

Electronic Supplementary Information

Experimental section

Materials

KOH, HCl, Erioglucine disodium salt (Coomassie Brilliant Blue -250, CAS: 6104-58-1), were purchased from Shanghai Macklin Biochemical Co., Ltd (China). Modified PTFE Granules was purchased from Daikin Fluorochemicals (China) Co., Ltd. Super P (Timcal Conductive Carbon Black) was purchased from Shanghai Haiyi Scientific Trading Co., Ltd (China). The Chinese cabbage was bought in local supermarket (To eliminate errors from constituents caused by the temper and seasons, we bought Chinese cabbage at four seasons and repeated the experiment whole year to average the results). Ni foam (NF) was bought from Kunshan District, Kunshan Kuangxun Electrical Co., Ltd (China). All chemicals were used without any further purification or dehydration.

Preparation of Chinese cabbage precures

The Chinese cabbage was cleaned by DI water. We used 3g ED salt and dissolved it into 100ml DI water to prepare the one-component activator solution. To make sure all the ED salt was melted, we use a magnetic stirring for half an hour. After moved the dark blue solution into an 500ml glass beaker, the leaves of Chinese cabbage was putted into it, only the stalk edge touched the solution to make sure the solution was absorbed into the bulk but not painted on the surface. Then the all equipment was putted in the shadows, to make sure the guard cells was not injured and the sunken stomata was open

largely. After about 24 hours, the leaves changed to dark blue. The blue cabbage and normal cabbage were moved into the laboratory vacuum freeze dryer and kept for 24 hours. then the cabbages were ground into powder and stored in a glass dryer before pyrolysis progress.

Preparation of carbon materials

A tube furnace which has argon as protective gas was used as the carbide device. To avoid the glaze decomposition of porcelain boat, which might release some metal ion steam when heated above 600°C, we use alundum boat as the heating container. 500, 700, 900°C were chosen as three temperature gradients. About 1g precures were used during every carbonization. The material was first heated to 300°C with the heating rate of 3°C/min, then was heated to aim temp with the heating rate of 5°C/min and kept for 180 min. The relatively slow temperature rate during room temp to 300°C was adopted because the bound water could be released adequately and reduce the formation of biological tar, which might have some negative influence to formation of micro poles. The as-prepared carbon materials were named as BCC-500-un, BCC-700-un, BCC-900-un, and CC-500-un, CC-700-un, CC-900-un, respectively. The suffix *un* means unwashed. Half of the materials was washed by 1 M HCl, and cleaned by DI water 3 times. The carbon materials then moved to a drying oven to get ready for the physical and chemical tests.

Characterizations

Scanning electron microscope (SEM) measurements were recorded on a FEI Apreo S scanning electron microscope. The structures of the samples were determined by

Transmission electron microscopy (TEM) images on a FEI Talos F200s transmission electron microscopy equipped with an energy-dispersive X-ray (EDX) spectrometer. X-ray diffraction (XRD) patterns were recorded by a Rigaku D/max-2400 X-ray diffractometer with Cu K α radiation. X-ray photoelectron spectroscopy (XPS) data were required using an A PHI-5702 instrument with Mg K α X-ray source, all the binding energies were corrected by using the contaminant carbon (C 1s =284.8 eV) as a reference. Fourier transform infrared spectrometry (FT-IR) data was collected from Nicolet NEXUS 670. The nitrogen adsorption-desorption isotherms were analyzed by the Brunauer–Emmett–Teller (BET) and Barrett–Joyner–Halenda (BJH) methods utilizing a ASAP 2020M instrument (Micromeritics, USA). Raman spectroscopy was collected from JY-HR800 micro-Raman (Horiba, Paris, France) The Vacuum Freeze Dryer we used was lab-1A-50 (Biocool, Beijing, China). All the electrochemical tests were acquired by CHI 660E (Chenhua, Shanghai, China).

Electrochemical measurements in three electrode system

All the materials used PTFE and super P as binder and conductive agent. The electrodes were prepared by mixing carbon materials we made with PTFE and super P with a weight ratio of 8:1:1 in ethanol as solution, and dropping the mixture on a 1*1 cm nickel foam sheet. Then the nickel foam with active materials onside was putted into an oil press and bear the pressure as 10 MPa for 10 seconds to eliminate the carrier's electrical double-layer capacitor and avoid the fall off of active materials. The loading mass of the calendared electrodes containing binder and super P is *ca.* 3 mg. The

supercapacitor was tested with a potential range from 0 to 1V vs. Ag/AgCl with 6 M KOH as electrolyte. Electrochemical impedance spectroscopy (EIS) measurements were carried out at 0 V vs. Ag/AgCl. Cyclic voltammetry (CV) and galvanostatic charge-discharge (GCD) measurements were measured with an electrochemical workstation in which specific capacitance was calculated from the following equations:

CV test: Average capacitance was obtained by integrating over the single entire loop of the CV figure.

$$C = \frac{S_{Area}}{2mv\Delta V}$$

Where C (F/g) is the specific capacitance, $S_{Area} = \oint IdV$ is the loop area, m (g) is the active material mass in the working electrode, v (v/s) means the scan rate, and ΔV (V) is the potential window.

GCD test: Single electrode specific capacitance (F/g) was determined from GCD test.

$$C = \frac{I \cdot \Delta t}{m \cdot \Delta V}$$

Where I (A) is instantaneous current, Δt (s) is discharge time, m is the carbon material mass in the working electrode and ΔV (V) is the potential window.

Electrochemical measurements in two electrode system

To test the energy and power densities of supercapacitor in actual operating environment, we assembled two-electrode supercapacitors by sandwiching a non-conducting porous nonwoven cloth separator between the electrodes and then

immersing them in electrolyte (the electrodes were saturated with the electrolyte overnight beforehand). The capacitor shell which we used was CR2032. The electrodes were prepared by mixing active materials with polytetrafluoroethylene (PTFE) and carbon black with a weight ratio of 80:10:10 in an ethanol solution. Generally, the loading mass of the electrodes containing binder and carbon black is ca. 3.0 mg. 6 M KOH used as aqueous for the assembly of supercapacitors. The specific capacitance of the supercapacitor cell was evaluated according to the following equation

$$C_s(F/g) = \frac{2I\Delta t}{m\Delta V}$$

Where C_s is the gravimetric capacitance of the single electrode, I (amperes) is the discharge current, Δt (seconds) is the discharge time, m (g) is the mass of a single electrode, ΔV is the potential window.

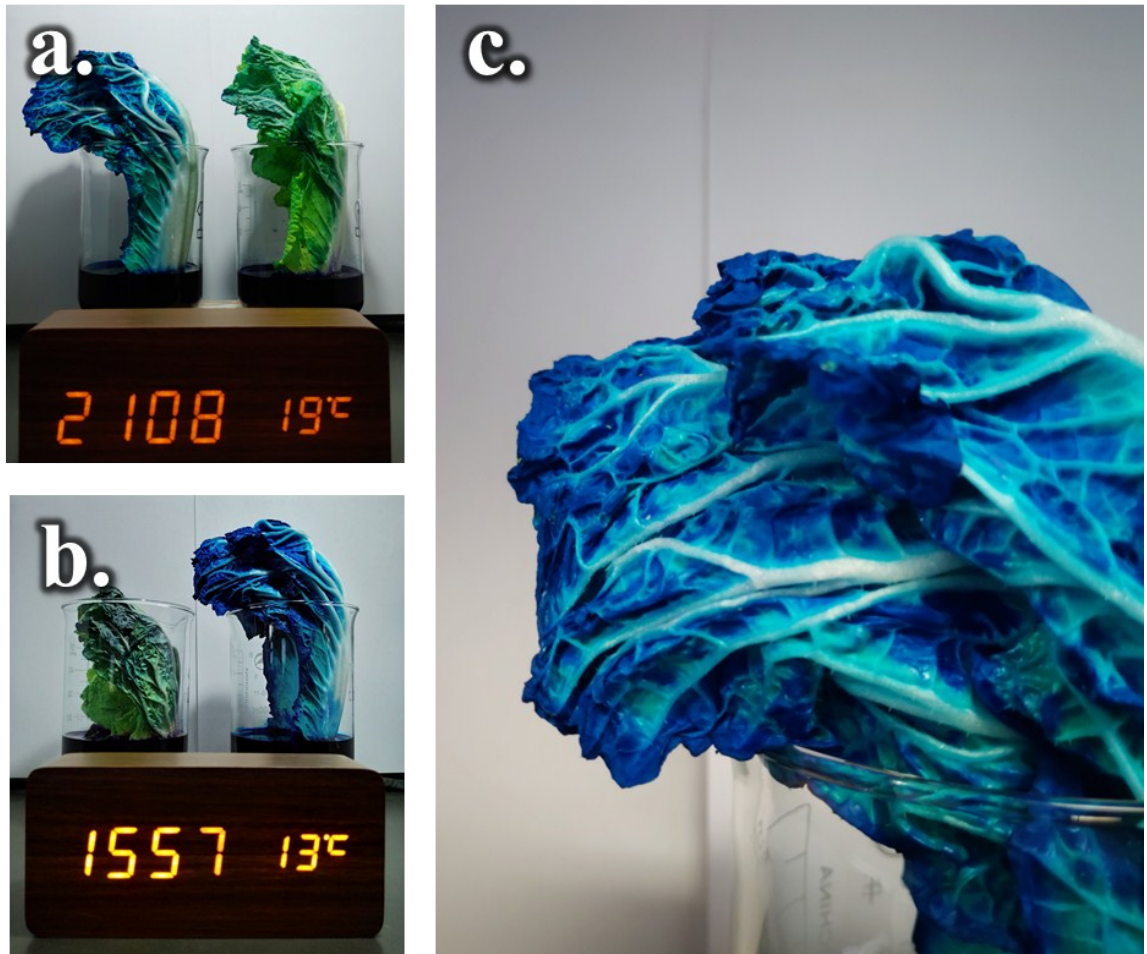


Fig. S1 The image of Chinese cabbage dipped in ED salt and KOH/ED salt for 12 h (a) and 30 h (b). The edge of blue cabbage is shown in pic. (C).

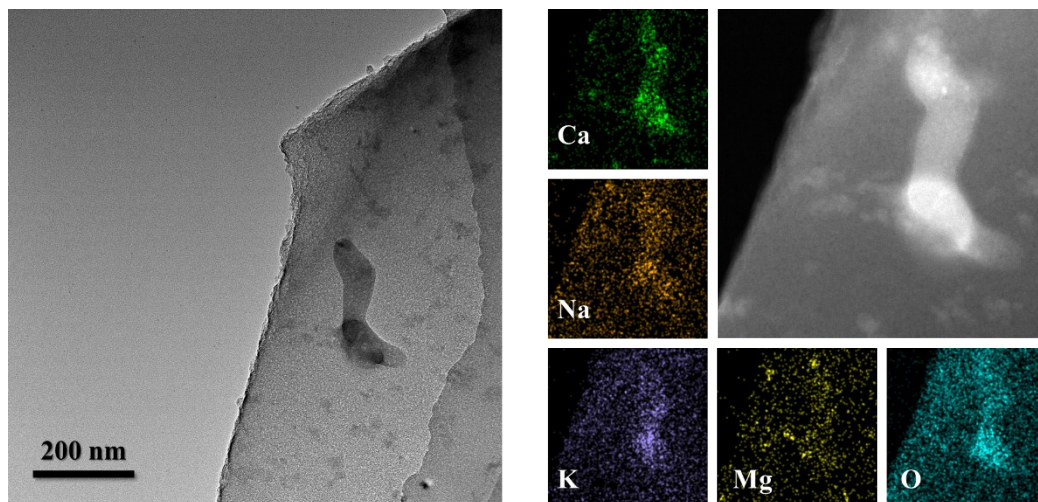


Fig. S2 The TEM image of CC-900 before washing progress & its HAADF-STEM and mapping image.

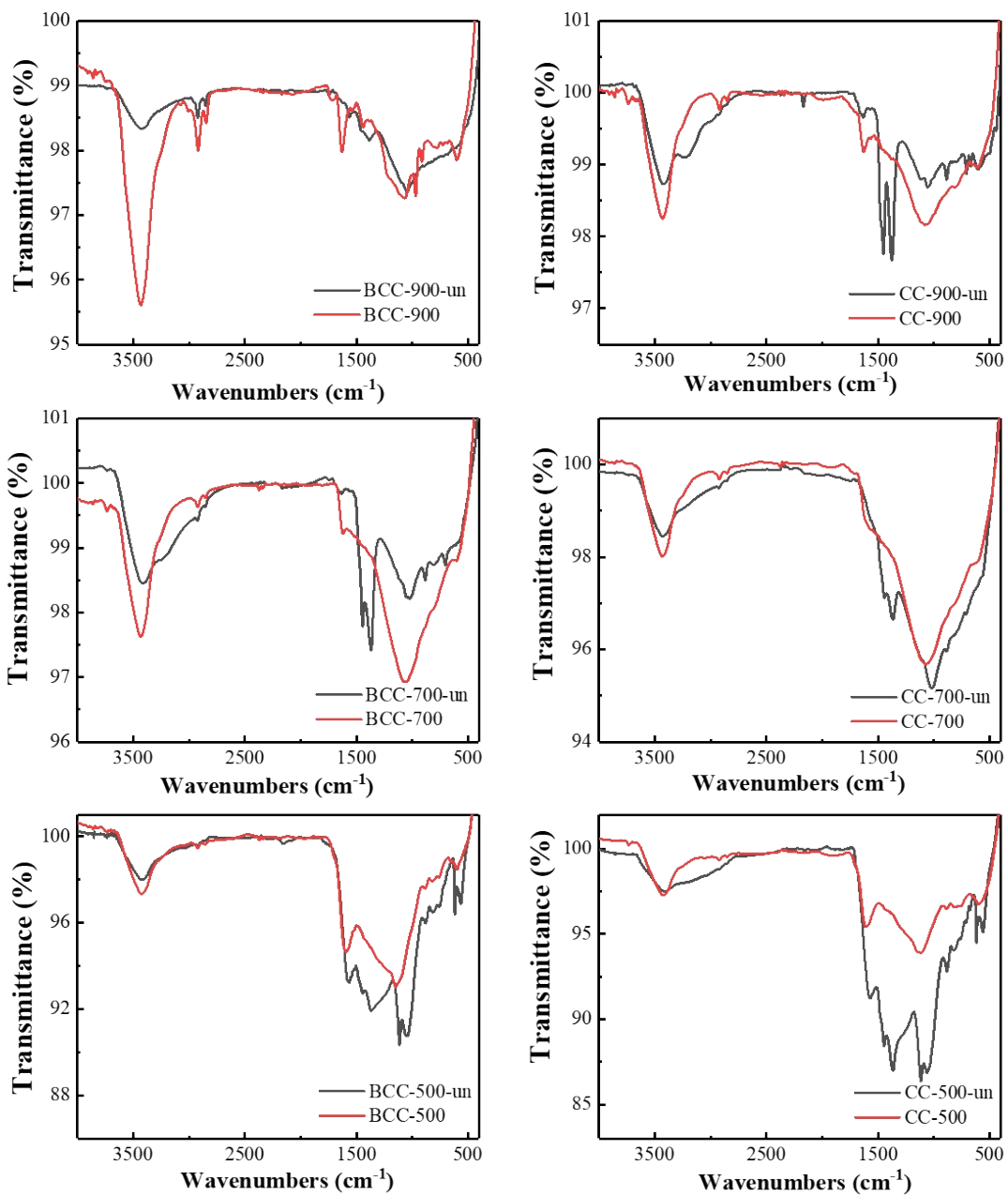


Fig. S3 The FT-IR images of Chinese cabbage materials before and after acid-washing.

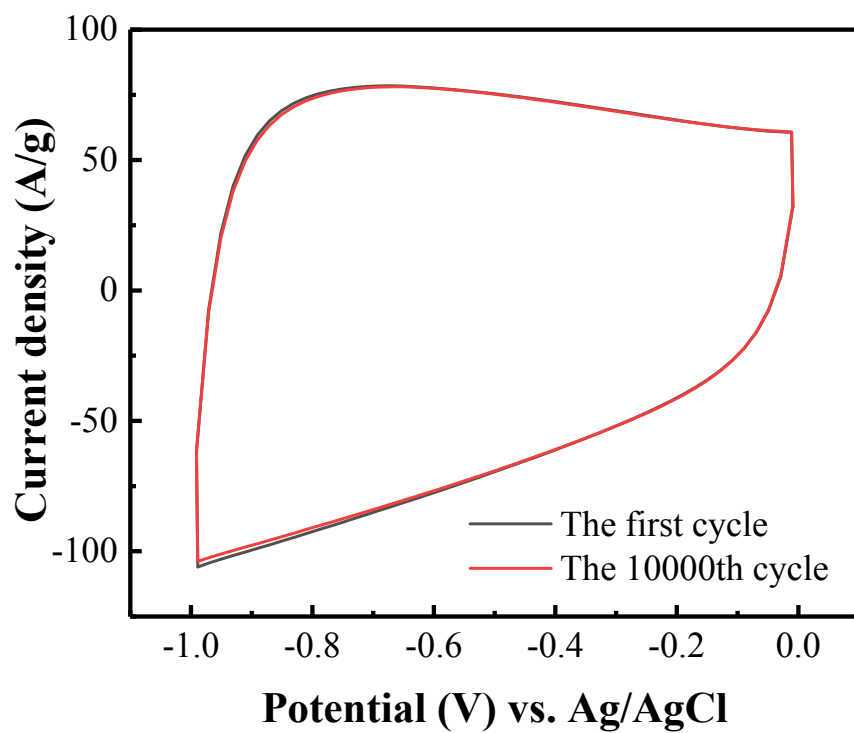


Fig. S4 CV profiles of BCC-900 before and after 10000 cycles at sweep rate of 100 mV/s.

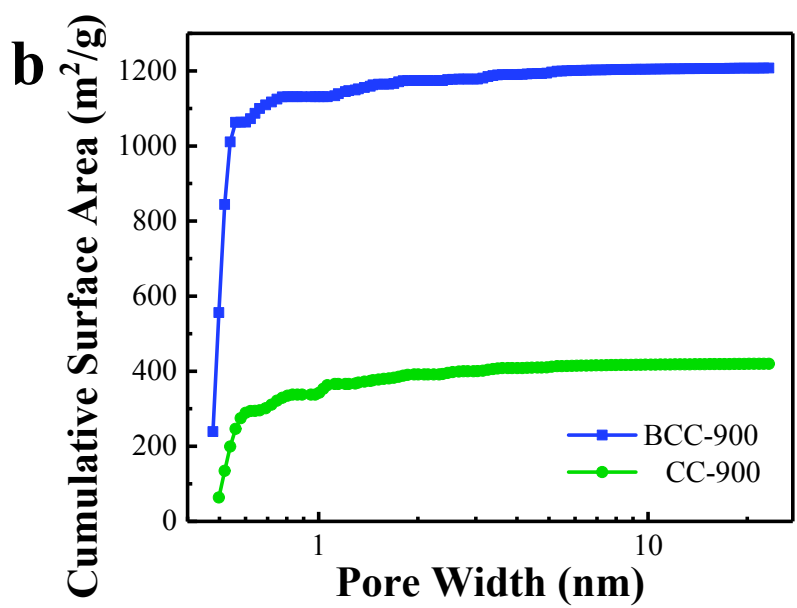
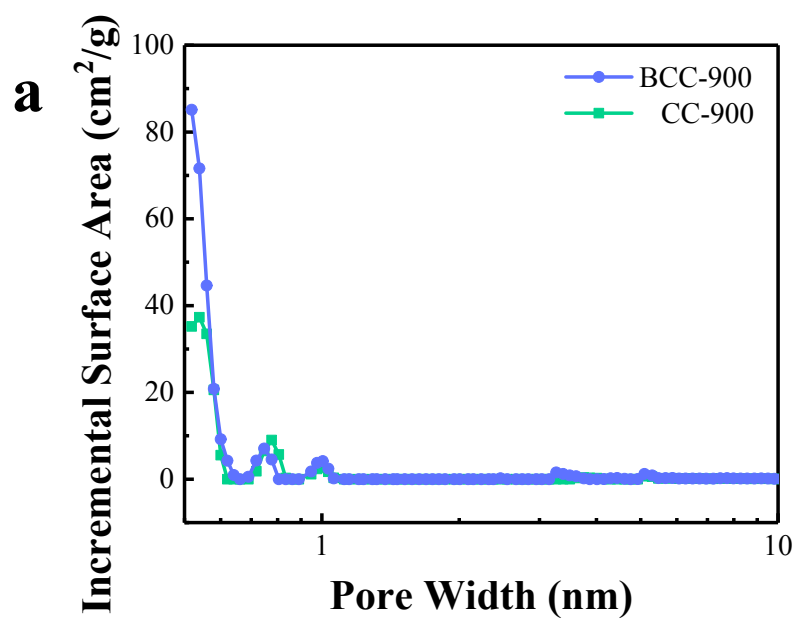


Fig. S5 Incremental (a) and cumulative (b) pore diameter distribution curves

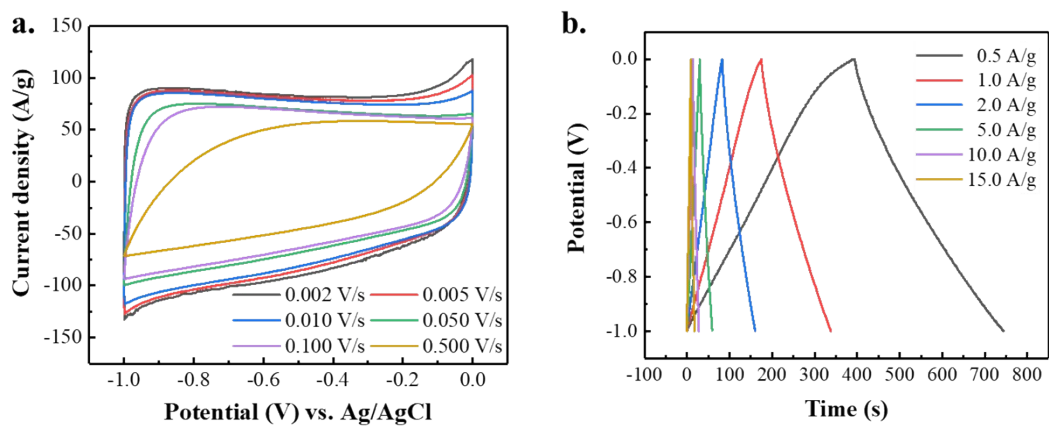


Fig. S6 CV curves (a) and galvanostatic charge-discharge data of BCC-900 in three electrode system

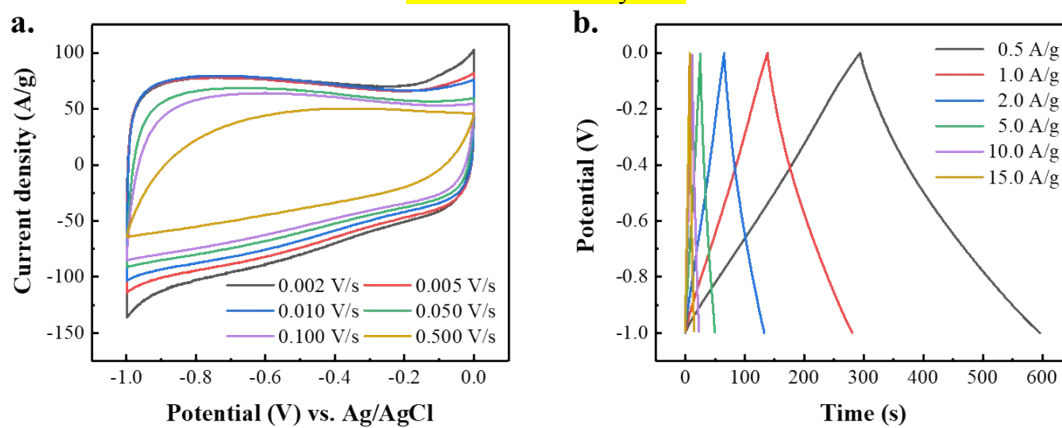


Fig. S7 CV curves (a) and galvanostatic charge-discharge data of BCC-700 in three electrode system

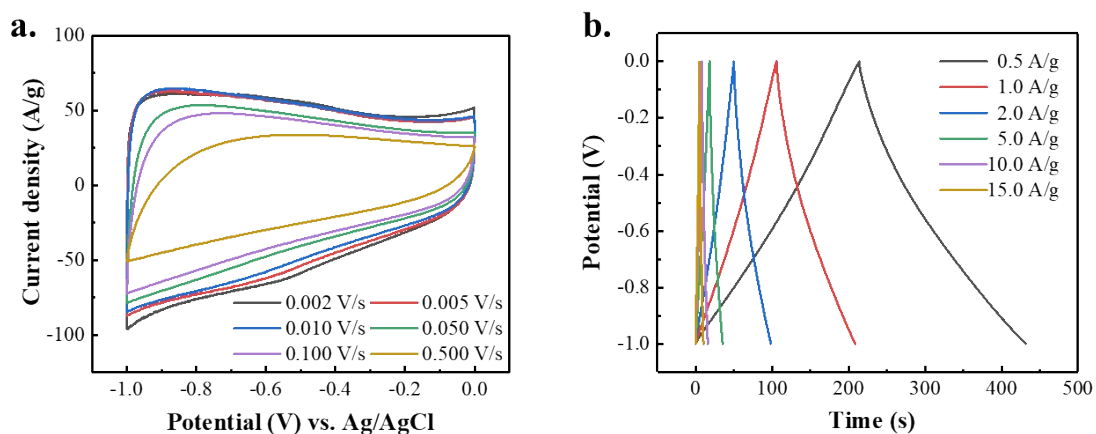


Fig. S8 CV curves (a) and galvanostatic charge-discharge data of BCC-500 in three electrode system

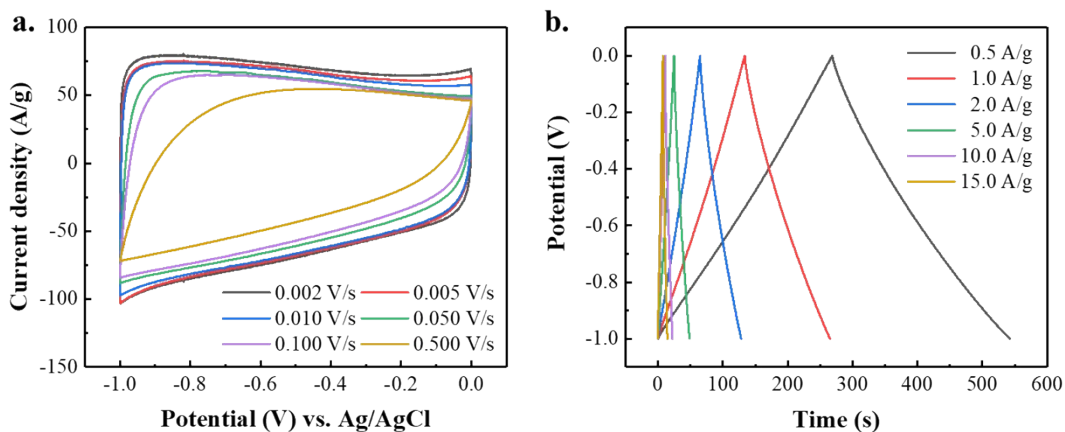


Fig. S9 CV curves (a) and galvanostatic charge-discharge data of CC-900 in three electrode system

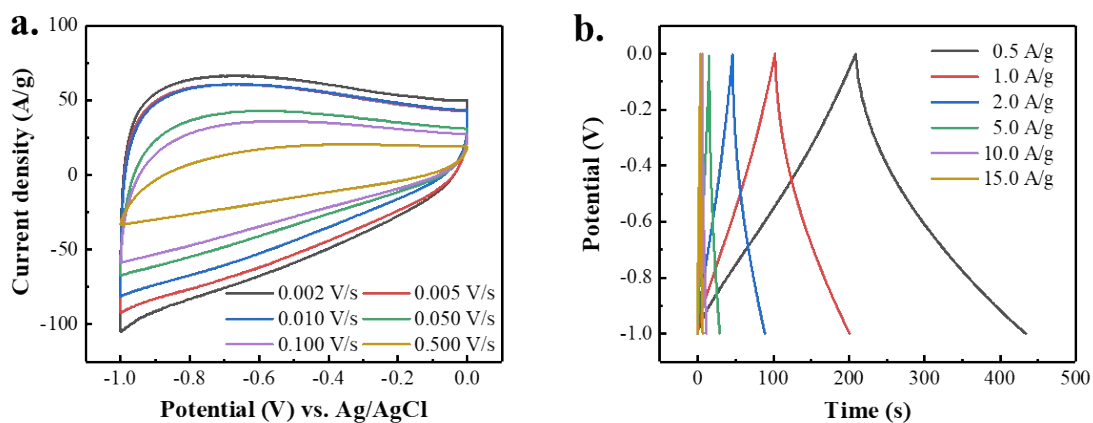


Fig. S10 CV curves (a) and galvanostatic charge-discharge data of CC-700 in three electrode system

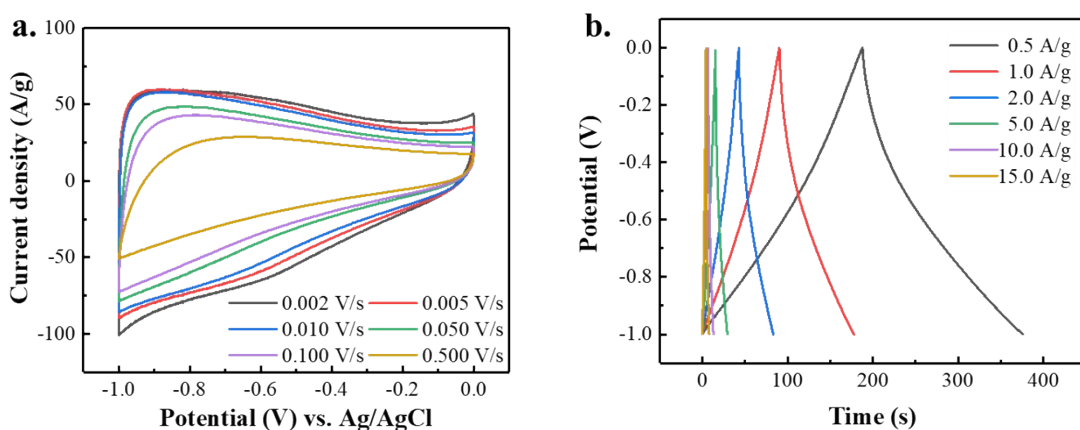


Fig. S11 CV curves (a) and galvanostatic charge-discharge data of CC-500 in three electrode system

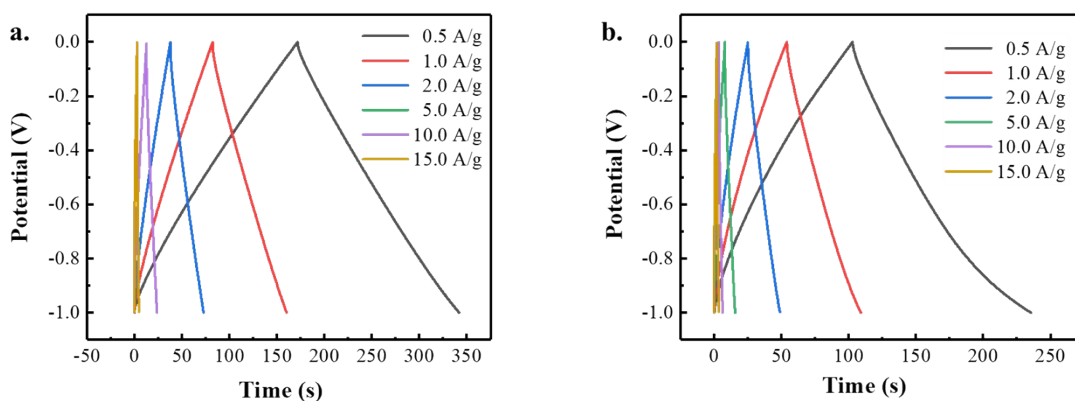


Fig. S12 Galvanostatic charge-discharge data of BCC-900 (a) and CC-900(b) in two electrode system

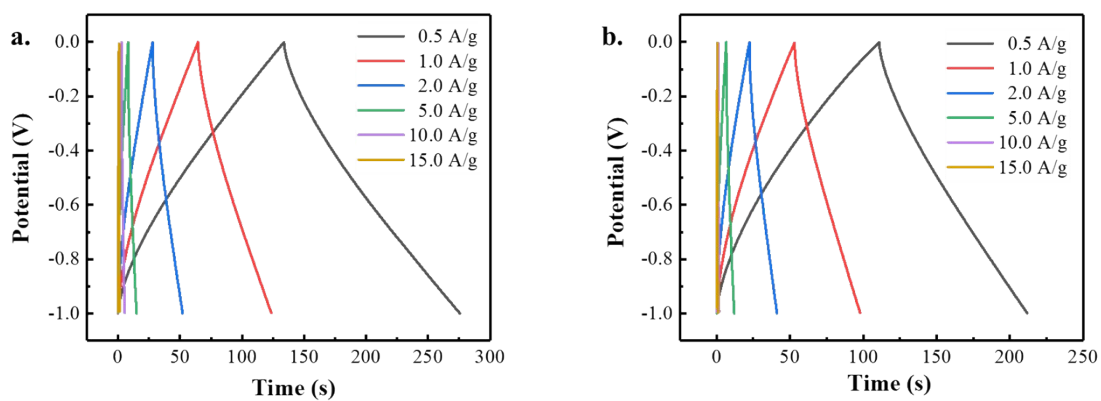


Fig. S13 Galvanostatic charge-discharge data of BCC-700 (a) and CC-700(b) in two electrode system

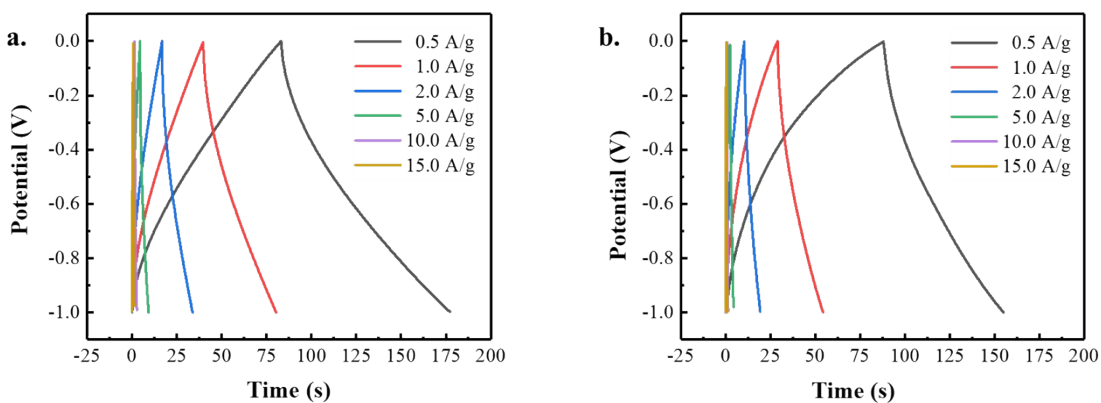


Fig. S13 Galvanostatic charge-discharge data of BCC-500 (a) and CC-500(b) in two electrode system

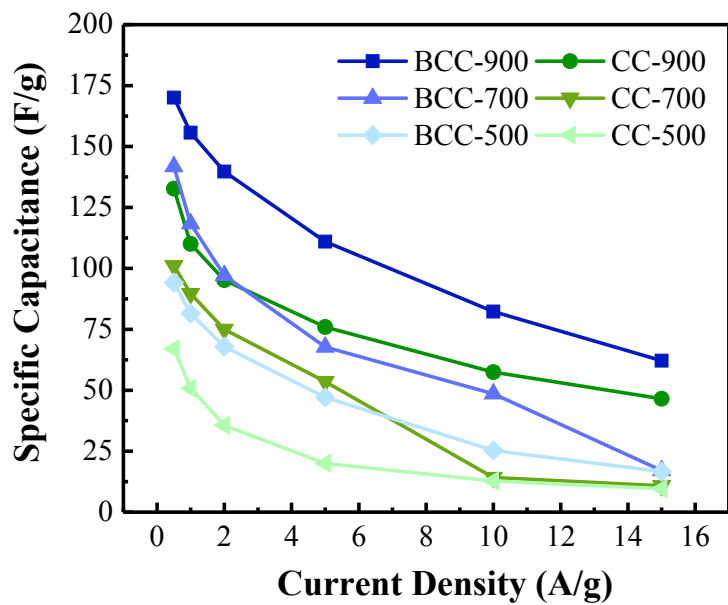


Fig. S14 The specific capacitance comparison at different current density of samples in two electrode system

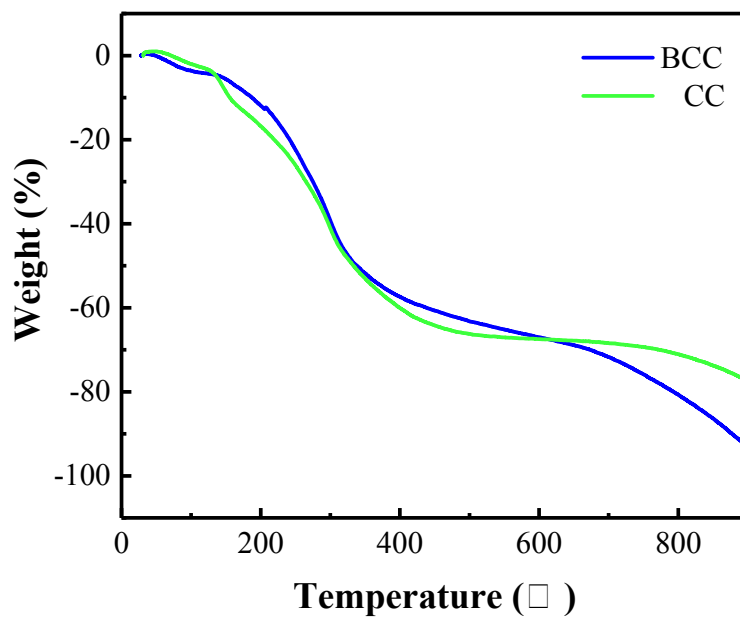


Fig. S15 TG curves of BCC and CC measured in N₂

Table S1. Comparison of specific capacitances of BCC-900 with other electrode materials.

Electrode material	Activation agency	Current density (A/g)	Specific capacitance (F/g)	Ref.
Graphene	KOH	0.2	170	1
Chinese cabbage	Erioglauricine disodium salt	0.5	172	This work
Schiff-base network	ZnCl ₂	0.2	377	2
Corncob	KOH	0.5	390	3
Denim cloth waste	H ₃ PO ₄	0.5	390	4
Chicken eggshell membranes	KOH	0.5	297	5
Wood sawdust	KOH	0.5	225	6
Banana flesh	CO ₂	1	178.9	7
Shiitake mushroom	H ₃ PO ₄ & KOH	1	306	8
Coffee ground	H ₃ PO ₄	0.05	180	9

References

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