Electronic Supplementary Information

Newly Design Porous/Sponge Red Phosphorus@Graphene and Highly Conductive Ni_2P Electrode for Asymmetric Solid State Supercapacitive Device With Excellent Performance

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Table. S1 Performance comparison of the nickel phosphide-based electrode materials in three-electrode configuration with previously published results.

S. No.	Electrode material	Electrolyte	Current density (Ag^{-1})	Specific capacitance (Fg^{-1})	Retention %	No of cycles	Ref.
1	Ni_2P	2.0M LiOH	1	418			1
2	Ni-coated Ni_2P	2.0M LiOH	1	581	92.3	3,000	1
3	Ni_2P nano belt	0.5M H_2SO_4	0.625	1074	86.7	3000	2
4	$Ni_2P/Ni_{12}P_5$	2M KOH	1	1325.7	81	20,000	3
5	Ni-P	2.0 M KOH	1	1338.7	71.4	1,000	4
6	Ni_2P	2.0 M KOH	1	843.3	100	1000	5
7	$Au/Ni_{12}P_5$	2.0 M KOH	0.2	806.1	91.0	1,000	6
8	Ni_2P/rGO	2.0 M KOH	1	2354	100	2,500	7
9	Ni_2P NS/NF	6.0 M KOH	2.5	3496	61.0	5,000	8
10	Ni_2P	2.0 M KOH	1	600	82.5	1,000	9
11	Ni2P@5%GR	3 M KOH	1	672.4	30	2000	10
12	Ni_2P nano particle	3M KOH	1	668.7	--	--	11
13	Ni_2P	2M KOH	1	1526.6	88	2,500	Present work
14	Ni_2p	2M KOH	1	980	--	--	Present work

Picture of the rP@rGO foam

Figure. S1 Picture of red phosphorus@graphene foam.

Assembled asymmetric supercapacitive device

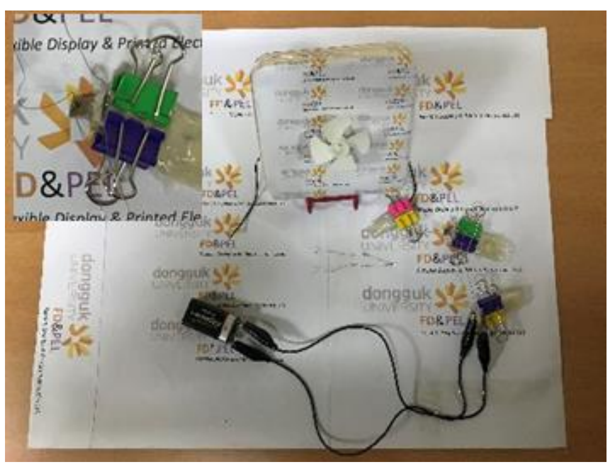

Figure. S2 Picture of assembled asymmetric supercapacitive device**.**

SEM, TEM, and HRTEM images of the B-rGO

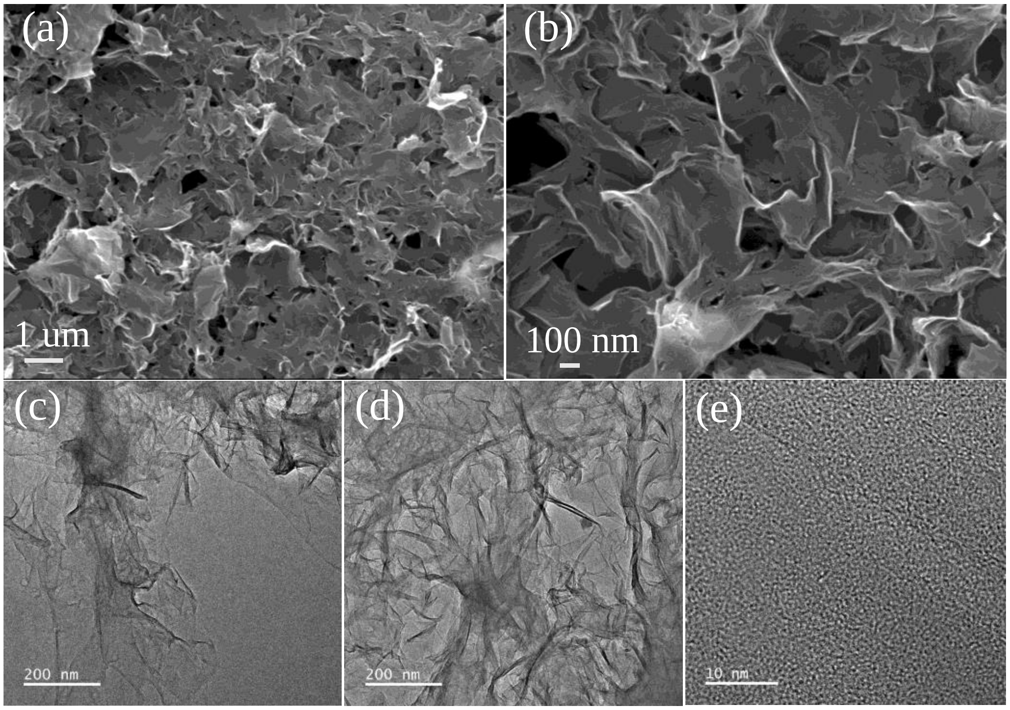

Figure. S3 (**a-b**) SEM images (**c-d**) TEM image and (**e**) HRTEM images of the B-rGO.

Survey spectra of the rP@rGO

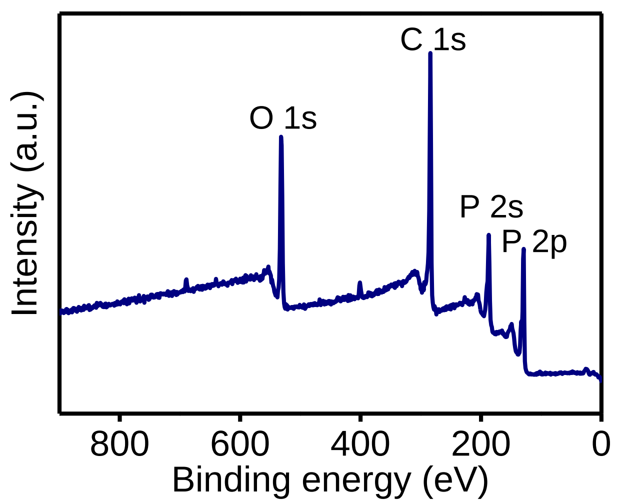

Figure. S4 XPS surway spectra of the rP@rGO.

O 1s spectra of the rP@rGO

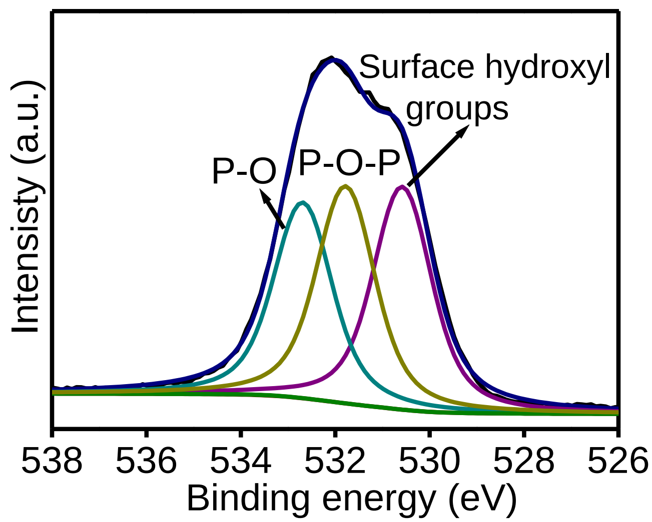

Figure. S5 O 1s spectra of the rP@rGO.

SEM and mapping images of the Ni_2P-1

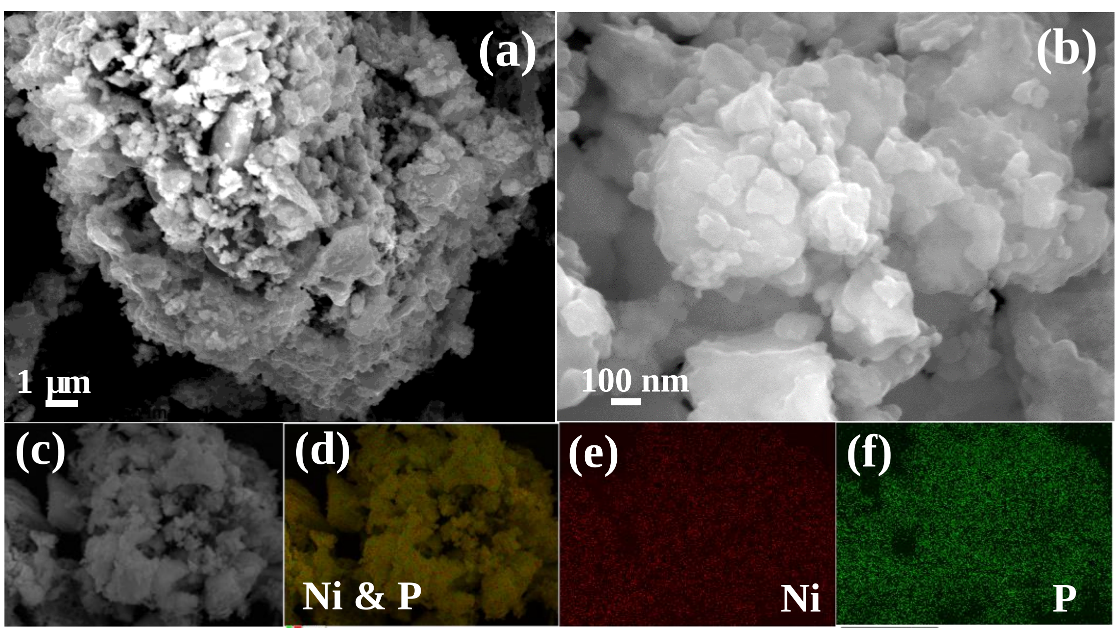

Figure S6. (**a** and **b**) SEM images, and (**c-f**) corresponding elemental mapping of the Ni_2P-1.

XPS spectra of Ni_2P-2

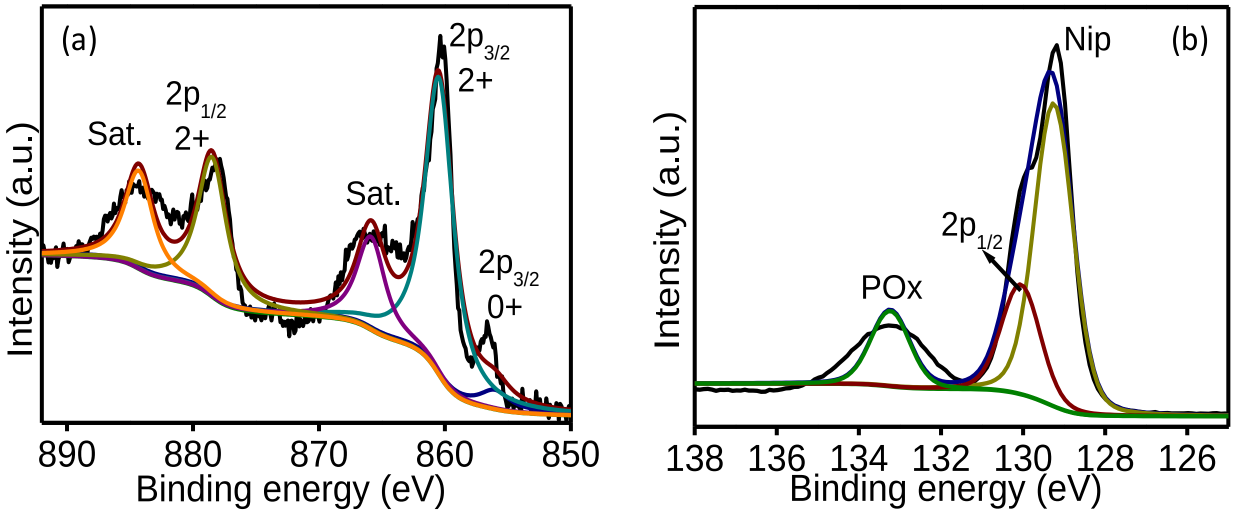

Figure S7. High magnification XPS spectra of Ni_2P (a) Ni and (b) P.

To estimate the specific capacitance of the as prepared positive and negative electrode inside the half-cell assembly the following equation were used.[3,5]

$$C = \frac{Idt}{mdV} \qquad \text{(S1)}$$

Where C is the specific capacitance (F/g), *I* is the applied current, t is the discharge time, m represent the mass of the active materials over the surface of the current collector, and *d*V is the applied potential window.

To estimate the specific capacitance of the assembled asymmetric supercapacitor gadget the following equation are used.[3,5]

$$C = \frac{Idt}{mdV} \qquad \text{(S2)}$$

Where C is the specific capacitance (F/g), *I* is the applied current, t is the discharging time, m is active mass loading over the surface of the current collector, and *d*V is the applied potential window.

Whereas the power density and energy density were estimated from the following equation:[5]

$$E = \frac{1}{2}CV^2 \qquad \text{(S3)}$$

$$P = \frac{E}{t} \qquad \text{(S4)}$$

Where C is the specific capacitance, V is the applied potential window and t is the discharging time of the device.

The CV profile of all the Ni_2P electrodes

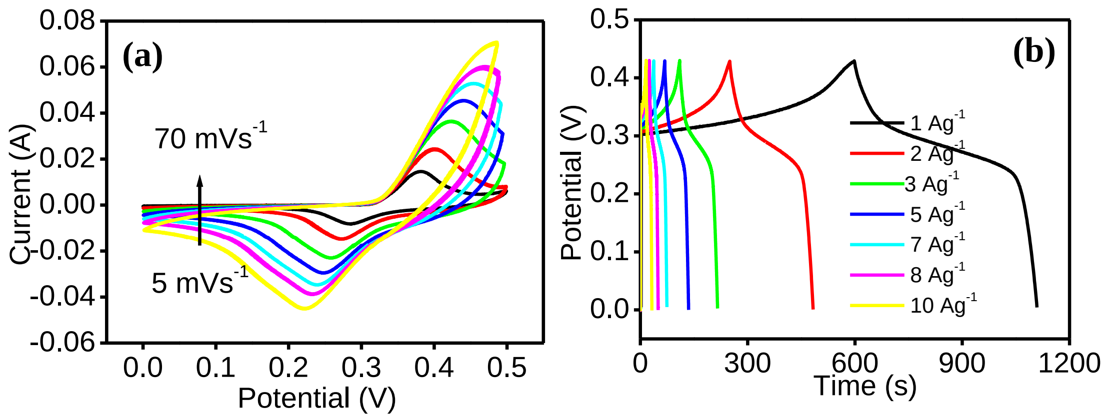

Figure S8. The CV (**a**) and CD (**b**) profile of Ni_2P-1electrode.

Picture of the assembled device illumination of the LED light

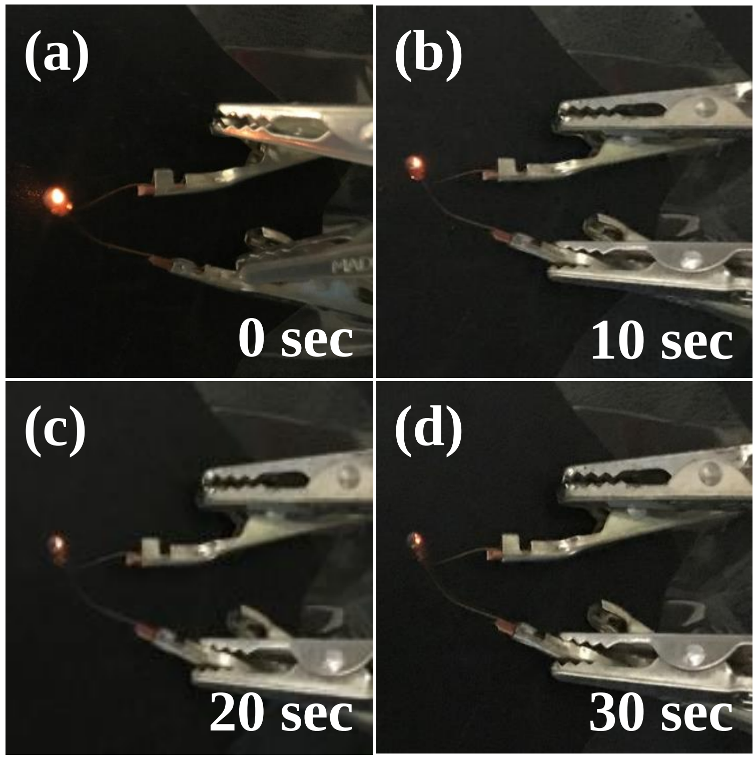

Figure S9. (a-d) Picture of the assembled device illumination of the LED light.

Picture of the assembled device and fan powered by the assembled device

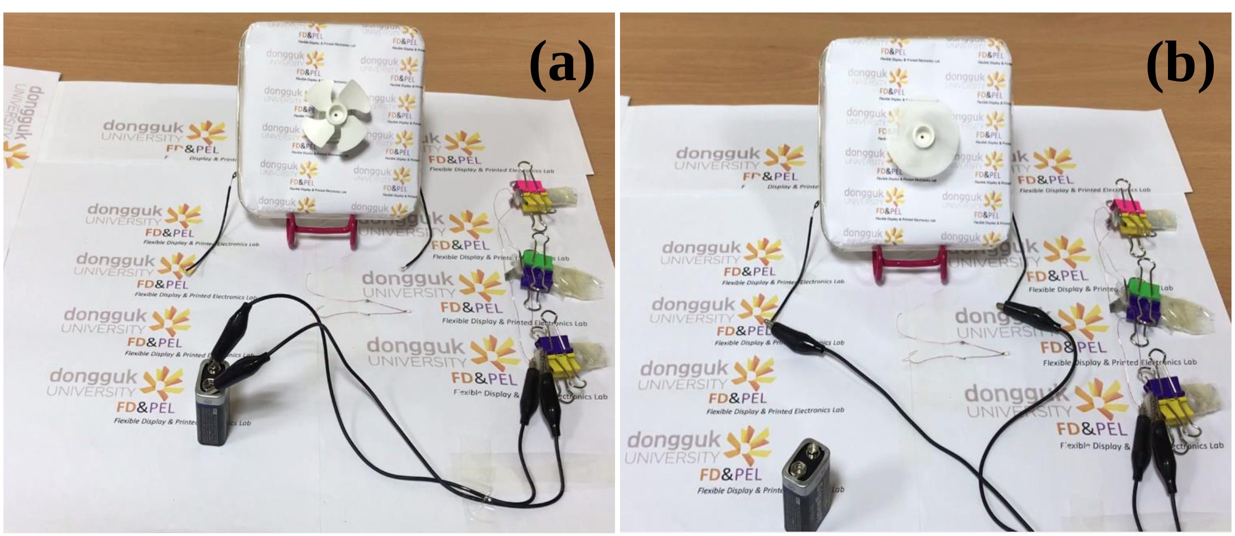

Figure S10. Picture of the assembled device and fan powered by the assembled device.

References

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