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## **Supporting Information**

## Realizing stable lithium deposition by in-situ grown Cu<sub>2</sub>S nanowires

## inside commercial Cu foam for lithium metal anodes

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Figure S1. Nitrogen adsorption/desorption isotherm of the 3D Cu<sub>2</sub>S NWs/Cu sample.



**Figure S2.** SEM image of the morphology of Li deposition on a) bare Cu foam and b) 3D  $Cu_2S$  NWs/Cu with current density of 1 mA cm<sup>-2</sup> for a total capacity of 1 mAh cm<sup>-2</sup> after 100 cycles.



**Figure S3.** SEM images of the morphology of Li deposited on (a, c) bare Cu foam and (b, d)  $3D Cu_2S$  NWs/Cu with current density of 2 mA cm<sup>-2</sup> for a total capacity of 1 mAh cm<sup>-2</sup> after 20 cycles. SEM images of (e, g) bare Cu foam and (f, h)  $3D Cu_2S NWs/Cu$  after the 50th plating.



**Figure S4.** SEM images of the morphology of Li deposited on (a, c) bare Cu foam and (b, d) 3D  $Cu_2S$  NWs/Cu with current density of 0.5 mA cm<sup>-2</sup> for a total capacity of 2 mAh cm<sup>-2</sup> after 50 cycles.



Figure S5. Illustration of the discharge/charge process of the 3D Cu<sub>2</sub>S NWs/Cu current collector.



Figure S6. (a) CV for the as-prepared 3D Cu<sub>2</sub>S NWs/Cu-Li cell. (b) S2p XPS spectra analysis of the SEI

layers for the 3D Cu<sub>2</sub>S NWs/Cu current collector.



Figure S7. Coulombic efficiency of bare Cu foam and 3D Cu<sub>2</sub>S NWs/Cu at 0.5 mA cm<sup>-2</sup> with a total capacity of 1 mAh cm<sup>-2</sup>.



**Figure S8.** Long cycling performance of 3D Cu<sub>2</sub>S NWs/Cu at a current density of 1 mA cm<sup>-2</sup> with a total capacity of 1 mAh cm<sup>-2</sup>. Inset shows the voltage-time curve with cycle time for 3D Cu<sub>2</sub>S NWs/Cu.



**Figure S9.** Coulombic efficiency of  $Cu(OH)_2$  NWs/Cu current collector at 1 mA cm<sup>-2</sup> with a total capacity of 1 mAh cm<sup>-2</sup> and (b) Voltage profiles for Li nucleation on the  $Cu(OH)_2$  NWs/Cu current collector.



**Figure S10.** Electrochemical impedance spectra (EIS) of bare Cu foam and 3D  $Cu_2S$  NWs/Cu (a) after 5 cycles and (b) after 50 cycles.



**Figure S11.** Voltage-time profiles of symmetric LilCu-Li and Lil3D Cu<sub>2</sub>S NWs/Cu-Li cells at 1 mA cm<sup>-2</sup> with a cycling capacity of 1 mAh cm<sup>-2</sup>.



Figure S12. Cycling performance of full cell with LiFePO<sub>4</sub> cathode and Li anode at 0.5 C.