Supporting Information

Biomass derived three-dimensional carbon framework for flexible fibrous supercapacitors and their application as wearable smart textile

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Calculation of the electrochemical capacitance for electrode and FSSC*:* The capacitances (C) of a AC-TC800-CFB electrode and FSSC were determined using both CV and GCD according to eqns (1) and (2), respectively:

$$\mathrm{C} = \frac{Q}{2V} = \frac{1}{2V\nu}\int_{V_-}^{V_+} i(V)dV \qquad (1)$$

where Q is the total voltammetric charge obtained by integrating the area within the CV curves, V is the scanned potential window ($V = V_+ - V_-$), ν is the scan rate of the CV curves, and i(V) is the current intensity.

$$\mathrm{C} = i/(\mathrm{dV}/\mathrm{dt}) \qquad (2)$$

where i is the discharge current in the GCD, t is the discharge time in the GCD, and V is the voltage.

The specific gravimetric capacitance $C_{mass\ (all\ electrode)}$ of the AC-TC800-CFB electrode and FSSC was calculated using

$$C_{\text{mass (all electrode)}} = C/m_D \tag{3}$$

$$C_{\text{mass (only activated material)}} = C/m_A \tag{4}$$

where m_D denotes the mass of the device (activated materials and current collector), and m_A indicates the mass of the activated materials (AC, TC, and CB) in a single electrode.

The specific length capacitance (C_{length}) of an AC-TC800-CFB electrode or FSSC was calculated using

$$C_{\text{length}} = C/L \tag{5}$$

where L denotes the length of an AC-TC800-CFB electrode or FSSC.

The specific areal capacitance C_{area} of the AC-TC800-CFB electrode or FSSC was calculated using

$$C_{area} = C/A \quad (6)$$

where A denotes the surface area of the overlapping portion, equal to the circumference of the cross-section multiplied by the length of the overlapped portion of the AC-TC800-CFB electrode or FSSC fiber.

The circumference was obtained by multiplying π by the diameter of the fibers obtained in the SEM images.

The specific volume capacitance (C_{volume}) of the AC-TC800-CFB electrode or FSSC was calculated using

$$C_{volume} = C/V \quad (7)$$

where V denotes the volume in the overlapping portion, which is equal to the cross-sectional area multiplied by the length of the overlapped portion of the AC-TC800-CFB electrode or FSSC fiber.

The specific energy density (E_i) and specific power density (P_i) of the FSSCs can be obtained from

$$E_i = \frac{1}{2} C_i U^2 \quad (8)$$

$$P_i = \frac{3600 E_i}{t_{discharge}} \quad (9)$$

where U is the total voltammetric charge obtained by integrating the area within the CV curves, and $t_{discharge}$ is the discharge time. C_i can be the mass (giving the gravimetric capacitance, F g^{-1}), length (giving the length capacitance, F cm^{-1}), area (giving the areal capacitance, F cm^{-2}), or volume (giving the volumetric capacitance, F cm^{-3}) of one electrode (C_i) or two electrodes ($2C_i$), which respectively result in gravimetric (W h kg^{-1}, W kg^{-1}), length (W h cm^{-1}, W cm^{-1}), areal (W h cm^{-2}, W cm^{-2}), or volumetric (W h cm^{-3}, W cm^{-3}) energy density (E_i) (eqn (8)) and power density (P_i) (eqn (9)).

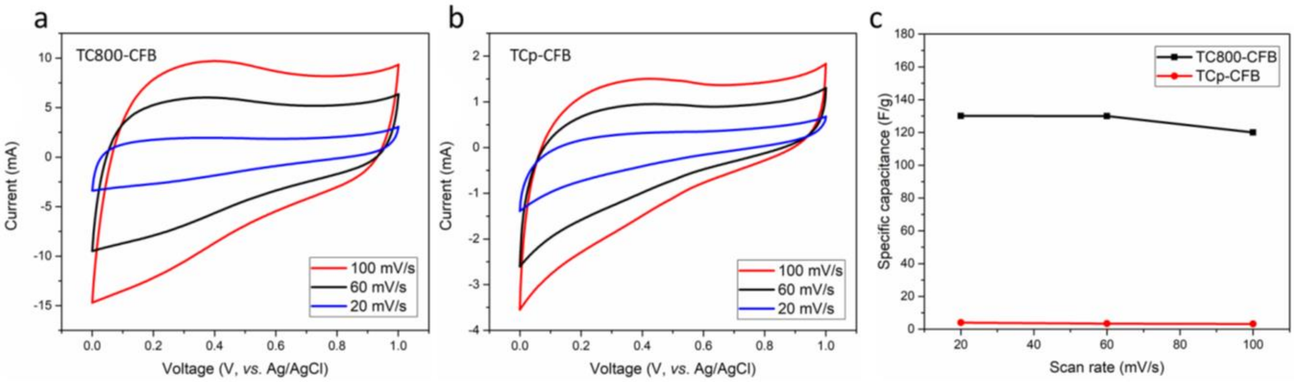

Fig. S1. The electrochemical characterization results for the electrodes based on three-electrode systems, and the electrolyte was an aqueous solution of 1 M H_2SO_4. The CV curves and specific capaacitances of TC800-CFB and TCp-CFB electrodes at different scan rates are shown (a–c).

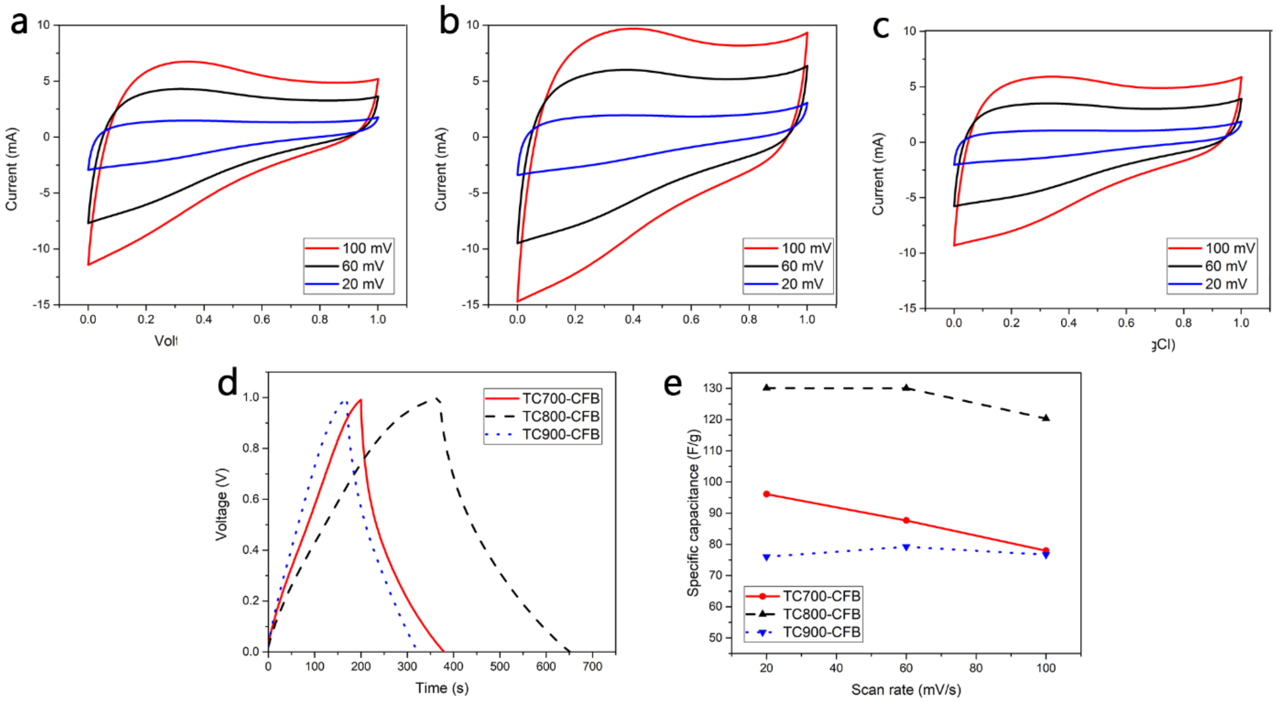

Fig. S2. The CV curves of TC-CFB electrodes treated at (a) 700, (b) 800 and (c) 900 ℃ and tested at different scan rates. (d) GCD test results of TC700-CFB, TC800-CFB, and TC900-CFB. Specific capacitance of TC700-CFB, TC800-CFB, and TC900-CFB measured under different scan rates.

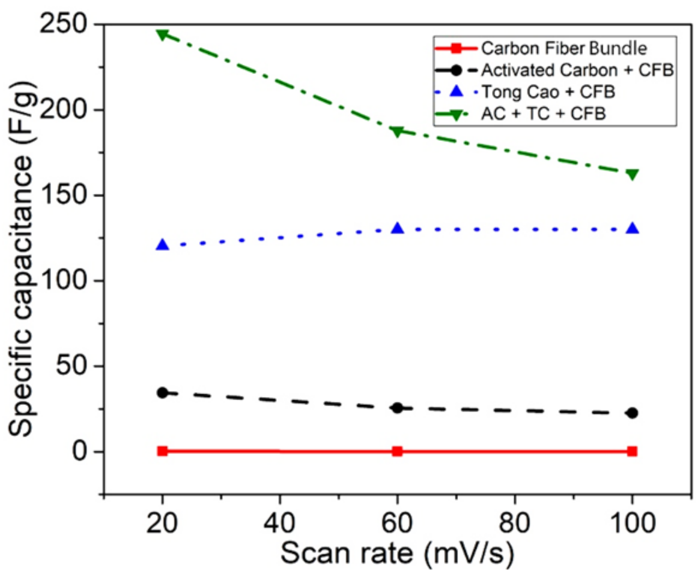

Fig. S3. Gravimetric capacitances, C_{mass}, for bare CFB, AC-CFB, TC-CFB, and AC-TC-CFB with a length of 1.5 cm tested at different scan rates using 1M H_2SO_4 as the electrolyte.

Table S1. Electrochemical performances of the AC-TC-CFB fiber supercapacitor.

Current density ($A g^{-1}$) \ Energy or power densities	E_{mass*} ($mWh kg^{-1}$)	E_{mass**} ($mWh kg^{-1}$)	E_{length} ($\mu Wh cm^{-1}$)	E_{area} ($\mu Wh cm^{-2}$)	E_{volume} ($mWh cm^{-3}$)	P_{mass*} ($mW kg^{-1}$)	P_{mass**} ($mW kg^{-1}$)	P_{length} ($mW cm^{-1}$)	P_{area} ($mW cm^{-2}$)	P_{volume} ($mW cm^{-3}$)
0.1	3.85	19.9	3.98	16.1	3.26	66.1	342	0.07	1.99	56.0
0.2	3.08	15.9	3.18	12.9	2.61	132	683	0.14	3.98	112
0.6	1.96	10.1	2.03	8.19	1.66	397	2050	0.41	11.9	336
1.0	1.43	7.40	1.48	5.98	1.21	661	3420	0.68	19.9	560
2.0	0.66	3.42	0.68	2.76	0.56	1320	6830	1.37	39.8	1120

E_{mass*}: mass energy density calculated based on electrode weight; E_{mass**}: mass energy density calculated based on the weight of activated material; E_{length}: length energy density; E_{area}: area energy density; E_{volume}: volume energy density; P_{mass*}: mass energy density calculated based on electrode weight; P_{mass**}: mass energy density calculated based on the weight of activated material; P_{length}: length power density; P_{area}: area power density; and P_{volume}: volume energy density.