Supplementary Information

Sponge integrated highly compressible all-solid-state supercapacitor with superior performance

Enke Feng, Guofu Ma*, Hui Peng, Fengting Hua, Wei Tang, Ziqiang Lei*

Key Laboratory of Eco-Environment-Related Polymer Materials of Ministry of Education, Key Laboratory of Polymer Materials of Gansu Province, College of Chemistry and Chemical Engineering, Northwest Normal University, Lanzhou 730070, China.

*Corresponding authors: magf@nwnu.edu.cn; leizq@nwnu.edu.cn.

Experimental materials:

Aniline (Shanghai Chemical Works, China) and Pyrrole (Aladdin Co., China) were distilled under reduced pressure. Sodium carboxymethyl cellulose (CMC, Tianjin Yuanli Chemical Co., China), *P*-toluenesulfonic acid (*P*-TSA, Aladdin Co., China). Ammonium persulfate (APS, Tianjin Damao Chemical Co., China). Polyvinyl alcohol (PVA, M_w = 44.05 M_w, Aladdin Co., China). $LiClO_4$ (Aladdin Co., China), and the other reagents were all analytical grade and were used as received without further treatment.

Calculation methods:

The specific capacitance (C_M, F g^{-1}) and volumetric capacitance (C_V, F cm^{-3}) of the devices were calculated from their GCD curves according to the following equation:[1]

$$C_M = Idt/mdV \quad (1) \quad \text{and} \quad C_V = Idt/VdV \quad (2)$$

where I (A) is the constant current, Δt (s) is the discharge time, m (g) is the total mass of the active material in both electrodes, V (cm^3) is the volume of the whole device, and ΔV (V) is the actual voltage excluding IR drop of the discharge process.

According to C_M (F g^{-1}) of a supercapacitor device, C_m (F g^{-1}) of a single electrode could be estimated as:[2]

$$C_m = 4C_M \qquad (3)$$

The energy density (E, Wh kg^{-1}) and power density (P, W kg^{-1}) of the devices were calculated using the following equations:[1]

$$E = 1/2C_M\Delta V^2 \qquad \text{and} \qquad P = E/\Delta t \qquad (4)$$

The volumetric energy density (E, mWh cm^{-3}) and power density (P, mW cm^{-3}) of the devices were obtained from the following equations:[3]

$$E = 1/2C_V\Delta V^2 \qquad \text{and} \qquad P = E/\Delta t \qquad (5)$$

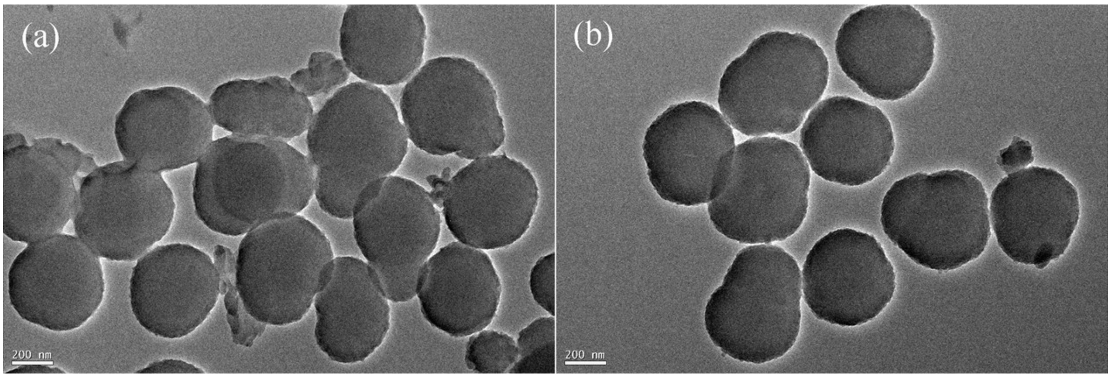

Fig. S1. (a) and (b) TEM images of the PANI based carbon nanospheres.

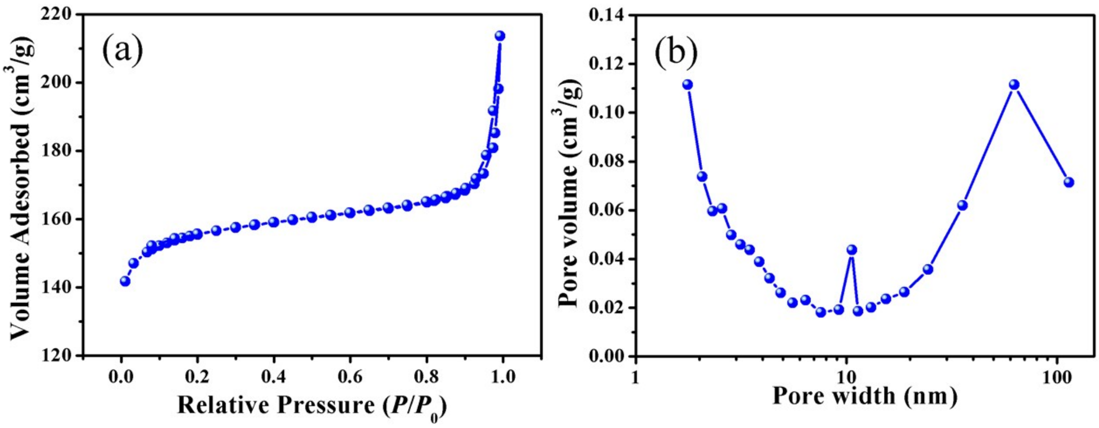

Fig. S2. (a) and (b) Nitrogen adsorption-desorption isotherms and pore-size distributions of the PANI based carbon nanospheres.

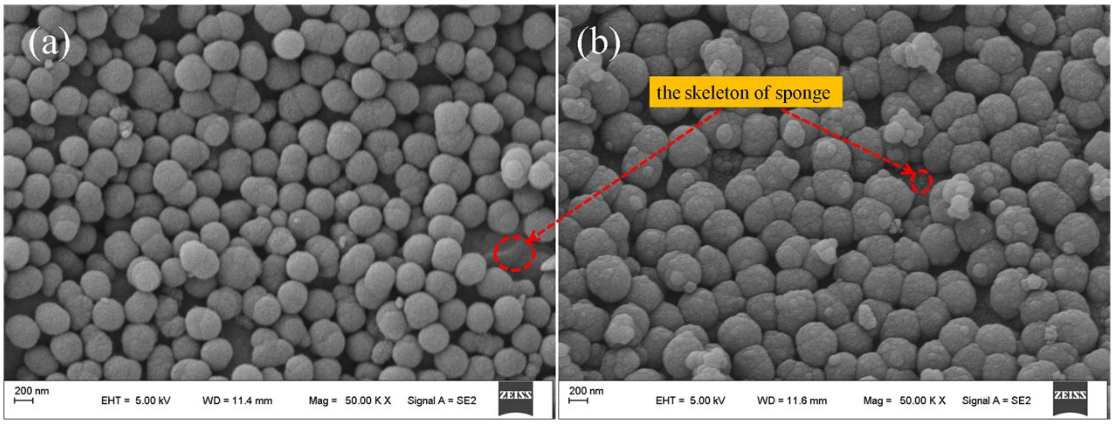

Fig. S3. (a) and (b) High magnification SEM images of PANI based carbon nanospheres coated sponge and PPy wraped PANI based carbon nanospheres coated sponge.

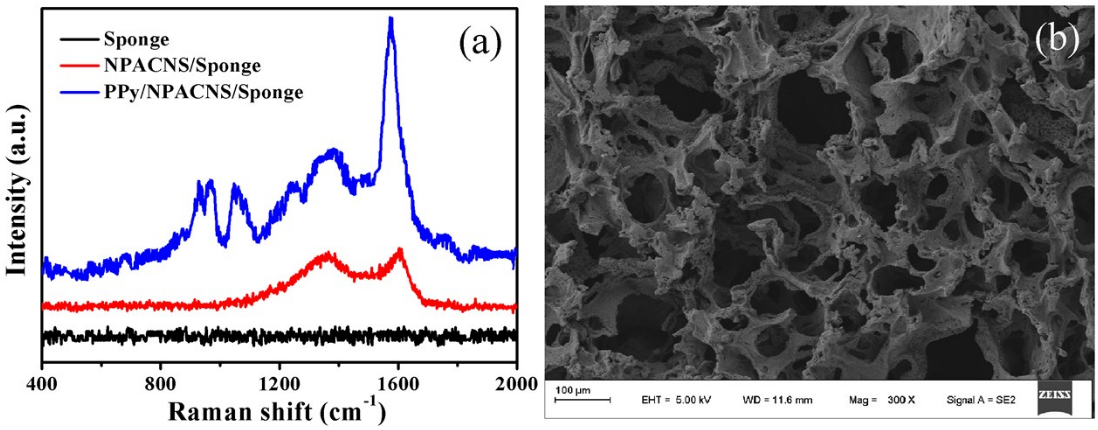

Fig. S4. (a) Raman spectra of the bare commercial sponge, PANI based carbon nanospheres coated sponge, and PPy wraped PANI based carbon nanospheres coated sponge. (b) SEM image of PVA/$LiClO_4$ gel electrolyte coated on PPy/NPACNS/sponge electrode.

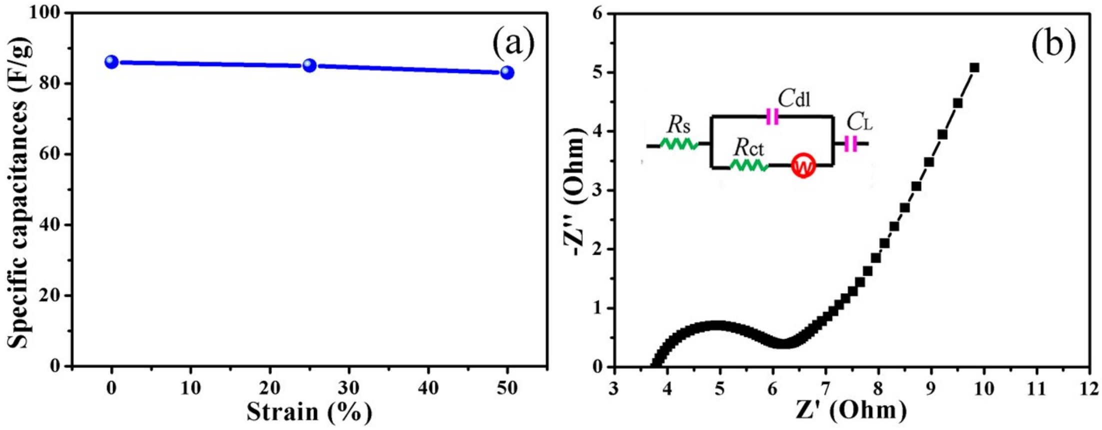

Fig. S5. (a) The specific capacitances of as-fabricated compressible all-solid-state supercapacitor under various compressing states. (b) The Nyquist impedance plot of as-fabricated compressible all-solid-state supercapacitor, and the inset showed an equivalent circuit used to fit the Nyquist spectra.

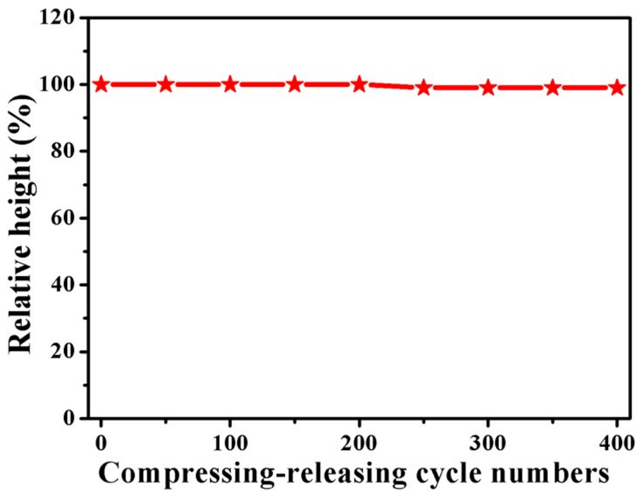

Fig. S6. The relative height variation of as-fabricated compressible all-solid-state supercapacitor as a function of compressing-releasing cycle numbers at maximum strain of 50%.

References

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