Supplementary Information

Flexible all-solid-state high-power supercapacitor fabricated with nitrogen-doped carbon nanofiber electrode material derived from bacterial cellulose†

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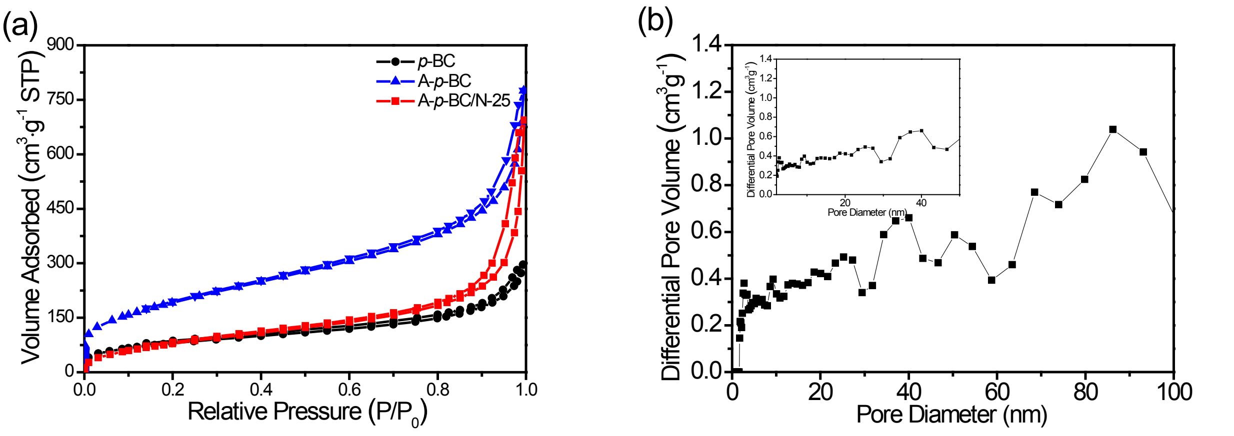

Fig. S1 (a) Nitrogen adsorption-desorption isotherms of *p*-BC, A-*p*-BC, and A-*p*-BC/N-25. (b) Pore size distribution of A-*p*-BC/N-25 (inset: magnified 2–50 nm region).

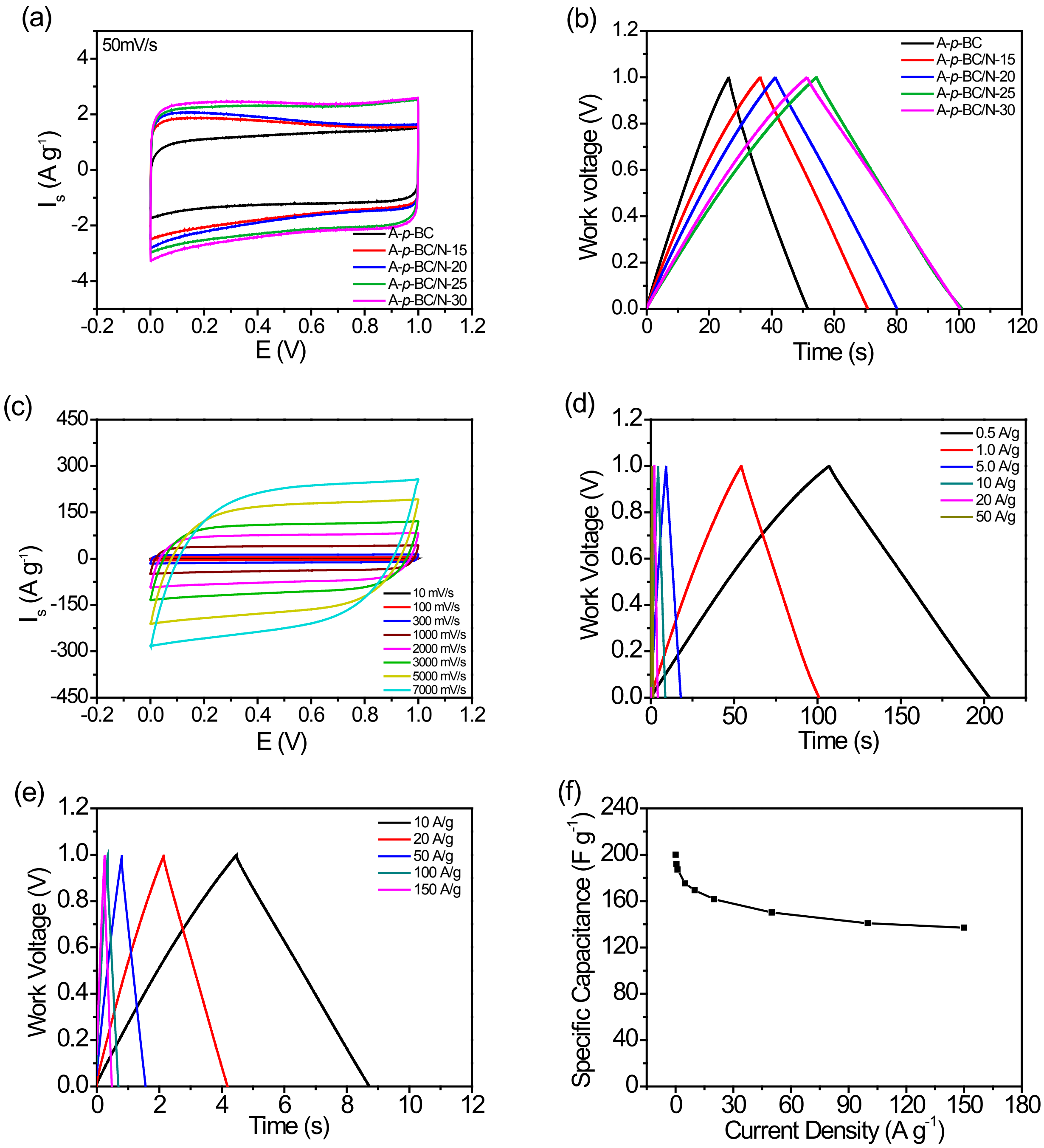

Fig. S2 Electrochemical properties of the materials measured *via* a two-electrode system in 2.0 M H_2SO4 aqueous electrolyte. (a) Cyclic voltammetry (CV) curves of A-*p*-BC/N-x and A-*p*-BC aqueous electrolyte capacitor at the scan rate of 50 mV s^{-1}. (b) Galvanostatic charge-discharge curves of A-*p*-BC/N-x and *p*-BC aqueous electrolyte capacitor at the current density of 1.0 A g^{-1}. (c) CV curves of A-*p*-BC/N-25 aqueous electrolyte capacitor at different scan rates. (d,e) Galvanostatic charge-discharge curves for A-*p*-BC/N-25 aqueous electrolyte capacitor at different current densities. (f) Variation of specific capacitance for the A-*p*-BC-25 aqueous electrolyte capacitor against current density.

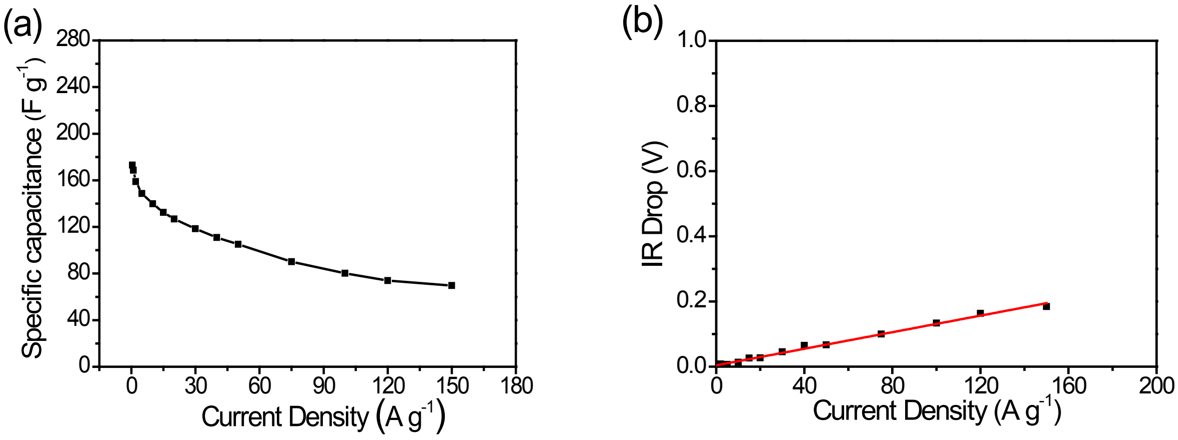

Fig. S3 (a) Variation of specific capacitance for the A-*p*-BC/N-25 flexible supercapacitor device against current density. (b) Potential drop (V_{drop}) of the A-*p*-BC/N-25 flexible supercapacitor at different discharge current densities.

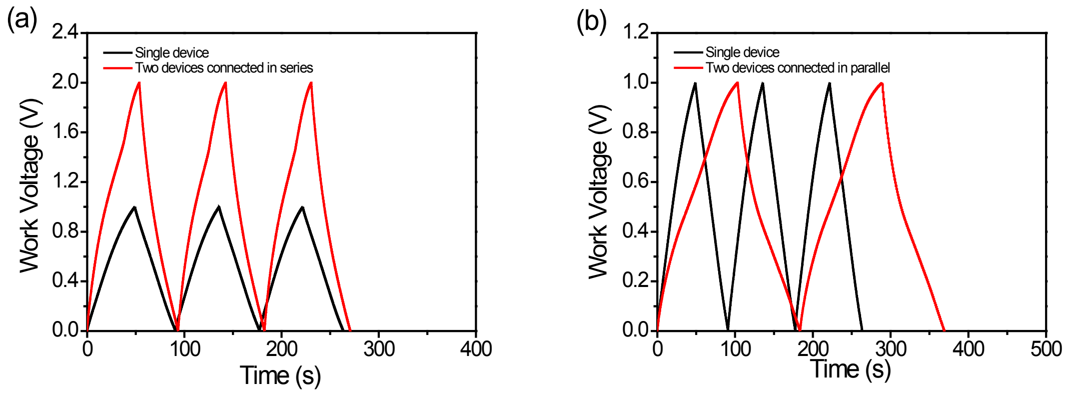

Fig. S4 Galvanostatic charge/discharge curves at the same current density for two A-*p*-BC/N-25 flexible supercapacitors connected (a) in series, and (b) in parallel.

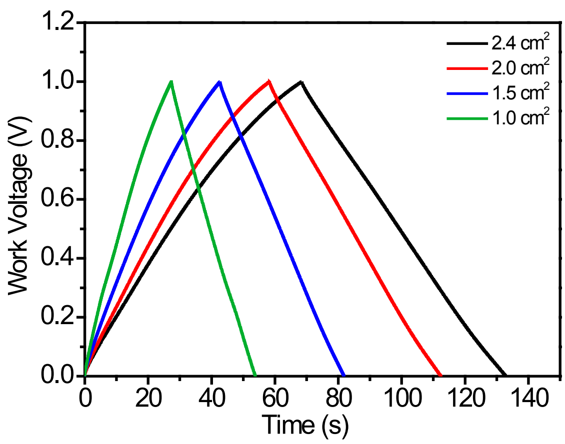

Fig. S5 Galvanostatic charge-discharge curves for all-solid-state supercapacitors with different electrode area at a fixed discharge current of 1.0 mA. All the electrode materials were A-*p*-BC/N-25.

Equations:

Specific capacitances of the supercapacitors were calculated from charge/discharge curves *via* the following equation:[1,2]

$$C_s = \frac{4 \times I \times \Delta t}{M \times \Delta V} \qquad (1)$$

where C_s (F g^{-1}) is specific capacitance of the supercapacitor, I (A) corresponds to the discharge current, ΔV (V) is the potential change within the discharge time Δt (s), and M (g) refers to the total mass of active materials on the two electrodes (Noting that the specific capacitance of the supercapacitor was calculated using the total mass of active materials on the two electrodes, rather than a single electrode.). Power density (P) and energy density (E), were calculated using eqs. (2) and (3).[2,3]

$$E = \frac{1}{8} \times C_s \times (\Delta V)^2 \qquad (2)$$

$$P_{av} = \frac{E}{\Delta t} \qquad (3)$$

where C_s (F g^{-1}) represents the specific capacitance of the supercapacitor measured from the eqs. (1), ΔV (V) refers to the potential change within the discharge time Δt (s), E (J g^{-1}) is the energy density, P_{av} (W g^{-1}) is the average power density.

The maximum specific power was calculated according to eqs. (4) and (5):[4]

$$IR_{drop} = a + bI \qquad (4)$$

$$P_{max} = \frac{V_0^{\,2}}{4M \times R_s} = \frac{(1 - a)^2}{2M \times b} \qquad (5)$$

where a represents the difference between the applied potential of 1.0 V and the charged potential of the capacitor, b means double the value of the internal resistance R_s (Ω), and I (A) is the discharge current, P_{max} (W g^{-1}) refers to the maximum power density, V_0 represents the practical work potential of the device, M (g) means the total mass of the device.

References

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