Supporting Information

Large area few-layered graphene with scalable preparation from waste biomass for high performance supercapacitor

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Formula and equation used in the manuscript.

The specific capacitance (C_{sp}) can be calculated from cyclic voltammetry via the equation

$$C_{sp} = \frac{I_{avg}}{\mathrm{m}\Delta v} \qquad (1)$$

where I_{avg} is the average current obtained from cathodic and anodic sweeps, υ is the scan rate, and m is the active mass of the pErGO material interdigitated onto the electrode surface.

The specific capacitance, C_{SP} was also calculated from galvanostatic charge-discharge curves by equation (2) as following

$$C_{SP} = \frac{I\Delta t}{\Delta V}\frac{1}{M} \qquad (2)$$

where, I (in A) is the discharge current, Δt (in s) is the discharge time, M (in g) is the active mass of device, and ΔV (in V) is the working voltage.

The energy density (*E*) and power density (*P*) of the supercapacitor system can be expressed by equation. (3) and (4) as following

$$E = \frac{\Delta V^2}{2\times 3600} C_{SP} \qquad (3)$$

$$P = \frac{E\times 3600}{\Delta t} \qquad (4)$$

Where (C_{sp}) is the mass specific capacitance.

Supporting data

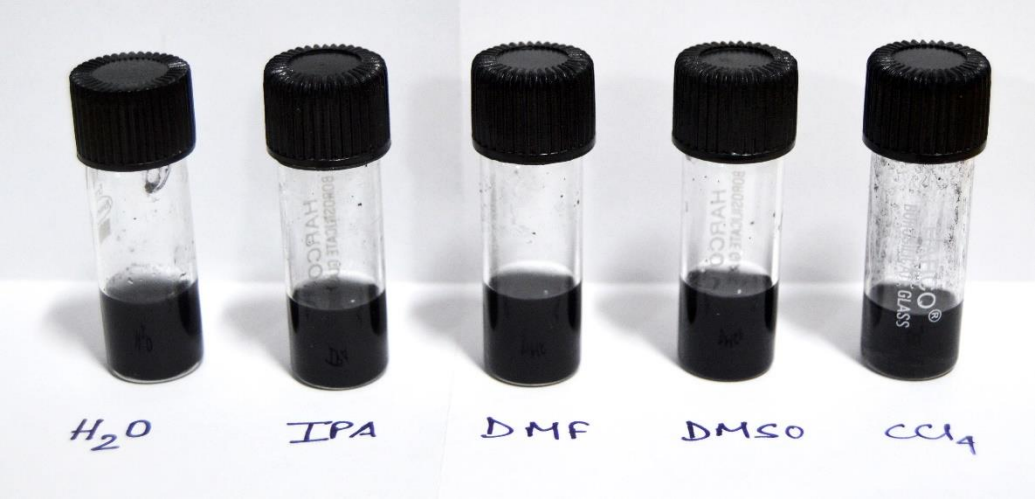

Figure S1: Digital picture of PS-FLG dispersed in solvent of different polarities like water, isopropanol, dimethylformamide, dimethyl sulfoxide and carbon tetrachloride.

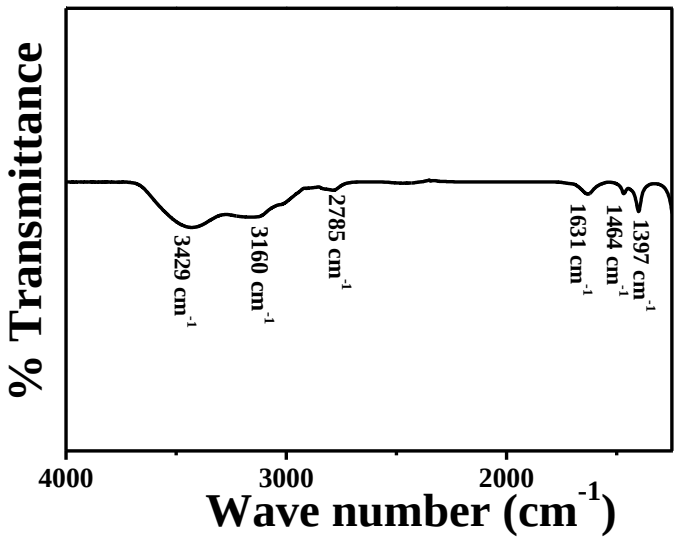

Figure S2: FT-IR spectrum of PS-FLG

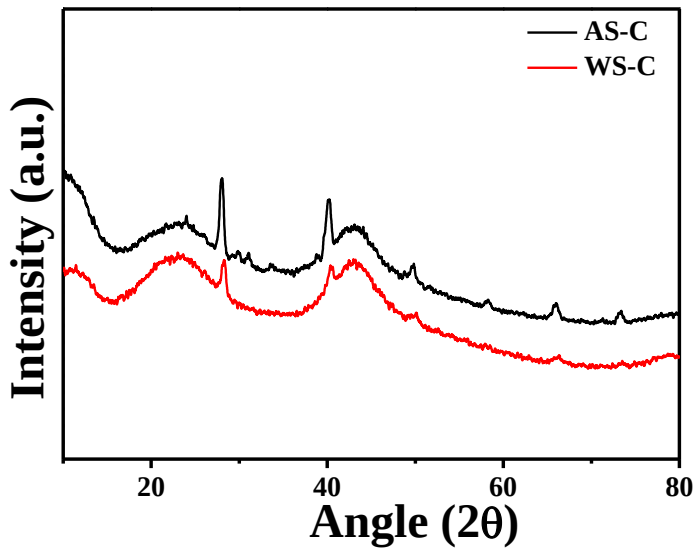

Figure S3: Comparative XRD analysis of WS-C and AS-C.

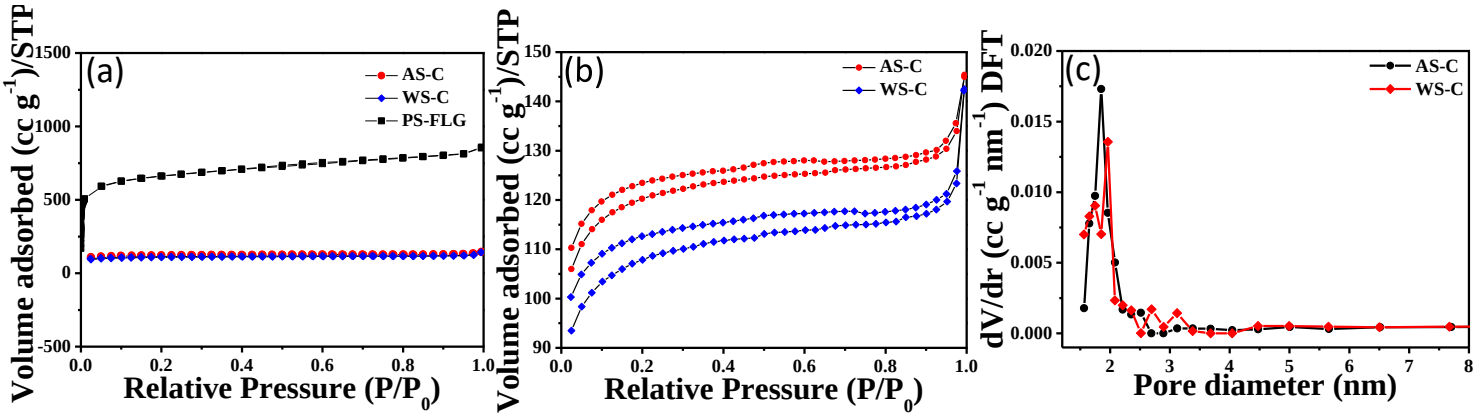

Figure S4: (a) Comparison of N_2 sorption analysis isotherm of PS-FLG with other nutshell derived carbon and (b) Magnified view of figure (a): BET adsorption isotherm plots of AS-C and WS-C. (c) pore size distribution plots of AS-C and WS-C.

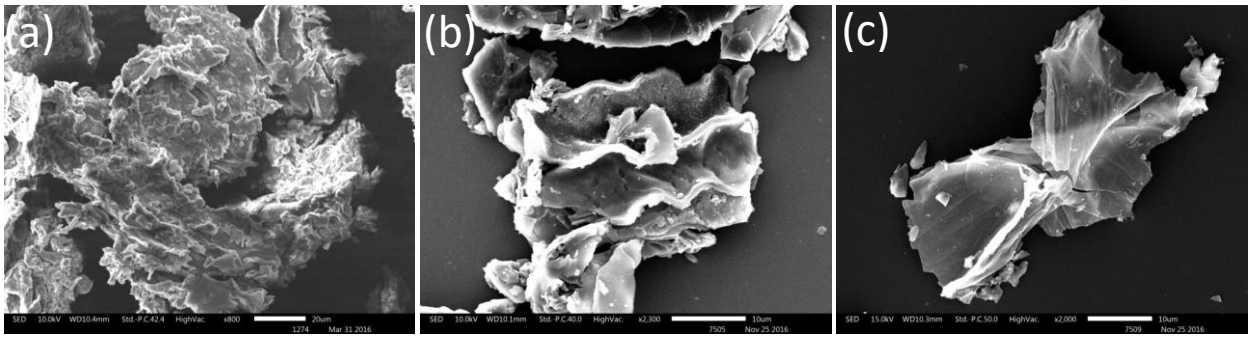

Figure S5. Microscopic surface analysis: SEM images of (a) Pre-carbonized sample (PS-P), (b) PS-C, (c) PS-G. Scale Bars: (a) 20 µm, (b) 10 µm & (c) 10 µm respectively.

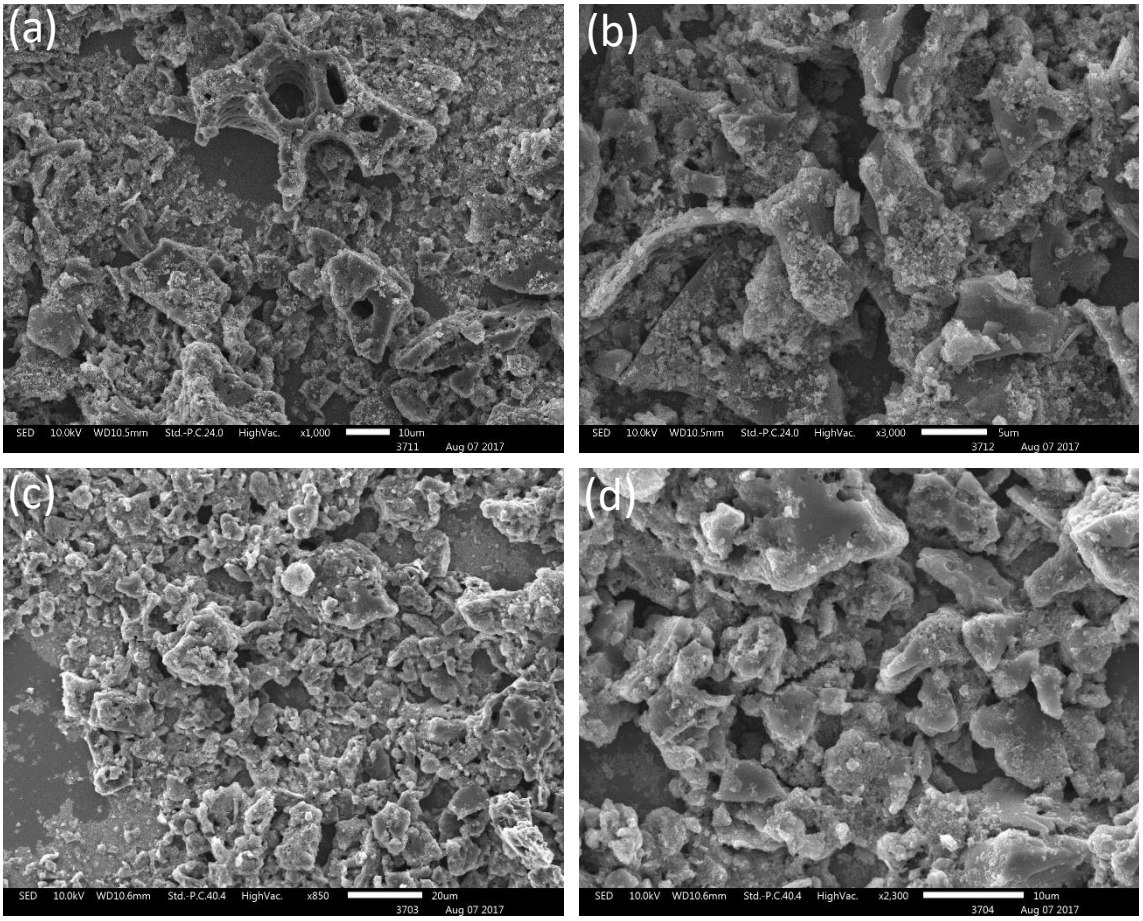

Figure S6. Comparative surface morphological studies: (a) & (b) Microscopic SEM images of Almond Shell Carbon (AS-C). Scale bar: 10 µm & 5 µm. (c) & (d) SEM images of Walnut Shell Carbon (WS-C). Scale bar: 20 µm & 10 µm.

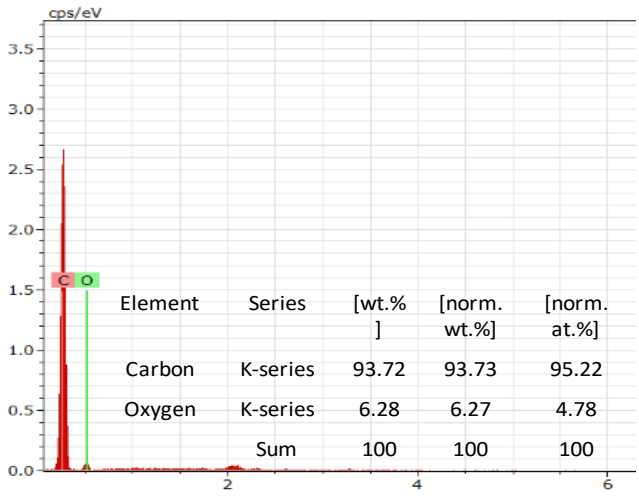

Figure S7. EDS graphs showing elemental distributions in PS-FLG.

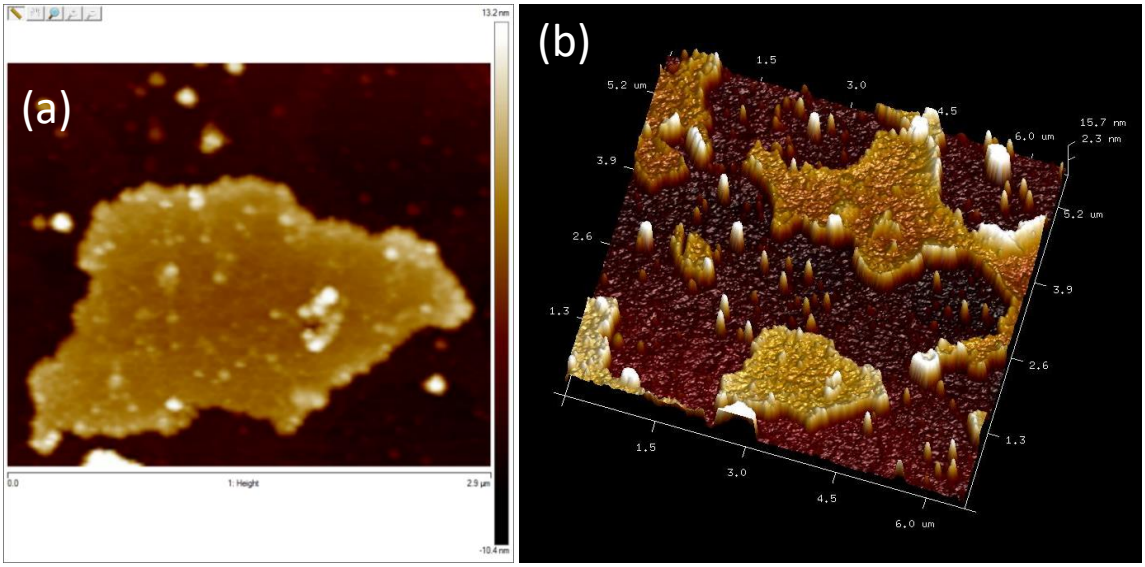

Figure S8. Tapping-mode AFM images of PS-FLG: (a) 2D image at 2.9 µm (b) 3D mapping of PS-FLG.

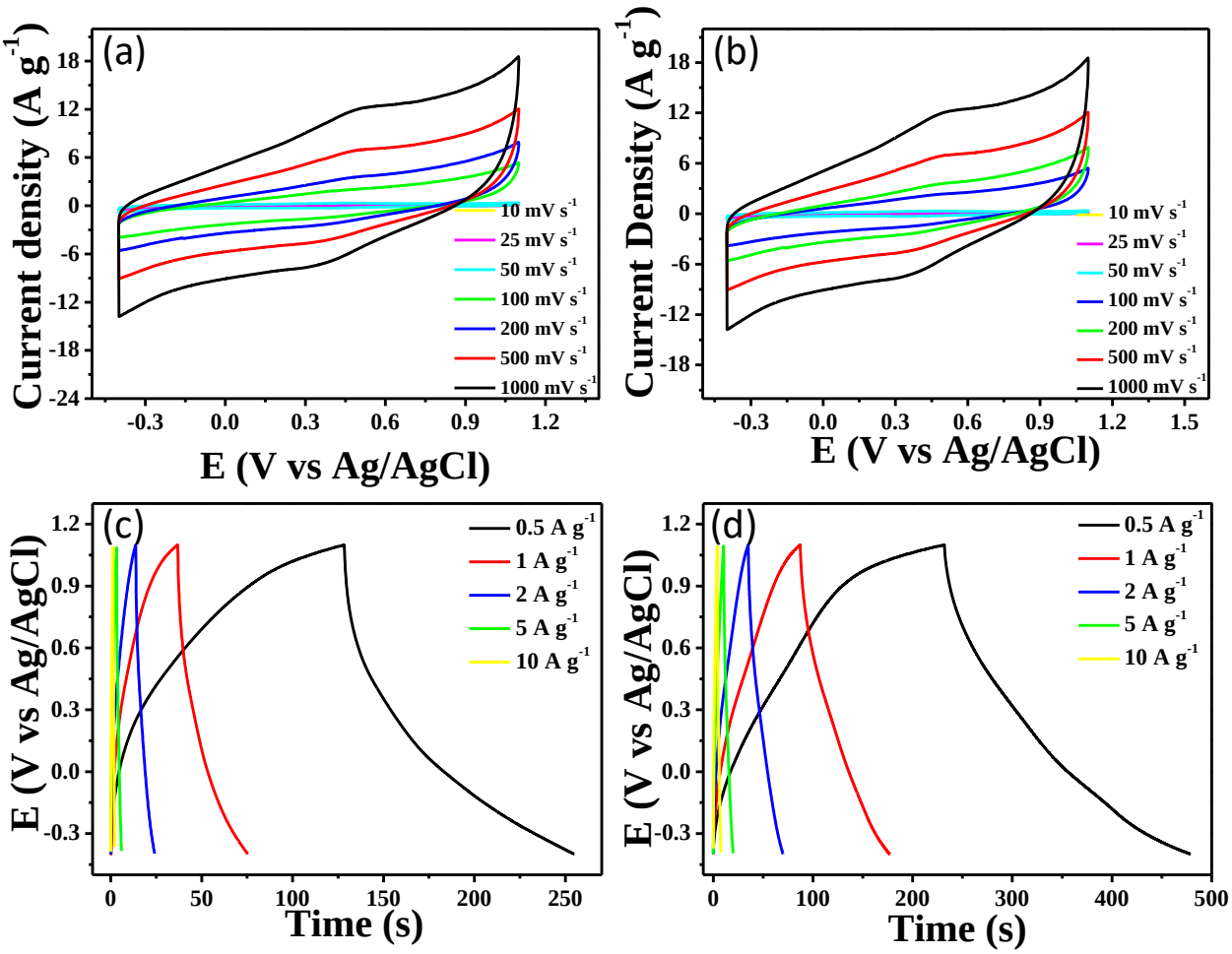

Figure S9: Cyclic voltammogram of (a) WS-C and (b) AS-C at different scan rates. Galvanostatic charge-discharge profile of (c) WS-C and (d) AS-C at different current densities.

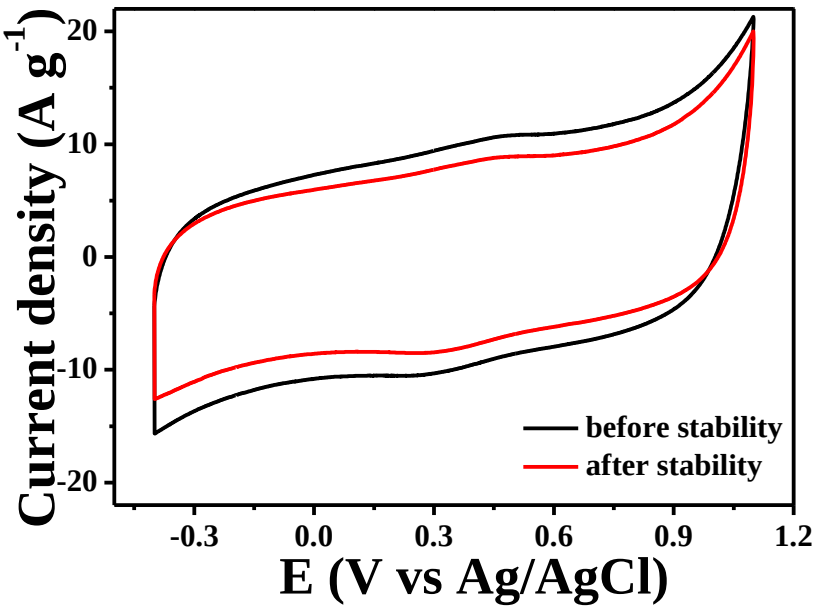

Figure S10: CV curves obtained before and after 5000 cycles of GCD at 10 A g^{-1}

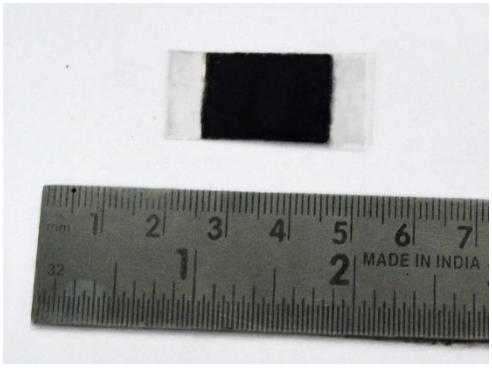

Figure S11: Digital picture of PS-FLG based solid-state supercapacitor device.

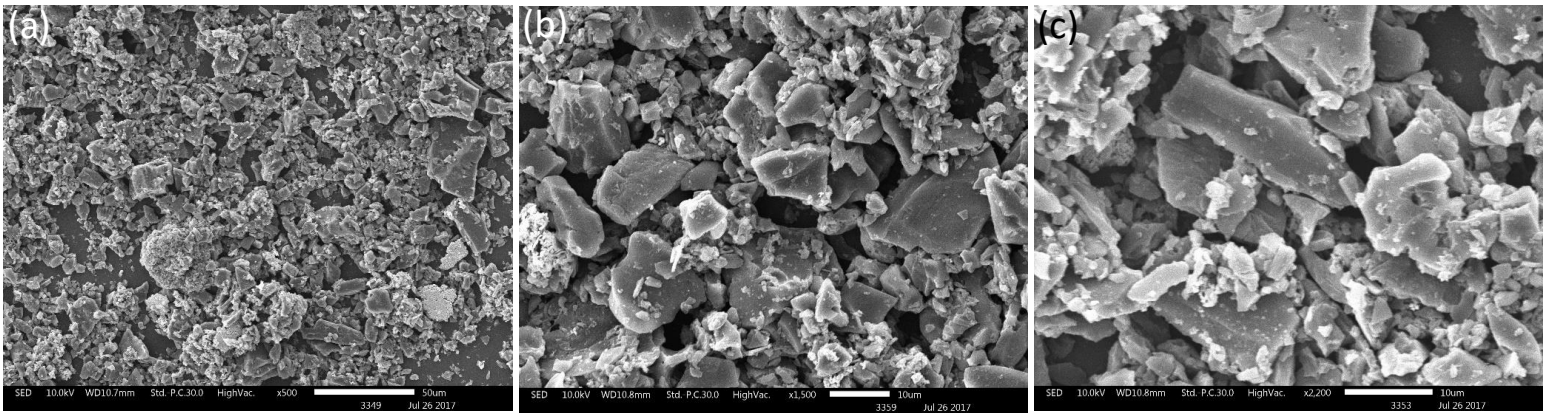

Figure S12. Microscopic SEM images of the solid-state device surface after modifying with the active material, PS-FLG. Scale bar: 50 µm, 10 µm & 10 µm.

Figure S13: Supporting video describes the performance and output deliverance of a supercapacitor device after charging it for 60 sec. the discharging performance of the device was monitored for 180 s.

File name: Supporting video-1

(See video attachment for details)

Table S1: Summarization of surface parameters of PS based materials

Samples	**S_{BET} (m^2g^{-1})**	**Pore size (nm)**	**Pore Volume (cc g^{-1})**
PS-C	645	1.14	0.37
PS-G	1554	1.22	0.93
PS-FLG	**2070**	**1.28**	**1.33**
WS-C	363	1.85	0.047
AS-C	403	1.96	0.035