Supporting Information

Hydrothermal synthesis of Zn-doped CuS as a binder-free positive electrode material for supercapacitors applications

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Electrochemical characterization

Electrochemical measurements were performed on an electrochemical workstation (CHI660E) using 3M KOH as the electrolyte at room temperature. The electrochemical testing including cyclic voltammetry (CV), galvanostatic charge and discharge (GCD) and electrochemical impedance spectroscopy (EIS). The area specific capacitance (Cs) and mass specific capacitance (Cm) of the supercapacitor can be calculated according to the Eq. (1) and (2), respectively:

$$C_m = \frac{I \cdot \Delta t}{\Delta V \cdot m} \quad \text{(S1)}$$

$$C_s = \frac{I \cdot \Delta t}{\Delta V \cdot S} \quad \text{(S2)}$$

Where I is the charge or discharge current (A), Δt and ΔV represent the voltage window (V) and the discharge time (s), S represent the geometric surface area of the active material (cm^2) and m represent the mass loading of the single electrode (g).

In order to achieve the optimum mass ratio of as-prepared positive electrode to AC negative electrodes, we examined the charge balance using the given equation, q+ = q−. The mass of the positive electrode and negative electrode was tuned according to the following Eq. S3 and Eq. S4:

$$Q = C \times \Delta V \times m \quad \text{(S3)}$$

$$\frac{m^+}{m^-} = \frac{C_- \times \Delta V_-}{C_+ \times \Delta V_+}$$

(S4)

Where C is the specific capacity (investigated through the three-electrode system); + and – represents positive and negative electrodes.

And the energy density (E) and power density (P) of an all-solid-state ASC can be calculated by the Eqs. (3) and (4), respectively:

$$E = \frac{1}{2} \times C \times \frac{\Delta V^2}{3600} \quad \text{(S5)}$$

$$P = \frac{E}{\Delta t} \times 3600 \quad \text{(S6)}$$

Where E and P are the energy density (mWh cm^{-2}) and the power density (mW cm^{-2}), C represent the specific capacitance of the all-solid-state ASC, ΔV and Δt represent the voltage window (V) and the discharge time(s), respectively.

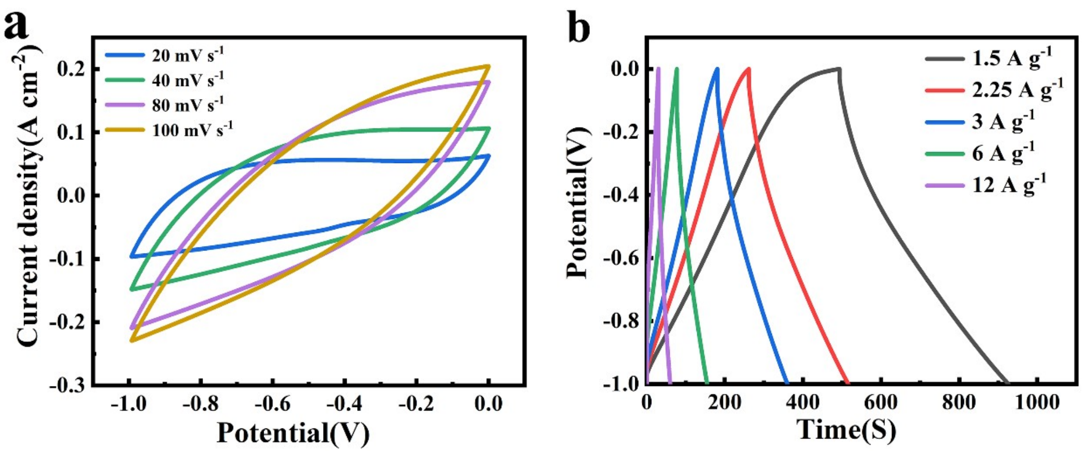

Figure S1：CV of different scan rates of activated carbon; (b) GCD of different current densities of activated carbon

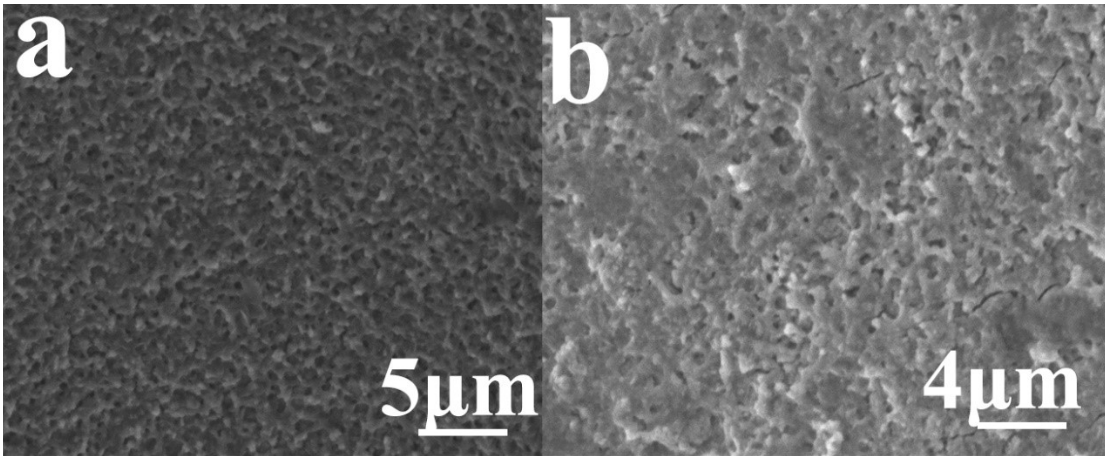

Figure S2：SEM of electrode material after cycling