Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Electronic Supplementary Information

Anodic Electrodeposition of Porous Nickel Oxide-Hydroxide on Passivated Nickel Foam for Supercapacitors

1. CV curves of the untreated, cleaned and annealed Ni foam

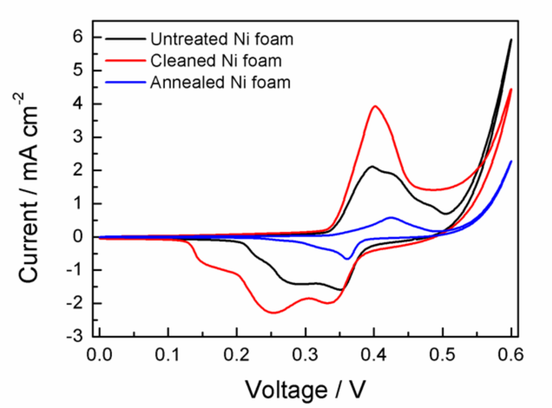

Fig. S1 CV curves of the untreated, cleaned and annealed Ni foam with the scan rate of 5 mV s^{-1}. The calculated areal capacitances of the three samples are 82.7, 145.6 and 18.2 mF cm^{-2}. It clearly shows that the current response of the untreated nickel foam, though a little smaller than that of the cleaned foam, is much larger than that of the annealed Ni foam.

2. CV curves of the cleaned and annealed Ni foam with porous NiO(OH) film

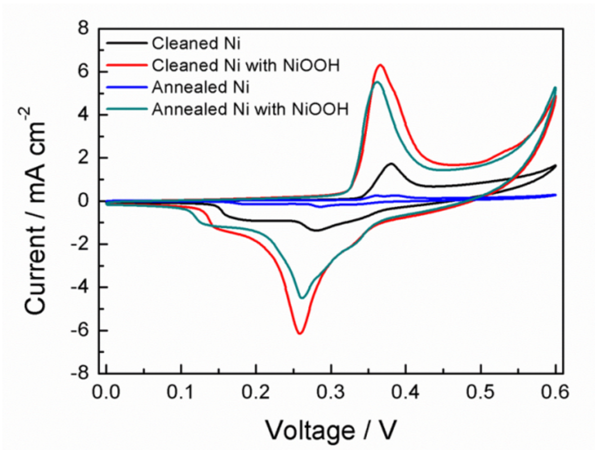

Fig. S2 CV curves of the cleaned and annealed Ni foam deposited with NiO(OH) at the same scan rate of 3 mV s^{-1}. The calculated areal capacitances are 70.9, 228.1, 12.6, 194.9 mF cm^{-2} for the cleaned Ni foam, cleaned Ni foam deposited with NiO(OH), the annealed Ni foam and annealed Ni foam deposited with NiO(OH), respectively.

3. XPS spectra of the Ni ($2p_{3/2}$) of the cleaned and the annealed Ni foam after immersion in KOH solution

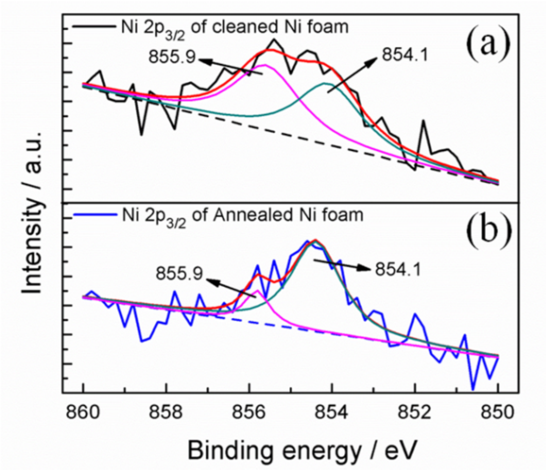

Fig. S3 (a) and (b) XPS spectra of the Ni ($2p_{3/2}$) of the cleaned and the annealed Ni foam after immersion in 1M KOH solution for 30 minutes. The Ni ($2p_{3/2}$) of the cleaned nickel foam can be deconvolved into two peaks at 854.1 and 855.9 eV, corresponding to nickel Ni^{2+} in NiO and $Ni(OH)_2$. The peak at 855.9 eV of the annealed Ni foam is much weaker than that of the as-cleaned foam, which means that high-temperature annealing passivates the surface and suppresses the reaction of Ni foam surface in KOH solution to form $Ni(OH)_2$.

4. Uniformity of the NiO(OH) on Ni foam

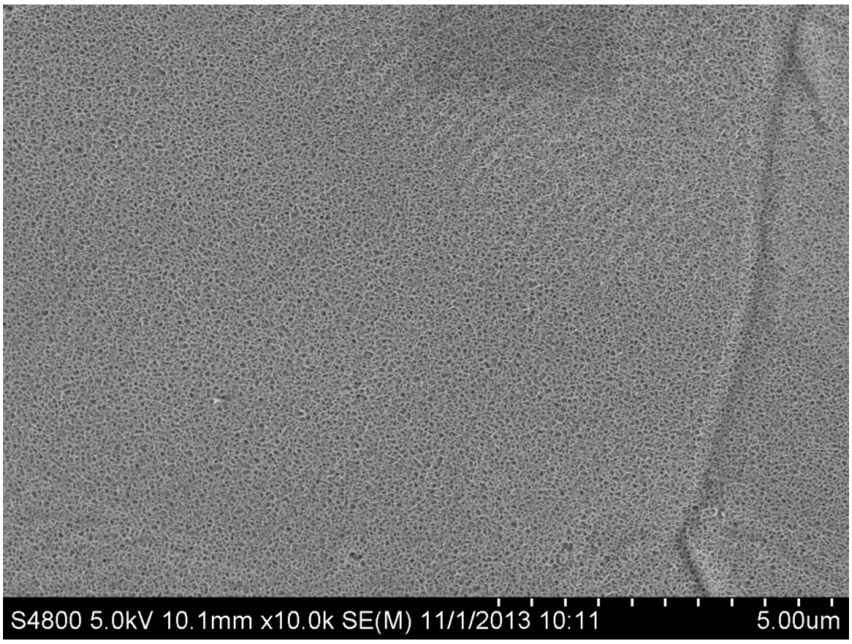

Fig. S4 Low- magnification SEM image of the NiO(OH) on 3D nickel foam.

5. Calculations method:

The areal capacitance (mF cm^{-2}) calculated from CV curves is got by the following equation:

$$C = \frac{1}{S \cdot v \cdot \Delta V} \int I dV$$

Here, S is the area of the supercapacitor electrode immersed in the electrolyte, v is the potential scan rate, ΔV is the potential window and I is the current on CV curves.

The specific capacitances (F g^{-1}) calculated from CV and GV curves are got by the following equations:

(1) CV method:

$$C = \frac{1}{m \cdot v \cdot \Delta V} \int I dV$$

Here, m is the mass of the active material on the electrode, v is the potential scan rate, ΔV is the potential window and I is the current on CV curves.

(2) GV method:

$$C = \frac{I_{discharge} \cdot \Delta t}{m \cdot \Delta V}$$

Here, m is the mass of the active material on the electrode, ΔV is the potential window, $I_{discharge}$ is the discharge current in GV test and Δt is discharge time at the current of $I_{discharge}$.

Methods to calculate the specific power and specific energy:

$$E = \frac{1}{2} C (\Delta V)^2$$

$$P = \frac{E}{\Delta t}$$

Here, E is the energy density, P is the power density, ΔV is the potential window, C and Δt is the specific capacitance and discharge time at the current of $I_{discharge}$.