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Facile large-scale synthesis of vertically aligned CuO nanowires on nickel foam: growth mechanism and remarkable electrochemical performance

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Active material mass determinations

The oxidation of Ni foam was determined using the following formula:

$$m_{NiO} = (m_2\text{-}m_1)\cdot (M_{NiO})/(M_O) \quad (1)$$

where m_{NiO} is the weight of NiO in Ni foam after heat treatment; m_1 is the weight of fresh Ni foam before heat treatment; m_2 is the weight of Ni foam after heat treatment; and M_O and M_{NiO} are the molar masses of O and NiO, respectively. Given that all samples underwent the same heat treatment strategy, the oxidation degree of Ni foam could be considered the same in each nickel foam. In this study, m_{NiO} was determined to be approximately 0.15 mg. The active materials in the as-prepared CuO nanowire arrays electrodes could be determined using the following formula:

$$m_{act} = m_3\text{-}m_1 + m_{NiO}\cdot M_{Ni}/M_{NiO} \quad (2)$$

where m_{act} is the total weight of active materials in the as-fabricated CuO nanwire arrays electrode (1.95 mg with a loading mass of about 1.8 and 0.15 mg for the CuO nanowire arrays and NiO, respectively); m_3 is the weight of the as-fabricated CuO nanowire arrays electrode ; and M_{Ni} is the molar mass of Ni.

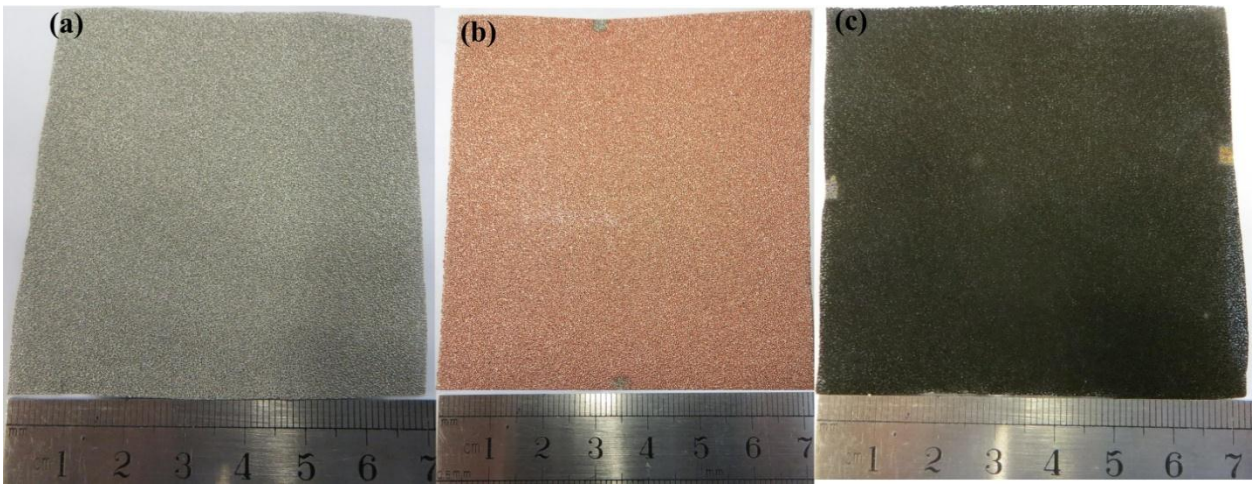

Figure S1. Photographs of (a) Ni foam, (b) Ni foam after e-beam evaporation of Cu, and (c) CuO nanowires on Ni foam after thermal oxidation

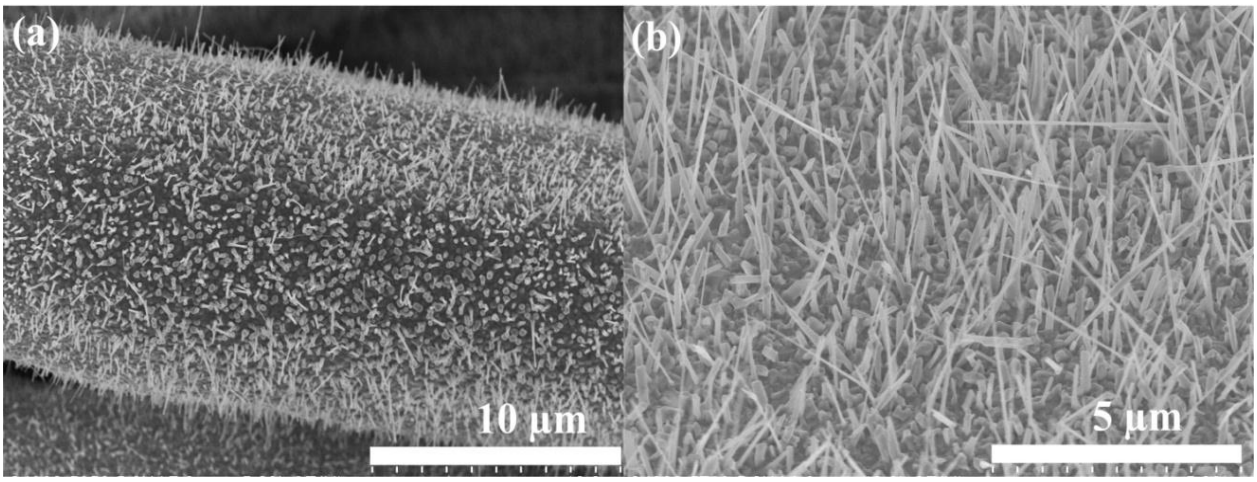

Figure S2. SEM images of CuO nanowires on (a) carbon fiber and (b) silicon substrate by heating the e-beam evaporated Cu film at 400 °C for 12 h in static air

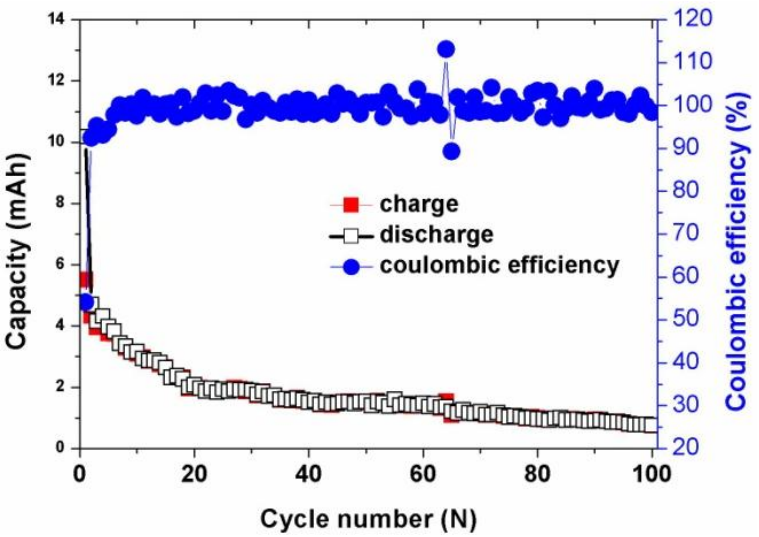

Figure S3. Cycle performance of carbon cotton (carbon cotton with high electronic conductivity has also ever been chosen as substrate for application in LIBs. However, carbon cotton is more expensive than nickel foam. Moreover, the carbon cotton itself can contribute large amount of absolute capacity as anode for LIBs. In addition, we found that the cyclic stability of carbon cotton is relatively poor as shown in Figure S3)

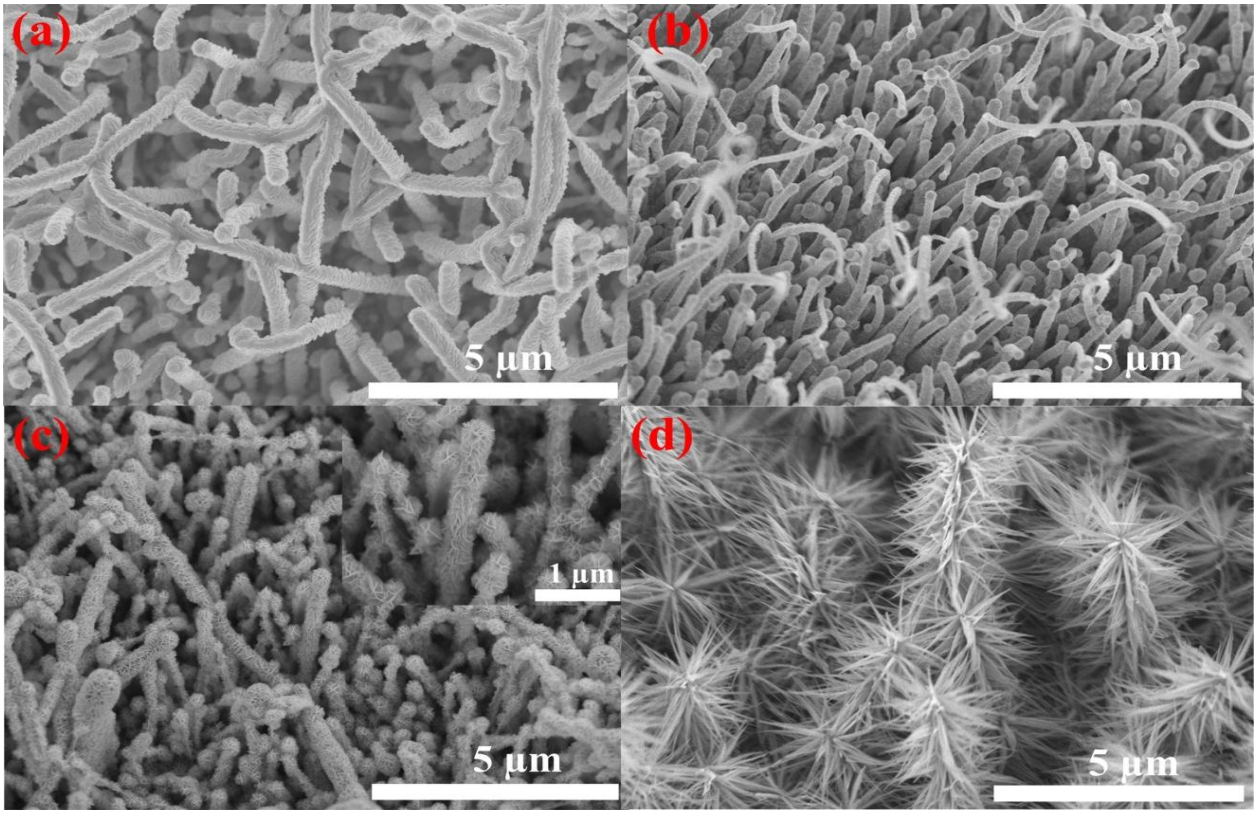

Figure S4. SEM images of (a) CuO nanowires-Al composite on Si substrate, (b) CuO nanowires-Co_3O_4 nanoparticles composite on Ni foam, (c) CuO nanowires-NiO nanoflakes composite on Ni foam, and (d) CuO nanowires-Co_3O_4 nanorods composite on Ni foam

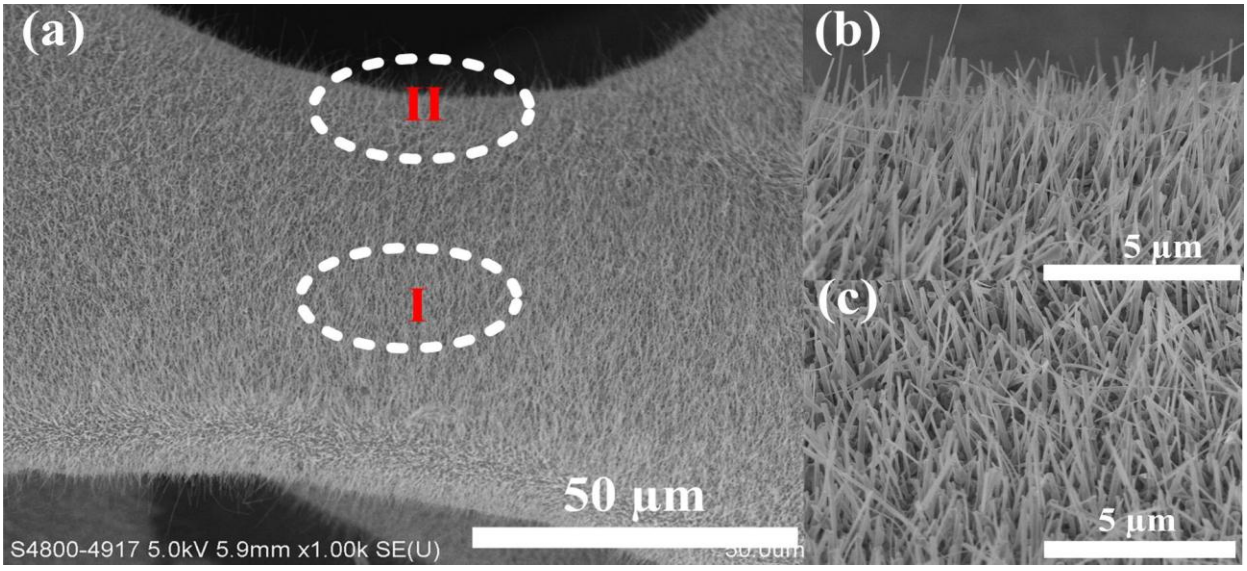

Figure S5. (a) SEM image of CuO nanowires, and (b-c) magnified SEM images of the nanowires taken from the places of II and I highlighted by the circles in (a), respectively

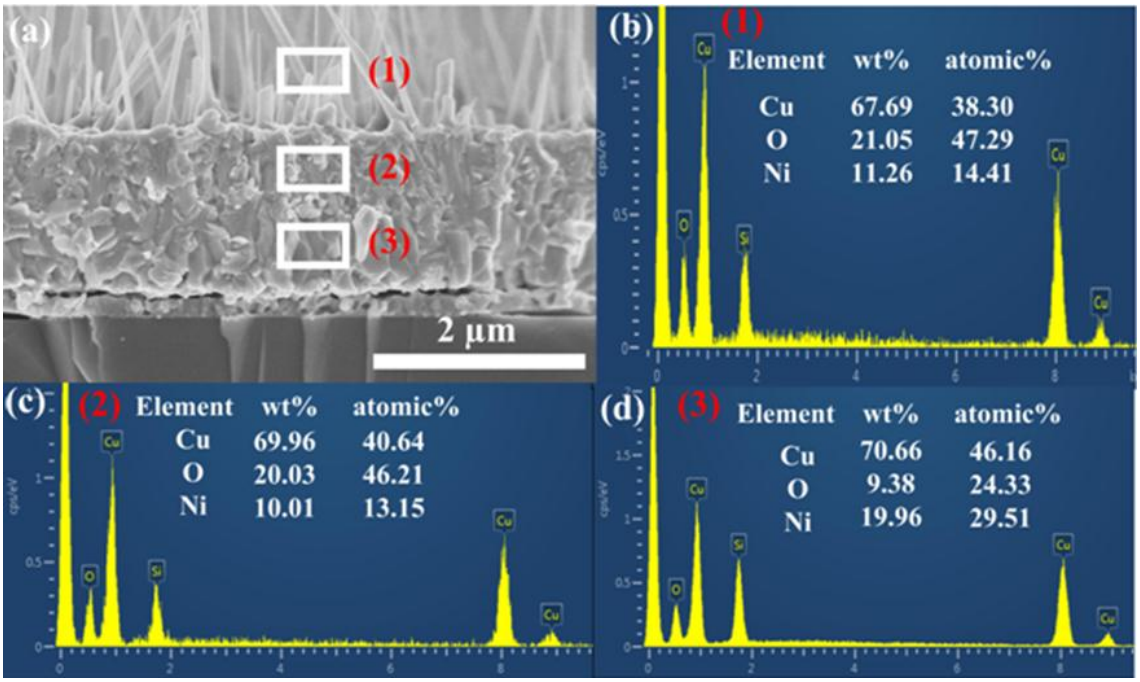

Figure S6 (a) Cross-sectional SEM image of CuO nanowires on Si substrate and EDS spectra (b-d) taken from the regions marked as (1), (2) and (3) shown in (a)

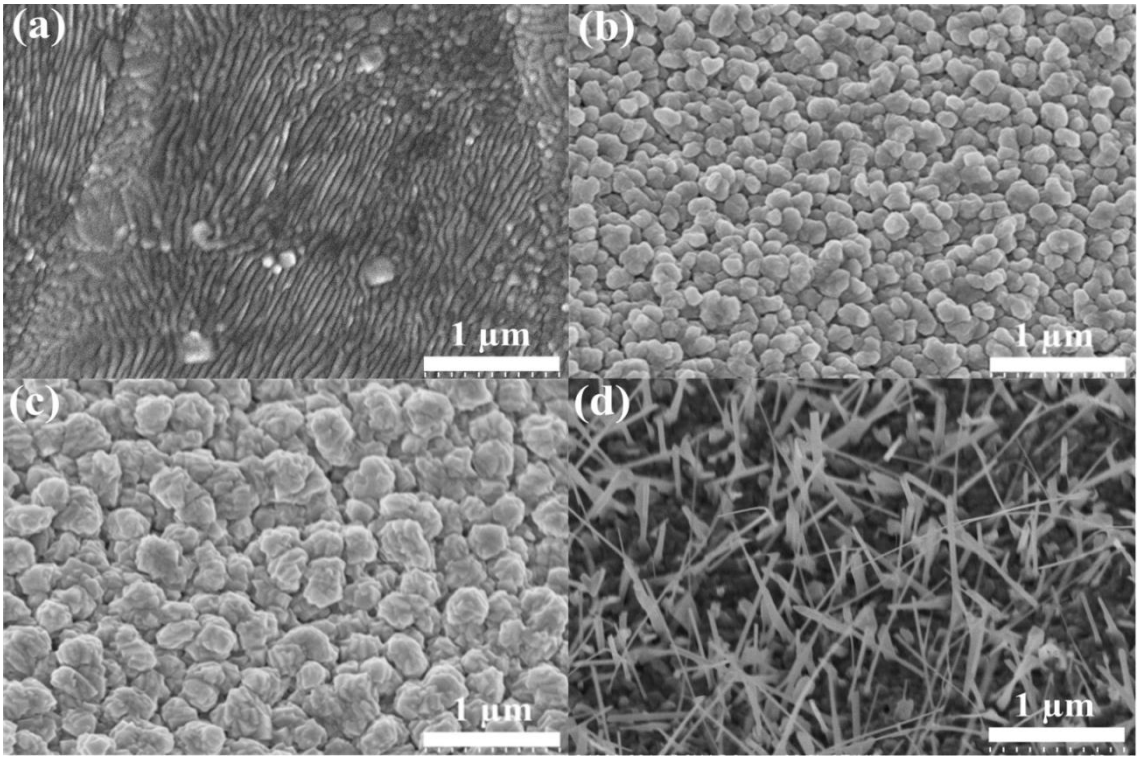

Figure S7. SEM images of (a) Cu film on nickel foam and (b-d) Cu films heated under different temperatures for 12 h: (b) 250 °C, (c) 300 °C, and (d) 350 °C

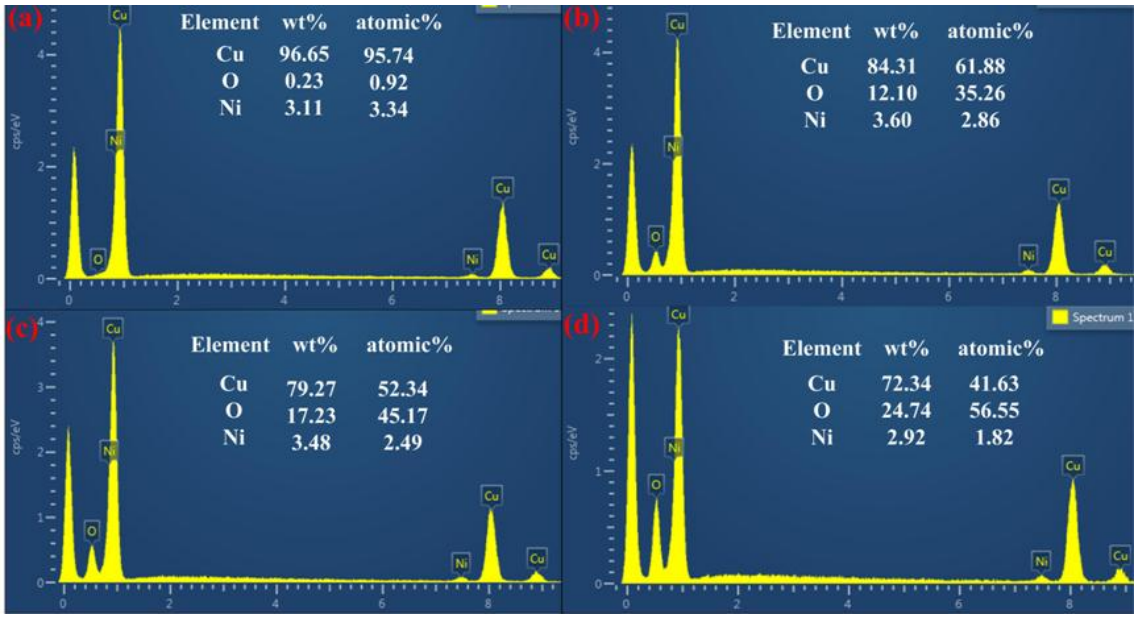

Figure S8 EDS spectra of (a) Cu film on nickel foam and (b-d) Cu films heated under different temperatures for 12 h: (b) 250 °C, (c) 300 °C, and (d) 350 °C