

Supplementary information

Uniform lithium deposition on N-doped carbon-coated current collectors

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Experimental section

Coating a Cu foil with polydopamine: A piece of a copper foil of 20 cm × 20 cm was placed in a petri dish. Tris buffer solution was prepared by dissolving 0.121 g of tris(hydroxymethyl)aminomethane in 100 mL of H₂O, followed by the addition of 0.2 g of dopamine hydrochloride. The mixture was subsequently stirred for 10 mins. The brown solution was poured on the Cu foil in the petri dish and kept still for the polymerization of dopamine to occur, thus coating the Cu foil surface. After 24 hours, the polydopamine-coated Cu foil was rinsed with water and ethanol three times, respectively.

Preparation of the Cu foil coated with nitrogen-doped carbon: The copper foil, coated with polydopamine, was cut into circular disks 0.5 inch in diameter. The disks were transferred to a flow furnace and carbonized at 600 °C for 2.5 hours in flowing Ar gas.

Electrochemical measurements: 2032-type coin cells were assembled with bare Cu foils or N-C coated Cu foils as working electrodes, and Li foil as counter/reference electrodes. The electrolyte was 1M lithium hexafluorophosphate (LiPF₆) in ethylene carbonate (EC) and diethyl carbonate (DEC) (1:1 in volume ratio). To investigate Li nucleation and deposition processes, galvanostatic charge/discharge tests were performed on an Arbin battery cycler (Arbin, BT 2000, USA). The working electrode was deposited with Li at a prescribed current density for a certain amount of time and, subsequently, stripped to a cutoff voltage of 0.8 V (vs. Li⁺/Li) at the same current density. The Coulombic efficiency (CE) was obtained from the ratio of Li stripping to deposition, following the equation: $CE = Q_{\text{stripping}}/Q_{\text{deposition}} \times 100\%$. Symmetric cells were assembled using a pristine Cu foil or a N-C coated Cu foil with a pre-stored Li capacity of 4 mAh cm⁻² as one electrode and a commercial Li foil as the other.

Structural and morphological characterization: Field-emission scanning electron microscope images were obtained with a Keck SEM (Zeiss 1550 FESEM). To observe the morphology of Li deposited on the current collectors, electrodes were extracted by disassembling the cells in an Ar-filled glovebox with low H₂O and O₂ level (<0.3 ppm), which was then rinsed with dimethyl carbonate (DMC) to remove residual electrolyte and salts.

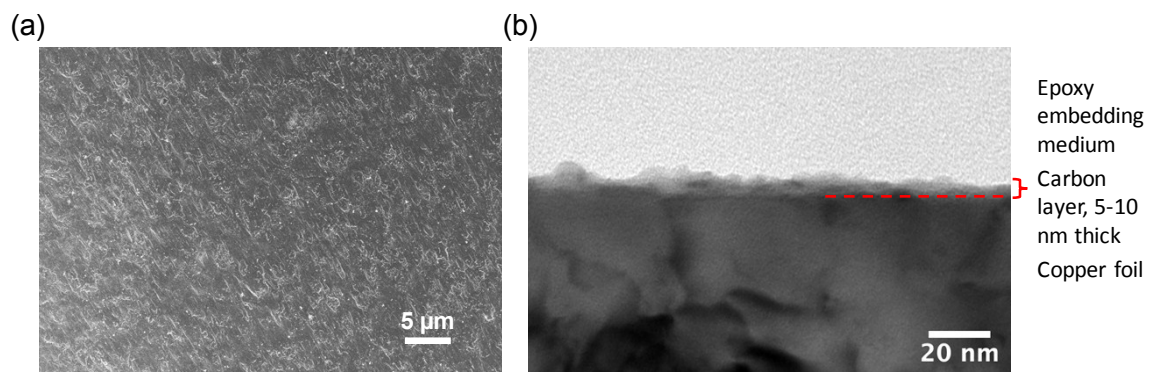


Fig. S1 (a) SEM image and (b) TEM image of nitrogen-doped carbon coated Cu foil.

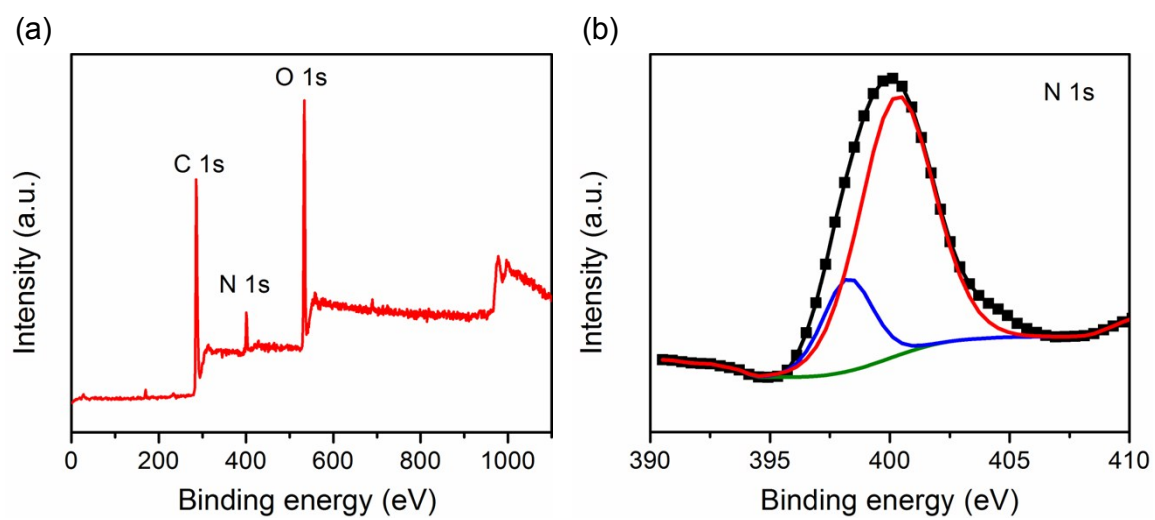


Fig. S2 XPS spectra of nitrogen-doped carbon coated Cu foil: (a) survey spectrum, and (b) N 1s spectrum.

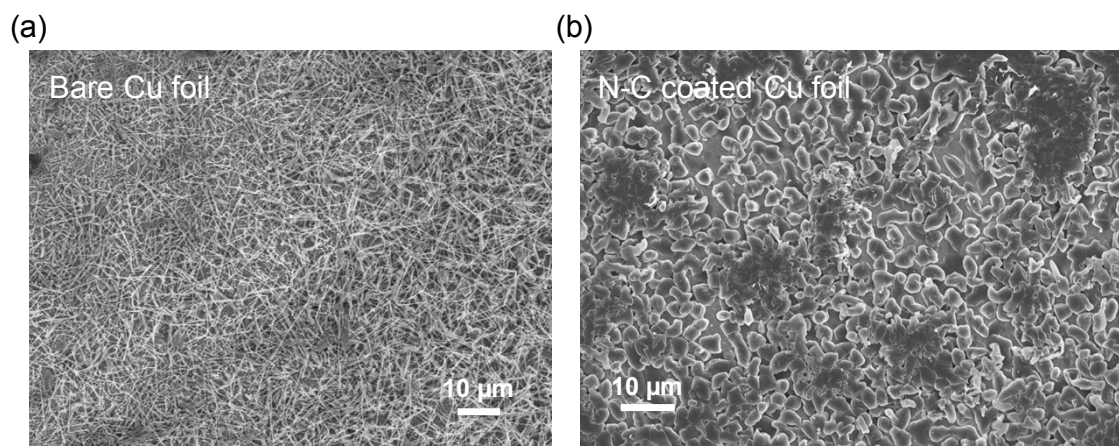


Fig. S3 The SEM images of the lithium deposited on (a) bare Cu foil and (b) N-doped carbon coated Cu foil at 0.5 mAh cm^{-2} .

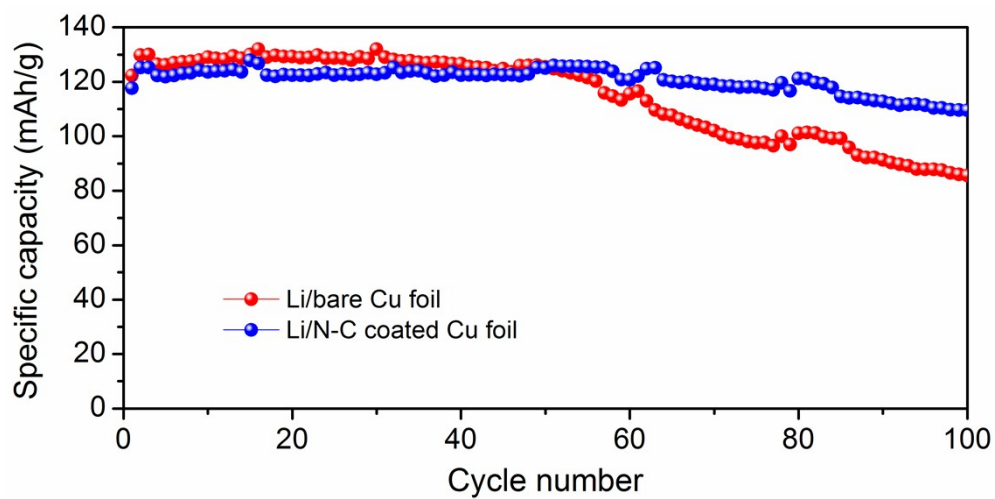


Fig. S4 Cycle performance of Li-LiFePO₄ full cells using Li grown on (a) bare Cu foil and (b) N-C coated Cu foil at a 1 C rate.