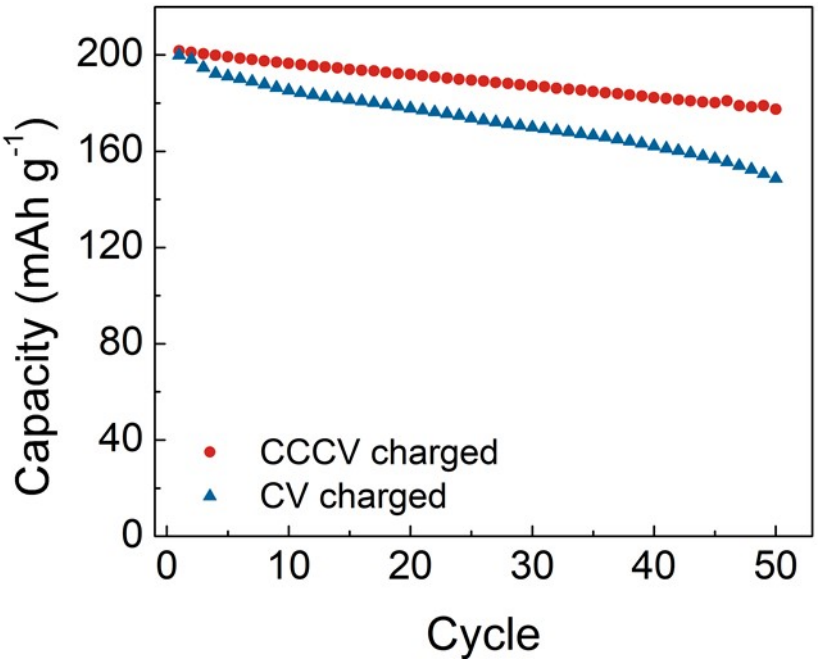


Figure S4. Cycle stability of CCCV (red) and CV (blue) charged cells.

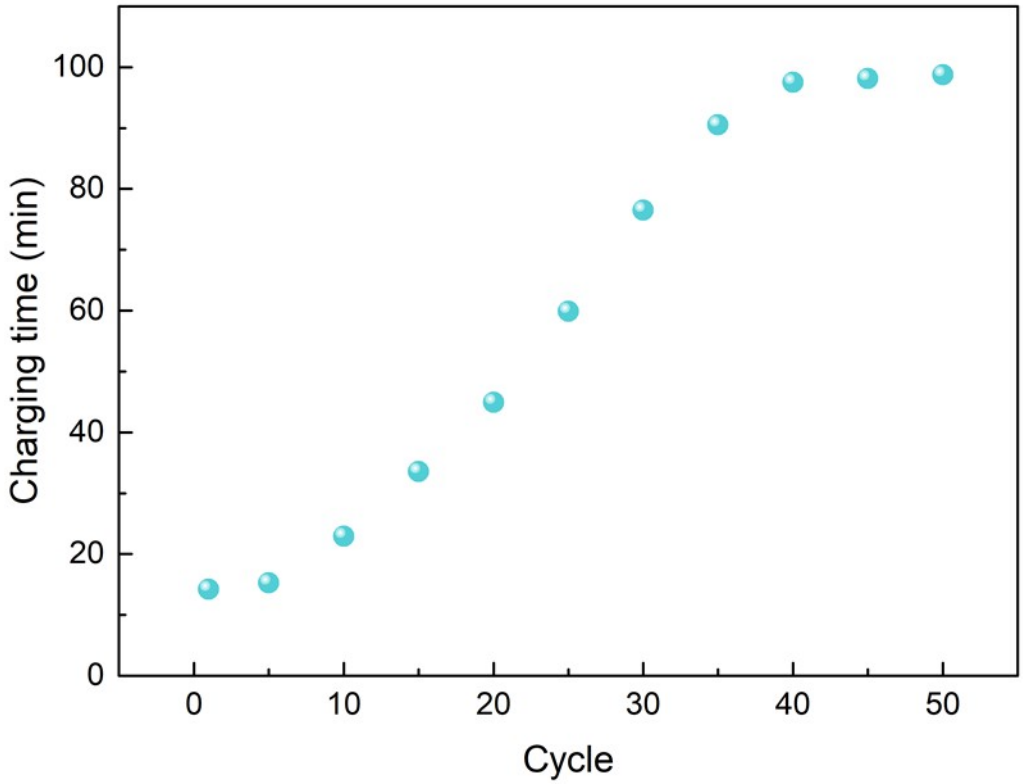


Figure S5. Charging time with every 5 cycles using CV charging protocol.

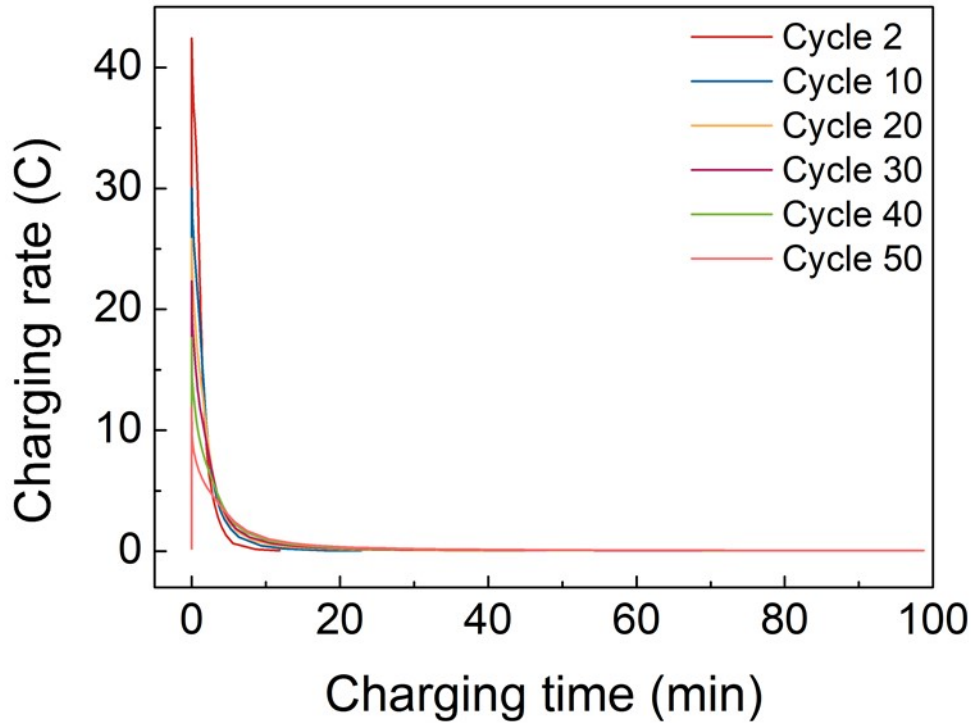


Figure S6. Charging rate profile of CV charging with every 10 cycles. Magnified image during initial 10 minutes is illustrated in Figure 4b.

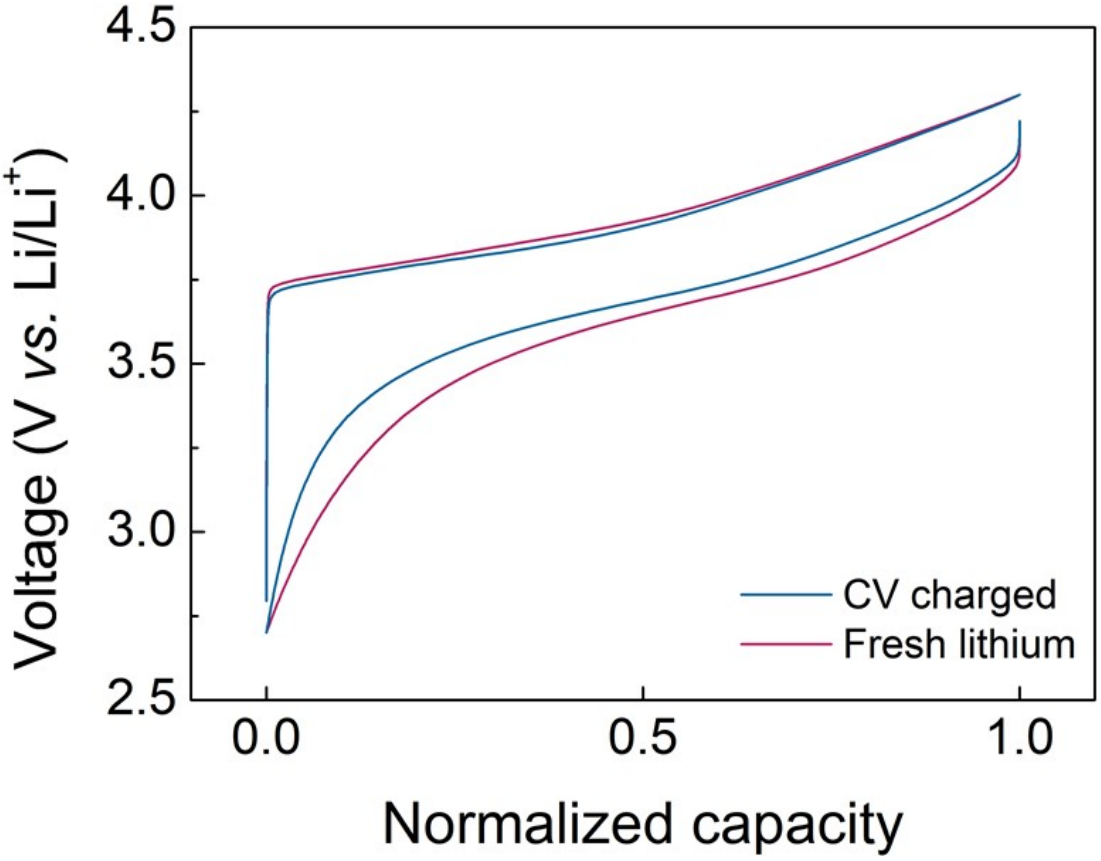
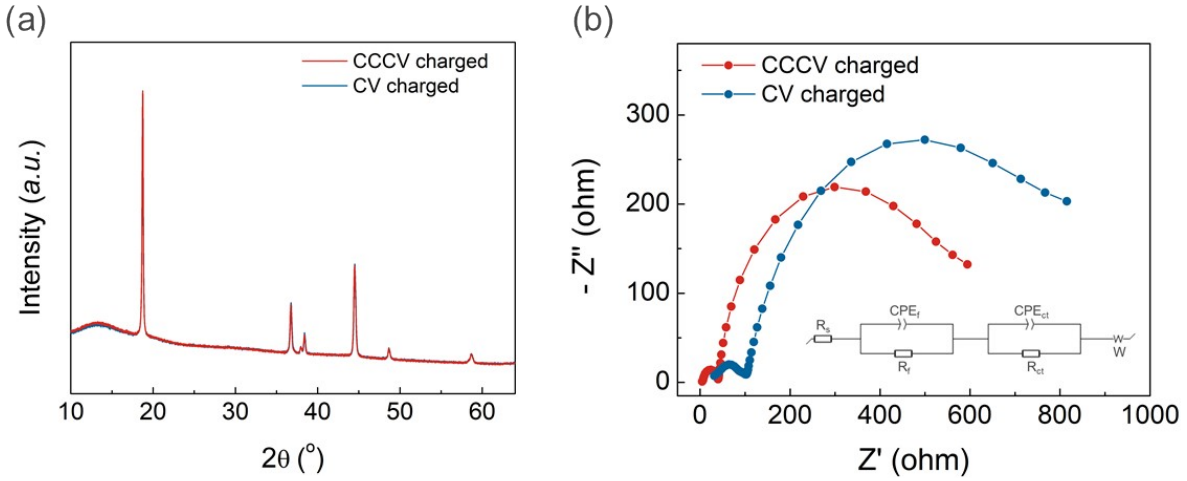


Figure S7. Voltage profile with normalized capacity after 50 cycles of CV charging (blue). After 50 CV charging cycling and re-assembling with new lithium metal and electrolyte (red), there was no improvement in voltage hysteresis, indicating the origin of voltage hysteresis is the cathode electrode.



	R_s (Ω)	R_f (Ω)	R_{ct} (Ω)
CCCV charged	5.8	31.4	460.2
CV charged	26.2	76.4	610.5

Figure S8. (a) XRD and (b) EIS data after 50 cycles of CCCV charging (red) and CV charging (blue). *a* and *c* lattice parameters for CCCV cycled were 2.86952(9) Å and 14.2327(13) Å, and for CV cycled were 2.86954(9) Å and 14.2330(13) Å. Equivalent circuit for EIS fitting is shown in the inset of Figure S8b. (R_s; ohmic resistance, R_f; SEI film resistance, R_{ct}; charge transfer resistance and W; Warburg impedance.)

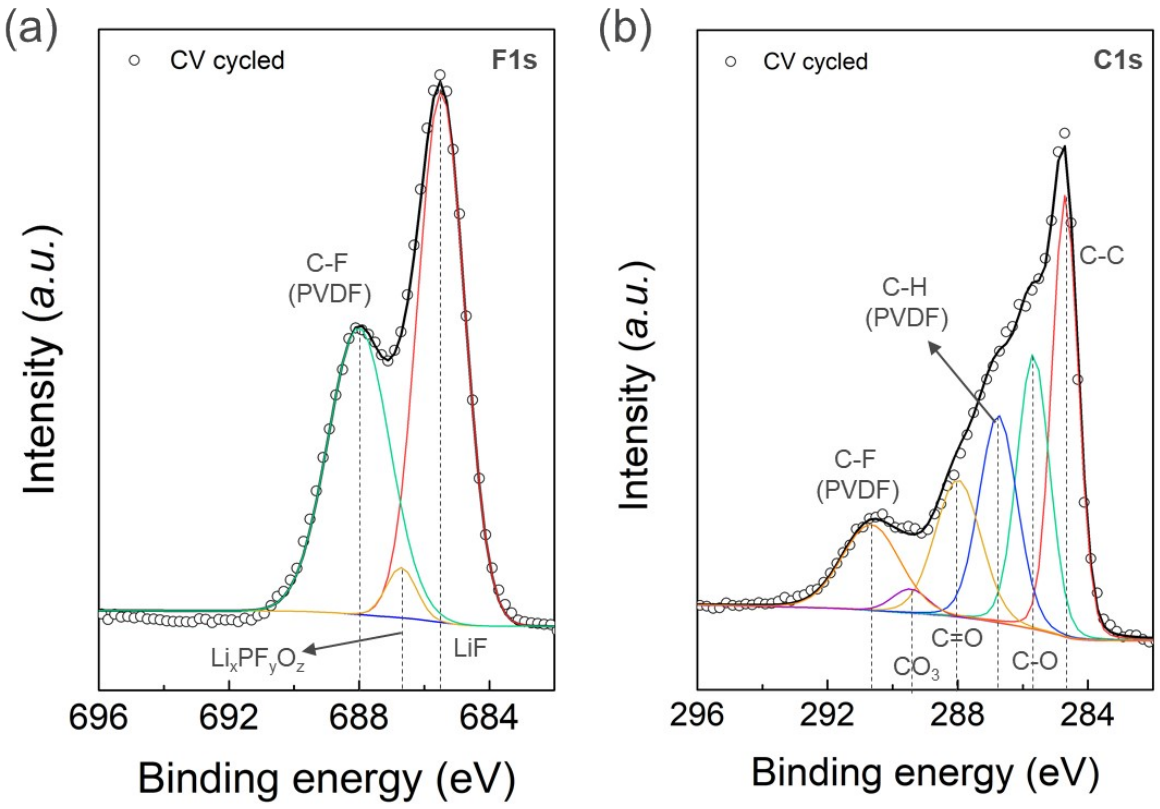


Figure S9. XPS spectra of (a) F1s and (b) C1s regions from CV cycled electrode with peak deconvolution.

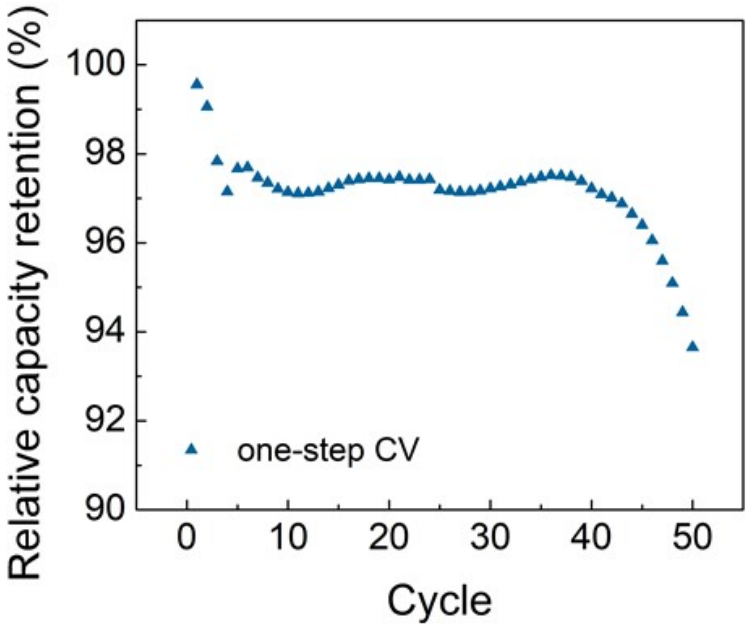


Figure S10. Relative capacity retention of one-step CV charging. Discharge capacity of one-step CV charging was normalized by two-step CV charging, which was acquired from the data in Figure 6c.

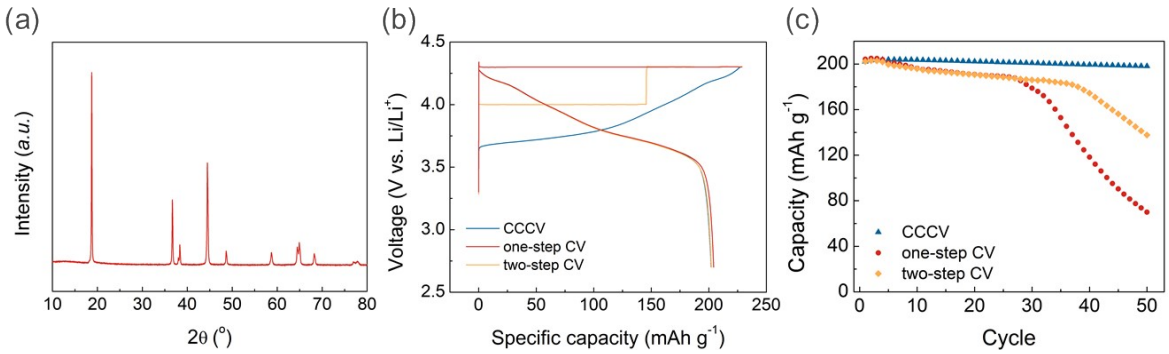


Figure S11. (a) XRD data of NCM811 obtained from co-precipitation method. (b) Voltage profile and (c) cycle stability of CCCV charging (blue), one-step CV charging (red) and two-step CV charging (orange).