

Supporting Information

Semi-Embedding Zn-Co₃O₄ Derived from Hybrid ZIFs into Wood-derived Carbon for High-performance Supercapacitors

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A: Calculate the single-electrode capacitance under the three-electrode system

The volume and specific capacitance of a single electrode in a three-electrode cell configuration can be calculated according to their GCD curves by the following equations:

$$C_{(Volume)} = \frac{I \times \Delta t}{V \times \Delta U}$$
$$C_{(Specific)} = \frac{I \times \Delta t}{m \times \Delta U}$$

where I is the discharge current, Δt is the discharge time, ΔU is the potential window of the discharge process, V is the effective volume of the electrode, and m is the mass of active material.

B: Calculate the asymmetric supercapacitor capacitance under the two-electrode system

The volume and specific capacitance of asymmetric supercapacitor under the two-electrode system can be calculated according to their GCD curves by the following equations:

$$C_{(Volume)} = \frac{I \times \Delta t}{V \times \Delta U}$$
$$C_{(Specific)} = \frac{I \times \Delta t}{m \times \Delta U}$$

In this case, V is the total volume of the two electrodes, and m is the total mass of the device. The energy density (E) and power density (P) were calculated according to the following equations respectively:

$$E = \frac{1}{2} \times C \times \Delta U^2$$
$$P = \frac{E}{\Delta t}$$

where C is the volume or specific capacitance of the asymmetric supercapacitor, Δt and

ΔU are the discharge time and potential window of the discharge process.

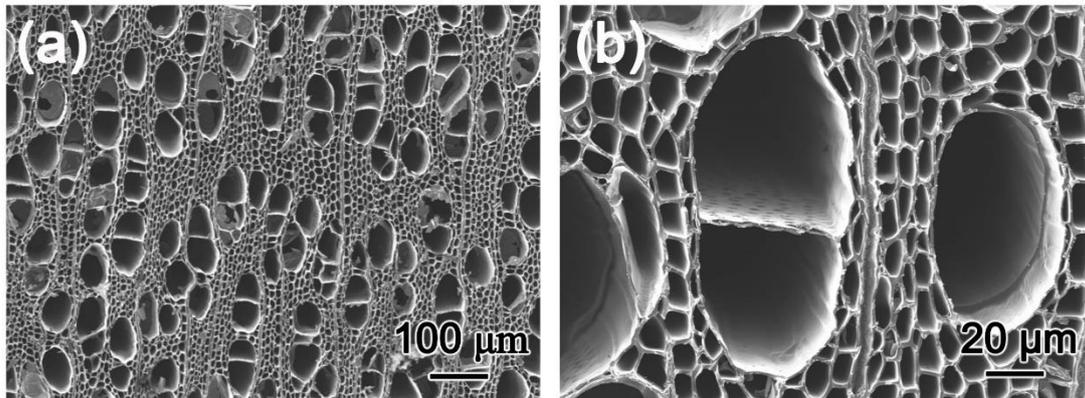


Figure S1. SEM of the poplar wood slice: perpendicular to the growth direction at different magnification times

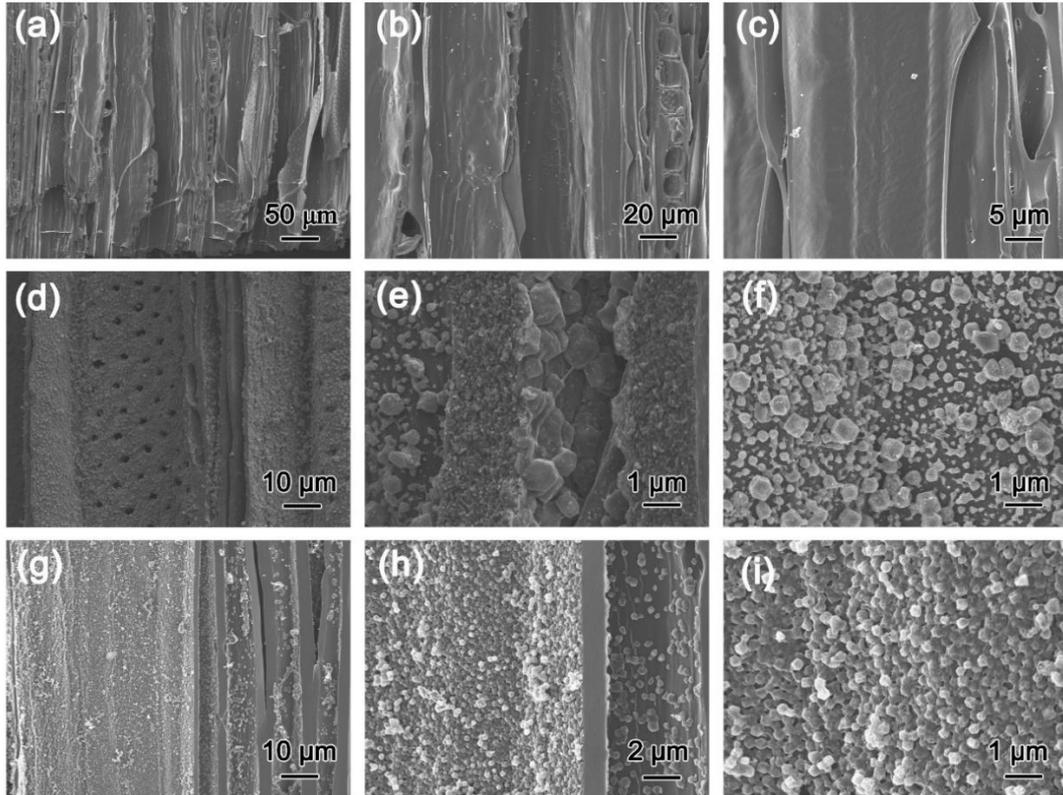


Figure S2. SEM images of nature wood (a-c), Co₃O₄@CW-230 (d-f) and Zn@CW-230 (g-i)

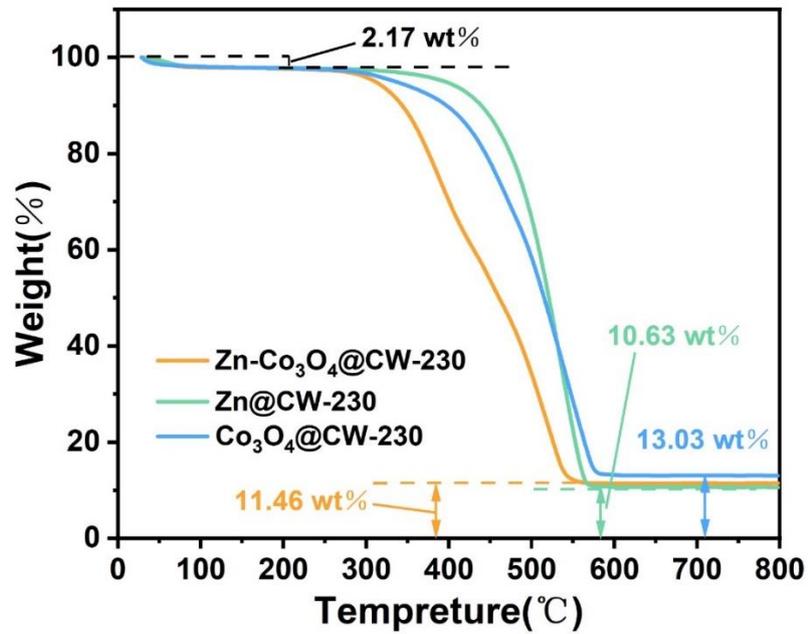


Figure S3. TGA curves of Zn@CW-230, Co₃O₄@CW-230, Zn-Co₃O₄@CW-230 composites in air.

Table S1. Analysis results of energy dispersive X-ray spectrogram

Element	Weight%	Atpmic%
C K	74.11	87.05
N K	0.76	0.77
O K	9.64	8.50
Co K	14.49	3.47
Zn K	0.98	0.21

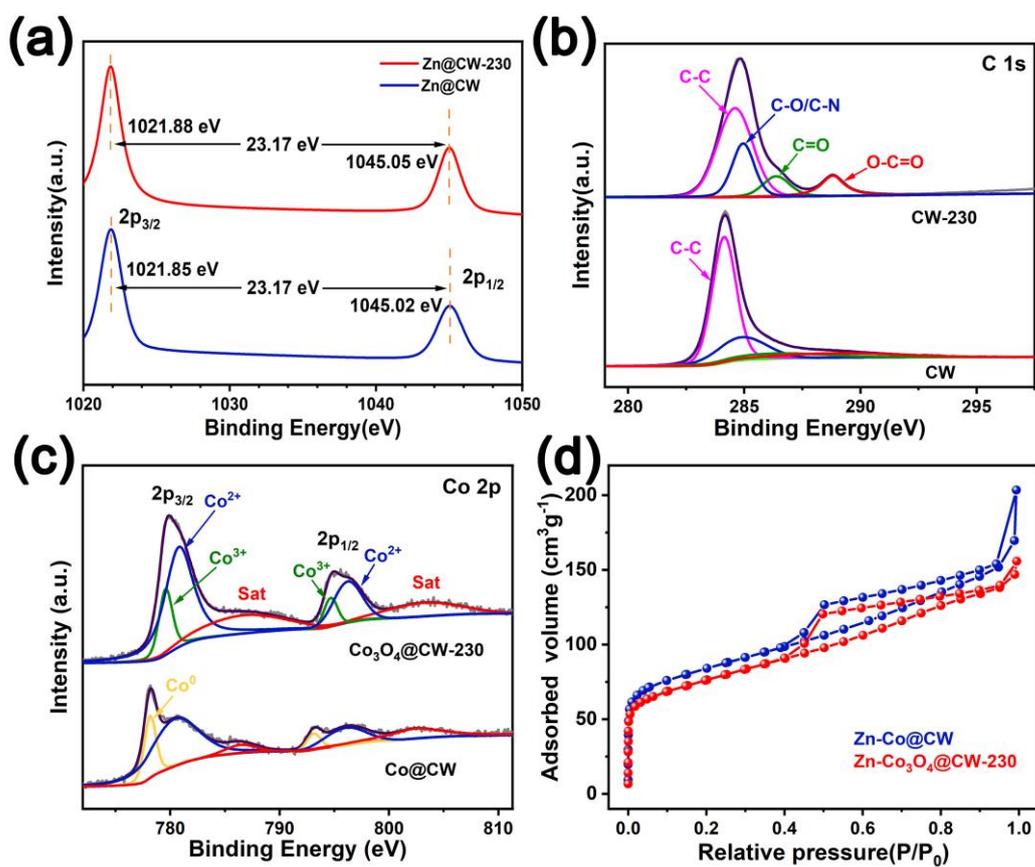


Figure S4. XPS spectra of Zn@CW and Zn@CW-230 for Zn 2p (a); CW and CW-230 for (b) C 1s; Co@CW and Co₃O₄@CW-230 for (c) Co 2p. (d) N₂ adsorption-desorption isotherm.

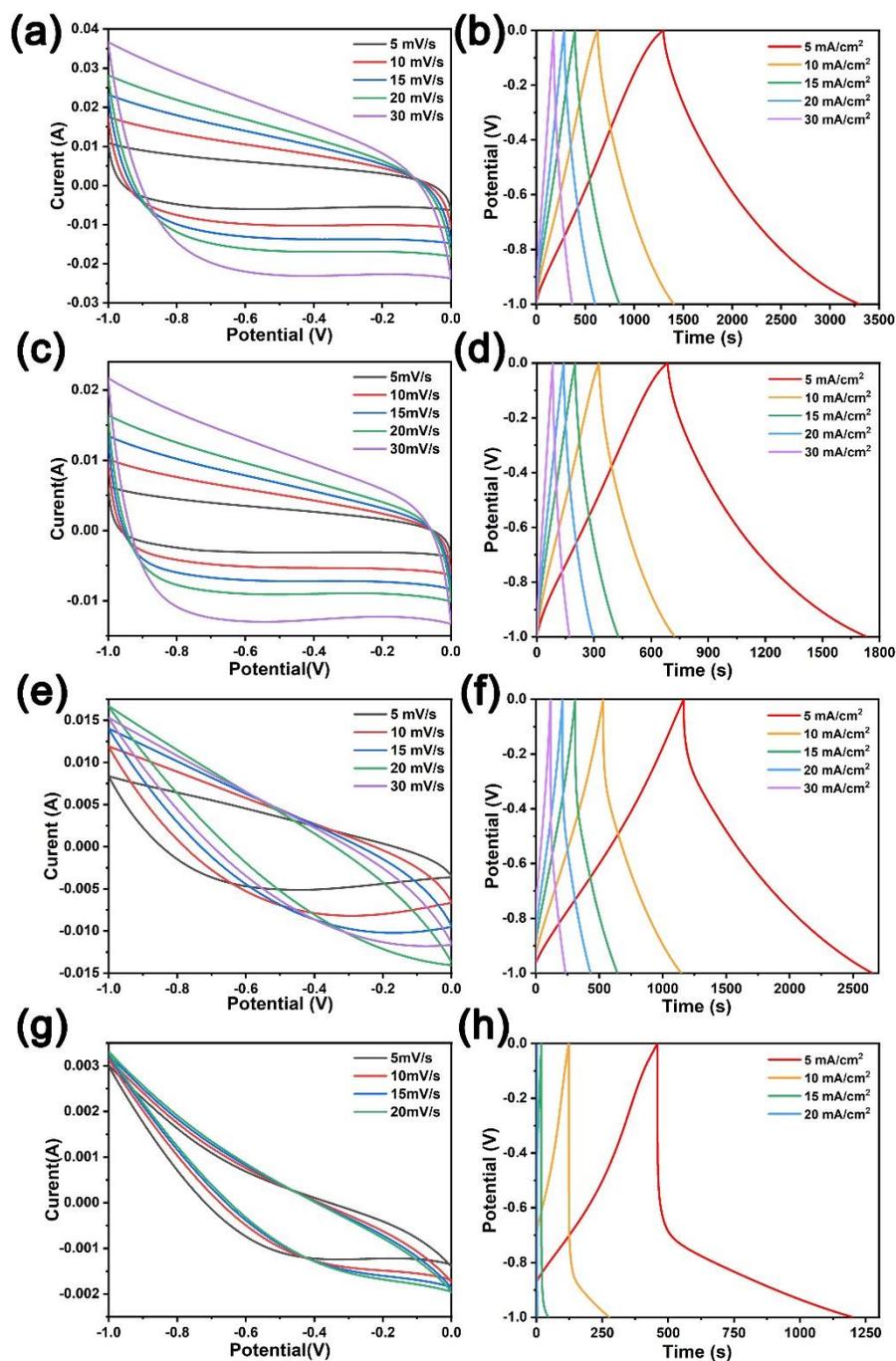


Figure S5. Cyclic voltammograms (CVs) at different scan rates and galvanostatic charge–discharge curves at different current densities of (a and b) Zn-Co@CW; (c and d) Co@CW; (e and f) Zn@CW;(g and h) CW.

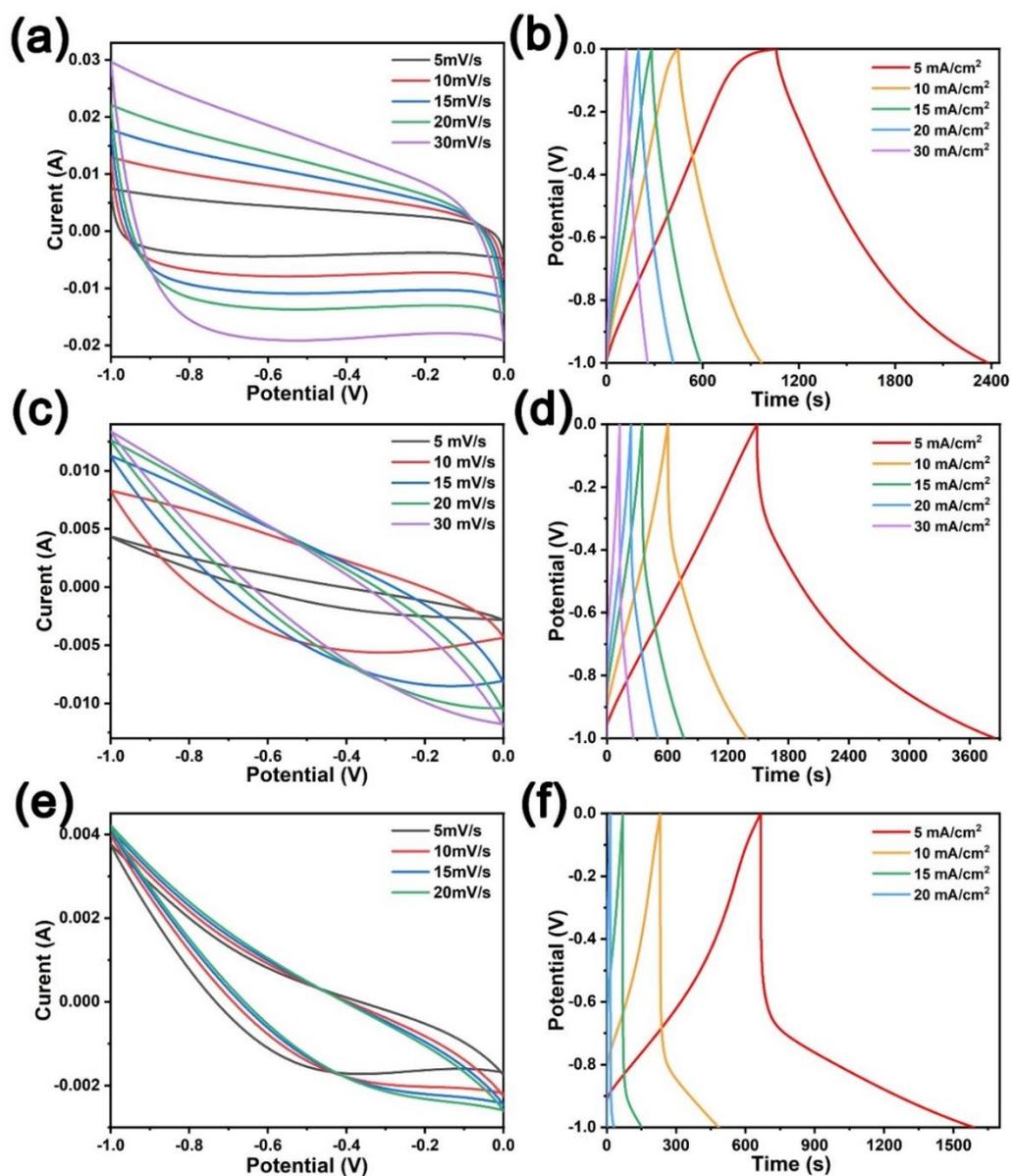


Figure S6. Cyclic voltammograms (CVs) at different scan rates and galvanostatic charge–discharge curves at different current densities of (a and b) Co₃O₄@CW-230; (c and d) Zn@CW-230; (e and f) CW-230.

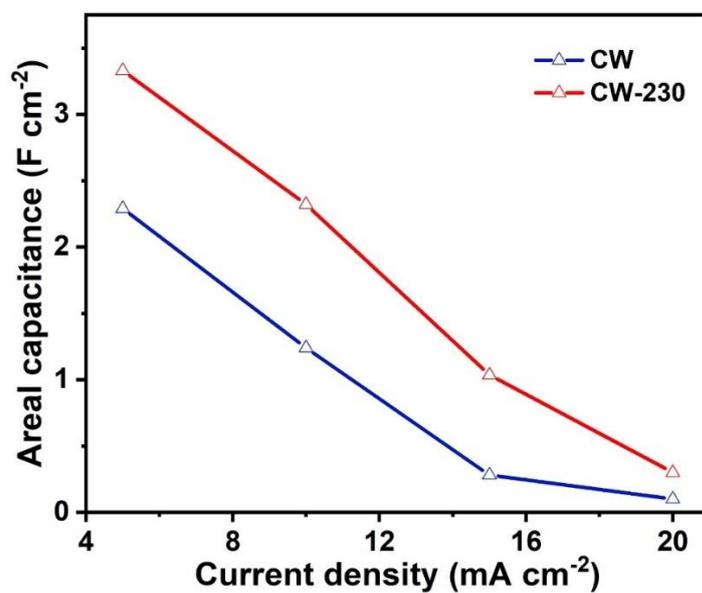


Figure S7. Specific capacitances of CW, CW-230 at different current densities.

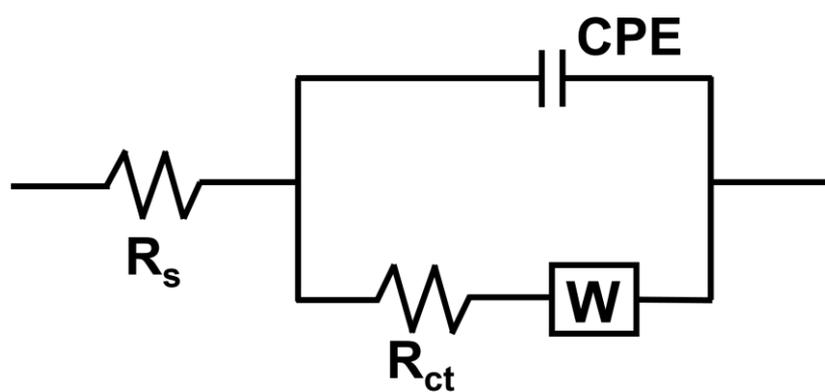


Figure S8. Equivalent circuit diagram fitted by Nyquist diagram.

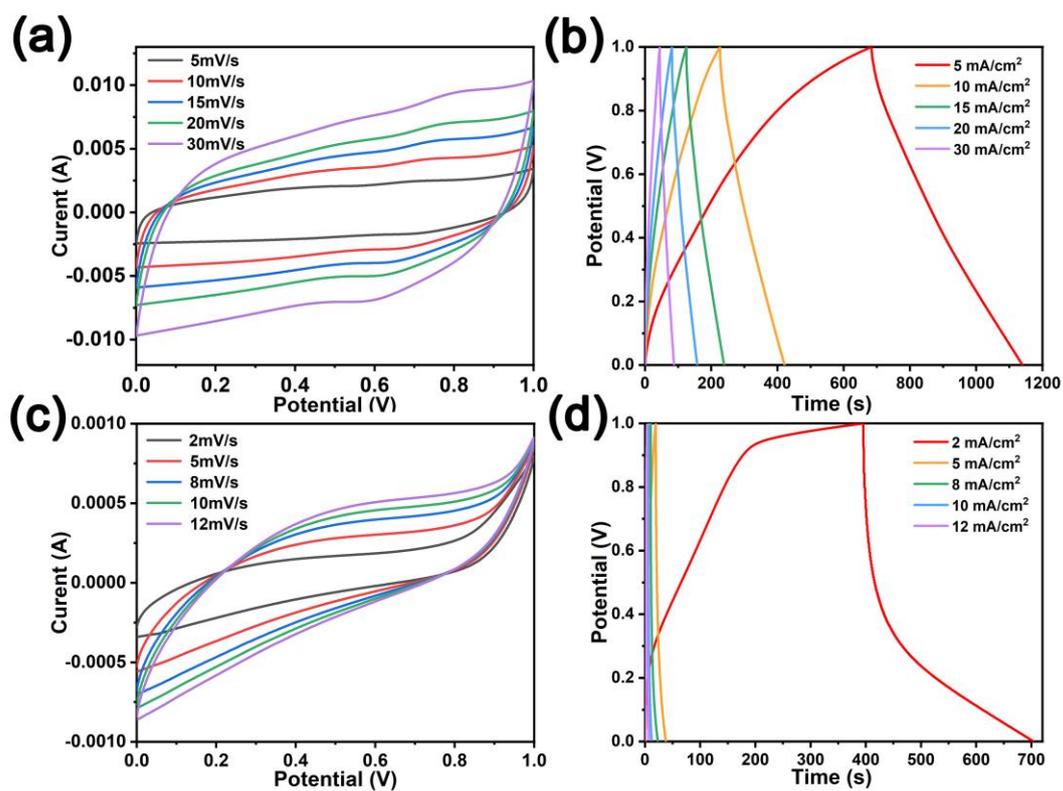


Figure S9. CVs at different scan rates and GCD curves at different current densities of (a and b) SC of $\text{Co}_3\text{O}_4@\text{CW-230}$. (c and d) SC of CW-230.



Figure S10. Photos of a two-electrode system of the $\text{Zn-Co}_3\text{O}_4@\text{CW-230}$ liquid-

state SC.

Table S2. Comparison of electrochemical performance of SC of Zn-Co₃O₄@CW-230 and some representative carbon-/metal oxide-based electrodes at device level.

Electrode material	Volumetric Energy density (mW h cm ⁻³)	Cycles/ retention	Specific capacitances	Ref.
CW@CoNiP-C//CW	/	5000/ 87.5%	1280 mF/cm ² , 5 mA/cm ²	[1]
NCS-ES/CW-20//AC	69.03 Wh/Kg, 862.88 W/kg	5000/ 102%	125.8 F/g, 1 A/g	[2]
MnO ₂ /ZnO//RGO	0.234 mW h/cm ³ , 133 mW/cm ³	5000/ 98.4%	250 mF/cm ² , 10 mV/s	[3]
CoP/MnO ₂ /CC	0.69 mW h/cm ³ , 114.2 mW/cm ³	5000/ 82%	571.3 mF/cm ² , 1 mA/cm ²	[4]
Fe ₂ O ₃ /MnO ₂	0.55 mW h/cm ³ , 139.1 mW/cm ³	5000/ 84%	180.4 mF/cm ² , 1 mA/cm ²	[5]
Co ₃ O ₄ /graphene hybrid fibers	/	10000/ 72.7%	196.3 mF/cm ² , 0.2 mA/g	[6]
CoSe ₂ //CC	0.588 mW h/cm ³ , 282 mW/cm ³	2000/ 94.8%	332 mF/cm ² , 1 mA/cm ²	[7]
C-ZIF-8@ACW	4.4 mW h/cm ³ 4.0mW/cm ³	10000/ 96.8%	3935 mF/cm ² , 1 mA/cm ²	[8]
Zn-Co ₃ O ₄ @CW-230	6.0 mW h /cm ³ 41.7 mW/cm ³	10000/ 97.3%	2610 mF/cm ² , 5 mA/cm ²	<i>This work</i>

Reference

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