Electronic Supplementary Information

Flowerlike Cu_2NiSnS_4 Microspheres for Application as Electrodes of Asymmetric Supercapacitors Endowed with High Energy Density

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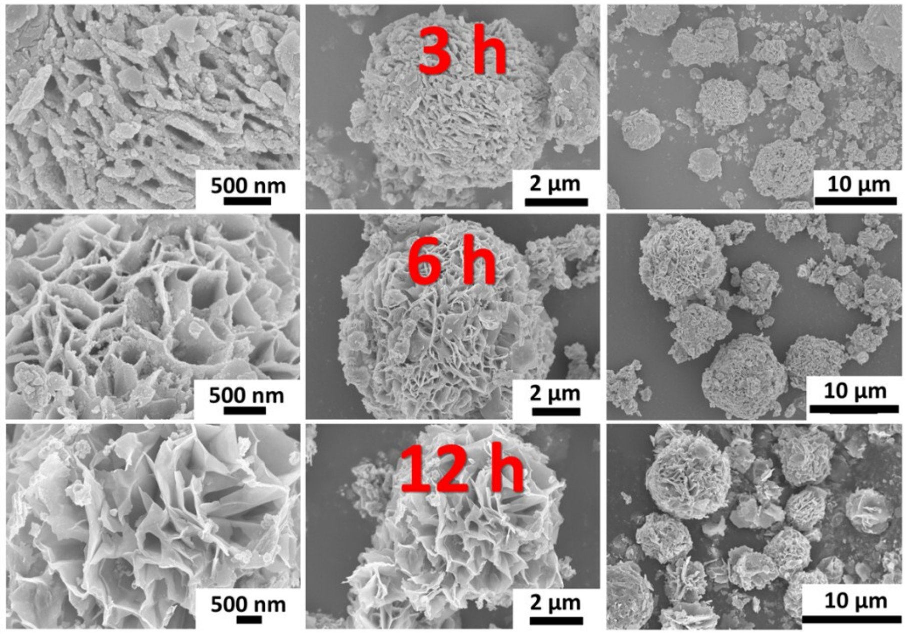

Figure S1: FESEM images at different magnifications of the samples (top, middle and bottom row are the samples obtained after 3 h, 6 h and 12 h of hydrothermal treatment).

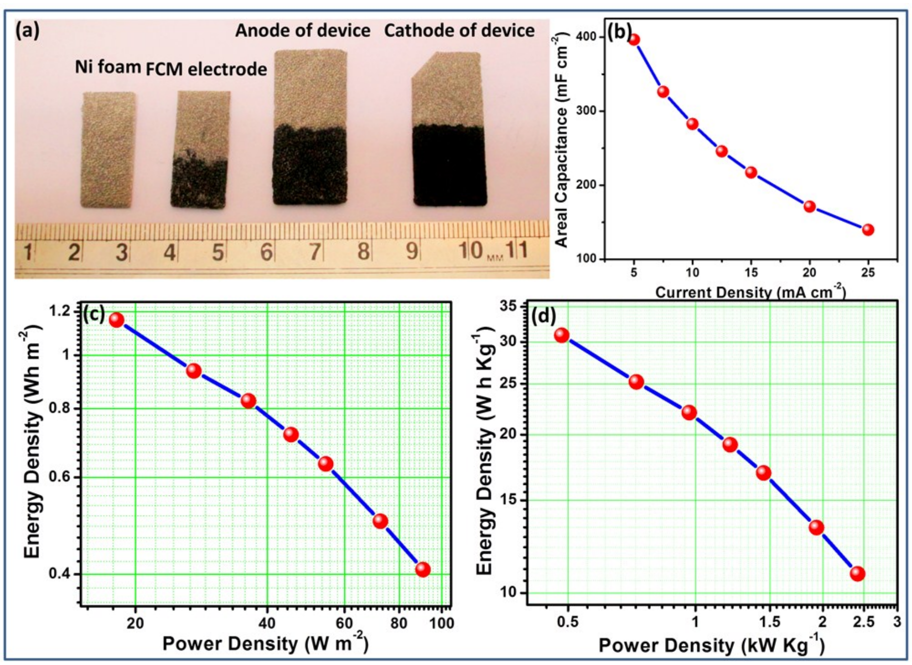

Figure S2: (a) Photograph of the prepared electrodes on Ni foam (b) Areal capacitance versus current density plot and (c) Areal and (d) Gravimetric ragone plots of the as fabricated asymmetric supercapacitor.

Additional formulae and calculations

The specific capacitance (C_S) of the electrodes is calculated from the following equations:

$$Cs = \frac{\int I(V)dV}{m \; X \; \Delta V \; X \; R} \qquad \text{-------------- (1)}$$

$$Cs = \frac{I \; X \; \Delta t}{m \; X \; \Delta V} \qquad \text{-------------- (2)}$$

Where I is the current, m is the active mass of the electrode material, ΔV is the potential window, R is the scan rate and Δt is the discharge time. $\int I(V)dV$ denotes the integral area within the closed CV curve. The above two equations calculates the specific capacitance from the CV and GCD curves respectively.

Volumetric capacitance is calculated employing the equation

$$C = \frac{I \; X \; \Delta t}{v \; X \; \Delta V} \qquad \text{---------------- (3)}$$

The volumetric energy and power densities of the device are calculated using the equations

$$E = \frac{1}{2} C (\Delta V)^{2} \qquad \text{---------------- (4)}$$

$$P = \frac{E}{\Delta t} \qquad \text{---------------- (5)}$$

Here C is the volumetric capacitance, ΔV is the potential window, v is the effective volume of the ASC, Δt is the discharge time, I is the charging current, E is the volumetric energy density and P is the volumetric power density.

Before assembling the device, the masses of the composite and activated carbon used for the fabrication of the positive and negative electrodes are in accordance to the equation

$$\frac{m_+}{m_-} = \frac{C_- \Delta V_-}{C_+ \Delta V_+} \qquad \text{---------------} \ (6)$$

Where m is the active electrode mass, C is the specific capacitance of electrode and ΔV is the voltage window. The suffixes '+' and '-' represent the parameter values for the positive and negative electrodes respectively.

Calculation of areal (C_A), gravimetric (C_S) and volumetric capacitances (C_V) of ASC

$C_A = (I \times \Delta t) / (A \times \Delta V)$ (in mF cm^{-2}) (when I is in mA)

Where A (in cm^2) is the total effective area of both the electrodes of the ASC.

$C_S = (I \times \Delta t) / (m \times \Delta V)$ (in F g^{-1}) (when I is in mA and m is in mg)

Here m is the total mass of active materials in both electrodes of ASC.

$C_V = (I \times \Delta t) / (v \times \Delta V)$ (in F cm^{-3}) (when I is in A)

v (in cm^3) is the effective volume of ASC.

Calculation of areal (E_A, P_A), gravimetric (E_S, P_S) and volumetric (E_V, P_V) energy and power densities of ASC

$E_A = C_A \times (\Delta V)^2 / 2$ (in mW s cm^{-2})

$E_A = C_A \times (\Delta V)^2 / 720$ (in W h m^{-2})

$P_A = E_A \times 3600 / \Delta t$ (in W m^{-2})

$E_S = C_S \times (\Delta V)^2 / 2$ (in W s g^{-1})

$E_S = C_S \times (\Delta V)^2 / 7.2$ (in W h Kg^{-1})

$P_S = E_S \times 3.6 / \Delta t$ (in kW Kg^{-1})

$(E_V = C_V \times (\Delta V)^2 / 2$ (in W s cm^{-3})

$E_V = C_V \times (\Delta V)^2 / 7.2$ (in mW h cm^{-3})

$P_V = E_V \times 3600 / \Delta t$ (in mW cm^{-3})

In all the calculations, ΔV and Δt are in volt and second respectively.