Supplementary information

Elastic carbon foam *via* direct carbonization of polymer foam for flexible electrodes and organic chemical adsorption

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Electrode preparation and electrochemical capacitance measurement

The electrodes for capacitive measurement were made by sandwiching the *ECFs* between two pieces of stainless steel mesh. All the electrochemical tests were carried out on a CHI 660D electrochemical workstation (CH Instruments Inc.). 1 M H_2SO_4 aqueous solution was used as electrolyte. The cyclic voltammetry (CV) were carried out in three-electrode cells with an Ag/AgCl electrode (saturated with KCl) used as reference electrode. Galvanostatic charge/discharge (chronopotentiometry, CP) tests were performed with the two-electrode cell in the cutoff potential range -0.2 to 0.6 V.

Calculation of porosity, density and carbon yield

The porosity is provided as a fraction of the void volume in the total volume, which follows our previous report [1].

$$\Theta = \frac{V_{void}}{V_{total}} \times 100\% = 1 - \frac{V_{solid}}{V_{total}} \times 100\% \quad (1)$$

Here, the V_{void} is volume of pores, the V_{solid} is volume of solid and the V_{total} is total or bulk volume of foam material including the solid and pore volume. The V_{total} of the foam with cuboid shape can be expressed as V_{total} = a*b*c. The a, b and c represent the three dimensions of the foam, respectively. The V_{solid} can be expressed as $V_{solid} = m/\boldsymbol{\rho}_m$, the m is the weight of foam, and the $\boldsymbol{\rho}_m$ is the density of materials. The density of carbon (carbonized at low temperature of 800-1000 ˚C) is about1.8 g cm^{-3}, the density of melamine resin is about 1.51 g cm^{-3}, which obtained from company For the a piece of elastic carbon foam with volume of 1.50 cm*1.10 cm*0.76 cm(1.254 cm^3), its

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weight is 0.0088 g. So, the porosity is calculated as

$$1-\frac{0.0088g}{1.8g\cdot cm^{-3}\times 1.254cm^{3}}\times 100\%=99.61\%$$

The density of the foam materials (ρ_f) are calculated as ratio of foam weight (mc) to V_{total},

$$\rho_f=\frac{m}{V_{total}} \qquad (2)$$

The carbonization rate(ξ_C) is means of char yield, which is calculated as,

$$\xi_C=\frac{m_c}{m_{MF}}\times 100\% \qquad (3)$$

m_c is the weight of carbon foam, m_{MF} is the weight of melamine foam.

Table S1 Properties of *ECFs* with different slenderness ratio.

Samples	Density of *MF* /mg cm^{-3}	Density of ECF / mg cm^{-3}	Porosity / %	$\bar{L}_f$ / μm	$\bar{L}_{ss}$ / μm	Slenderness ratio $\bar{L}_f / \bar{L}_{ss}$	Plastic deformation/ %
ECF	7.2	5.0	99.68	61	2.9	26.7	0
ECF -1	11.1	7.93	99.56	63	3.8	16.6	5.3
ECF -2	12.0	8.64	99.52	47	4.1	11.5	21.5
RVC	—	54	97	354	48	7.2	100

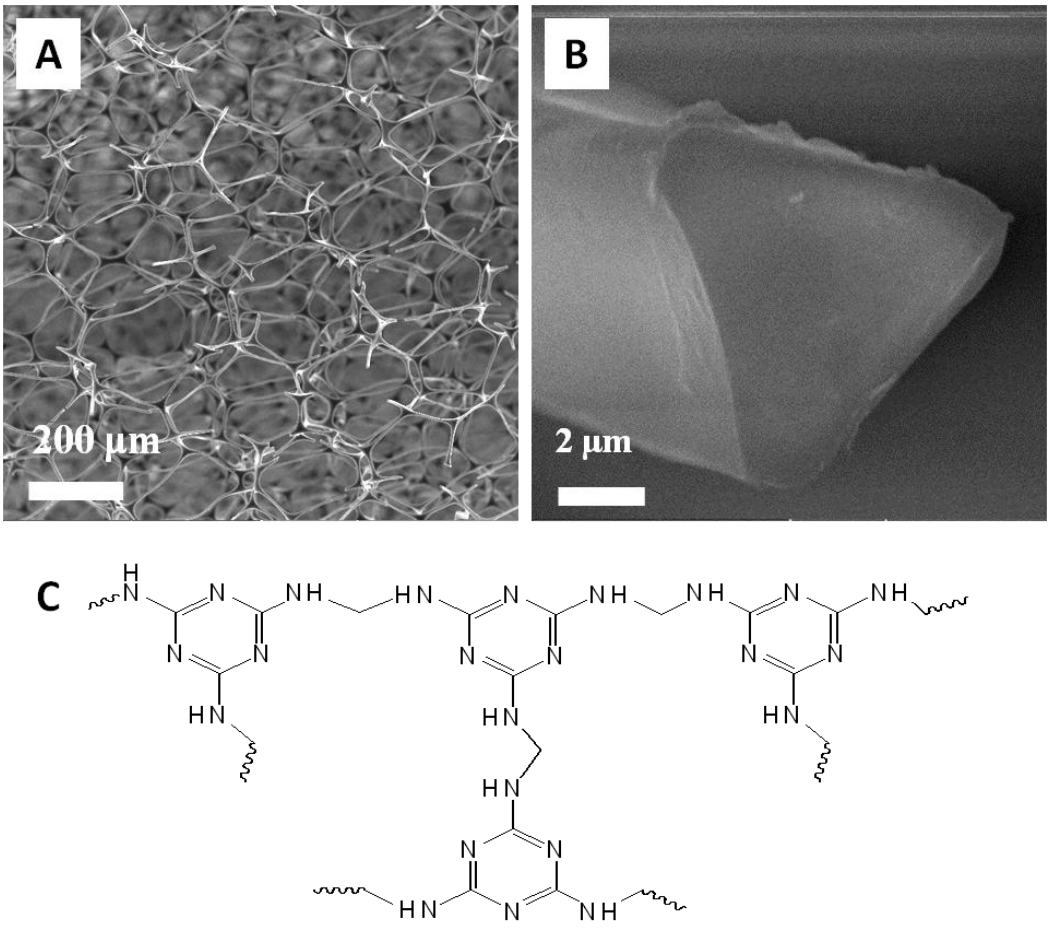

Figure S1. Figure S1. (A) SEM image of *MF*, (B) the cross-sectional image of the network fiber in the *MF*, (C) macromolecular structure *MF*.

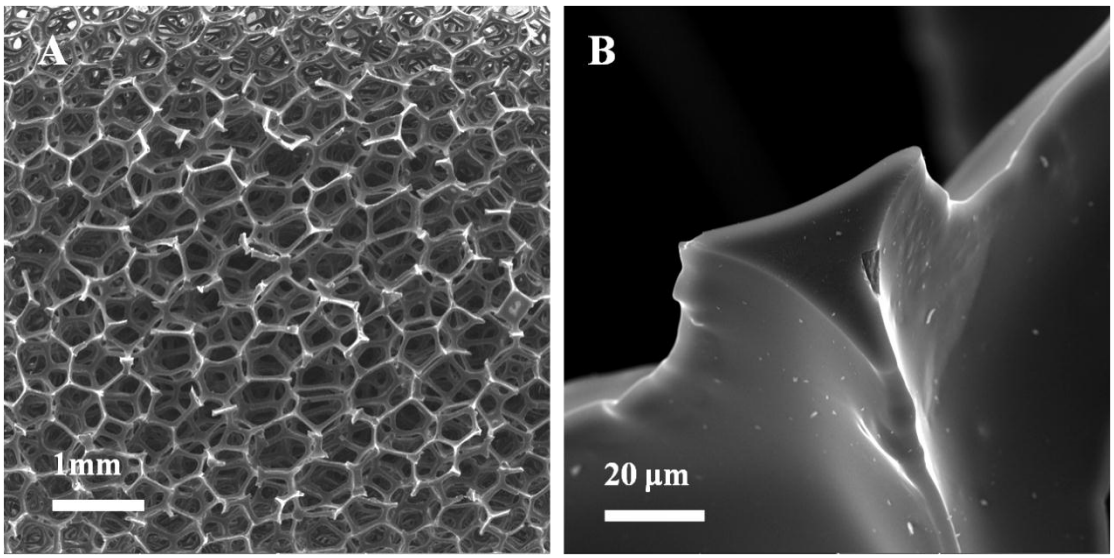

Figure S2. SEM images of RVC, (A) overview image and (B) cross-section image of the network.

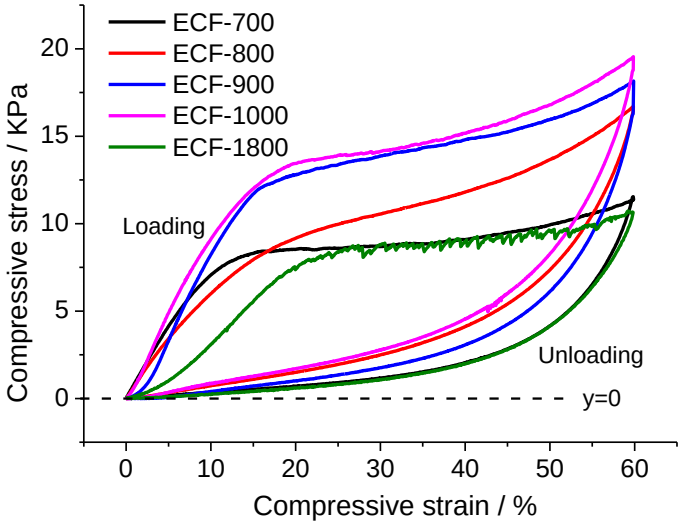

Figure S3 Loading and unloading compressive stress-strain curves of *ECFs* prepared at temperature of 700, 800, 900, 1000 and 1800 ˚C.

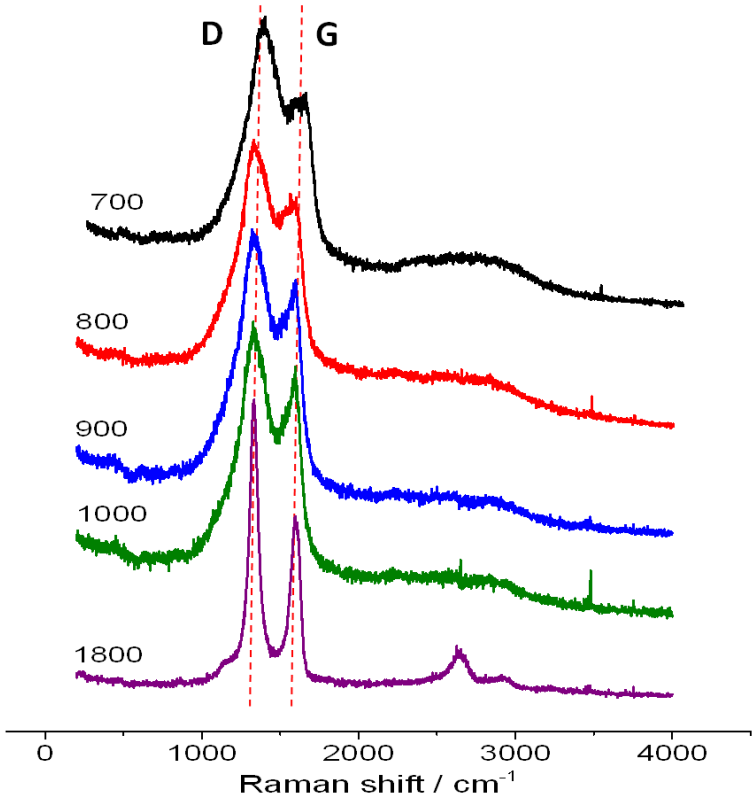

Figure S4 Raman spectra of *ECFs* prepared at temperatures of 700, 800, 900, 1000, and 1800 ^{o}C

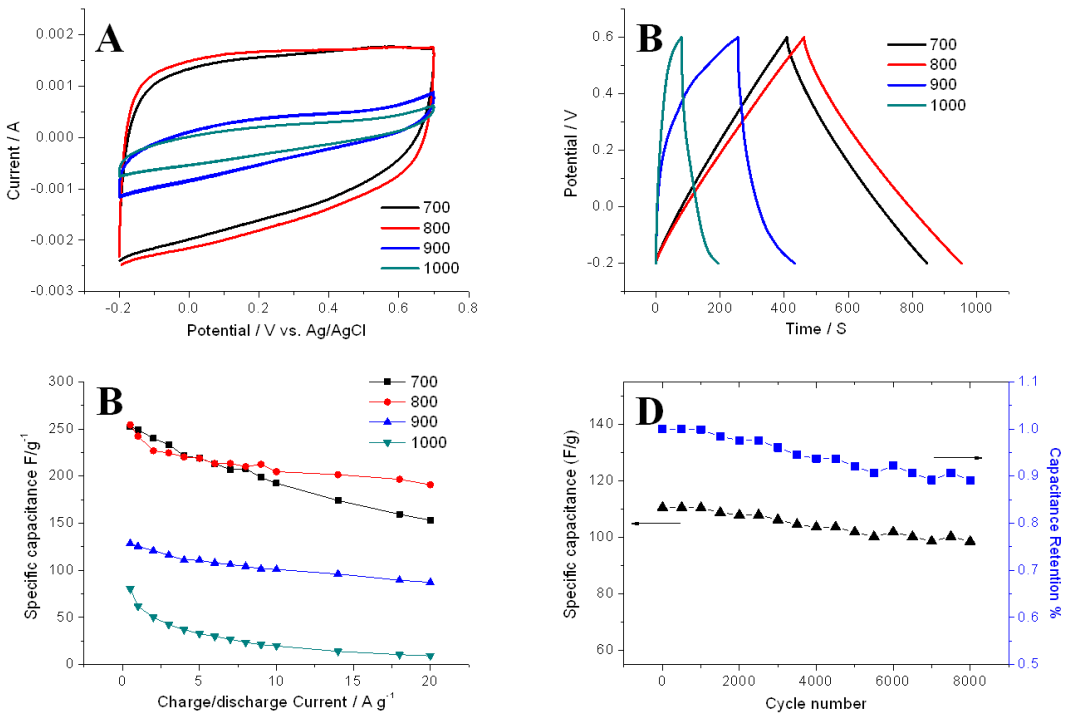

Figure S5 Capacitance performance of the *ECFs* preparing at different temperature in 1 M H_2SO_4. (A) Cyclic voltammograms at scan rate of 5 mV s^{-1}, (B) Charge/discharge curves at current density of 50 A g^{-1} and (C) relationship between capacitance and charge/discharge current density, (D) Specific capacitance and capacitance retention curves of *ECF* prepared at 800 ˚C for 8000 cycles at 50A g^{-1}.

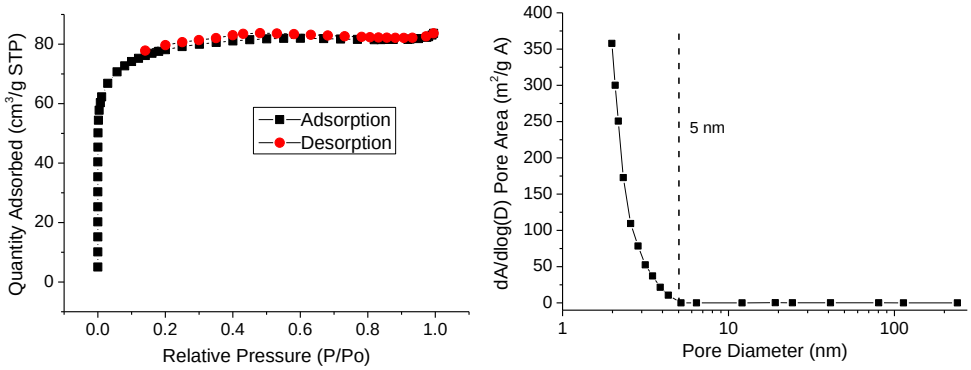

Fig. S6 (A) N_2 absorption and desorption isotherm linear plot and (B) pore size distribution of the *ECF* materials

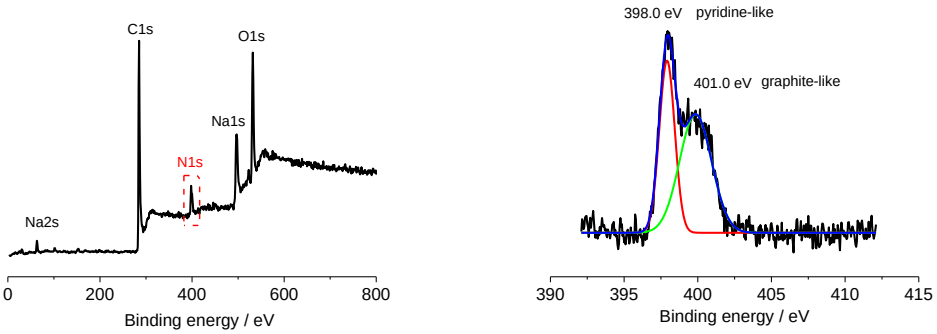

Fig. S7 XPS spectra of *ECF* carbonized at 800 ˚C (left) survey, (right) high resolution spectra of N1s.

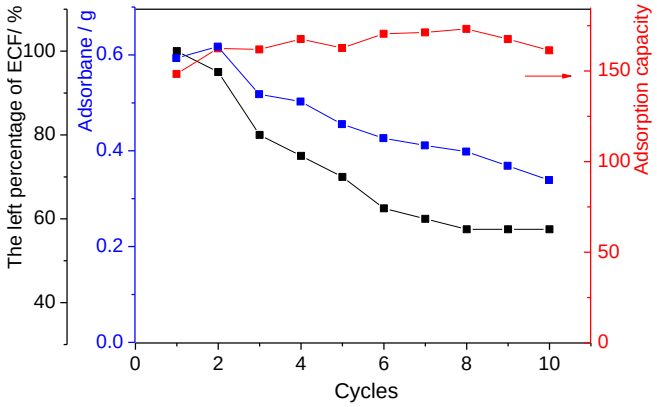

Fig. S8 Absorption properties of *ECF* towards ethanol for ten cycles.

Reference

[1] *S.L. Chen, H.Q. Hou, F. Harnisch, S.A. Patil, A.A. Carmona-Martinez, S. Agarwal, Y.Y. Zhang, S. Sinha-Ray, A.L. Yarin, A. Greiner, U. Schroder, Electrospun and solution blown three-dimensional carbon fiber nonwovens for application as electrodes in microbial fuel cells, Energy & Environmental Science, 4 (2011) 1417-1421.*