Supporting Information

Rapid In-situ Growth of β-$Ni(OH)_2$ Nanosheet Arrays on Nickel Foams as Integrated Electrodes for Supercapacitors Exhibiting Ultrahigh Energy Density

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In order to calculate the mass of $Ni(OH)_2$, the samples (2 cm^{-2}) were kept in a tube furnace at 650 ℃ for 6 h with a heating rate of 10 ℃ min^{-1} and provided on-going H_2 , then the reactions following equation S1 and S2:

$$Ni(OH)_2 = NiO + H_2O \quad \text{(S1)}$$

$$NiO + H_2 = Ni + H_2O \quad \text{(S2)}$$

According to the change of weight, the active mass of $Ni(OH)_2$ could be calculated as 12.46 mg, then the loading density was 6.23 mg cm^{-2}.

To calculate the mass ratio of electrode materials, it is adjusted according to following equation S3:

$$\frac{m^+}{m^-} = \frac{C_s^- \times \Delta V^-}{C_s^+ \times \Delta V^+} \quad \text{(S3)}$$

C_s (F g^{-1}) is the specific capacitance of electrode material, ΔV is the potential window and m (g) is the mass of electrode materials. The calculate result is 2, which means the loading density of active carbon is 12.46 mg cm^{-2}.

Energy density (*E*) and power density (*P*), are two main parameters to survey the performance of cell. *E* (Wh Kg^{-1}) and *P* (W Kg^{-1}) can be described using the following equations S4 and S5:

$$E = \frac{I}{m}\int_{t1}^{t2} V dt \quad \text{(S4)}$$

$$P = \frac{E}{\Delta t} \quad \text{(S5)}$$

Where *m* are the mass of the electrode materials consist of negative and positive electrodes, *V* is the device potential window, Δt is the discharging time and *I* is the discharge/charge current.

List of Videos

Video. S1 β-$Ni(OH)_2$ nanosheets in-situ grown on nickel foam collector while supplied 0.4 V voltage in 1 M KOH electrolyte.

File: Video. S1.mp4

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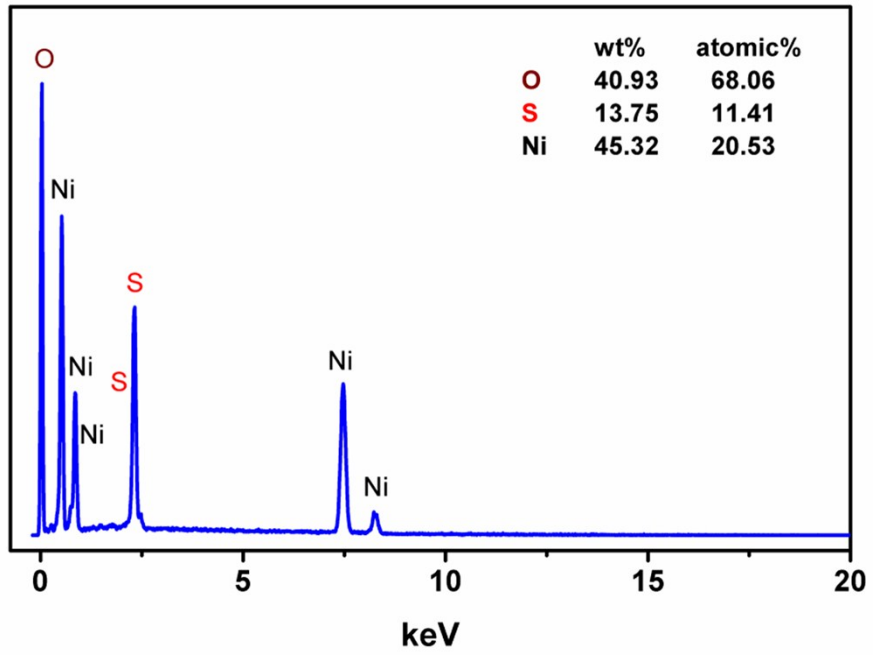
Fig. S1 Energy dispersive spectrum (EDS) of NF after 2 M H_2SO_4 pre-treatment.

Fig. S2 A photograph of the ASC device assembled with membrane, β-$Ni(OH)_2$@NF cathode and activated carbon (AC)@NF anode.

Fig. S3 CV curves of the ASC in different potential ranges at a scan rate of 50 mV s^{-1} (a), and GCD curves of the ASC in different potential ranges at a current density of 4 mA cm^{-2} (b).

Fig. S4 CV curves of the AC at different scan rates from 2 mV s^{-1} to 100 mV s^{-1} (a), and GCD curves of the AC at different current density from 0.5 A g^{-1}- 2.5 A g^{-1} (b). Specific capacity as a function current density for the AC electrodes (c). Nyquist plots of AC

electrode (d) (insets are the magnified view of the Nyquist curves and equivalent circuit).



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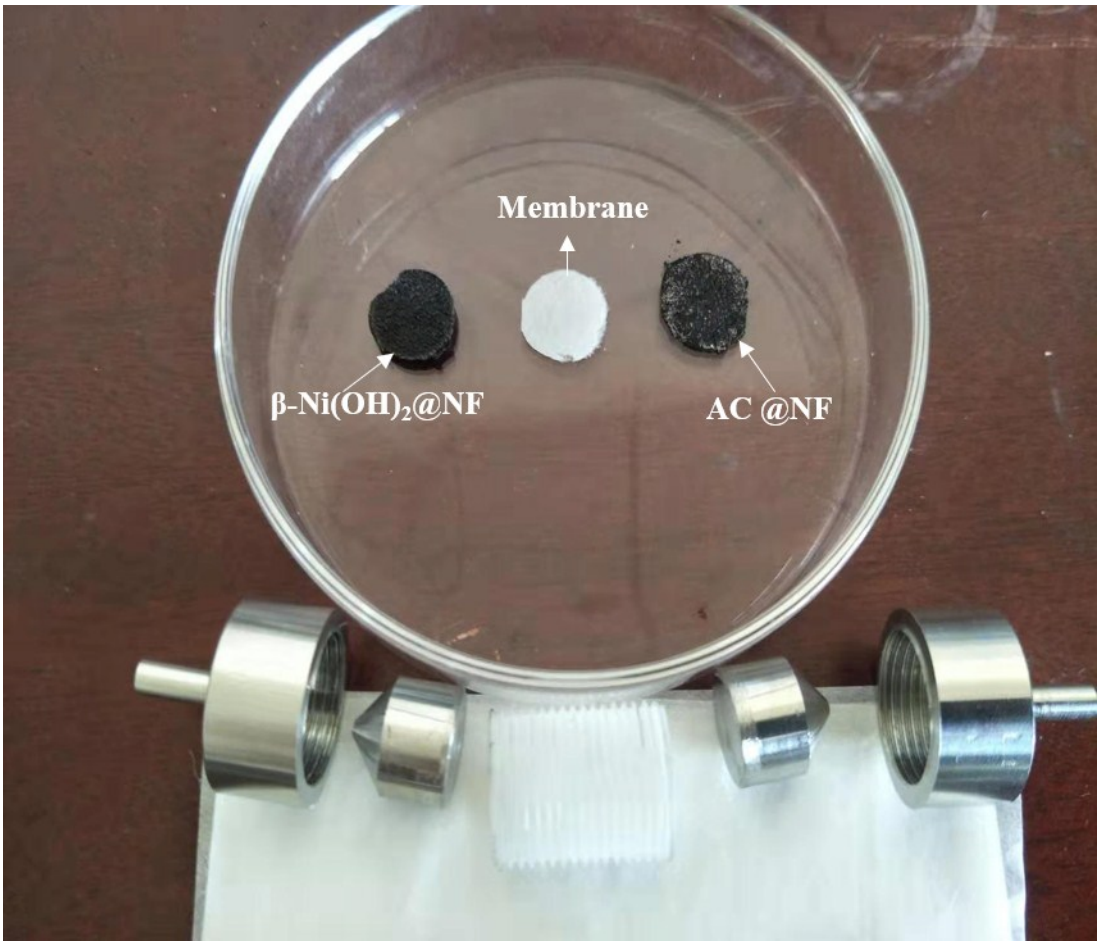

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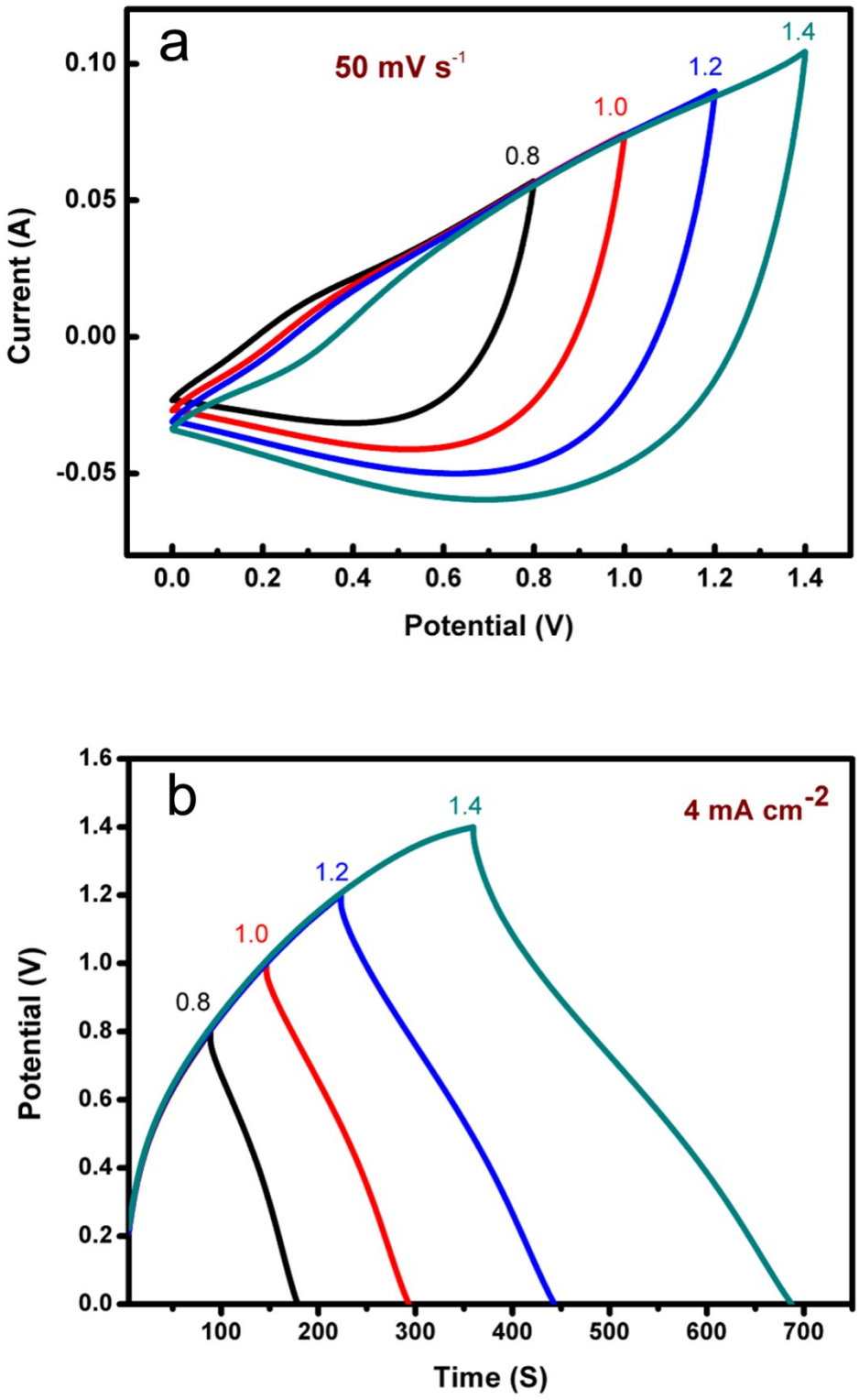

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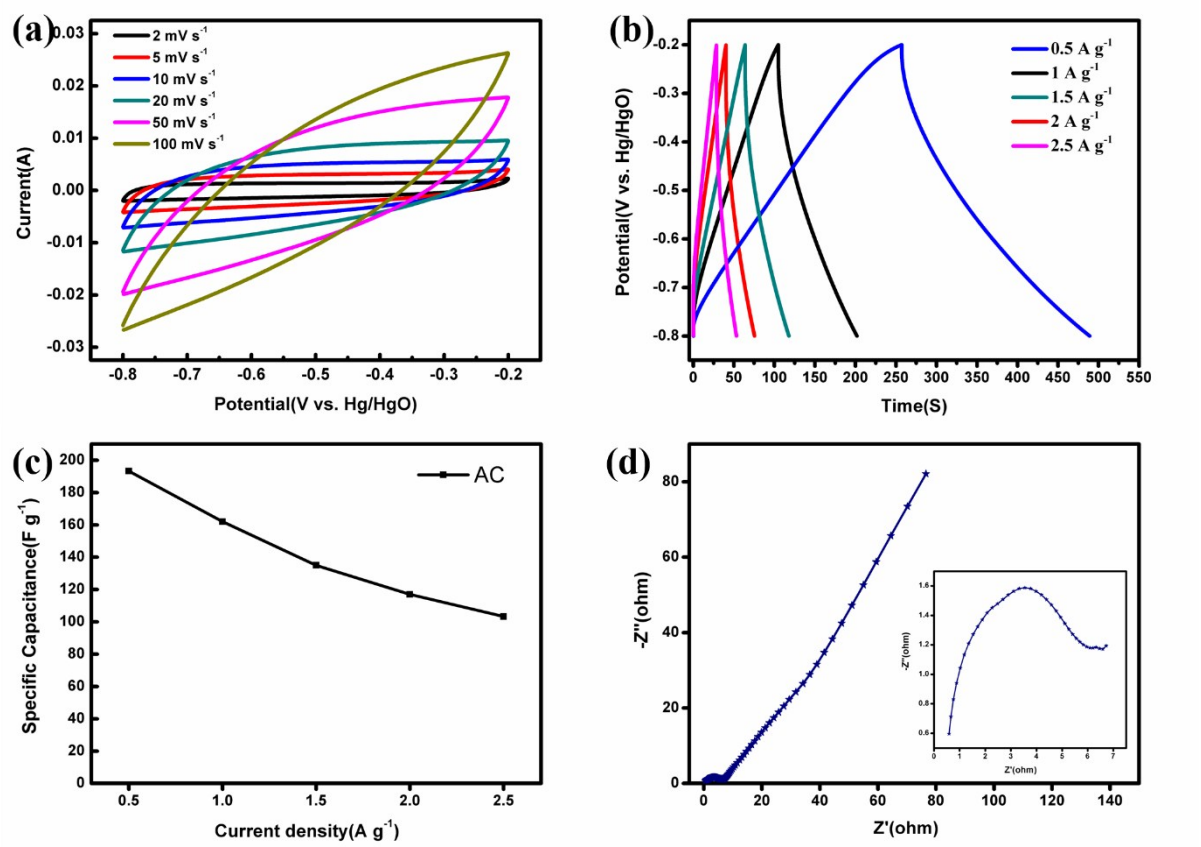

Fig. S4 CV curves of the AC at different scan rates from 2 mV s^{-1} to 100 mV s^{-1} (a), and GCD curves of the AC at different current density from 0.5 A g^{-1}- 2.5 A g^{-1} (b). Specific capacity as a function current density for the AC electrodes (c). Nyquist plots of AC electrode (insets are the magnified view of the Nyquist curves and equivalent circuit).