Supporting Information

"Three in One" 3D Mixed Skeletons Design enables Dendrite-free Li Metal Batteries

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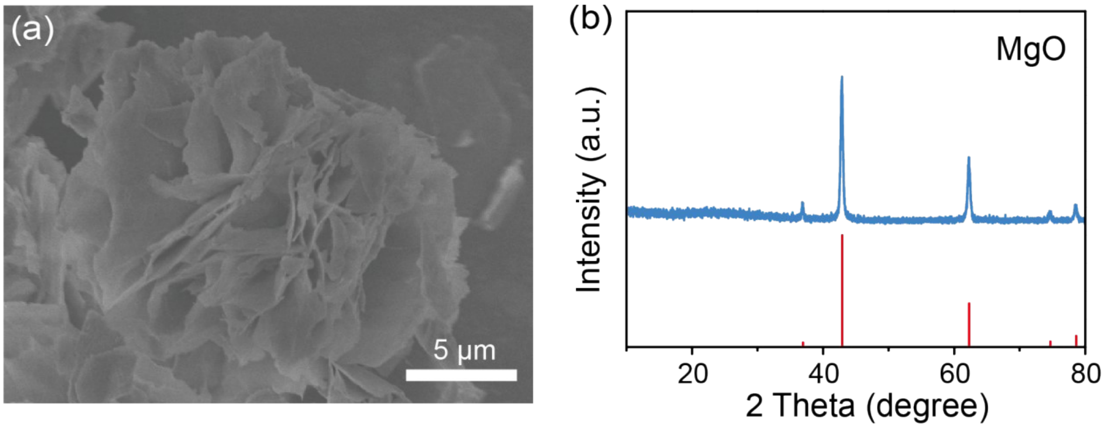

Figure S1. a) SEM image of MgO. b) XRD pattern of MgO.

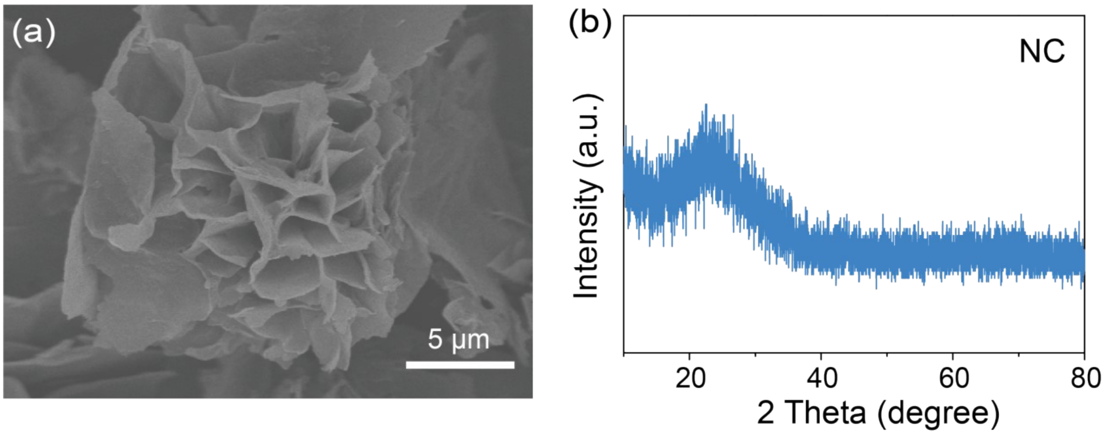

Figure S2. a) SEM image of N-doped carbon. b) XRD pattern of N-doped carbon.

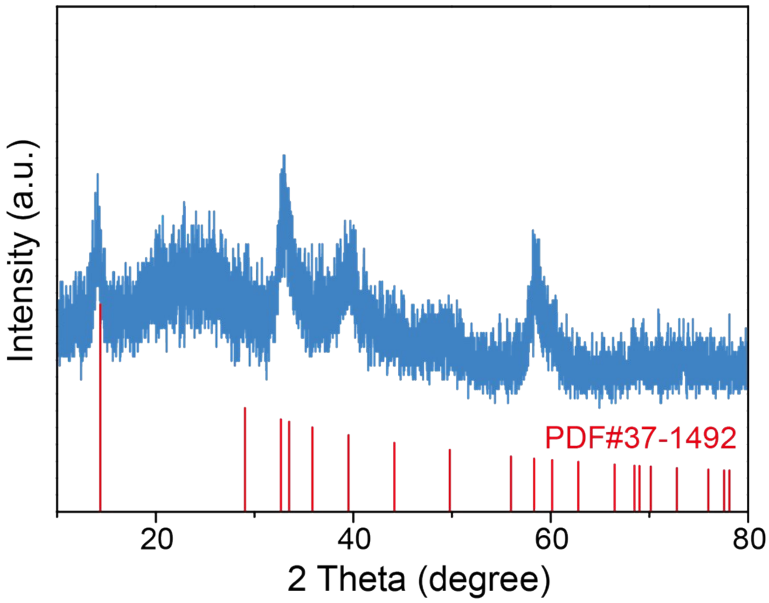

Figure S3. XRD pattern of h-MoS_2-NC.

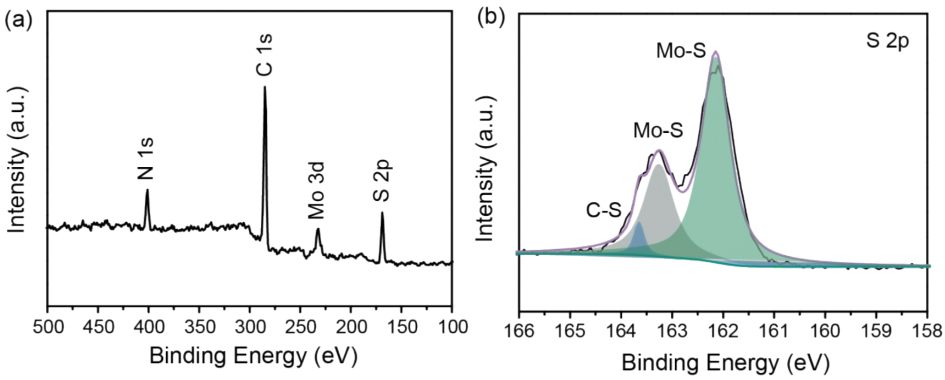

Figure S4. XPS spectra of the h-MoS_2-NC: a) survey spectrum, b) S 2p spectrum.

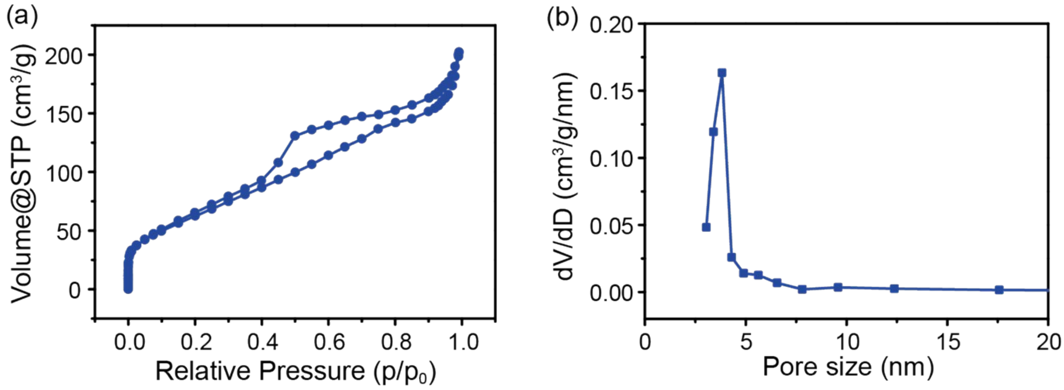

Figure S5. a) N_2 adsorption-desorption isothermal curve of the h-MoS_2-NC, b) Pore size distribution of h-MoS_2-NC.

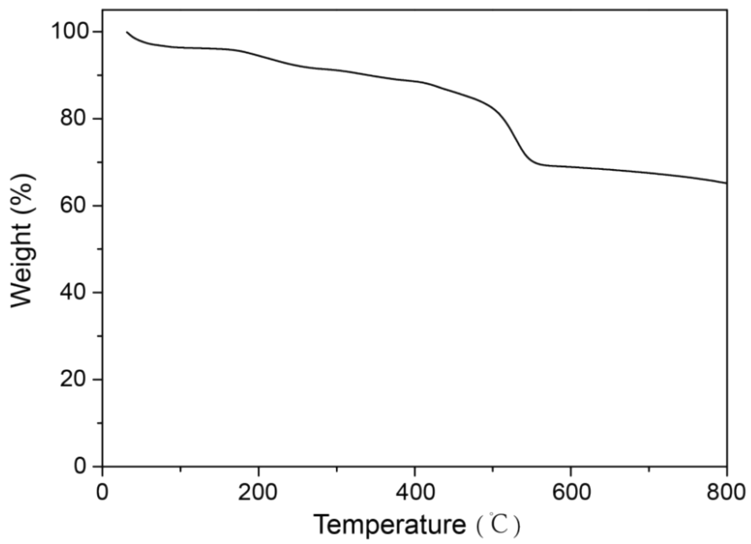

Figure S6. TGA curve of the h-MoS_2-NC.

TGA of h-MoS_2-NC was tested in air from room temperature to 800℃. The N-doped carbon framework was decomposed and MoS_2 was oxidized to MoO_3 till the temperature rise to 600℃. Thus the remaining mass (68.3%) is attributed to MoO_3. The content of MoS_2 in h-MoS_2-NC is calculated based on the following conversion:

$$2MoS_2+7O_2 \rightarrow 2MoO_3+4SO_2$$

$$\frac{\omega_{MoS_2}}{M_{MoS_2}} = \frac{\omega_{MoO_3}}{M_{MoO_3}}$$

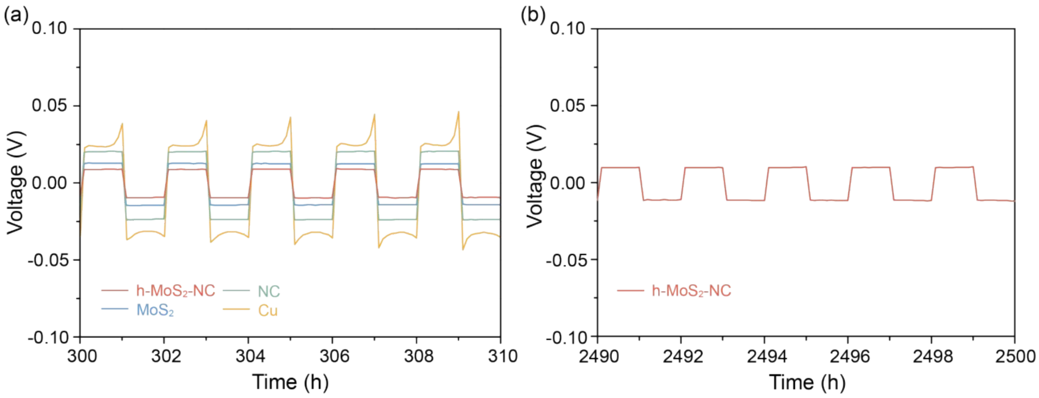

Figure S7. The detailed voltage curves at different time.

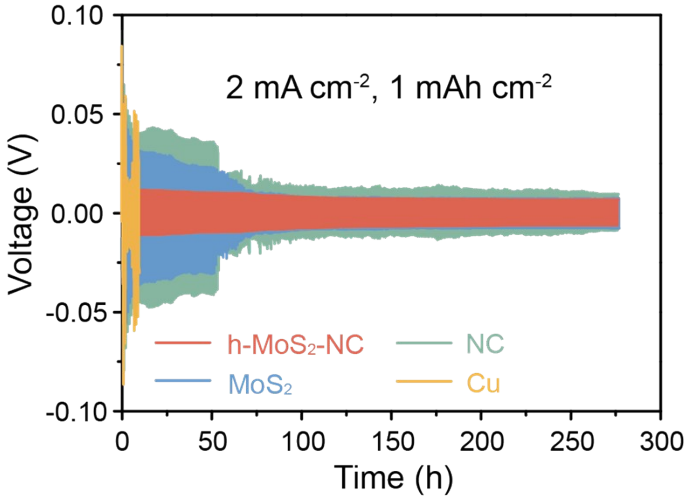

Figure S8. Voltage-time profiles of Li plating/stripping cycles at 2 mA cm^{-2}.

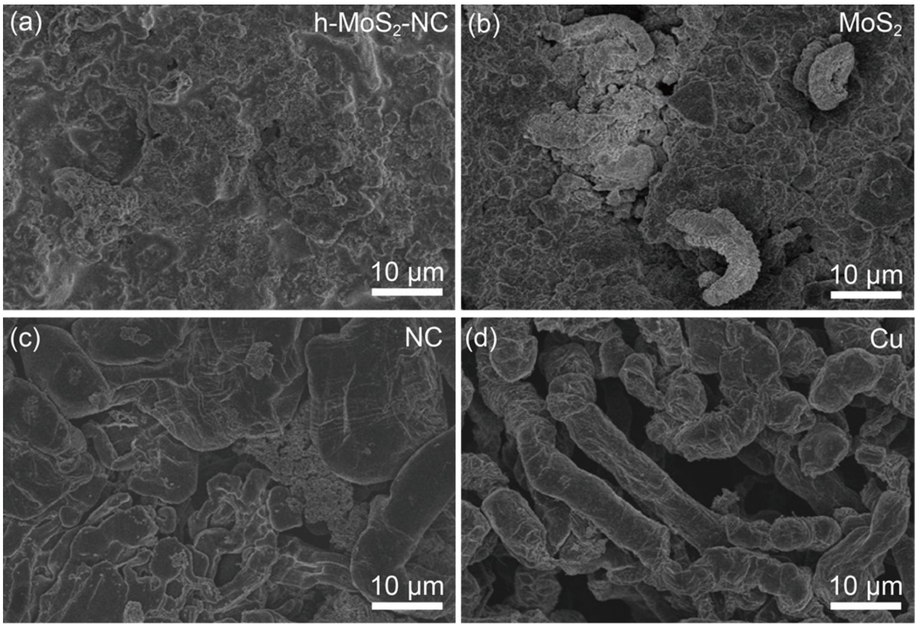

Figure S9. SEM images of a) h-MoS_2-NC, b) MoS_2, c) NC, and d) Cu foil after 50 cycles.

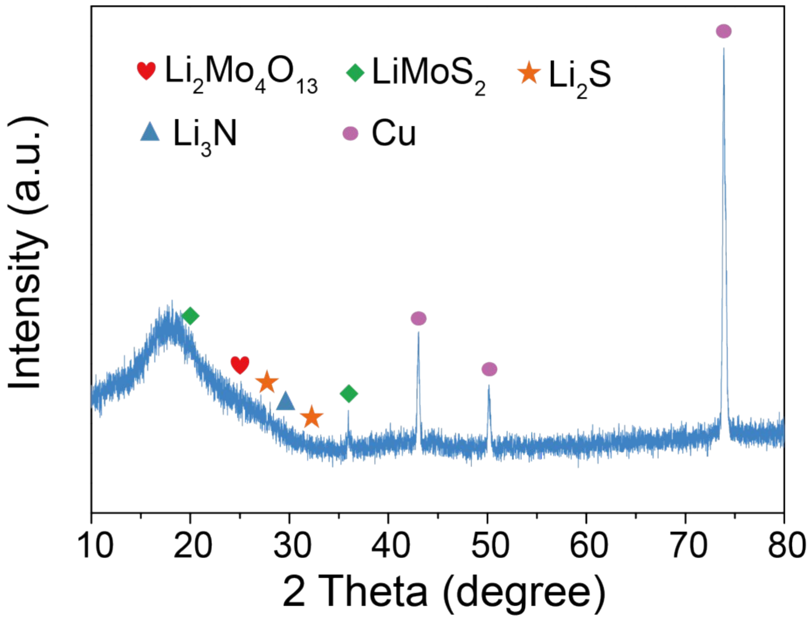

Figure S10. XRD spectrum of h-MoS_2-NC after cycling.

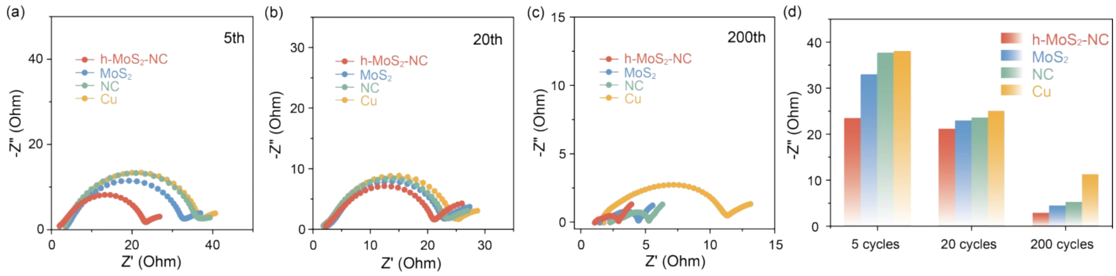

Figure S11. EIS spectra of h-MoS_2-NC, MoS_2, NC, and Cu at a) 5th, b) 20th and c) 100th cycles at 1 mA cm^{-2} for 1 mAh cm^{-2}. d) EIS of symmetric cell after different cycles.

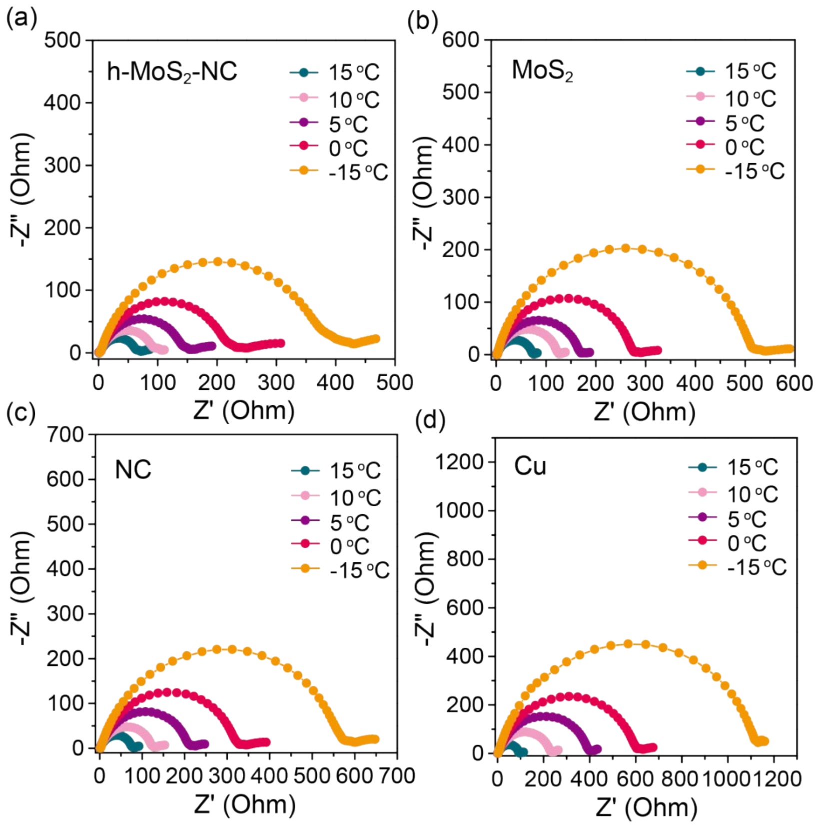

Figure S12. Nyquist plots at different temperatures for a) h-MoS_2-NC, b) MoS_2, c) NC, and d) Cu.

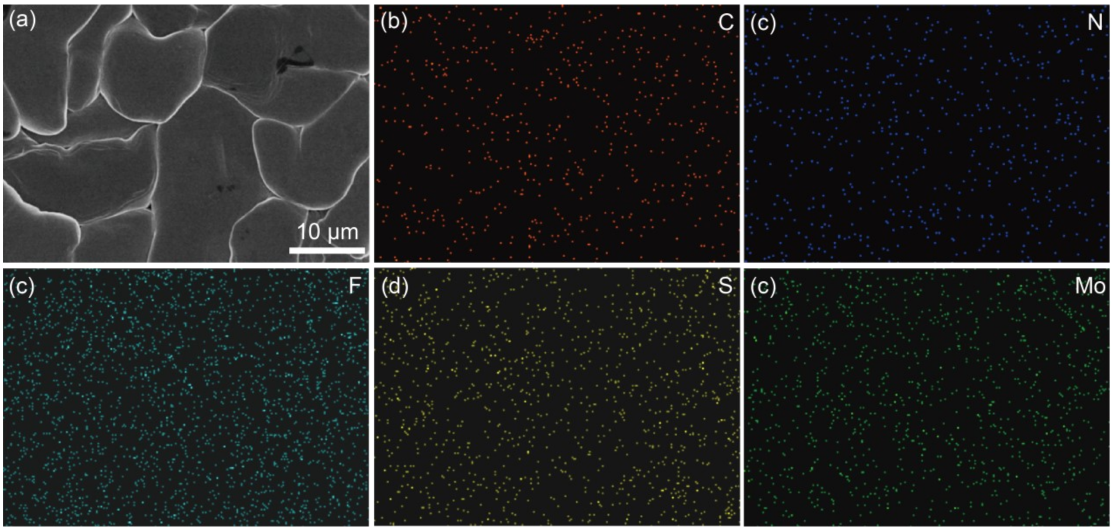

Figure S13. EDS Mapping of h-MoS_2-NC after plating 10 mAh cm^{-2} Li.

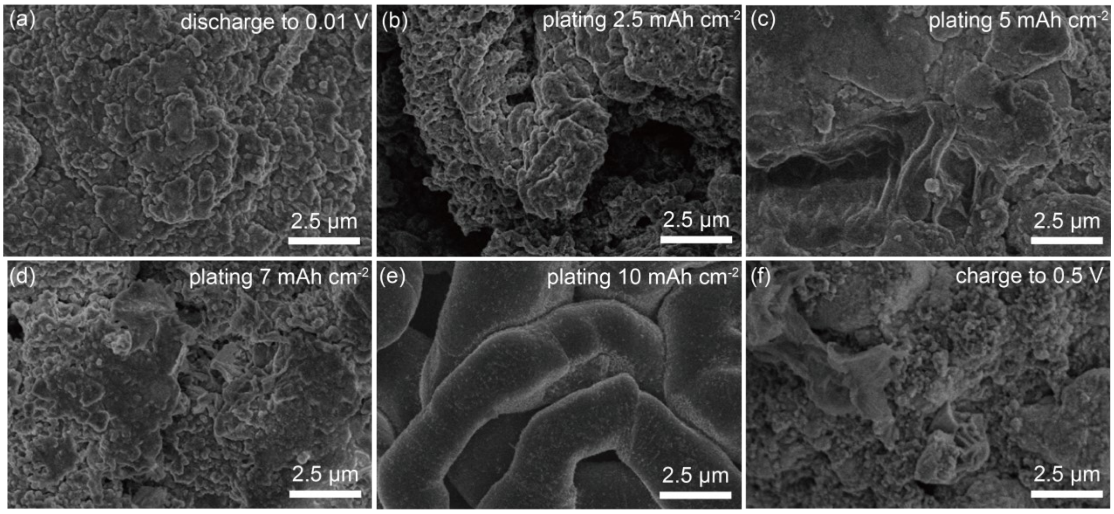

Figure S14. SEM images of MoS_2 after a) discharging to 0.01 V, b) plating 2.5 mAh cm^{-2} Li, c) plating 5 mAh cm^{-2} Li, d) plating 7 mAh cm^{-2} Li, e) plating 10 mAh cm^{-2} Li, and f) charging to 0.5 V.

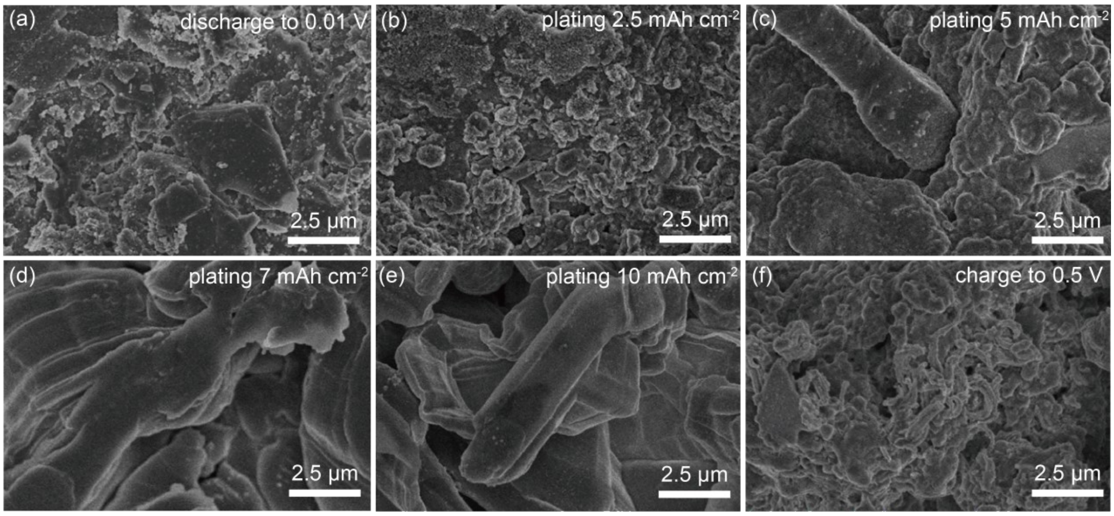

Figure S15. SEM images of NC after a) discharging to 0.01 V, b) plating 2.5 mAh cm^{-2} Li, c) plating 5 mAh cm^{-2} Li, d) plating 7 mAh cm^{-2} Li, e) plating 10 mAh cm^{-2} Li, and f) charging to 0.5 V.

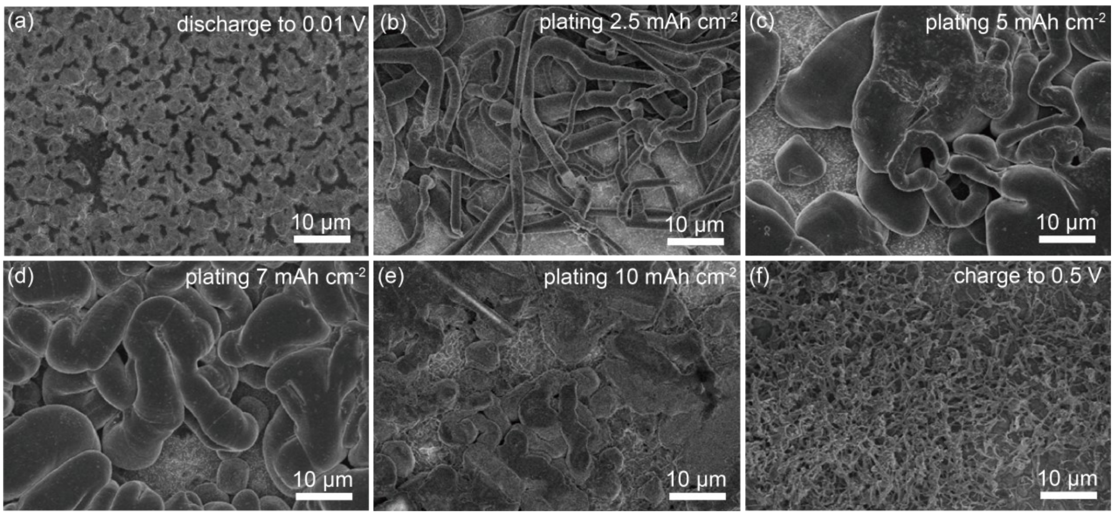

Figure S16. SEM images of Cu after a) discharging to 0.01 V, b) plating 2.5 mAh cm^{-2} Li, c) plating 5 mAh cm^{-2} Li, d) plating 7 mAh cm^{-2} Li, e) plating 10 mAh cm^{-2} Li, and f) charging to 0.5 V.

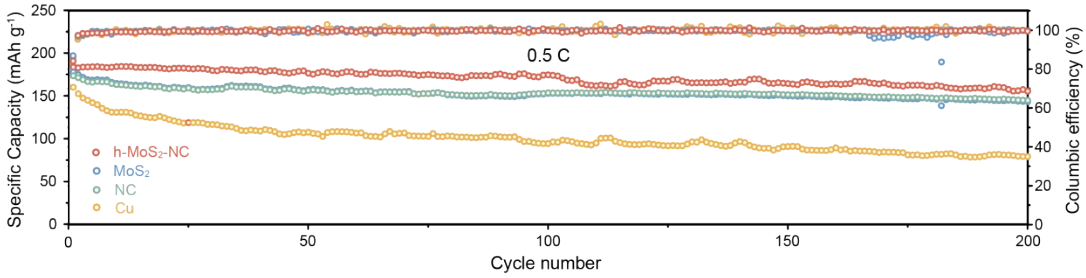

Figure S17. The cycling performances at 0.5 C of NCM111 full cells.

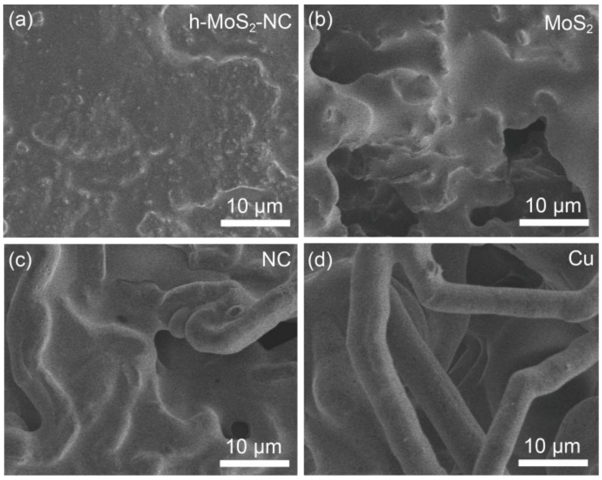

Figure S18. SEM images of a) Li@h-MoS_2-NC and b) Li@MoS_2, c) Li@NC, and d) Li@Cu anode

Table S1. Cyclic performance comparison of symmetric cells using different anodes

Sample	Cycle Time (h)	Current Density (mA cm^{-2})	Capacity (mAh cm^{-2})	Reference
h-MoS_2-NC	**2500**	**1**	**1**	**This work**
Li/graphene-C/Li_3N	1000	1	1	*Energy Storage Mater. 2022, 46 563-569*
MoS_2@NSPCB	2000	1	1	*Adv. Sci.2022,9, 2204232*
Li–SiOx/C@C-Cu	2000	1	1	*Adv. Energy Mater. 2023, 13, 2204075*
Li//Ag@NC@LAZP-Li	1000	1	1	*ACS Sustainable Chem. Eng. 2023, 11, 1785-1796*
Co_3O_4-CCNFs	1600	2	1	*Small 2023, 19, 2207764*
PCNF/MoS_2-Li	1000	0.5	1	*Chem. Eng. J. 2022, 429 132479*
GO-Zn/Cu	600	1	1	*Energy Storage Mater. 2023, 56 572-581*
Li@$Ti_3C_2T_x$/g-C_3N_4	1000	0.5	0.5	*Adv. Sci. 2022, 9, 2103930*
Ag-Li_2Se@CFC/Li	2000	1	1	*Chem. Eng. J. 2023, 462, 142034*
Graphite-SiO_2 Li	1700	0.5	1	*Adv. Energy Mater.2019, 9, 1901486*
MIECS@Li	1000	1	1	*ACS Appl. Energy Mater. 2021, 4, 6106-6115*