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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:

$$\sigma = \frac{l}{R_b \times A} \tag{S(1)}$$

Where σ 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 (Ω).

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

$$C_s = \frac{1}{v(V_c - V_a)} \int_{V_a}^{V_c} I(V)dV \tag{S(2)}$$

$$C_S = \frac{I \times t}{m \times \Delta V} \tag{S(3)}$$

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 ΔV is the voltage drop upon discharging.

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

$$C(f) = \frac{-1}{2\pi f M \times Z''(f)} \tag{S(4)}$$

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:

$$C''(f) = \frac{Z'(f)}{2\pi f M \times |Z(f)|^2} \tag{S(5)}$$

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 (τ_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:

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

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:

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

$$\mathrm{P} = \frac{\mathrm{E}}{\mathrm{t}} \tag{S(8)}$$

where P, C, ΔV, 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.

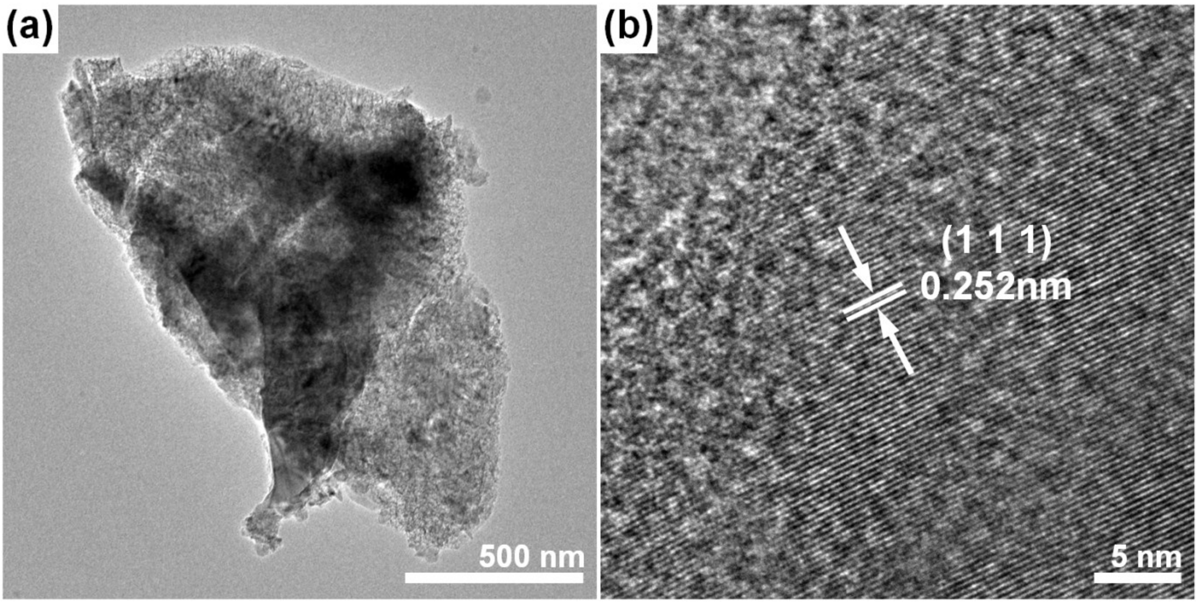

Figure S1. (a) Low-magnification FE-TEM image of SiCF. (b). High-magnification FE-TEM image of SiCF.

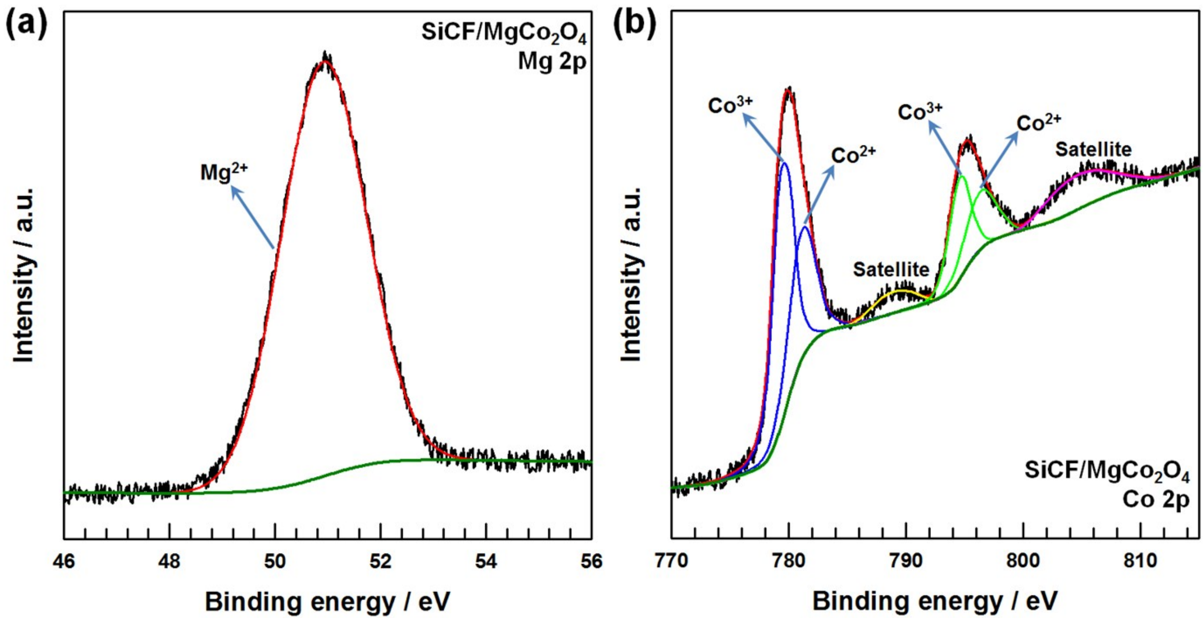

Figure S2. (a) Deconvoluted XPS Mg 2p spectra of SiCF/$MgCo_2O_4$. (b) Deconvoluted XPS Co 2p spectra of SiCF/$MgCo_2O_4$.

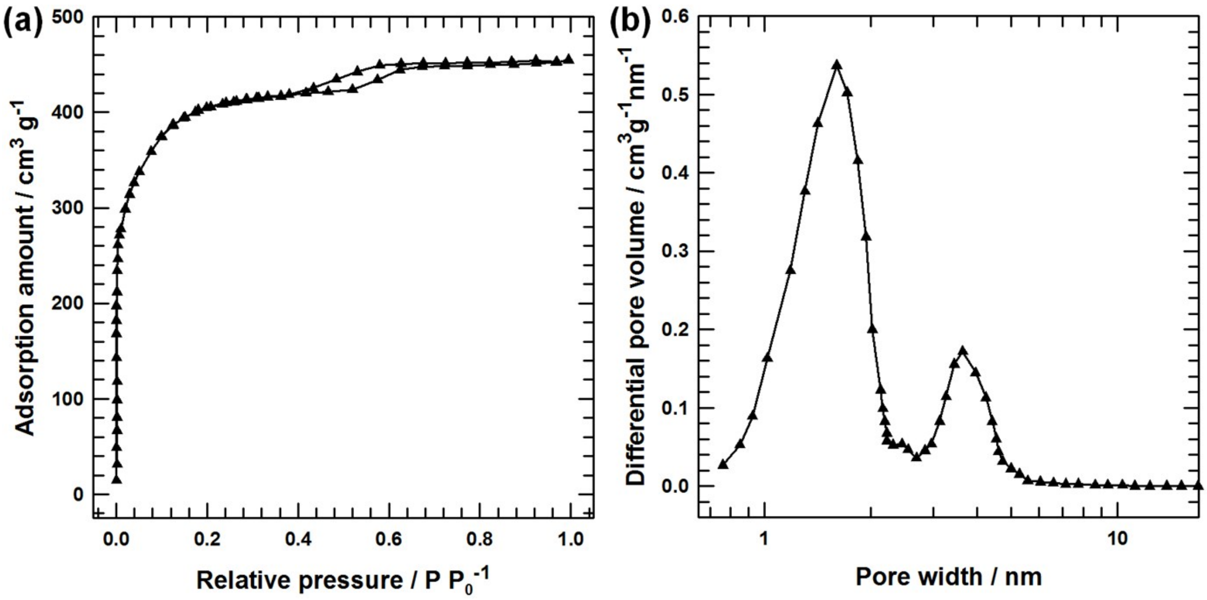

Figure S3. (a) Nitrogen adsorption-desorption isotherm of SiCF. (b) Pore size distribution of SiCF.

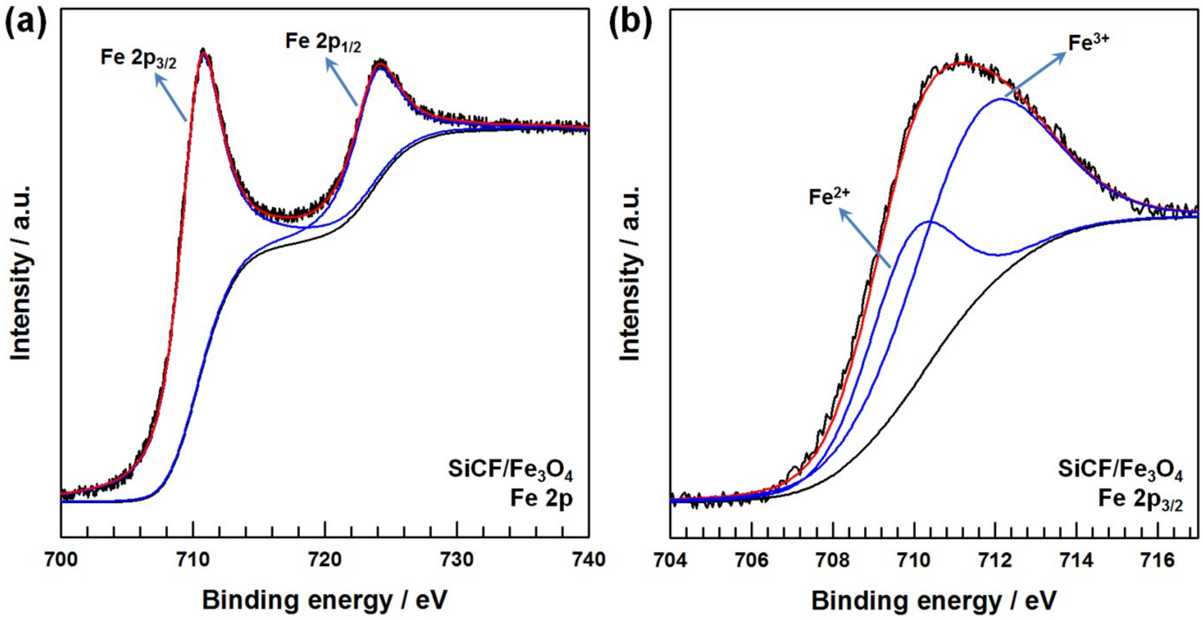

Figure S4. (a) Deconvoluted XPS Fe 2p spectra of SiCF/Fe_3O_4. (b) Deconvoluted XPS Fe 2p$_{3/2}$ spectra of SiCF/Fe_3O_4.

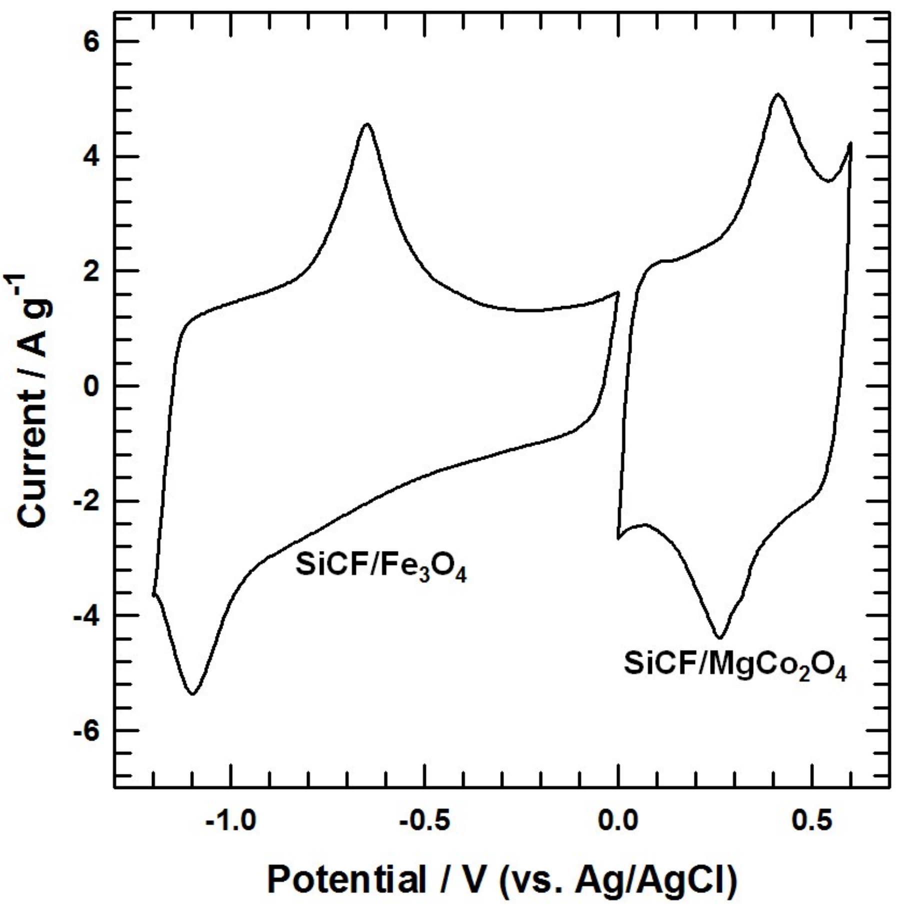

Figure S5. Comparative CV curves of SiCF/Fe_3O_4 and SiCF/$MgCo_2O_4$ electrodes performed in a three electrode cell at a scan rate of 5 mV s^{-1}.

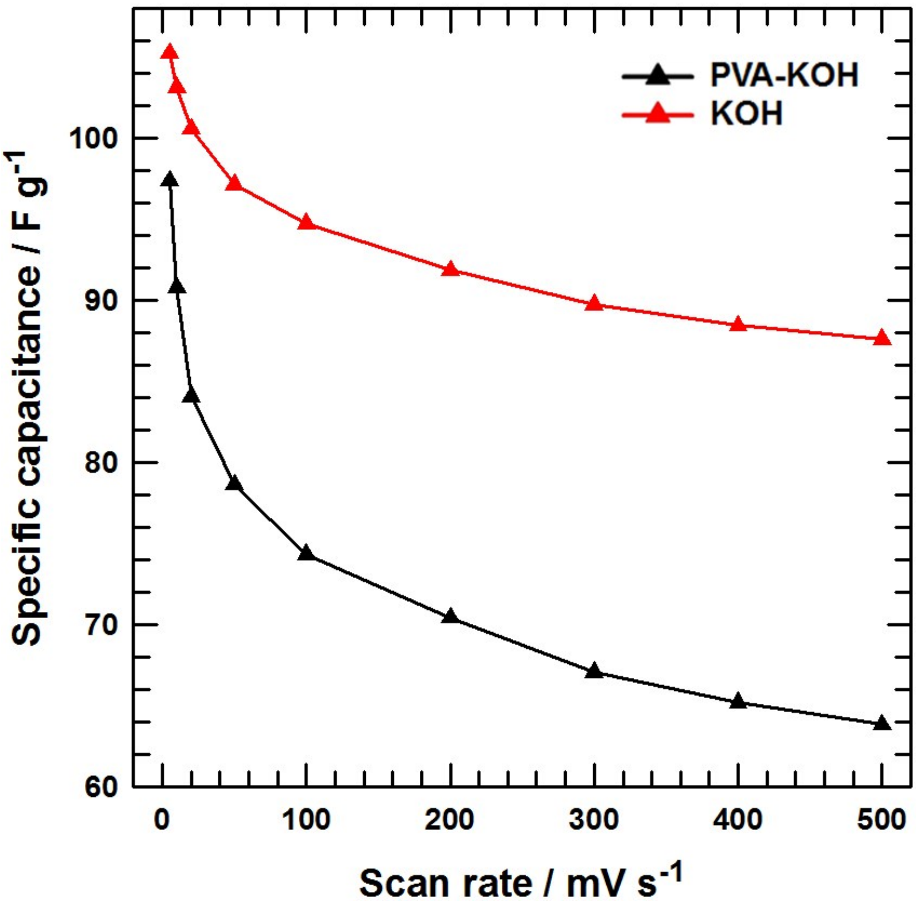

Figure S6. Specific capacitances for SiCF/$MgCo_2O_4$//SiCF/Fe_3O_4 cell with KOH aqueous and PVA-KOH gel electrolyte at different scan rates.

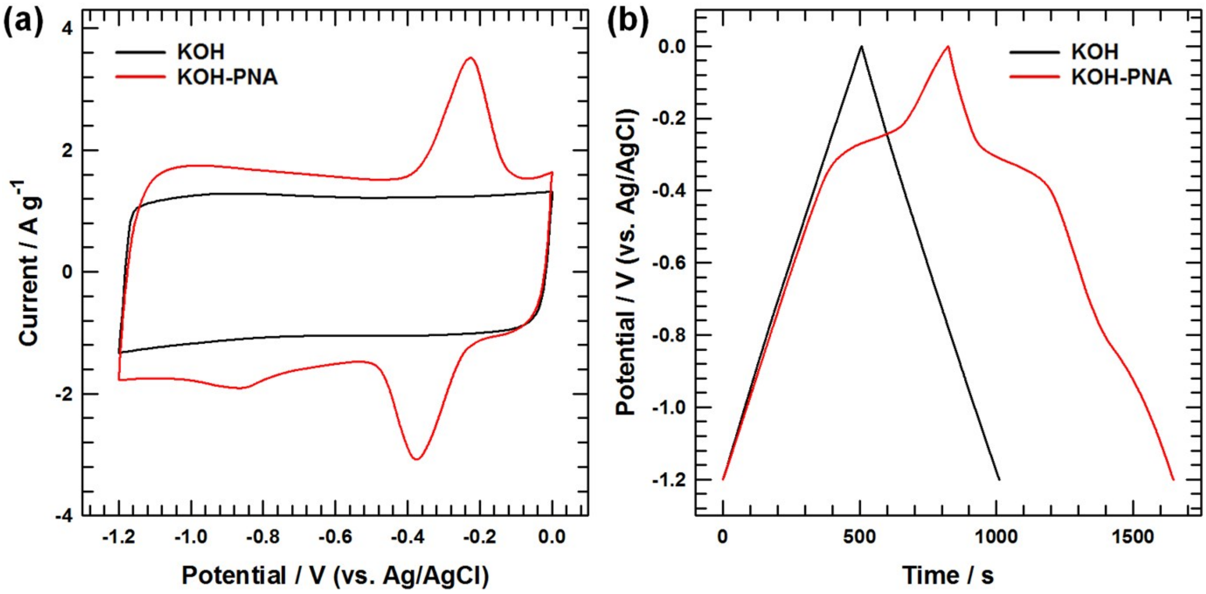

Figure S7. (a) CV curves of KOH and KOH-PNA aqueous electrolyte with SiCF electrode performed in a three electrode cell at a scan rate of 5 mV s^{-1}. (b) Gavanostatic charge/discharge curves of KOH and KOH-PNA aqueous electrolyte with SiCF electrode performed in a three electrode cell at a current density of 0.5 A g^{-1}.

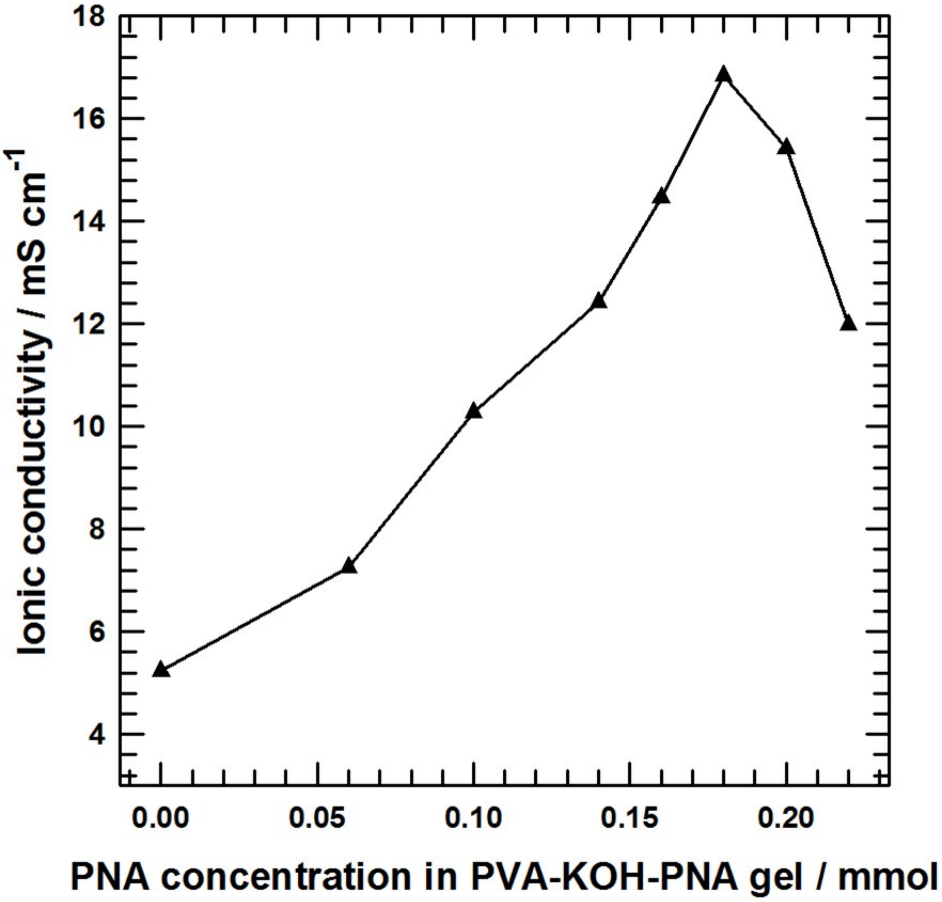

Figure S8. Ionic conductivity of PVA-KOH-PNA gel electrolyte containing different amounts of PNA (PVA = 1 g, KOH = 1 g).