

**Boosting Zn-Ion Adsorption in Cross-Linked N/P Co-Incorporated Porous Carbon Nanosheets for Zinc-Ion Hybrid Capacitor**

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## Figure captions

**Figure S1.** a) and b) SEM images of CNPK.

**Figure S2.** a) Raman spectra and b) XPS survey spectra of CK and CNPK.

**Figure S3.** CV curves at different scan rate of a) CK electrode and b) CNPK electrode.  
c) GCD profiles of the CK electrode.

**Figure S4.** CV curves at different scan rate of a) CK and b) CNPK. c) GCD profiles of aqueous ZHC based on CK cathode.

**Figure S5.** CV curves at different scan rate of a) CNK and b) CPK, GCD profiles of aqueous ZHC based on c) CNK and d) CPK cathode, e) specific capacities at different specific currents and f) Ragone plot of the assembled ZHC based on CNK and CPK.

**Figure S6.** Specific capacities at different specific currents of CNPK based quasi-solid ZHC device.

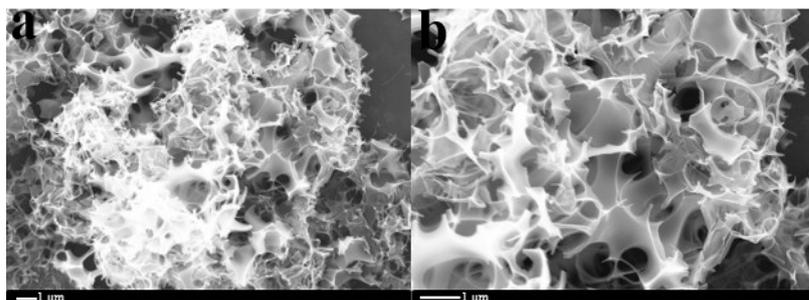
## Table captions

**Table S1** Pore structure parameters of CK and CNPK.

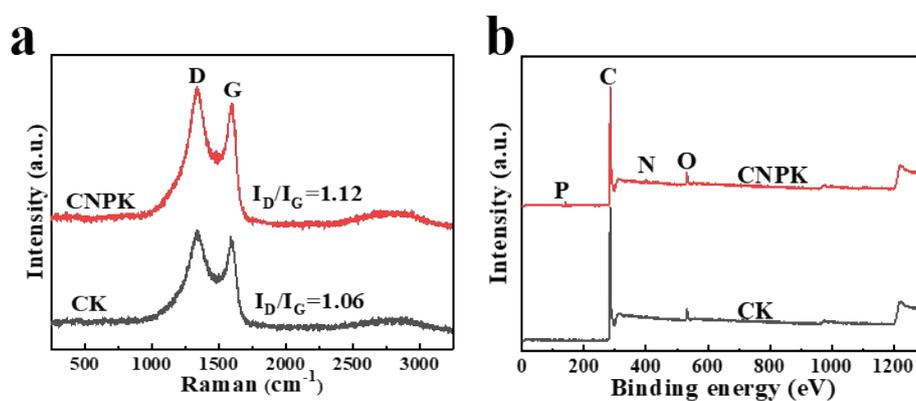
**Table S2** Contents of C, O, N and P elements in CK and CNPK.

**Table S3** Electrochemical properties comparison of various ZHCs based on different cathodes.

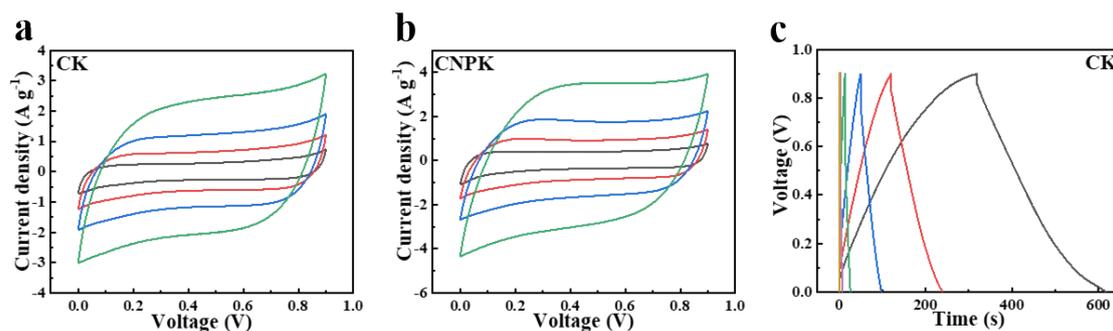
**Table S4** Relative energy value along the reaction pathway of carbon surface with different kinds of N and P.



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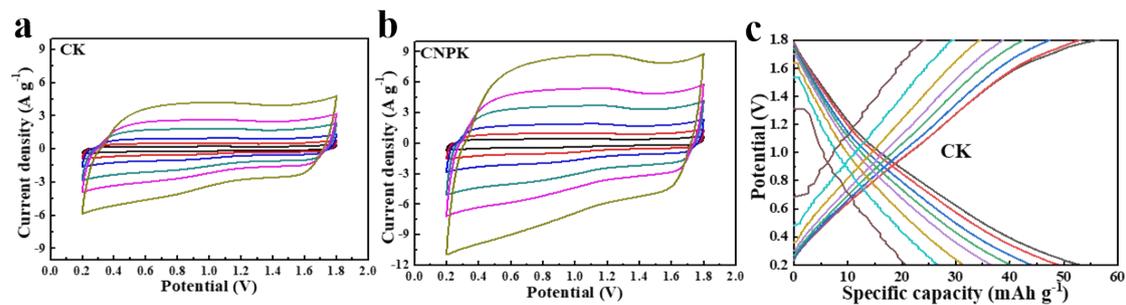


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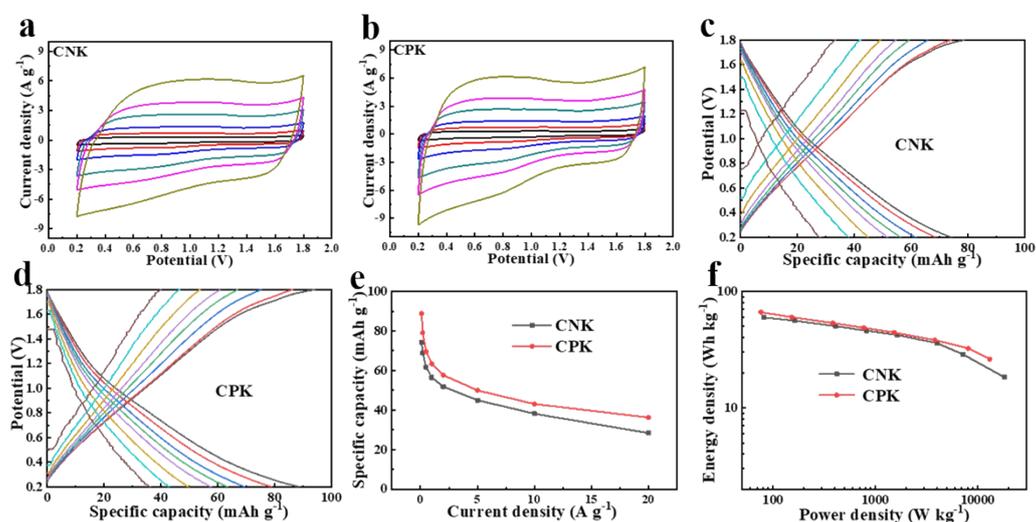


**Figure S3.** CV curves at different scan rate of a) CK electrode and b) CNPK electrode.

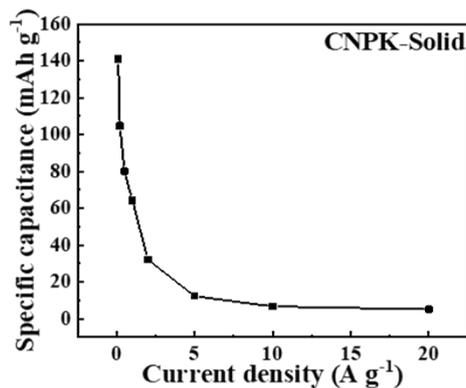
c) GCD profiles of the CK electrode.



**Figure S4.** CV curves at different scan rate of a) CK and b) CNPK. c) GCD profiles of aqueous ZHC based on CK cathode.



**Figure S5.** CV curves at different scan rate of a) CNK and b) CPK, GCD profiles of aqueous ZHC based on c) CNK and d) CPK cathode, e) specific capacities at different specific currents and f) Ragone plot of the assembled ZHC based on CNK and CPK.



**Figure S6.** Specific capacities at different specific currents of CNPK based quasi-solid ZHC device.

**Table S1** Pore structure parameters of CK and CNPK.

Samples	$D_{ap}$ (nm)	$S_{BET}$ (m <sup>2</sup> g <sup>-1</sup> )	$S_{micro}$ (m <sup>2</sup> g <sup>-1</sup> )	$V_t$ (cm <sup>3</sup> g <sup>-1</sup> )	$V_{micro}$ (cm <sup>3</sup> g <sup>-1</sup> )
CK	2.34	1644	1292	0.96	0.548
CNPK	2.53	2038	980	1.29	0.428

**Table S2** Contents of C, O, N and P elements in CK and CNPK.

Samples	C1s (at. %)	O1s (at. %)	N1s (at. %)	P2p (at. %)
CK	95.23	4.77	-	-
CNPK	90.81	4.43	2.62	2.14

**Table S3** Electrochemical properties comparison of various ZHCs based on different cathodes.

Material	Electrolyte	Voltage	C	CR	E	Ref.
Activated carbon	ZnSO <sub>4</sub>	0.5-1.8 V	121 (0.1 A g <sup>-1</sup> ) 41.0 (20 A g <sup>-1</sup> )	91% after 10000 cycles	84	12
Activated carbon	ZnSO <sub>4</sub>	0.5-1.5 V	72.1 (0.05 A g <sup>-1</sup> ) 45.0 (0.6 A g <sup>-1</sup> )	100% after 10000 cycles	24.9	9
Activated carbon	Zn(CF <sub>3</sub> SO <sub>3</sub> )	0-1.8 V	85 (0.1 A g <sup>-1</sup> ) 72.0 (1 A g <sup>-1</sup> ) 65.4 (0.06 A g g <sup>-1</sup> )	91% after 20000 cycles	52.7	18
ZnHCFs	ZnSO <sub>4</sub>	0.8-1.9 V	32.3 (0.3 A g <sup>-1</sup> ) 1) 73 (0.2 A g <sup>-1</sup> )	-	100	37
Natural graphite	Zn(OAc) <sub>2</sub> /choline acetate/water	0-1.8 V	73 (0.2 A g <sup>-1</sup> )	86% after 1000 cycles	52.6	38
porous carbon	gelatin/ZnSO <sub>4</sub> gel	0.2-1.8 V	132.7 (0.2 A g <sup>-1</sup> ) 54.5 (4 A g <sup>-1</sup> )	87.6% after 10000 cycles	82.36	20
CNPK	ZnSO <sub>4</sub>	0.2-1.8	103 (0.1 A g <sup>-1</sup> )	101.8% after 10000 cycles	165.4	<b>This</b>

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52.0 (20 A g<sup>-1</sup>)

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C: Specific capacity (mAh g<sup>-1</sup>)

CR: Capacity retention

E: Energy density (Wh kg<sup>-1</sup>)

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**Table S4** Relative energy value along the reaction pathway of carbon surface with different kinds of N and P.

Name	*-OH+Zn <sup>2+</sup>	*-OH(Zn)	*-OZn+H <sup>+</sup>
graphene	0	-1.3	2.06
Pyridine N	0	-0.21	1.16
Pyrrole N	0	-0.22	1.23
Graphite N	0	-0.19	1.09
P-C-OH	0	-0.16	0.78
C-P-OH	0	-0.33	1.28

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