Polypyrrole-decorated 2D carbon nanosheet electrodes for supercapacitors with high areal capacitance

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Electronic Supplementary Information

Supplementary Methods:

Method S1. Calculation of ionic conductivity of EGN/PPY nanocomposite electrodes.
Method S2. Calculation of the cell capacitance of EGN/PPY SC cell.
Method S3. Calculation of the area specific capacitance of EGN/PPY SC cell.
Method S4. Calculation of the area specific energy density of EGN/PPY SC cell.
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Method S6. Calculation of the volumetric energy density of EGN/PPY SC cell.
Method S7. Calculation of the volume specific capacitance of EGN/PPY SC cell.
Method S8. Calculation of the volume specific energy density of EGN/PPY SC cell.

Supplementary Figure:

Fig. S1. FTIR spectra of (a) pure PPY; (b) $EGN_{0.1}PPY_{0.9}$, (c) $EGN_{0.2}PPY_{0.8}$, (d) $EGN_{0.3}PPY_{0.7}$, (e) $EGN_{0.4}PPY_{0.6}$, (f) $EGN_{0.5}PPY_{0.5}$, (g) $EGN_{0.6}PPY_{0.4}$, (h) $EGN_{0.7}PPY_{0.3}$, (i) $EGN_{0.8}PPY_{0.2}$, (j) $EGN_{0.9}PPY_{0.1}$ nanocomposite; (k) EGN and (l) NFG.
Fig. S2. (a) N_2 sorption isotherms and (b) BJH pore-size distribution curve of $EGN_{0.5}PPY_{0.5}$ nanocomposite.

Method S1. Calculation of ionic conductivity of EGN/PPY nanocomposite electrodes.
The ionic conductivity of the SC electrodes is calculated by using the equation

$$\sigma = \frac{T}{R_b \times A}$$

Where σ is the ionic conductivity in S/cm, T is the total thickness of the SC cell (in cm), R_b is the bulk electrolyte resistance (in Ω), and A is the geometrical area of electrodes (in cm^2).

Method S2. Calculation of the cell capacitance of EGN/PPY SC cell.
The cell capacitance of the SC is calculated by using equation

$$C_{cell} = \frac{It_{dis}}{\Delta E}$$

Where, C_{cell} is the cell capacitance of the SC, I is the charging current, t_{dis} is the discharging time, and ΔE is the operating potential window.

Method S3. Calculation of the area specific capacitance of EGN/PPY SC cell.
The area specific capacitance of the SC is calculated by using the equation

$$C_{cell,sp,A} = \frac{C_{cell}}{A_{ele}}$$

Where, $C_{cell,sp,A}$ is the area specific capacitance of the SC and A_{ele} is the geometric area of the SC electrode.

Method S4. Calculation of the area specific energy density of EGN/PPY SC cell.

The area specific energy density ($E_{cell,sp,A}$) of the SC is calculated by using the equation

$$E_{cell,sp,A} = \frac{C_{cell,sp,A}\ X\ (\Delta E)^2}{2\ X\ 3600}$$

Method S5. Calculation of the volumetric capacitance of EGN/PPY SC cell.

The volumetric capacitance of the SC is calculated by using the equation

$$C_{cell,V} = \frac{C_{cell}}{V_{cell}}$$

Where, $C_{cell,V}$ is the volumetric capacitance of the SC and V_{cell} is the total volume of the SC.

Method S6. Calculation of the volumetric energy density of EGN/PPY SC cell.

The volumetric energy density ($E_{cell,V}$) of the SC is calculated by using the equation

$$E_{cell,V} = \frac{C_{cell,V}\ X\ (\Delta E)^2}{2\ X\ 3600}$$

Method S7. Calculation of the volume specific capacitance of EGN/PPY SC cell.

The volume specific capacitance of the SC is calculated by using the equation

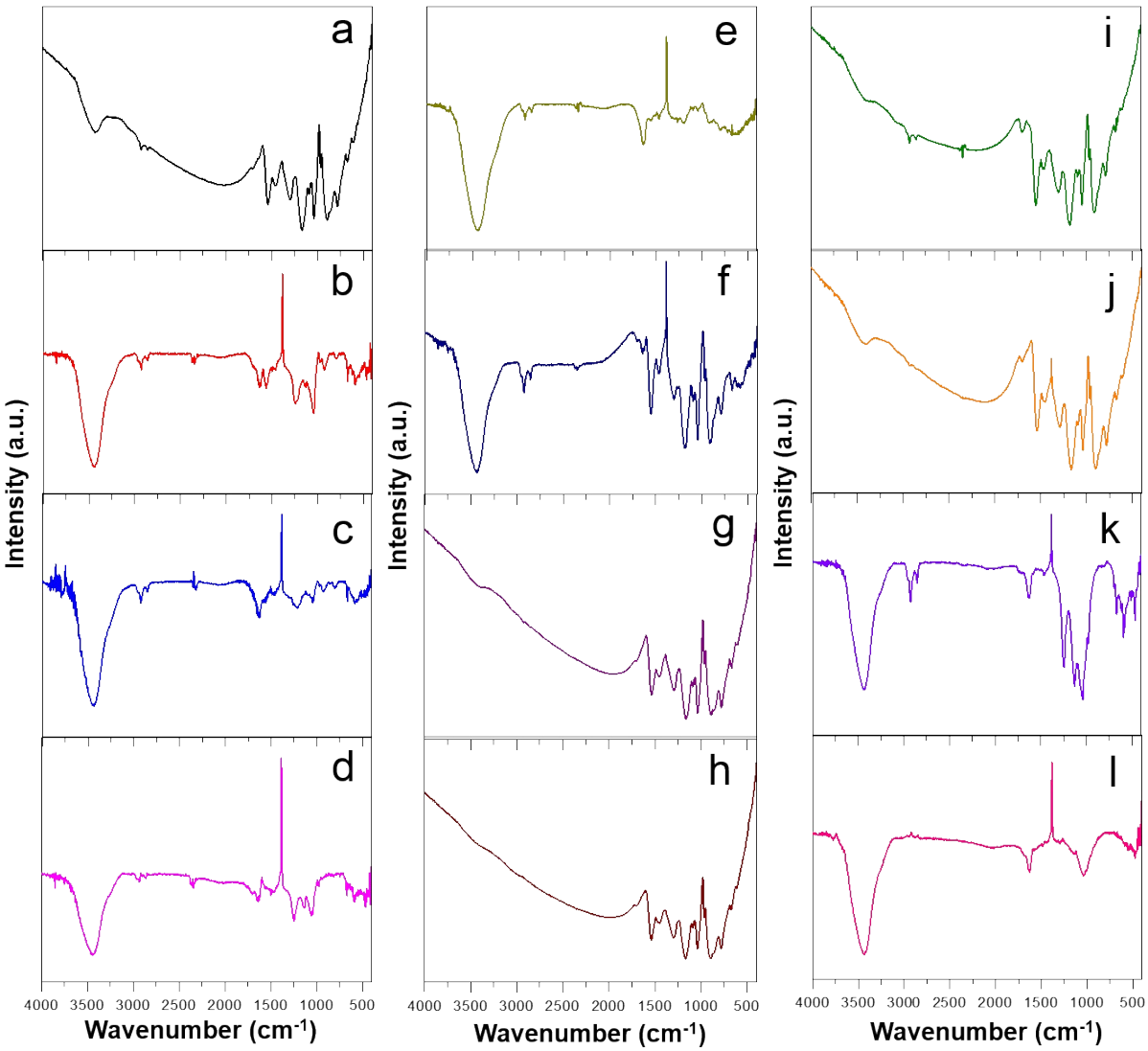
$$C_{cell,sp,V} = \frac{C_{cell}}{V_{ele}}$$

Where, $C_{cell,sp,V}$ is the volume specific capacitance of the SC and V_{ele} is the total volume of the SC electrodes.

Method S8. Calculation of the volume specific energy density of EGN/PPY SC cell.

The volume specific energy density ($E_{cell,sp,V}$) of the SC is calculated by using the equation

$$E_{cell,sp,V} = \frac{C_{cell,sp,V}\ X\ (\Delta E)^2}{2\ X\ 3600}$$



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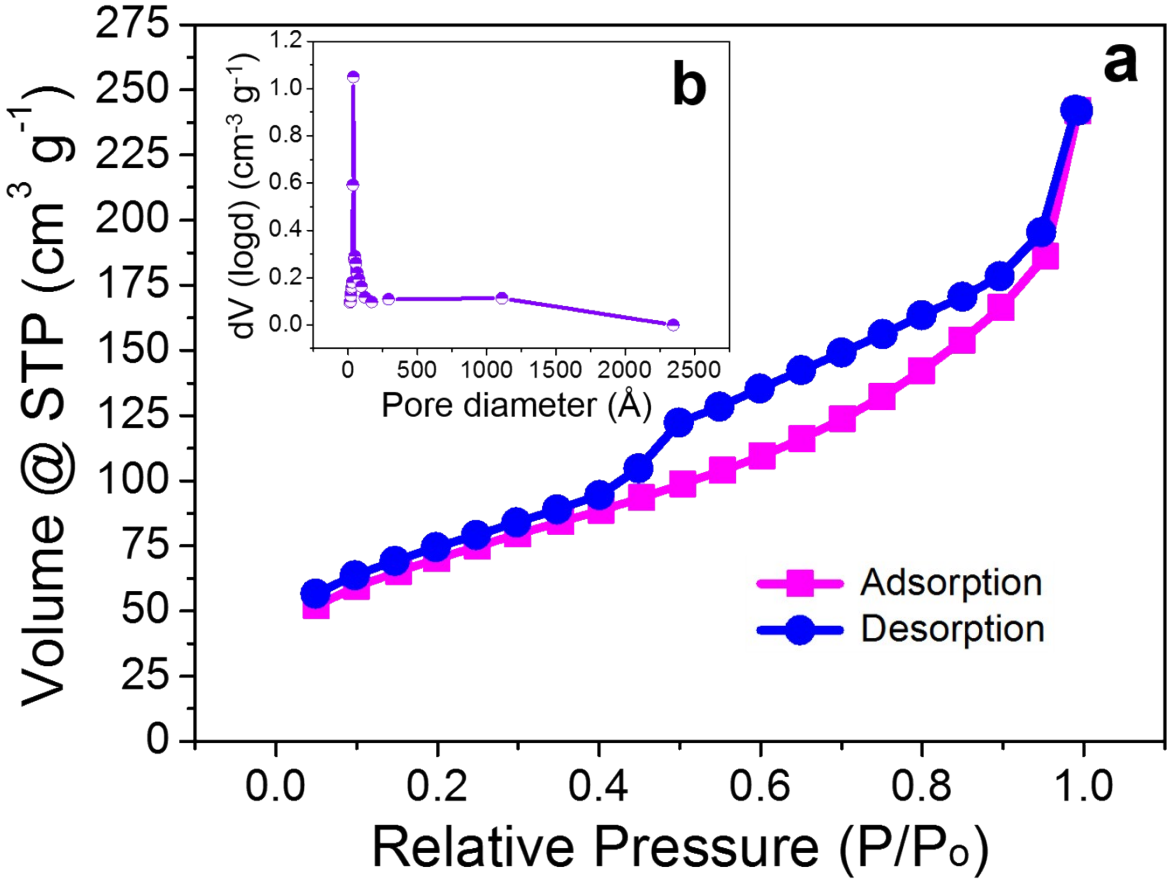

Fig. S2. (a) N_2 sorption isotherms and (b) BJH pore-size distribution curve of $EGN_{0.5}PPY_{0.5}$ nanocomposite.