Supporting Information

for

N, O Co-doped Hierarchically Carbon Cathode for High-performance Zn-Ion Hybrid Supercapacitor with Enhanced Pseudocapacitance

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Calculation

(1) For the Trasatti and Dunn analysis[1-3]

In order to resolve quantitatively the contribution from capacitive and diffusion-controlled processes in the total charge, the dependency of the voltammetric sweep rate on the current response was studies. The total measured voltammetric charge could be expressed as a function of scan rate through the following equations:

$$i(V) = k_1 v + k_2 v^{1/2} \tag{S1}$$

$$i(V)/v^{1/2} = k_1 v^{1/2} + k_2 \tag{S2}$$

where, i(V) is the measured current as a function of potential that is considered to be comprised of both capacitive currents (which vary as $k_1 v$) and diffusion-controlled currents (which vary as $k_2 v^{1/2}$). By determining constants k_1 and k_2, the fraction of the current from diffusion and capacitance can be distinguished.

(2) The specific capacity (C, mAh g-1) for ZHSs was calculated from the galvanometric charge-discharge curves using the following equations:

$$C = 2I \int V\, dt / 3.6Vm \tag{S3}$$

where I (A), $\int V dt$ (Vs), V (V) and m (g) represent the discharge current (A), the integral area under charge/discharge curve, the voltage after ohmic drop, and the mass of active material in cathode, respectively.

Energy density and power density for the ZHS device were calculated based on the mass of active material of cathode using the following equations:

$$E = I \int V\, dt / 3.6m \tag{S4}$$

$$P = 3600E/t \tag{S5}$$

Where E (Wh kg^{-1}) is the energy density, P (W kg^{-1}) is the power density, t (s) is the discharge time.

Supporting Figure

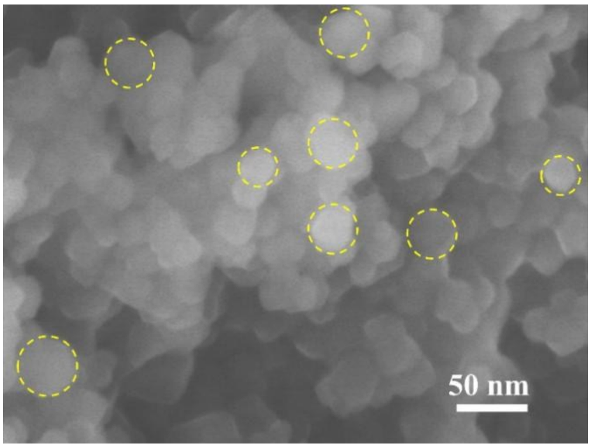


Fig. S1. SEM image of ZIF-8.

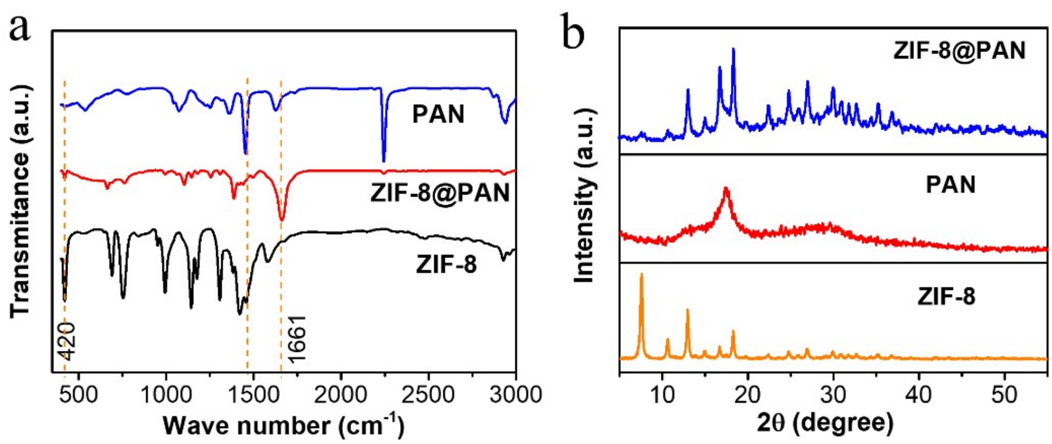


Fig. S2. FTIR spectra (a) and XRD patterns (b) of ZIF-8 and ZIF-8@PAN.

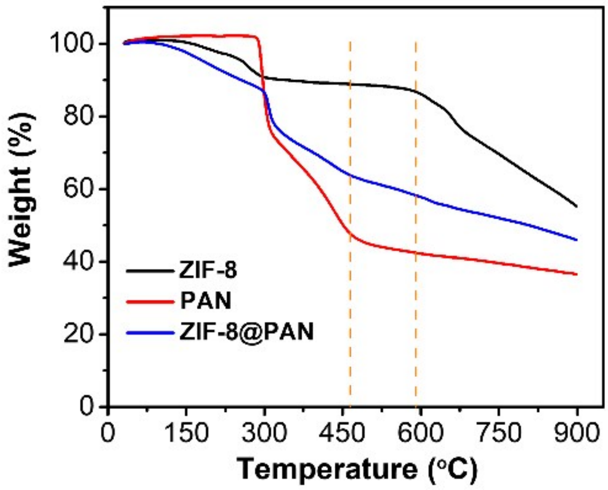


Fig. S3. TG curves of ZIF-8, PAN and ZIF-8@PAN

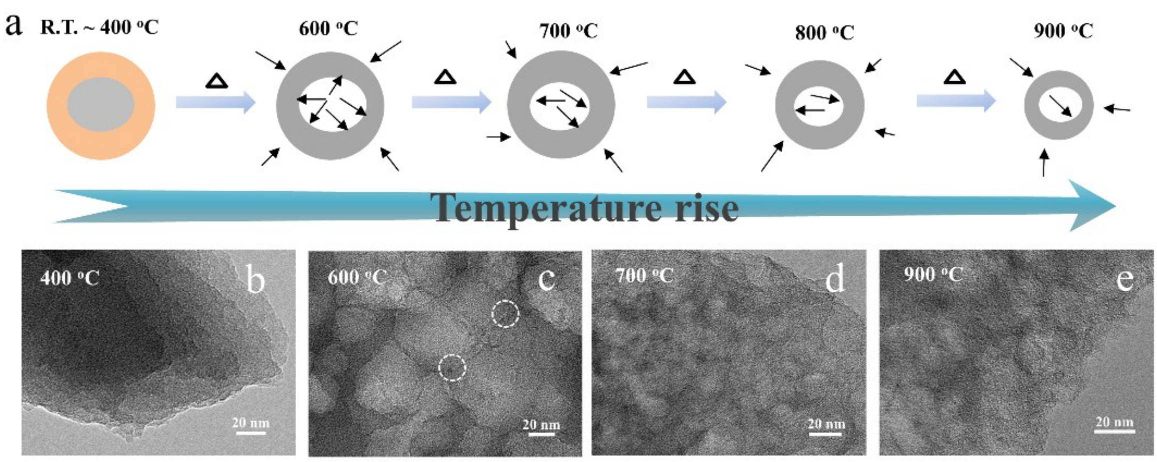


Fig. S4. (a) the formation process of HPC and (b-e) the TEM images of samples obtained at different temperature (holding on 2 h).

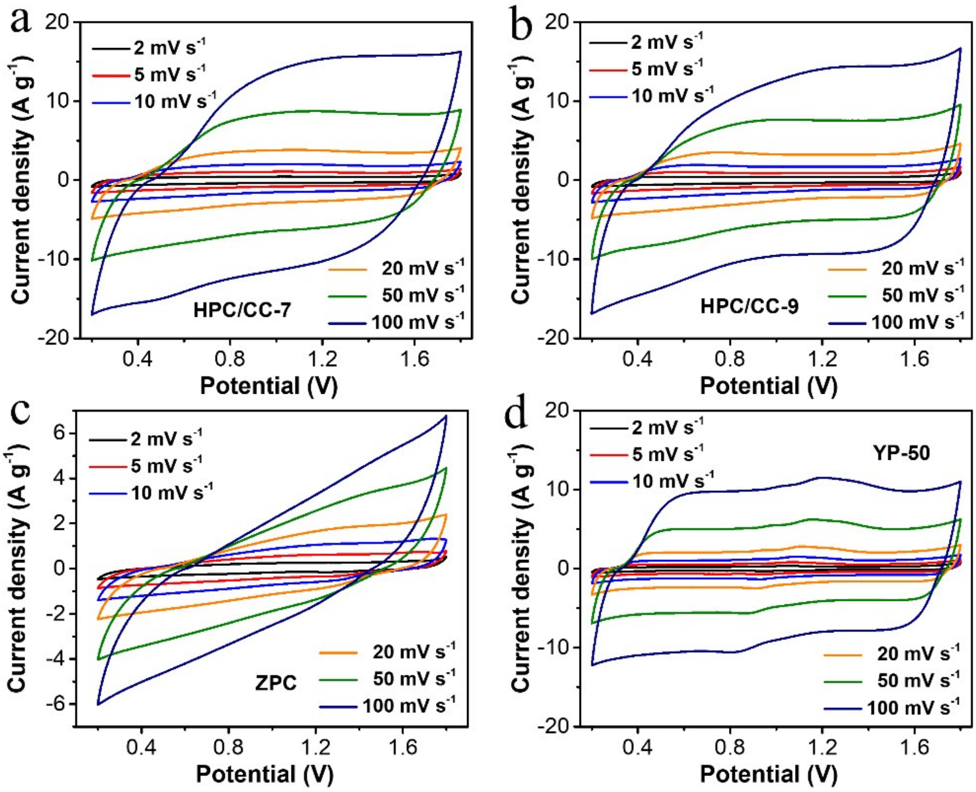


Fig. S5. CV curves of ZHSs at different scan rates.

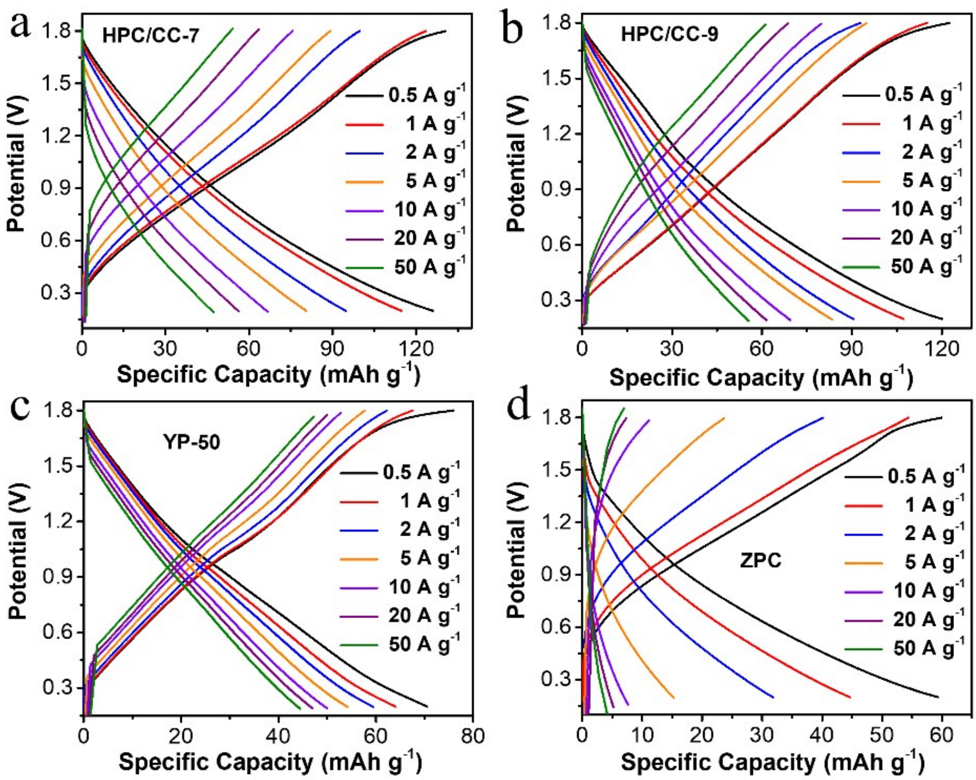
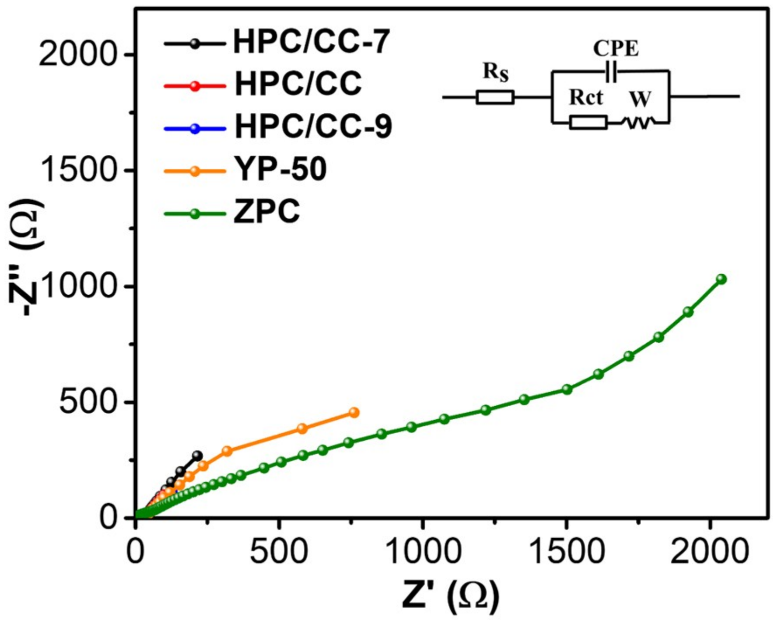


Fig. S6. GCD curves of the ZHSs at different density currents.



c

Fig. S7. EIS spectra of ZHSs (inset: the electrical equivalent circuit used for fitting EIS spectra).

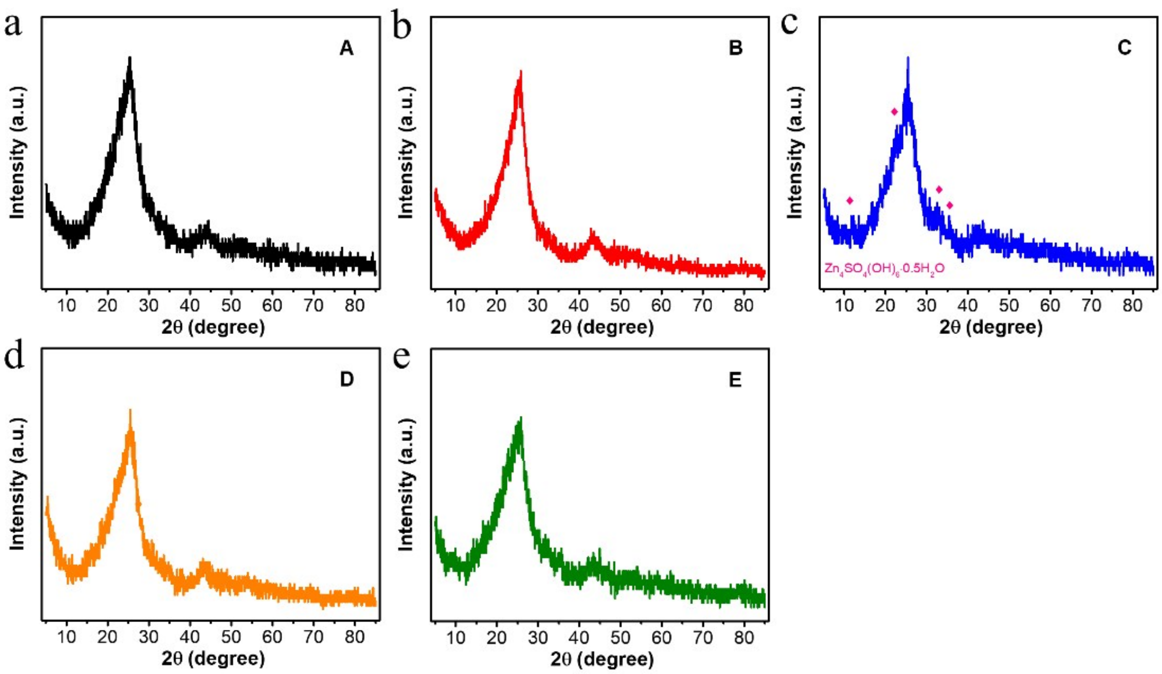


Fig. S8. XRD patterns of HPC/CC electrodes at different discharge-charge stages.

Supporting Tables

Table S1. The texture characteristics of all samples.

Sample	S_{BET} [a] (m^2 g^{-1})	V_{total} [b] (cm^3 g^{-1})	V_{micro} [c] (cm^3 g^{-1})	V_{meso} [d] (cm^3 g^{-1})	S_{micro} [c] (m^2 g^{-1})	S_{meso} [d] (m^2 g^{-1})
HPC/CC-7	276.49	0.161	0.095	0.066	232.06	44.43
HPC/CC	197.45	0.139	0.063	0.076	149.86	47.59
HPC/CC-9	168.10	0.099	0.056	0.043	135.95	32.15

[a] The specific surface area were calculated by using multiple BET method.

[b] The total pore volume were calculated at the relative pressure of 0.99.

[c] The pore volume and specific surface area of micropores were calculated by using t-plot method.

[d] The pore volume of mesopores and specific surface area were calculated by subtracting the volume of micropores from the total volume.

Table S2. XPS results of all samples.

Sample	C 1s (at. %)	N 1s (at. %)	O 1s (at. %)
HPC/CC-7	84.35	10.25	5.40
HPC/CC	89.73	6.52	3.76
HPC/CC-9	95.07	2.38	2.54

Table S3. Performance comparison of aqueous ZHSs based on different cathodes.

Materials	Electrolyte	Self-standing	Current Density (A g^{-1})	Capacity (mAh g^{-1})	Reference
HPC/CC	2M $ZnSO_4$	Yes	0.5 20	138.5 75	This work
AC	2M $ZnSO_4$	No	0.1 20	121 41	[4]
AC	1M $Zn(CF_3SO_3)_2$	No	0.1 2	144 (F g^{-1}) 64 (F g^{-1})	[5]
AC	0.5M $ZnSO_4$	No	0.1 4	100 69.2	[6]
aMEGO	3M $Zn(CF_3SO_3)_2$	No	0.1 20	210 (F g^{-1}) 110 (F g^{-1})	[7]
LDC	1M $ZnSO_4$	No	0.5 20	127.7 42.8	[8]
FAC	2M $ZnSO_4$	No	0.1 20	435 (F g^{-1}) 198 (F g^{-1})	[9]
DV2C@CNT	1M $ZnSO_4$	Yes	0.5 10	190.2 (F g^{-1}) 90.2 (F g^{-1})	[10]
$RuO_2 \cdot H_2O$	$Zn(CF_3SO_3)_2$	No	0.1 20	122 98	[11]
Ti3C2	2M $ZnSO_4$	Yes	0.5 3	132 121	[12]
MCHSs	2M $ZnSO_4$	No	0.1 10	174.7 96.9	[13]
AC	2M $ZnSO_4$	No	0.5 20	468 (F g^{-1}) 150 (F g^{-1})	[14]
HCSs	$ZnSO_4$ PAM	No	0.5 4	86.8 47.1	[15]

Reference

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