Supplementary Information

Biomass-derived O, N-codoped 3D porous carbon prepared by black fungus and hericium erinaceus for high performance supercapacitor

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Experimental Materials

The raw materials (e.g. black fungus and hericium erinaceus) were purchased from Guangxi province, China. Distilled water, ethanol (95 %), potassium hydroxide (KOH) and concentrated hydrochloric acid (HCl) were obtained commercially.

Structural characterization

The morphologies of prepared carbon materials were observed by field emission environmental scanning electron microscopy (FEI Quanta 200 FEG), Raman spectra were recorded by Raman spectrometer (in Via), and the composition and structure of materials were recorded by X-ray powder diffractometer (Rigaku D/max 2500 v/pc). The BET (Brunauer-Emmett-Teller) surface area of these prepared carbon materials was obtained by using the BET equation with Quantachrome Instruments, and the pore size distribution of materials was analyzed by Density Functional Theory (DFT) method.

Electrochemical measurement

The electrochemical performance was measured under two-electrode configuration with 6.0 M KOH as electrolyte. Cyclic voltammetry (CV) curves and galvanostatic charge-discharge (GCD) curves were recorded by using electrochemical working station (CHI 690E, Shanghai, China) except the GCD curves of cycle life were investigated on LAND (Wuhan LAND, China). Electrochemical impedance spectroscopy (EIS) was measured at 100 kHz ~ 10 mHz with an amplitude of 5 mV.

Table S1. Specific surface area and pore volume of FAC_X and HAC_X samples.

Sample	S_{BET}[a] ($m^2\ g^{-1}$)	S_{micro}[b] ($m^2\ g^{-1}$)	S_{meso}[c] ($m^2\ g^{-1}$)	V_{total}[d] ($cm^3\ g^{-1}$)	V_{micro}[e] ($cm^3\ g^{-1}$)	V_{meso}[f] ($cm^3\ g^{-1}$)	Average pore diameter (nm)
FAC_1	363.5	319.5	44.0	0.177	0.141	0.036	0.889
FAC_2	1227.3	1083.8	143.5	0.451	0.386	0.065	1.278
FAC_3	1501.6	1132.0	369.6	0.621	0.402	0.219	1.332
HAC_1	957.2	879.1	78.1	0.423	0.312	0.111	1.030
HAC_2	1362.0	1154.3	207.7	0.523	0.410	0.113	1.186
HAC_3	1667.5	1248.6	418.9	0.652	0.447	0.205	1.352

[a] Specific surface area calculated by BET method.

[b] Micropore surface area based on t-plot method.

[c] $S_{meso} = S_{BET} - S_{micro}$.

[d] Total pore volume at $P/P_0 = 0.99$.

[e] Micropore pore volume from t-plot method.

[f] $V_{meso} = V_{total} - V_{micro}$.

Table S2. Comparison of the specific capacitance of biomass-based carbon materials at different test conditions.

Biomass materials	Activation agent	BET (m^2 g^{-1})	Specific capacitance (F g^{-1}) / test system	GCD measurement	Electrolyte	Reference
Rapeseed dregs	$ZnCl_2$	1417	170.5 / three-electrode	5 mV s^{-1}	1 M H_2SO_4	1
Loofah sponge	KOH	2718	309.6 / three-electrode	1000 mA g^{-1}	6 M KOH	2
Mushroom (Shiitake)	H_3PO_4-KOH	2988	238 / two-electrode	200 mA g^{-1}	6 M KOH	3
Bamboo char	KOH	1732	222 / two-electrode	500 mA g^{-1}	6 M KOH	4
Corn grain	KOH	3199	257 / two-electrode	50 mV s^{-1}	6 M KOH	5
Rice husk	$ZnCl_2$	1527	245 / two-electrode	50 mA g^{-1}	6 M KOH	6
Osmanthus flower	KOH	1463	255 / three-electrode	1000 mA g^{-1}	6 M KOH	7
Peanut shell	$ZnCl_2$	1552	184 / two-electrode	50 mA g^{-1}	6 M KOH	8
comcob	KOH	64.8	247/ two-electrode	500 mA g^{-1}	6 M KOH	9
Silkworm	self activation	2523	235 / two-electrode	1000 mA g^{-1}	6 M KOH	10
Black fungus	KOH	1227	209.3 / two-electrode	1000 mA g^{-1}	6 M KOH	This work
Hericium erinaceus	KOH	1362	238.6 / two-electrode	1000 mA g^{-1}	6 M KOH	This work

Table S3. Comparison of the energy density and power density of biomass-based carbon materials.

Biomass materials	Energy density (Wh kg^{-1})	Power density (W kg^{-1})	Reference
Mushroom (Shiitake)	8.2	100	3
Bamboo char	6.68	100.2	4
Rice husk	8.36	59.8	6
comcob	8.9	128.2	9
Silkworm	7.9	234	10
Large AC/AC	3.96	100	11
Walnut shell	7.97	180.8	12
Black fungus	7.3	250	This work
Hericium erinaceus	8.3	250	This work

AC, activated, microporous carbon.

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