Supporting online Materials for

*p-nitroaniline redox-active solid-state electrolyte for battery-like electrochemical capacitive energy storage combined with asymmetric supercapacitor based on metal oxides functionalized β-polytype porous silicon carbide electrodes*

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1. Calculations and equations

The ionic conductivity of electrolyte can be calculated by the following equation:

$$\sigma = \frac{1}{R_b \times A}$$ \hspace{1cm} \text{(S1)}

Where $\sigma$ is the ionic conductivity (S cm$^{-1}$), $l$ is the distance between the two stainless steel sheets (cm), $A$ is the contact area of the electrolyte film with stainless sheets during the experiment (cm$^2$), $R_b$ is the bulk resistance ($\Omega$).

The specific capacitances ($C_s$) are calculated from the CV and galvanostatic charge/discharge curves using the following equation:

$$C_s = \frac{1}{v(V_c - V_a)} \int_{V_a}^{V_c} I(V) dV$$ \hspace{1cm} \text{(S2)}

$$C_s = \frac{I \times t}{m \times \Delta V}$$ \hspace{1cm} \text{(S3)}

where $C_s$ is the specific capacitance (F g$^{-1}$), $v$ is the potential scan rate (mV s$^{-1}$), $V_c - V_a$ represents the sweep potential range (V), $I(V)$ denotes the response current density (A g$^{-1}$), $I$ is the discharge current, $t$ is the discharge time, $m$ is the mass of active material, and $\Delta V$ is the voltage drop upon discharging.

The frequency response capacitances were estimated using a series-RC circuit model:

$$C(f) = \frac{-1}{2\pi f M \times Z''(f)}$$ \hspace{1cm} \text{(S4)}

where $C$ is the capacitance (F/g), $f$ is the frequency, $M$ is total mass of active materials in both electrodes (g), and $Z''(f)$ is the imaginary part of the impedance.

The frequency-dependent imaginary ($C''(f)$) component of the capacitance were obtained from the impedance spectra according to the following equation:

$$C''(f) = \frac{Z'(f)}{2\pi f M \times |Z(f)|^2}$$ \hspace{1cm} \text{(S5)}

where $C''(f)$ is the imaginary capacitance, $f$ is the frequency, $M$ is total mass of active materials in

both electrodes (g), $Z'(f)$ is the real part of the impedance, respectively, and $|Z(f)|$ is the absolute value of the impedance.

The time constant ($\tau_0$), which is a characteristic parameter indicating the rate capability of an electrical system, can be estimated from the peak frequency of $C''(f)$ using the following equation:

$$\tau_0 = \frac{1}{f} \quad \text{S(6)}$$

where $f$ is the frequency corresponding to the peak frequency of the imaginary capacitance.

The power density and energy density of symmetrical supercapacitor systems were calculated using the following equations:

$$E = \frac{1}{2}C(\Delta V)^2 \quad \text{S(7)}$$

$$P = \frac{E}{t} \quad \text{S(8)}$$

where $P$, $C$, $\Delta V$, $t$, and $E$ represent the power density (W kg$^{-1}$), specific capacitance based on the mass of the electroactive material (F g$^{-1}$), cell voltage for charging and discharging (V), discharge time (s), and energy density (W h kg$^{-1}$), respectively.
Figure S1. (a) Low-magnification FE-TEM image of SiCF. (b) High-magnification FE-TEM image of SiCF.
Figure S2. (a) Deconvoluted XPS Mg 2p spectra of SiCF/MgCo$_2$O$_4$. (b) Deconvoluted XPS Co 2p spectra of SiCF/MgCo$_2$O$_4$. 
Figure S3. (a) Nitrogen adsorption-desorption isotherm of SiCF. (b) Pore size distribution of SiCF.
Figure S4. (a) Deconvoluted XPS Fe 2p spectra of SiCF/Fe$_3$O$_4$. (b) Deconvoluted XPS Fe 2p$_{3/2}$ spectra of SiCF/Fe$_3$O$_4$. 
Figure S5. Comparative CV curves of SiCF/Fe$_3$O$_4$ and SiCF/MgCo$_2$O$_4$ electrodes performed in a three electrode cell at a scan rate of 5 mV s$^{-1}$. 
Figure S6. Specific capacitances for SiCF/MgCo$_2$O$_4$/SiCF/Fe$_3$O$_4$ cell with KOH aqueous and PVA-KOH gel electrolyte at different scan rates.
Figure S7. (a) CV curves of KOH and KOH-PNA aqueous electrolyte with SiCF electrode performed in a three electrode cell at a scan rate of 5 mV s$^{-1}$. (b) Gavanostatic charge/discharge curves of KOH and KOH-PNA aqueous electrolyte with SiCF electrode performed in a three electrode cell at a current density of 0.5 A g$^{-1}$. 
Figure S8. Ionic conductivity of PVA-KOH-PNA gel electrolyte containing different amounts of PNA (PVA = 1 g, KOH = 1 g).