

# Supporting information

## **One-pot Preparation of Lithium Compensation Layer, Lithiophilic Layer and Artificial Solid Electrolyte Interphase for Lean-lithium Metal Anode**

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**KEYWORDS:** lean-lithium metal anode; lithium supplementation; physical vapor deposition; lithium fluoride; artificial SEI; lithiophilic current collector

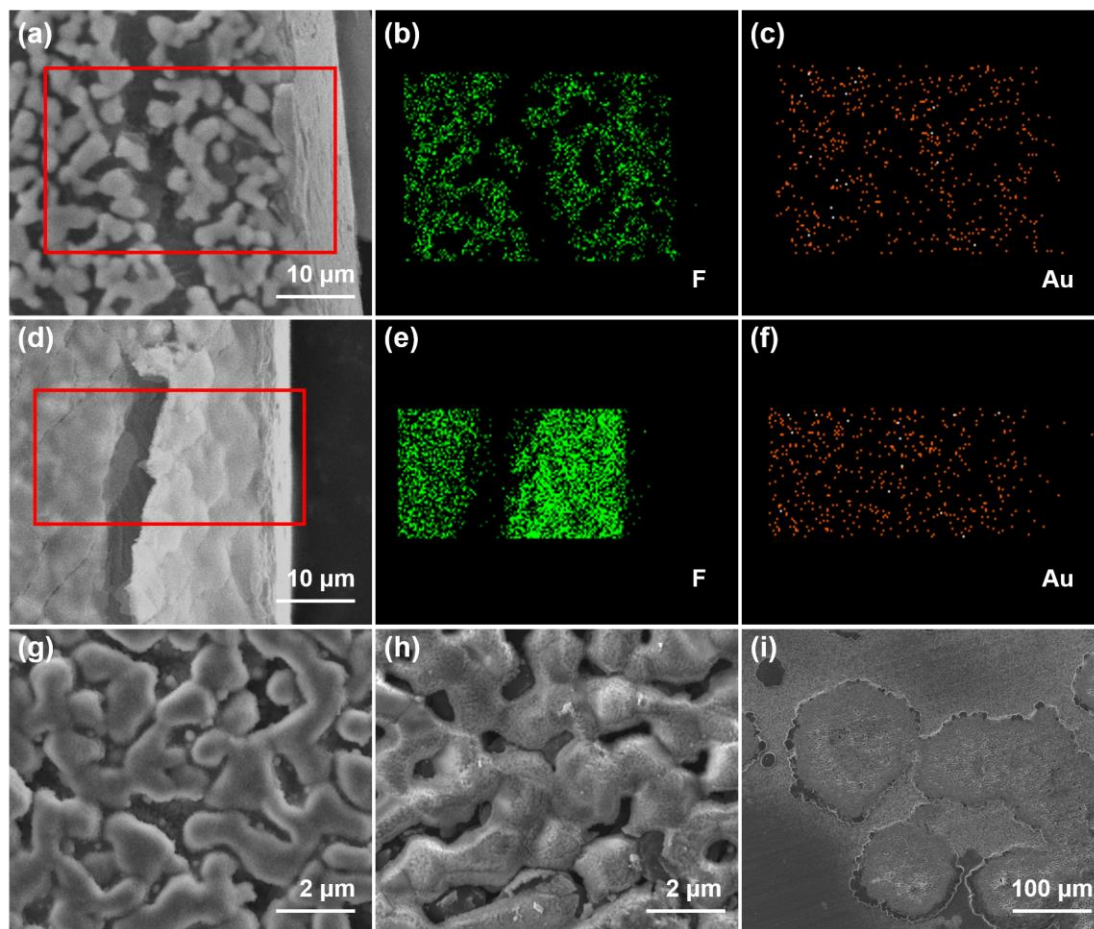


Fig. S1 SEM image and the corresponding elemental mapping image of (a-c) CLAF, and (d-f) CALF. Surface morphology at high magnification of (g) CLAF, and (h) CALF. (i) CALF surface morphology at low magnification.

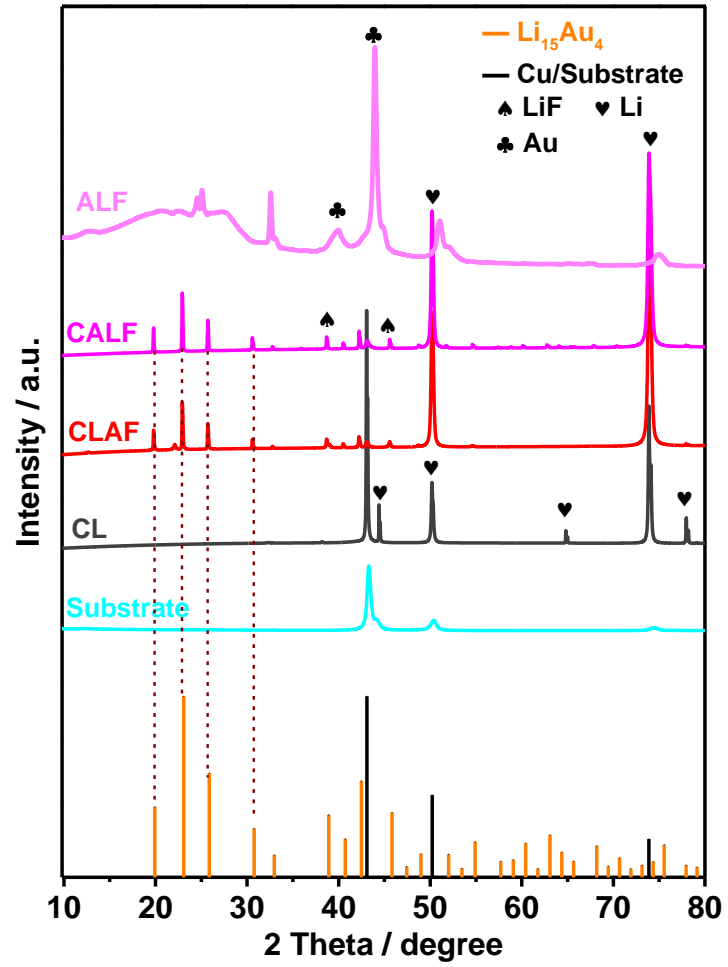


Fig. S2 XRD patterns of CLAF, CALF, ALF and test device.

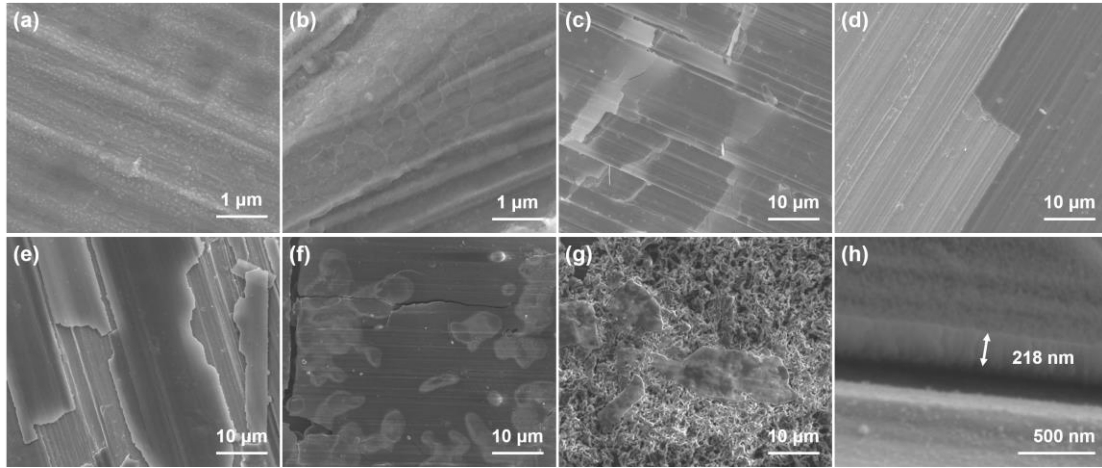


Fig. S3 Morphology of (a) 10 nm, (b) 50 nm, (c) 100 nm, (d) 200 nm, and (e) 300 nm LiF vapor deposited layer on Cu substrate. (f) Deposition, (g) stripping behaviors and (h) side view image of lithium on Cu substrate coated with 200 nm LiF layer at  $0.5 \text{ mA cm}^{-2}$  and  $1 \text{ mAh cm}^{-2}$ .

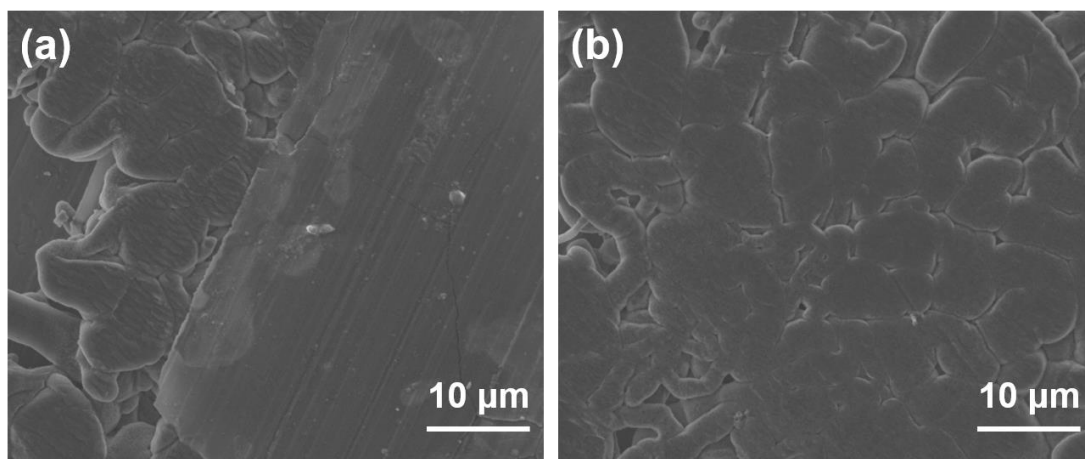


Fig. S4 Morphology of lithium deposition behaviors on (a) Au@LiF and (b) 80 Au layer at  $0.5 \text{ mA cm}^{-2}$  and  $1 \text{ mAh cm}^{-2}$ .

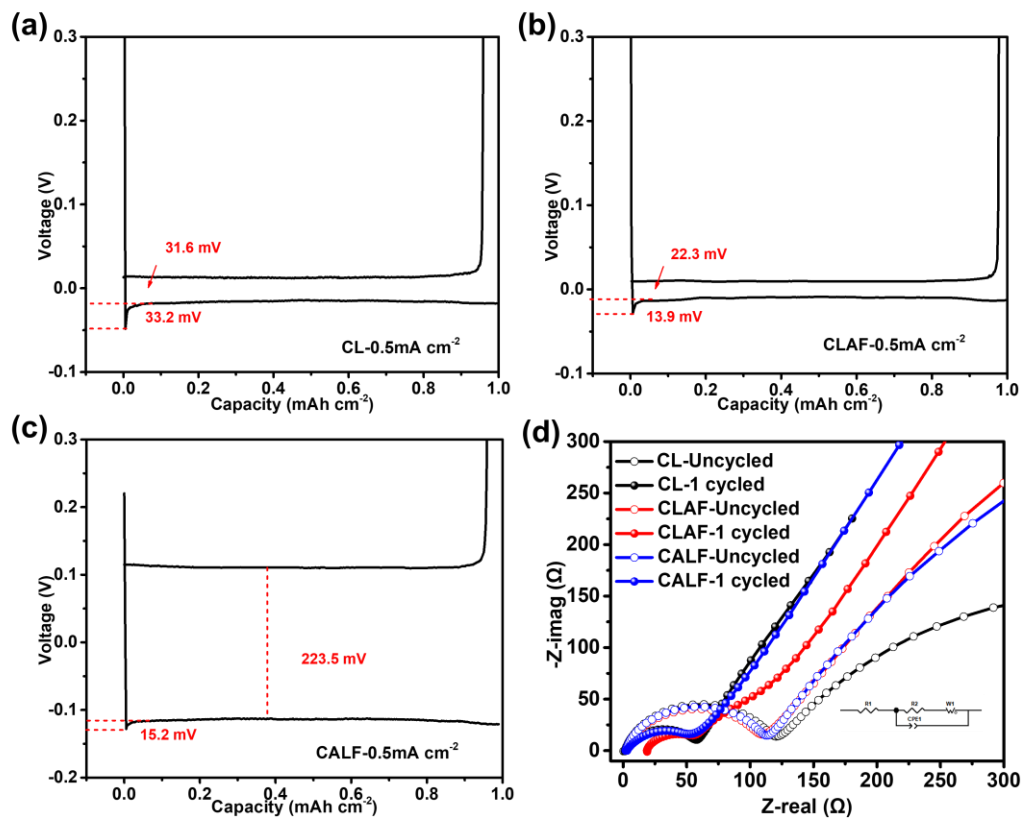


Fig. S5 Polarization and overpotential profiles of selected of (a) CL, (b) CLAF, and (c) CALF at  $0.5 \text{ mA cm}^{-2}$  and  $1 \text{ mAh cm}^{-2}$ . EIS fitting profiles (d) during the first cycle.

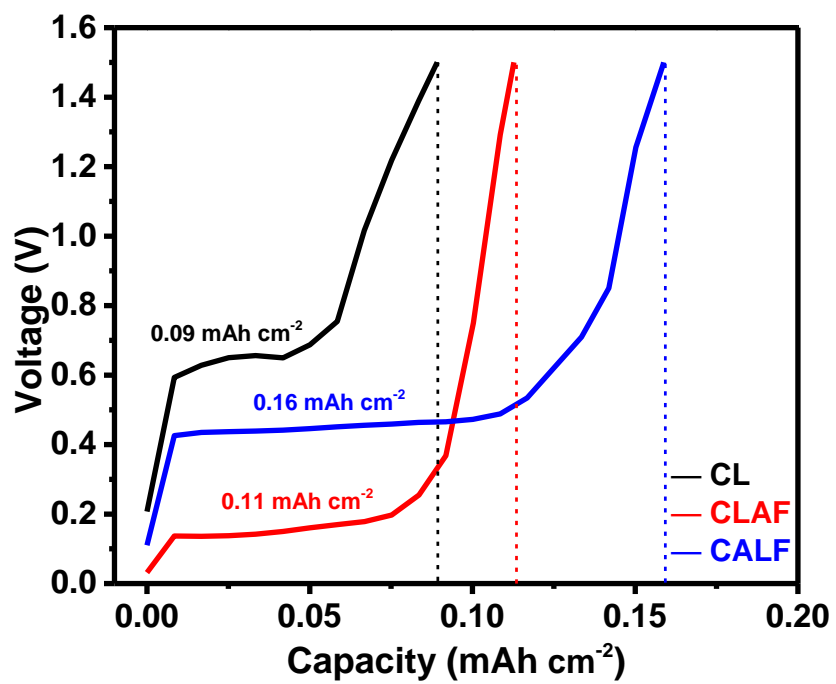


Fig. S6 Initial lithium replenishment capacity of CLAF, CALF and CL at 0.5 mA cm<sup>-2</sup> and charge to 1.5 V.

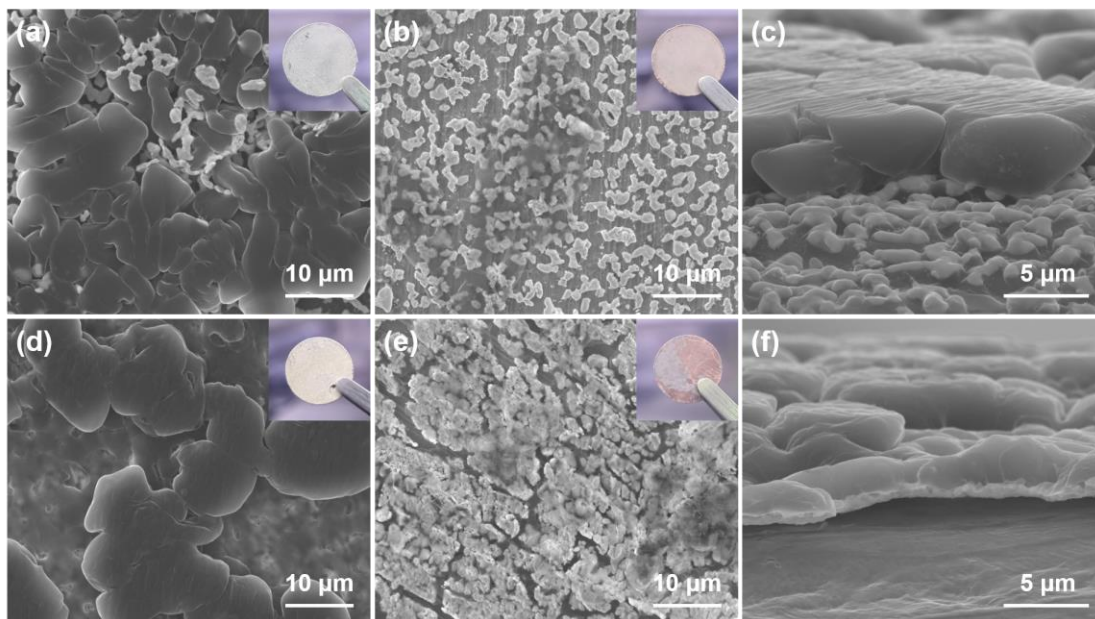


Fig. S7 SEM images of lithium deposition behaviors on (a) CLA, (d) CAL, stripping behaviors on (b) CLA, and (e) CAL at  $0.5 \text{ mA cm}^{-2}$  and  $1 \text{ mAh cm}^{-2}$ . Side view images of deposition behaviors on (c) CLA, and (f) CAL.



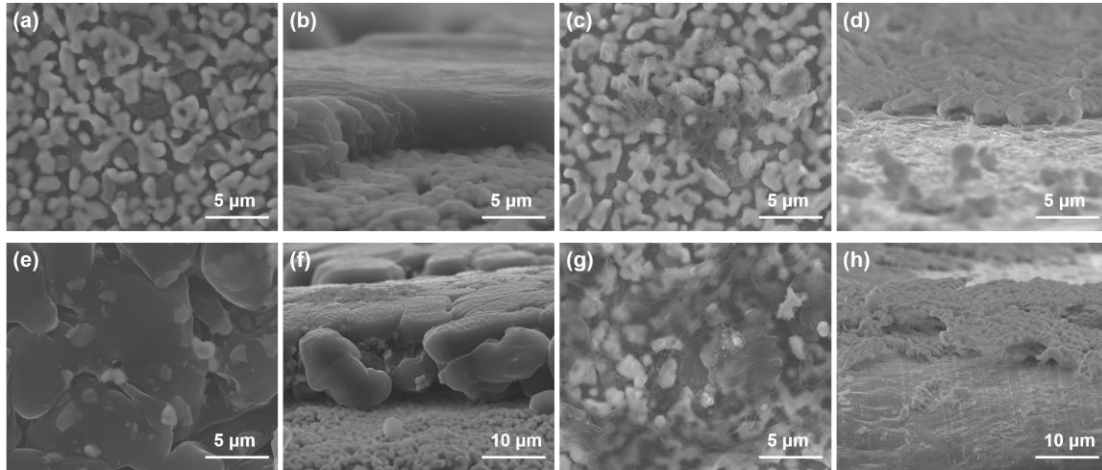


Fig. S8 Deposition state of lithium on CLAF at  $0.5 \text{ mA cm}^{-2}$  and different capacities. Deposition (a) at  $2 \text{ mAh cm}^{-2}$  and (b) side view; (e) at  $3 \text{ mAh cm}^{-2}$  and (f) side view. After stripping (c) at  $2 \text{ mAh cm}^{-2}$  and (d) side view; (g) at  $3 \text{ mAh cm}^{-2}$  and (h) side view.

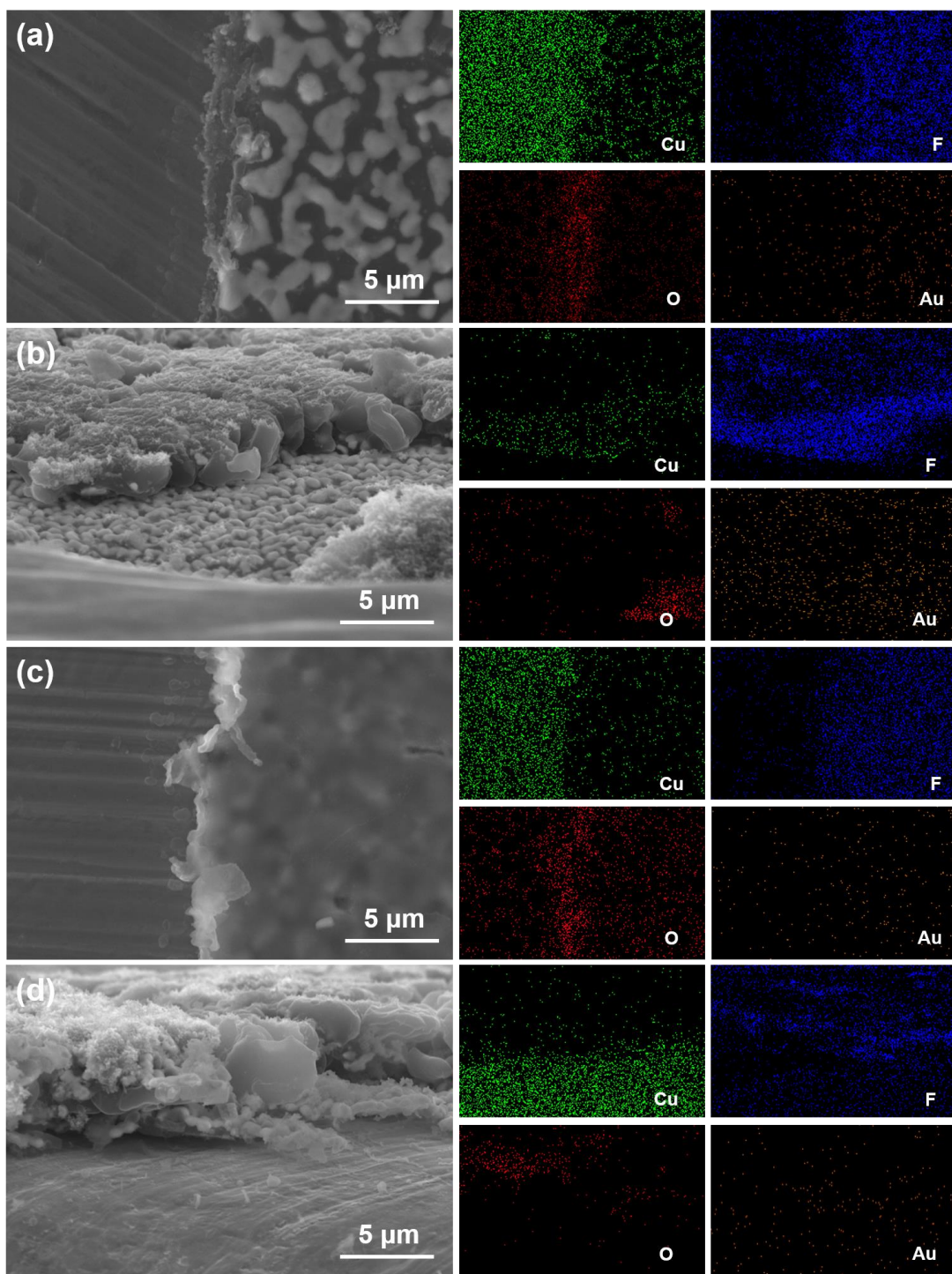


Fig. S9 Morphology of lithium deposition behaviors and the EDS mapping of (a) top view of CLAF, (b) cross section of CLAF; (c) top view of CALF, and (d) cross section of CALF after 10 cycles at  $0.5 \text{ mA cm}^{-2}$  and  $1 \text{ mAh cm}^{-2}$ .

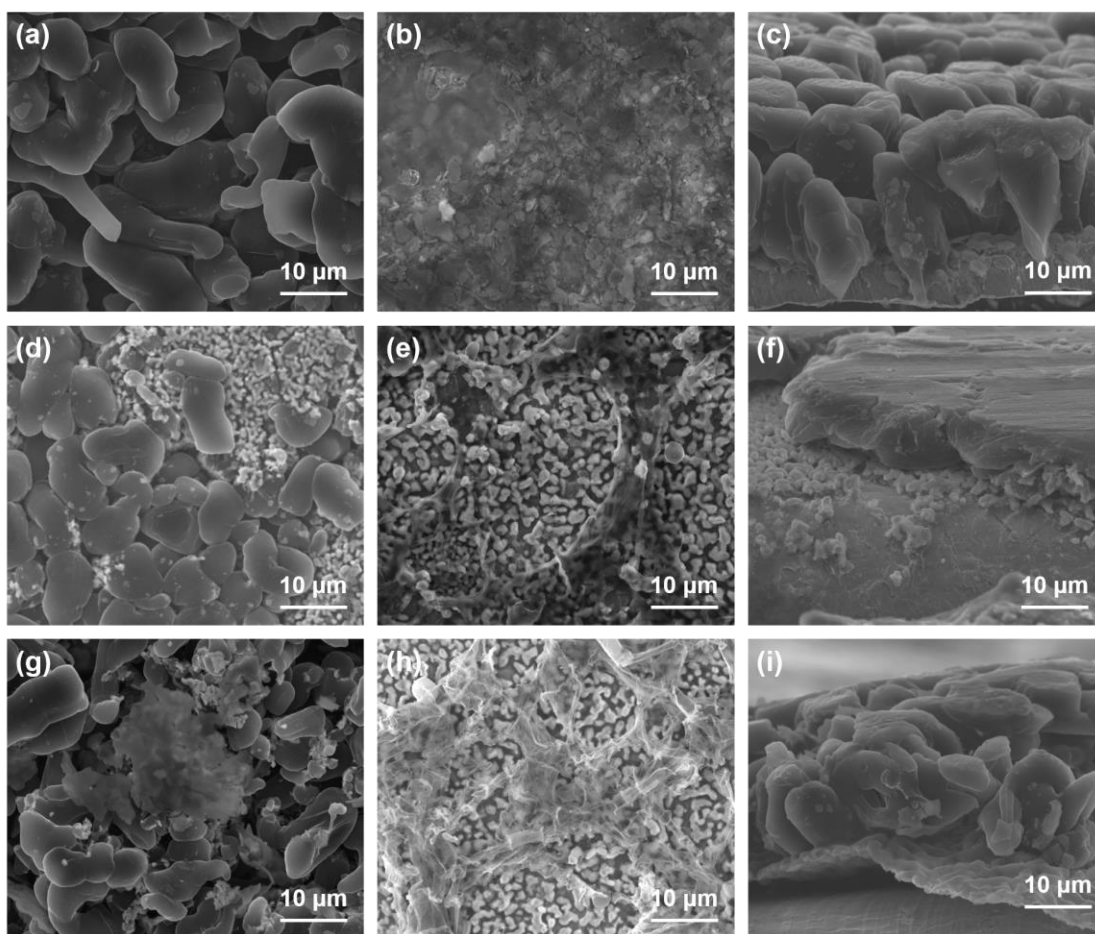


Fig. S10 Plating/stripping patterns and side view of (a-c) CL, (d-f) CLAF, and (g-i) CALF at  $0.5 \text{ mA cm}^{-2}$  and  $5 \text{ mAh cm}^{-2}$ .

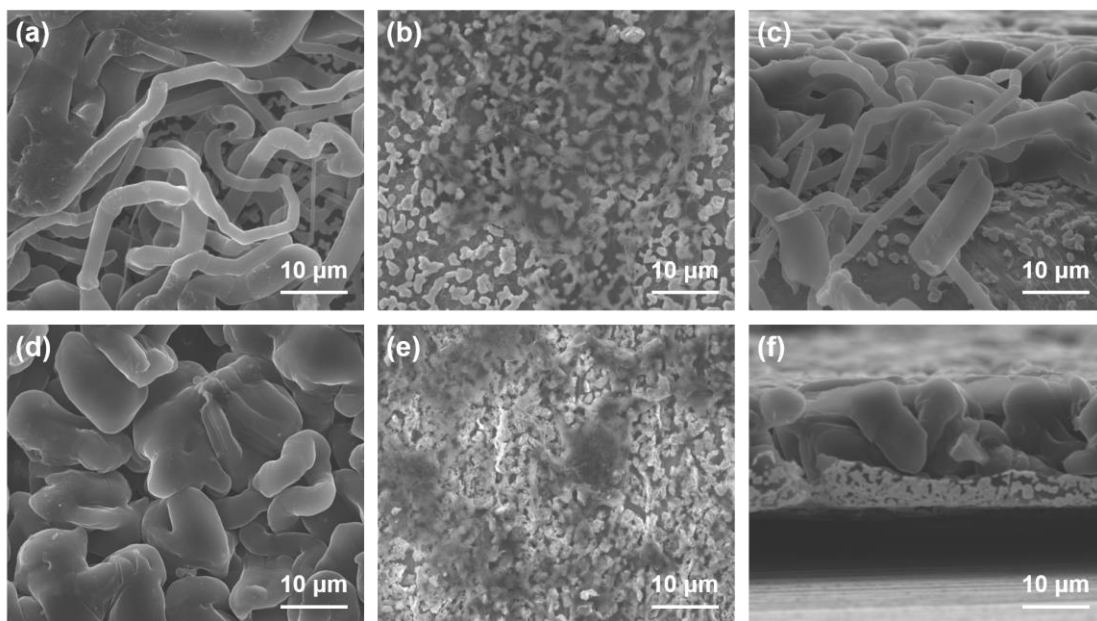


Fig. S11 Plating/stripping patterns and side view of (a-c) CLA, and (d-f) CAL at  $0.5 \text{ mA cm}^{-2}$  and  $5 \text{ mAh cm}^{-2}$ .

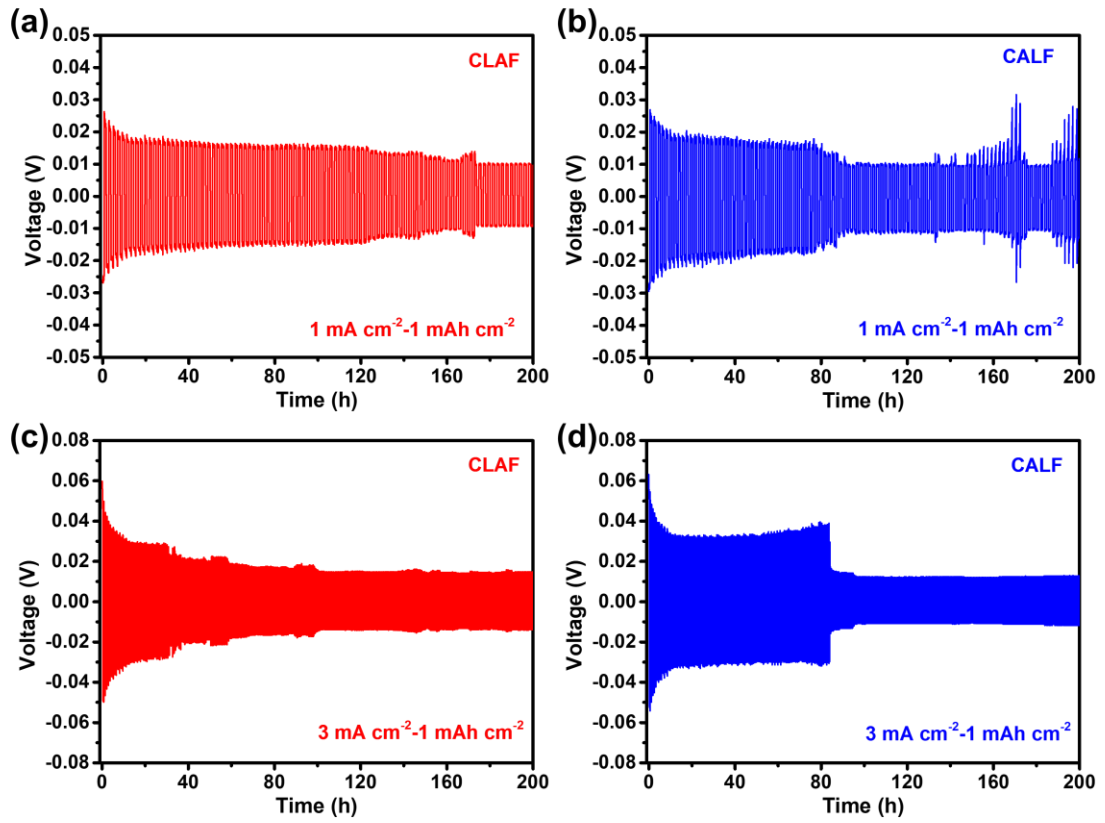


Fig. S12 Cycling performance of symmetric cells: (a, c) CLAF at  $1 \text{ mA cm}^{-2}$  and  $3 \text{ mA cm}^{-2}$ ; (b, d) CALF at  $1 \text{ mA cm}^{-2}$  and  $3 \text{ mA cm}^{-2}$ .

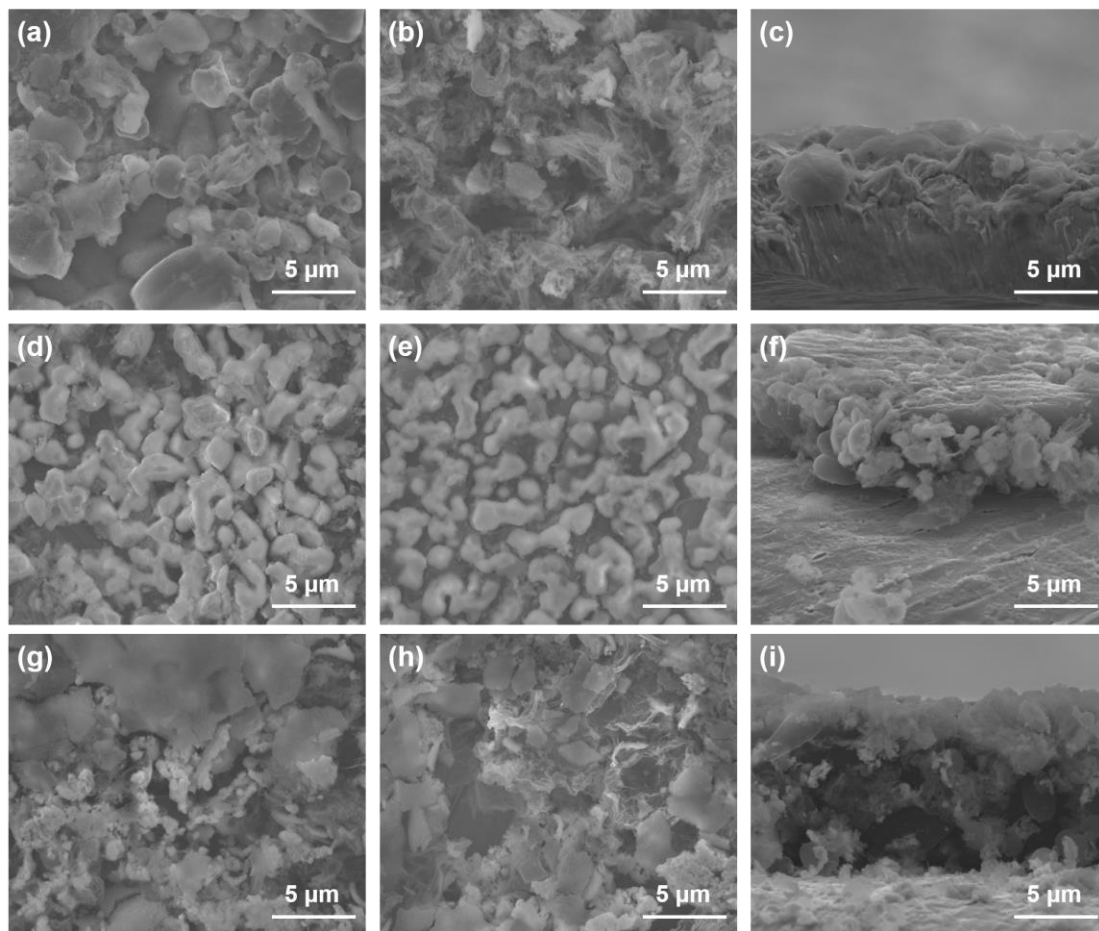


Fig. S13 After 10 cycles the plating/stripping patterns and side view of (a-c) CL, (d-f) CLAF, and (g-i) CALF at 0.5 mA cm<sup>-2</sup> and 1 mAh cm<sup>-2</sup>.

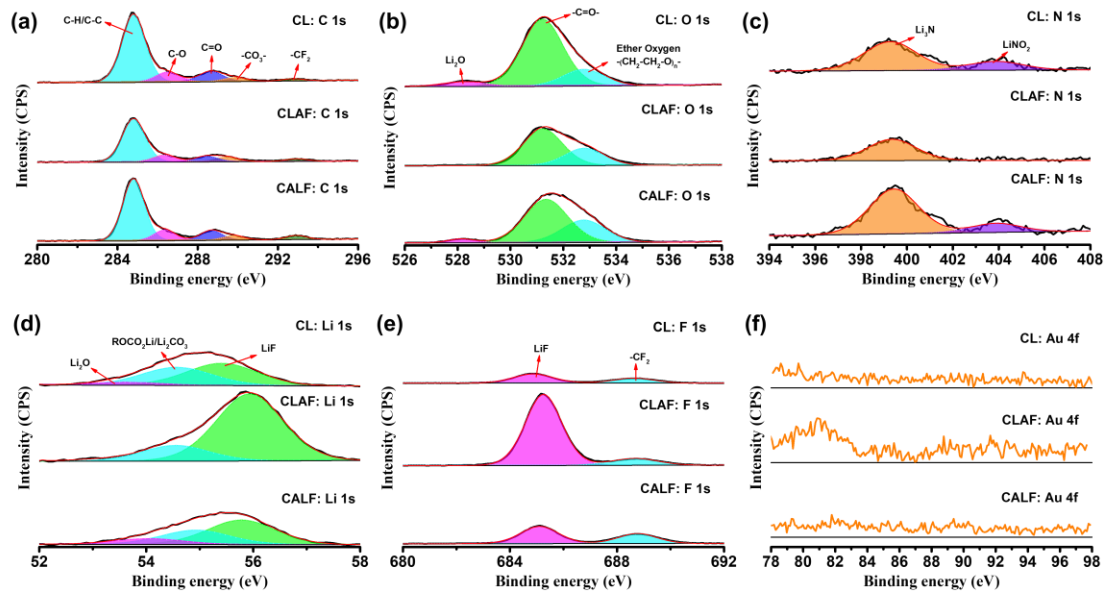


Fig. S14 XPS spectra of (a) C 1s, (b) O 1s, (c) N 1s, (d) Li 1s, (e) F 1s, and (f) Au 4f of as-prepared electrodes from half-cells stripped of all active lithium after 50 cycles at  $0.5 \text{ mA cm}^{-2}$ .

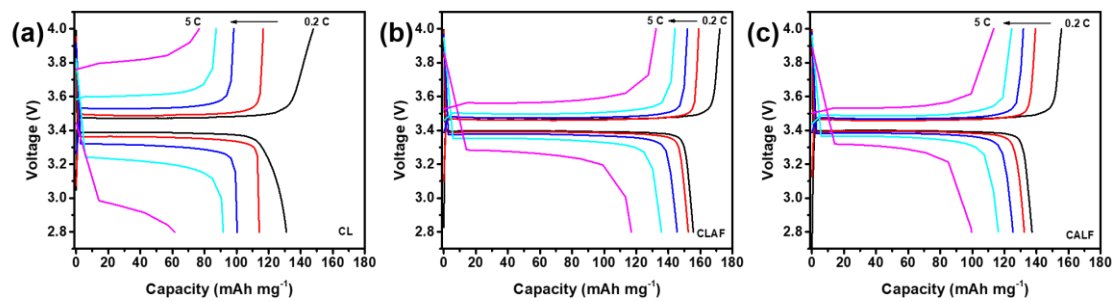


Fig. S15 Charge/discharge voltage plateau of the full cell at each rate (0.2 C, 0.5 C, 1 C, and 5 C) of (a) CL, (b) CLAF, and (c) CALF assembled with LFP.