Electronic Supplementary information

From waste to Energy storage: Post-consumer waste expanded polystyrene/rGO composite as high performance self-standing electrode for coin cell supercapacitors

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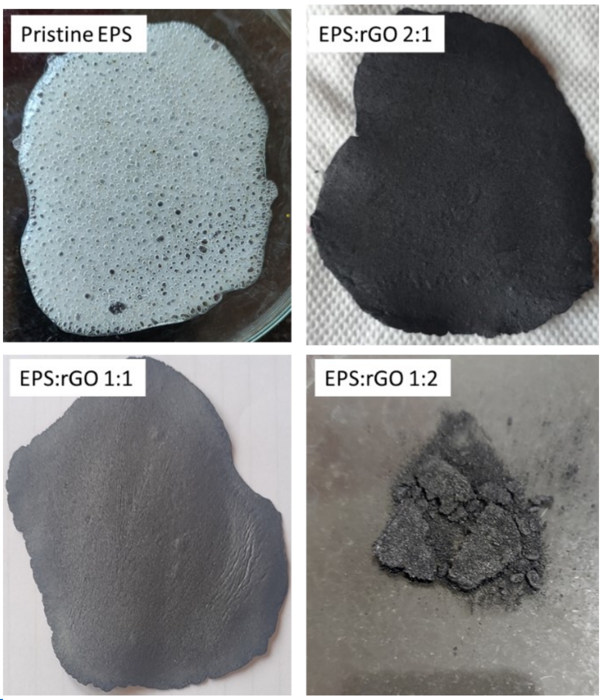

Fig. S1 Photographs of different compositions of EPS/rGO composite film

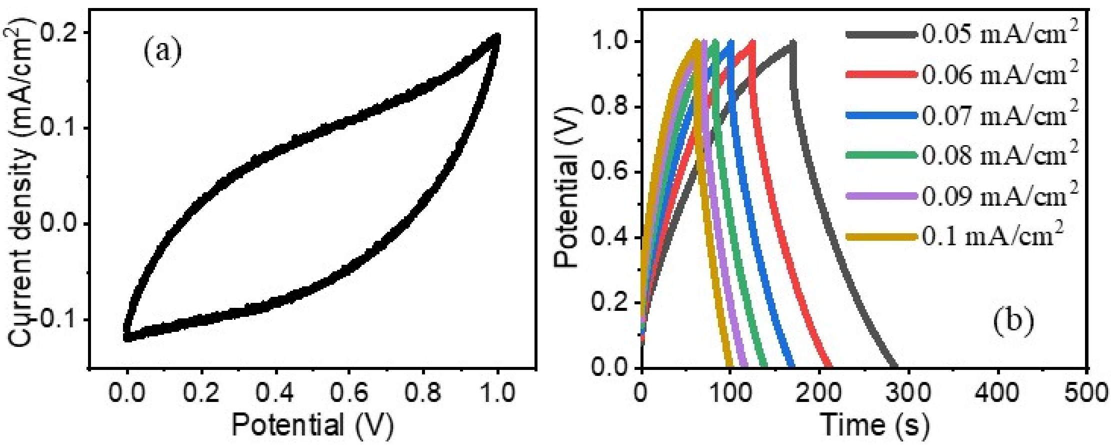

Fig. S2 (a) CV (b) GCDs at varied current densities of the symmetric coin cell fabricated with EPS/rGO (2:1) in 6 M KOH

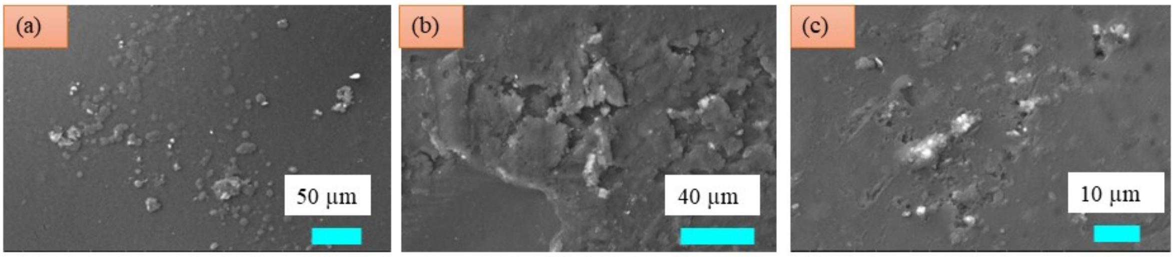

Fig. S3 (a, b, c) FE-SEM images of pristine EPS

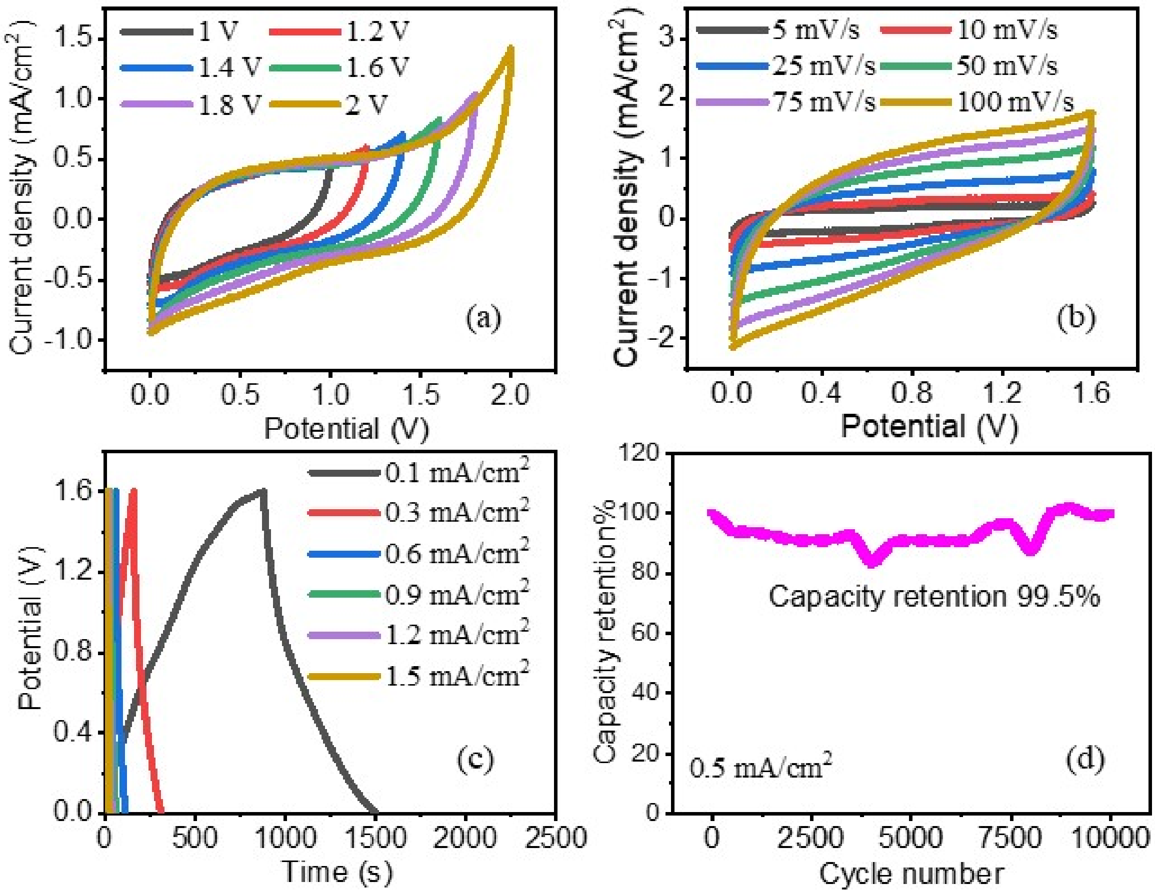

Fig. S4 (a) CVs at varied voltage window (b) CVs at varied scan rates (c) GCDs at varied current densities (d) Capacity retention of the EPS/rGO symmetric coin cell in 1 M Na_2SO_4

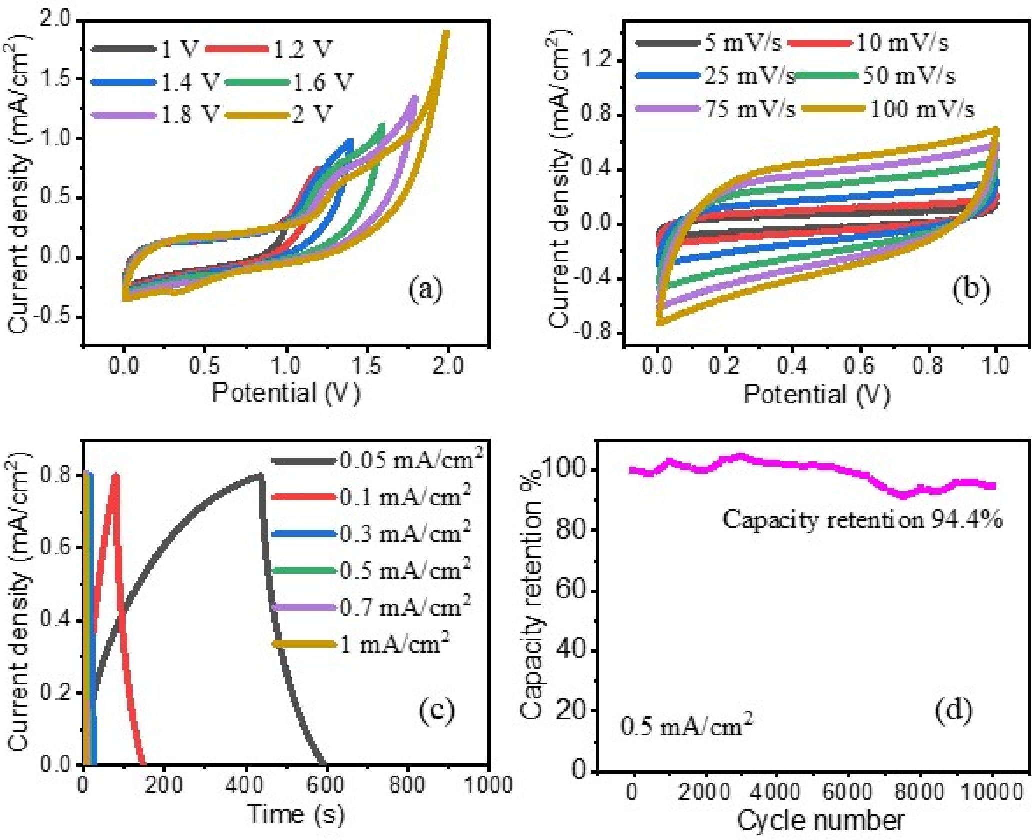

Fig. S5 (a) CVs at varied voltage window (b) CVs at varied scan rates (c) GCDs at varied current densities (d) Capacity retention of the EPS/rGO symmetric coin cell in 1 M H_2SO_4

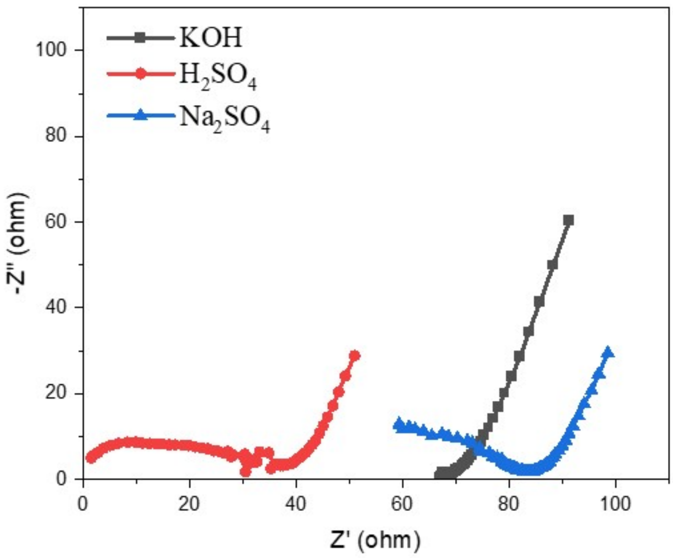

Fig. S6 Nyquist plots EPS/rGO electrode in a three-electrode system with aqueous 1 M KOH, 1 M H_2SO_4, 1 M Na_2SO_4

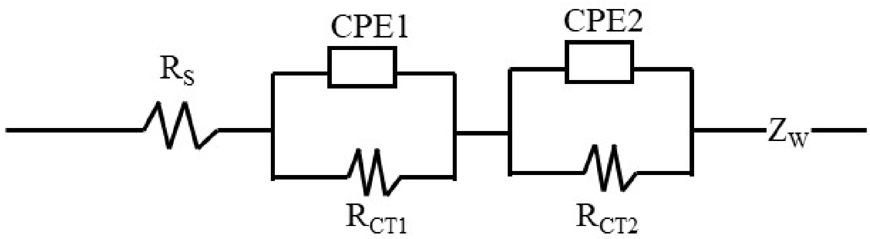

Fig. S7 The equivalent circuit model for the EIS analysis

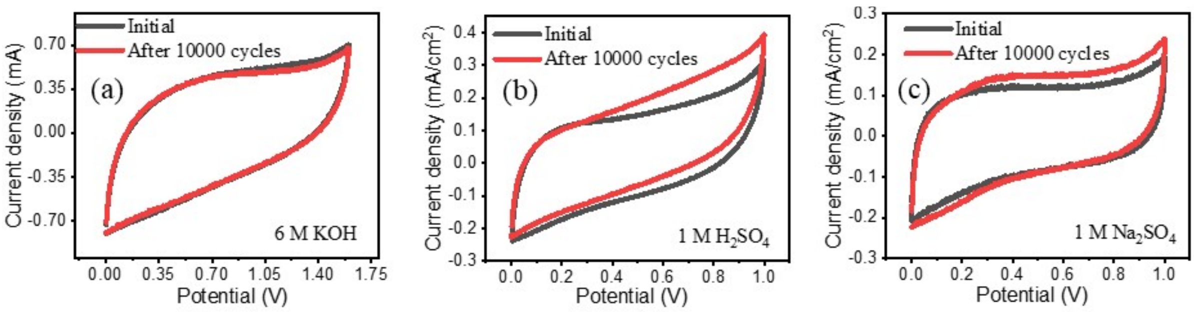

Fig. S8 (a-c) CVs of the EPS/rGO symmetric coin cell recorded at initial and after 10,000 cycles in 6 M KOH, 1 M H_2SO_4, 1 M Na_2SO_4

Formulae used for calculations

The formula used to calculate the areal capacitance of the PS/rGO nanocomposite in a three-electrode system from the GCD curves is as follows[1, 2]:

$$C_a = \frac{I \times \Delta t}{A \times \Delta V}$$

where, C_a is the areal capacitance in mF/cm^2. I is the applied current in mA/cm^2, Δt is the discharge time in s, ΔV is the potential window in V, A is the geometrical area of the electrodes.

For, areal capacitance of the PS/rGO nanocomposite (symmetric) for a coin cell from the GCD curves:

$$C_a = \frac{I \times \Delta t}{A \times \Delta V}$$

where, C_a is the areal capacitance in mF/cm^2. I is the applied current in mA/cm^2, Δt is the discharge time in s, ΔV is the potential window in V, A is the total geometrical area of the both electrodes.

For, areal energy and power density from the GCD curves:

$$E = \frac{C_a \times (\Delta V)^2}{2 \times 3600}$$

where, E is the energy density in mWh/cm^2, C_a is the areal capacitance in mF/cm^2, ΔV is the potential window in V

$$P = \frac{E \times 3600}{\Delta t}$$

where, P is the power density in mW/cm^2, E is the energy density in mWh/cm^2, Δt is the discharge time in s

References

1. Y. Zhu, S. Cheng, W. Zhou, J. Jia, L. Yang, M. Yao, M. Wang, P. Wu, H. Luo, and M. Liu, *ACS Appl Mater Interfaces.*, 2017, 9, 13173-13180.
2. X. Tang, H. Zhou, Z. Cai, D. Cheng, P. He, P. Xie, D. Zhang, and T. Fan, *ACS nano*, 2018, 12, 3502-3511.