Electronic Supplementary Information

Green and All-carbon Asymmetric Supercapacitor Based on Polyaniline Nanotubes and Anthraquinone Functionalized Porous Nitrogen-doped Carbon Nanotubes with High Energy Storage Performance

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Calculations of specific capacitance, energy density and power density based on the galvanostatic charge-discharge curves:

(1) In three-electrode configuration, specific capacitances derived from galvanostatic tests can be calculated from the equation:

$$C = I\Delta t/m\Delta V \quad (1)$$

where I (A) is the discharging current, Δt (s) is the discharge time, ΔV (V) is the voltage interval of discharge, and m (g) is the mass of active material in the working electrode.

(2) In two-electrode asymmetric cell configuration, specific capacitances derived from galvanostatic tests can be calculated from the equation:

$$C = I\Delta t/m\Delta V \quad (2)$$

where I (A) is the constant discharge current, Δt (s) is the discharging time, m (g) is the total mass of two electrodes, and ΔV (V) is the voltage interval of discharge.

Energy density (E) and power density (P) derived from galvanostatic tests can be calculated from the following equations:

$$E = 0.5C\,(\Delta V)^2 \quad (3)$$

$$P = E/\Delta t \quad (4)$$

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where C (F g^{-1}) is the capacitance of the two-electrode capacitor, ΔV (V) is the voltage decrease in discharge and Δt (s) is the time spent in discharge, respectively.

The calculation formula for the mass of AQ:

$$Q = \int Idt = \int_{Va}^{Vb} \frac{I}{\frac{dV}{dt}} dV = \frac{1}{V} \int_{Va}^{Vb} IdV \quad (1)$$

$$m_A = n_A \cdot M_A = \frac{\Delta Q}{z \cdot F} M_A \quad (2)$$

where Q (C), I (A), t (s), V (V), m_A (g), n_A (mol), M_A (mol g^{-1}), F and z are voltammetric charge, instantaneous anodic (cathodic) current at a given potential range, sampling time, potential range, material mass taking part in redox reaction, amount of substance of active materials, molar mass of active materials, Faraday constant and stoichiometric coefficient of electron transport in electrochemical processes while Va and Vb (V) are the selected boundary of potential range, respectively. ΔQ (C) is defined as a charge contributed by cathodic or anodic reaction of AQ, which is numerically equal to the integral area of the region (S1 or S2) as shown in Fig. 5a.

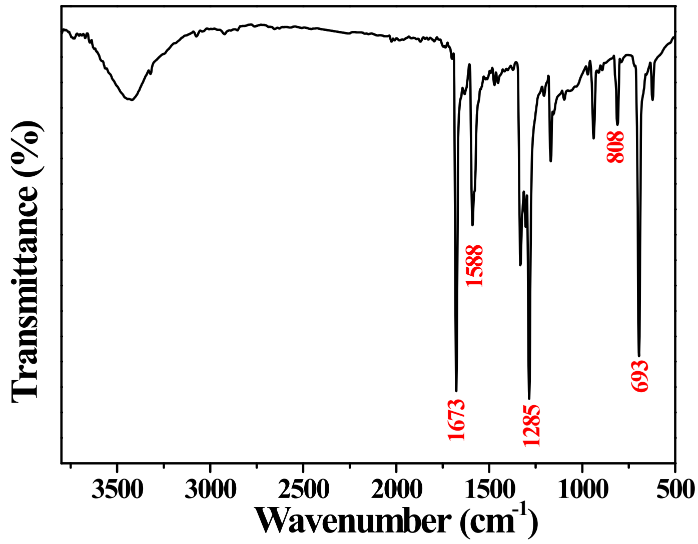

Fig. S1 FT-IR spectra of AQ.

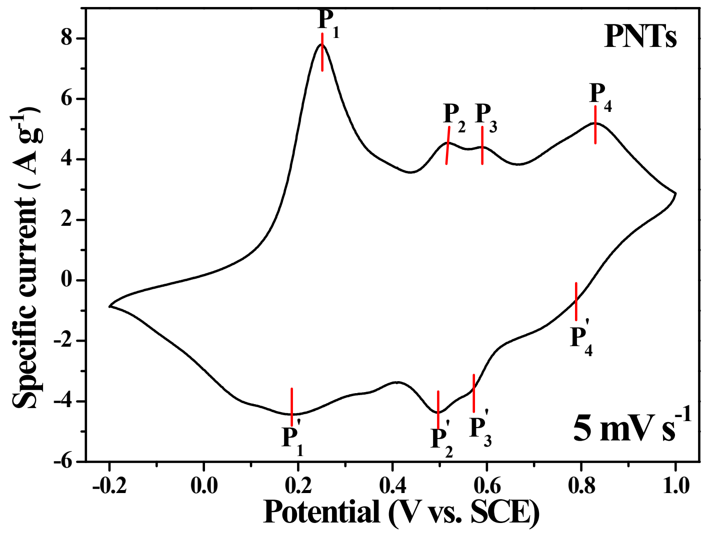

Fig. S2 CV curve of PNTs at 5 mV s^{-1} in 1 M H_2SO_4 aqueous solution.

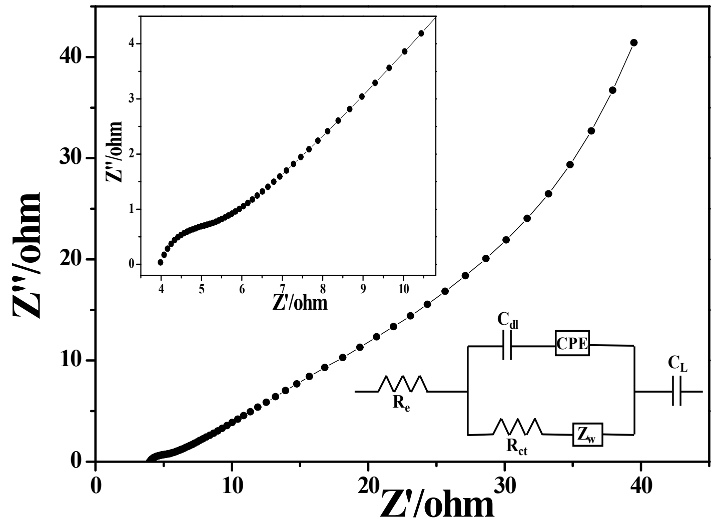

Fig. S3 Nyquist plots of AQ@PNCNTs//PNTs ASC (the inset of modeled equivalent circuit of electrochemical impedance spectroscopy).

Table S1 The specific surface area and pore parameters of samples.

Sample	BET surface area ($m^2\ g^{-1}$)	Pore volume ($cm^3\ g^{-1}$)	Average pore width (nm)
PNTs	23.96	0.138	229.86
PNCNTs	1753.69	1.151	28.73
AQ@PNCNTs	1005.51	0.722	26.24

Table S2 The electrochemical parameters of redox peaks on the AQ@PNCNTs CV curves: The anodic and cathodic potential (E_{pa} and E_{pc}), the peak potential separation (E_{ps}), the mass anodic and cathodic peak current (i_{pa} and i_{pc}) and the peaks current ratio (i_{pa}/i_{pc}).

The scan rate	E_{pa} (V)	E_{pc} (V)	E_{ps} (V)	i_{pa} (A g^{-1})	i_{pc} (A g^{-1})	i_{pa}/i_{pc}
5 mV s^{-1}	-0.0945	-0.1069	0.0124	14.03	13.64	1.0286
10 mV s^{-1}	-0.0889	0.1110	0.0221	26.29	25.90	1.0151
20 mV s^{-1}	-0.0835	-0.1149	0.0314	38.13	37.47	1.0176
30 mV s^{-1}	-0.0789	-0.1213	0.0424	49.53	48.00	1.0319
40 mV s^{-1}	-0.0718	-0.1243	0.0525	71.64	69.38	1.0326
50 mV s^{-1}	-0.0647	-0.1342	0.0695	109.71	107.03	1.0250