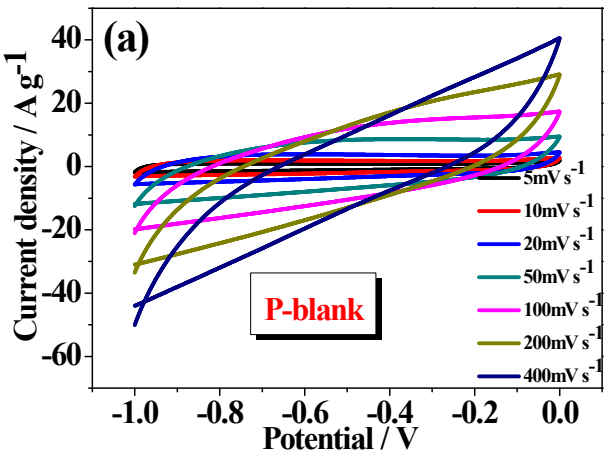
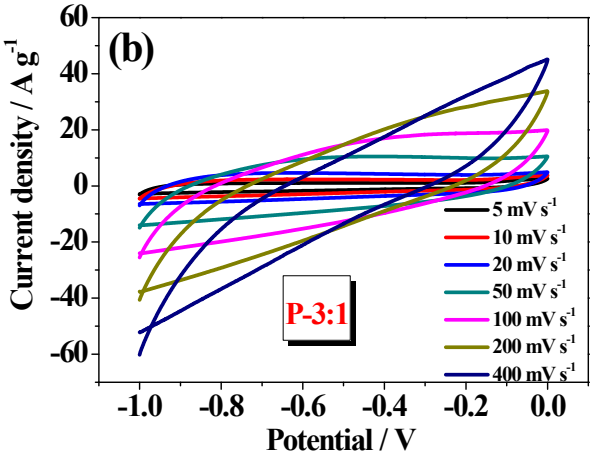
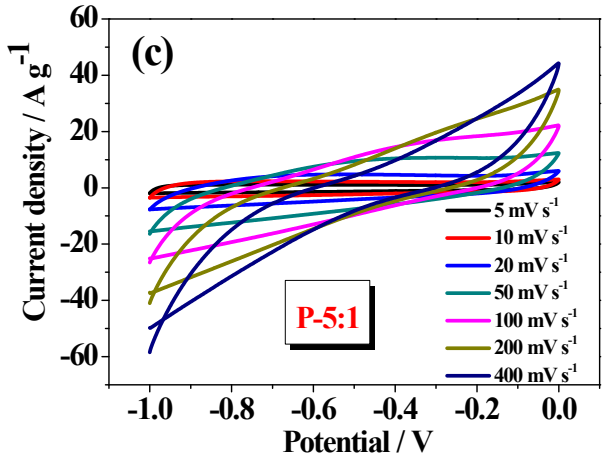
Supporting Information:

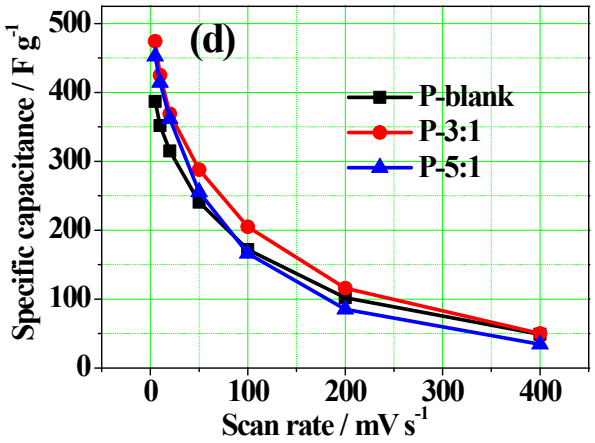
Remarkable capacitive enhancements of templated carbon materials by the redox additive electrolyte of *p*-phenylenediamine

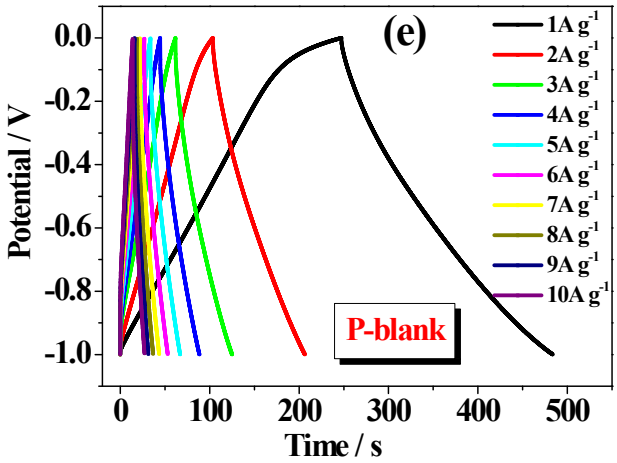
Yong Fu Nie[1+], Qian Wang[1+], Hai Tao Yi[1], Xiang Ying Chen[1,*], and Zhong Jie Zhang[2,]**

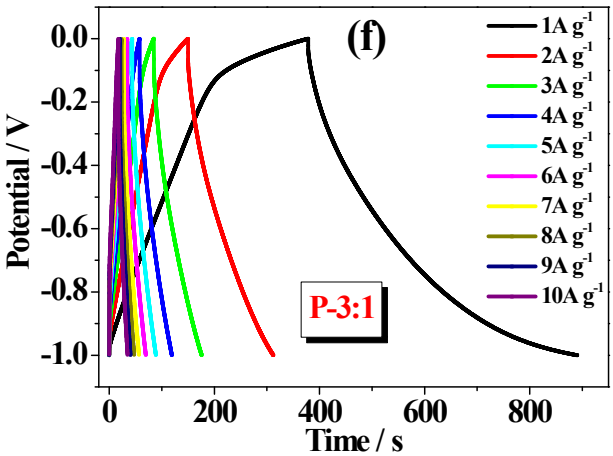

(a)
Current density / A g-1
Potential / V
P-blank
5mV s-1
10mV s-1
20mV s-1
50mV s-1
100mV s-1
200mV s-1
400mV s-1


(b)
Current density / A g-1
Potential / V
P-3:1
5 mV s-1
10 mV s-1
20 mV s-1
50 mV s-1
100 mV s-1
200 mV s-1
400 mV s-1


(c)
Current density / A g-1
Potential / V
P-5:1
5 mV s-1
10 mV s-1
20 mV s-1
50 mV s-1
100 mV s-1
200 mV s-1
400 mV s-1


(d)
Specific capacitance / F g-1
Scan rate / mV s-1
P-blank
P-3:1
P-5:1


(e)
Potential / V
Time / s
P-blank
1A g-1
2A g-1
3A g-1
4A g-1
5A g-1
6A g-1
7A g-1
8A g-1
9A g-1
10A g-1


(f)
Potential / V
Time / s
P-3:1
1A g-1
2A g-1
3A g-1
4A g-1
5A g-1
6A g-1
7A g-1
8A g-1
9A g-1
10A g-1

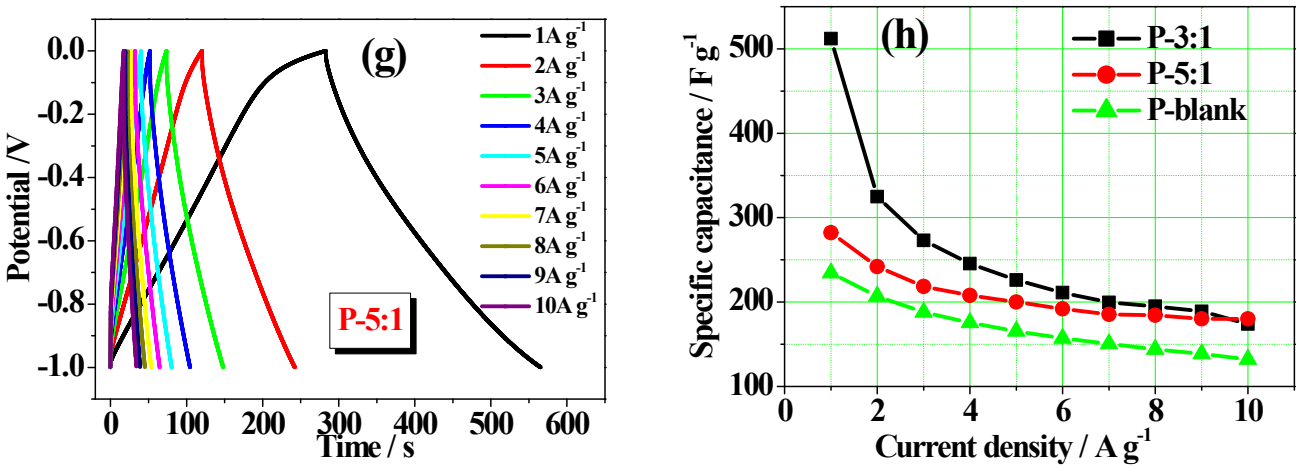


Fig. S1. P-blank, P-3:1, P-5:1 samples: (a, b, c) CV curves; (d) specific capacitances calculated from CV curves; (e, f, g) GCD curves; (h) specific capacitances calculated from GCD curves.

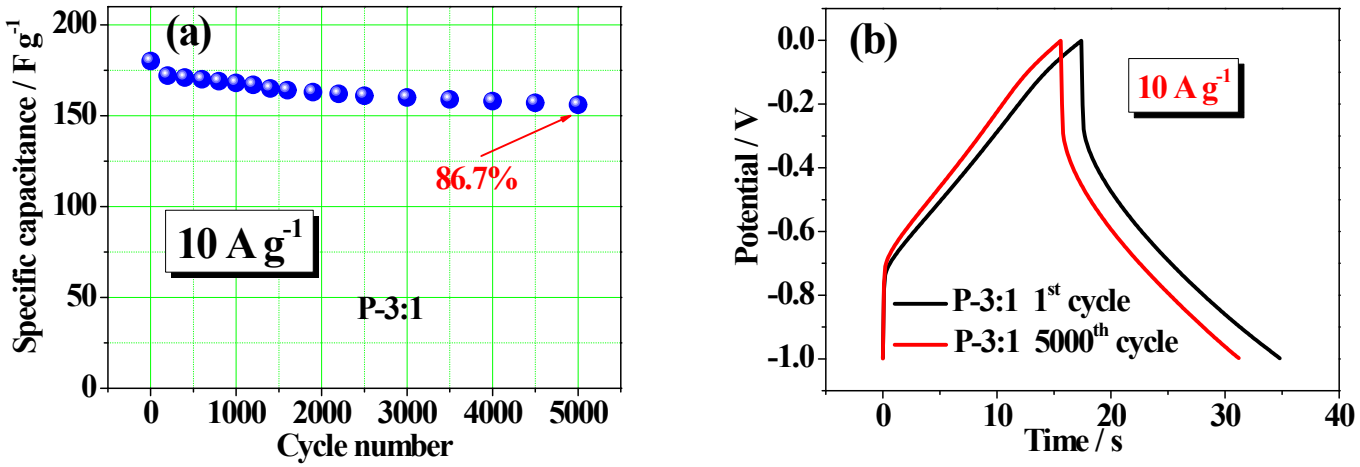


Fig. S2. P-3:1 carbon sample: (a) cycling stability measured at 10 A g^{-1}; (b) GCD curves before/after 10^4cycles cycling stability measured at 10 A g^{-1}.

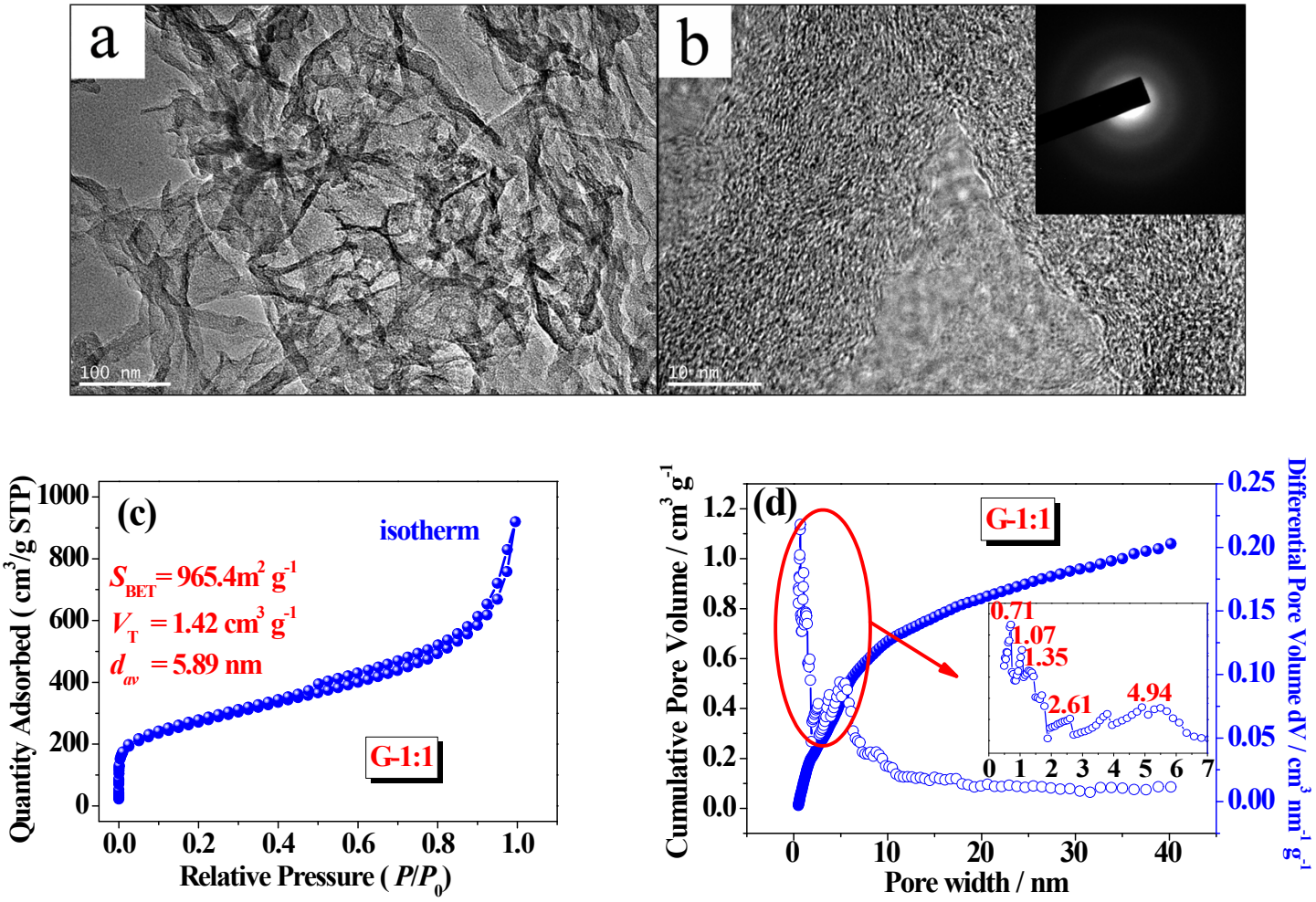
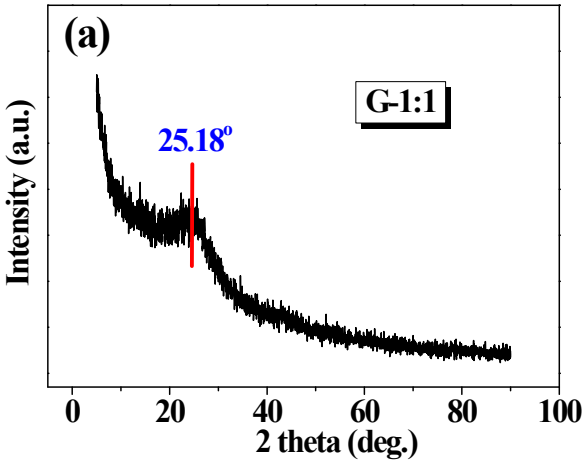
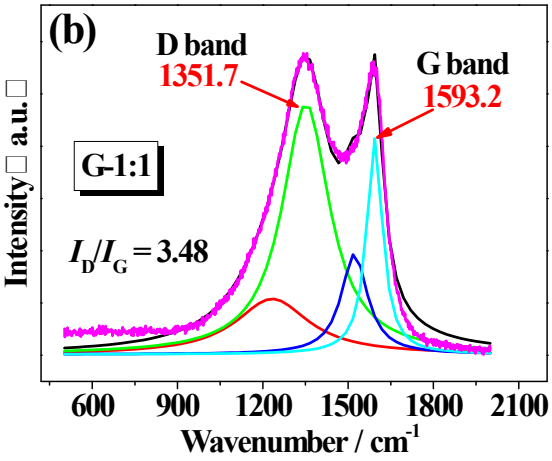
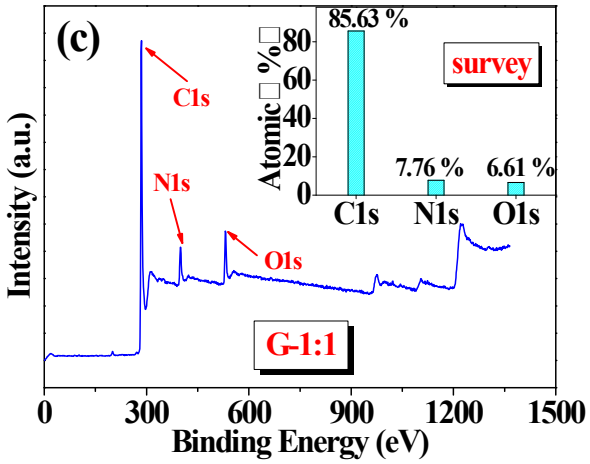
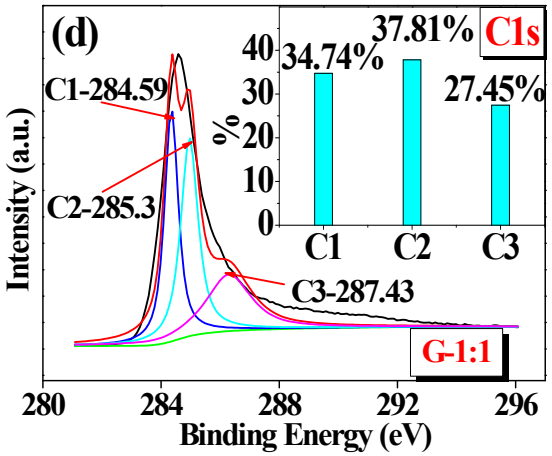


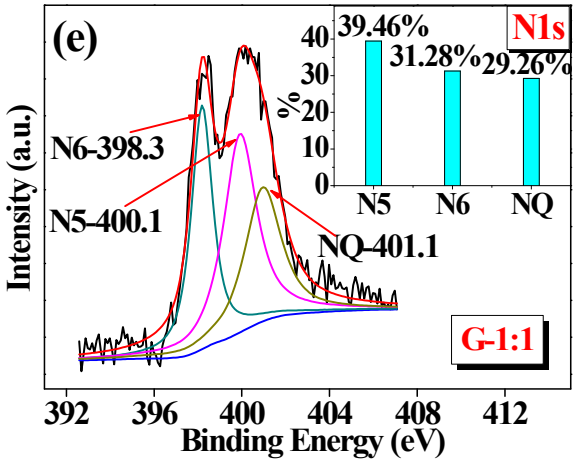
Fig. S3. The **G-1:1** sample: (a-b) HRTEM images as well as the magnified SAED pattern (the insets); (c) N_2 adsorption-desorption isotherm; (d) cumulative pore volume and pore size distribution curves (estimated by using a slit/cylindrical NLDFT model).


(a)
G-1:1
25.18°
Intensity (a.u.)
0
20
40
60
80
100
2 theta (deg.)


(b)
D band
1351.7
G band
1593.2
G-1:1
I_D/I_G = 3.48
Intensity a.u.
600
900
1200
1500
1800
2100
Wavenumber / cm-1


(c)
C1s
N1s
O1s
survey
85.63 %
7.76 %
6.61 %
Atomic %
C1s
N1s
O1s
G-1:1
Intensity (a.u.)
0
300
600
900
1200
1500
Binding Energy (eV)


(d)
C1-284.59
C2-285.3
C3-287.43
C1s
34.74%
37.81%
27.45%
%
C1
C2
C3
G-1:1
Intensity (a.u.)
280
284
288
292
296
Binding Energy (eV)


(e)
N6-398.3
N5-400.1
NQ-401.1
N1s
39.46%
31.28%
29.26%
%
N5
N6
NQ
G-1:1
Intensity (a.u.)
392
396
400
404
408
412
Binding Energy (eV)

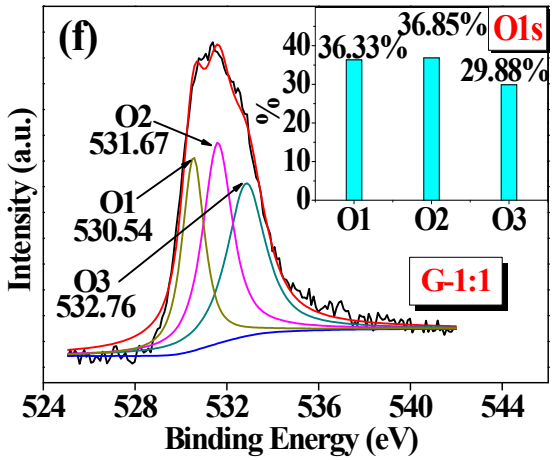
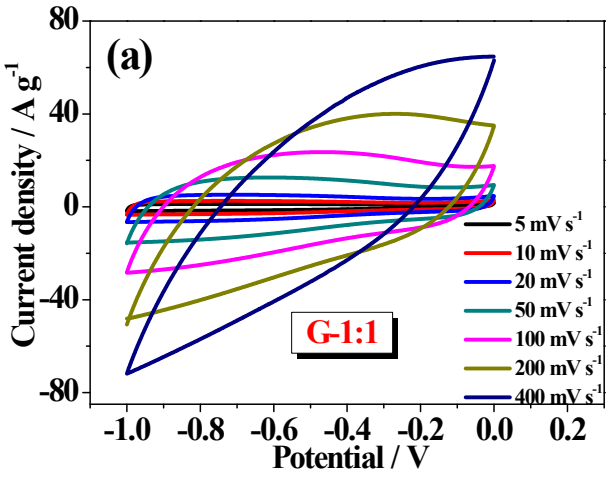
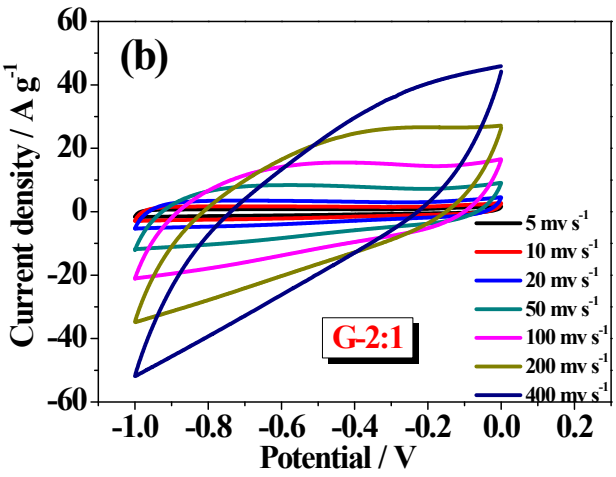
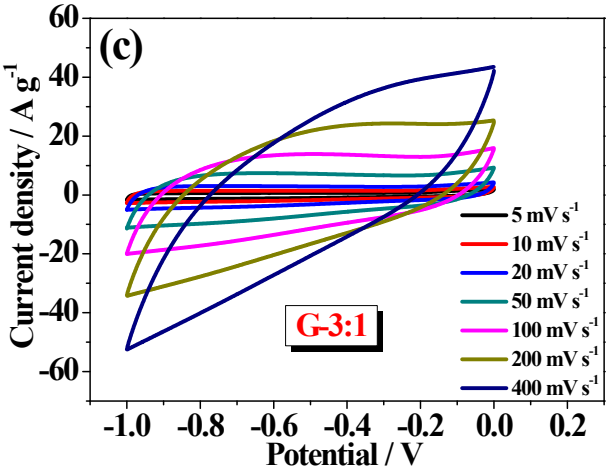
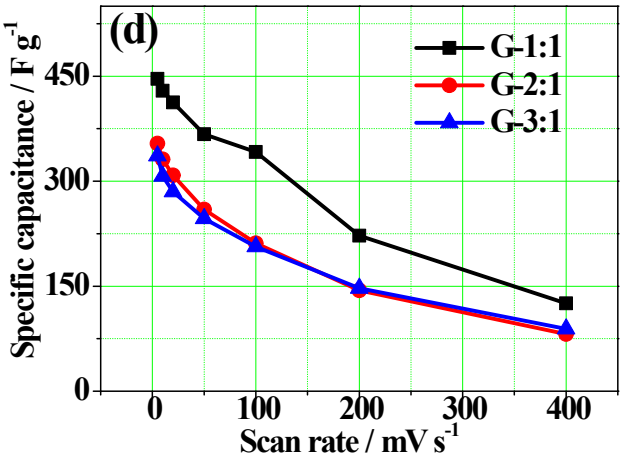

(f)
O2
531.67
O1
530.54
O3
532.76
O1s
36.33%
36.85%
29.88%
%
O1
O2
O3
G-1:1
Intensity (a.u.)
524
528
532
536
540
544
Binding Energy (eV)

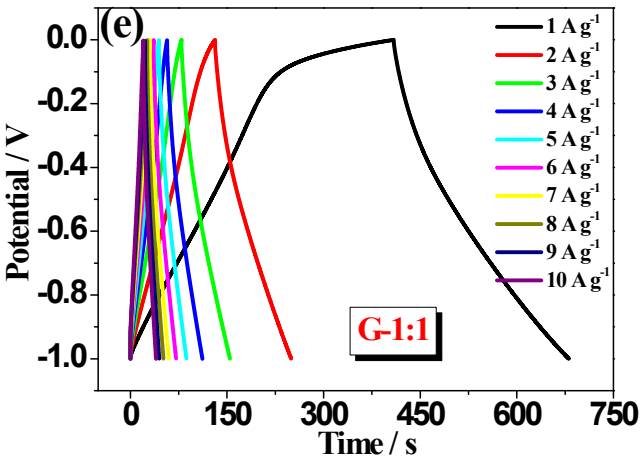
Fig. S4. The **G-1:1** sample: (a) XRD pattern; (b) Raman spectrum with deconvoluted peaks; (c) survey (the insets are summary of carbon/oxygen/nitrogen contents); (d, e, f) C1s, N1s, O1s spectra with deconvoluted peaks (the insets are contents of different carbon, nitrogen, oxygen species).

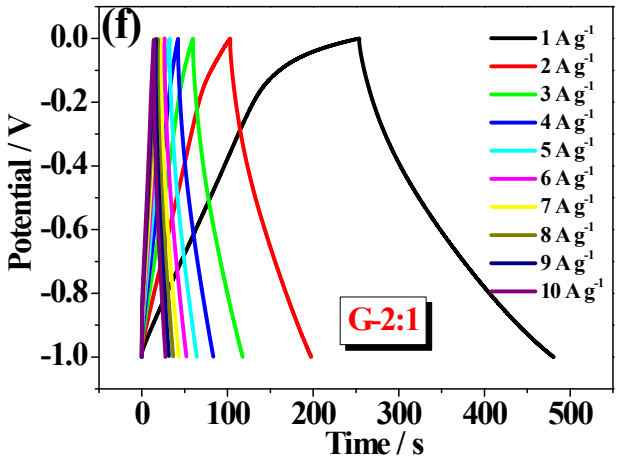

(a)
Current density / A g-1
Potential / V
G-1:1
5 mV s-1
10 mV s-1
20 mV s-1
50 mV s-1
100 mV s-1
200 mV s-1
400 mV s-1


(b)
Current density / A g-1
Potential / V
G-2:1
5 mv s-1
10 mv s-1
20 mv s-1
50 mv s-1
100 mv s-1
200 mv s-1
400 mv s-1


(c)
Current density / A g-1
Potential / V
G-3:1
5 mV s-1
10 mV s-1
20 mV s-1
50 mV s-1
100 mV s-1
200 mV s-1
400 mV s-1


(d)
Specific capacitance / F g-1
Scan rate / mV s-1
G-1:1
G-2:1
G-3:1


(e)
Potential / V
Time / s
G-1:1
1 A g-1
2 A g-1
3 A g-1
4 A g-1
5 A g-1
6 A g-1
7 A g-1
8 A g-1
9 A g-1
10 A g-1


(f)
Potential / V
Time / s
G-2:1
1 A g-1
2 A g-1
3 A g-1
4 A g-1
5 A g-1
6 A g-1
7 A g-1
8 A g-1
9 A g-1
10 A g-1

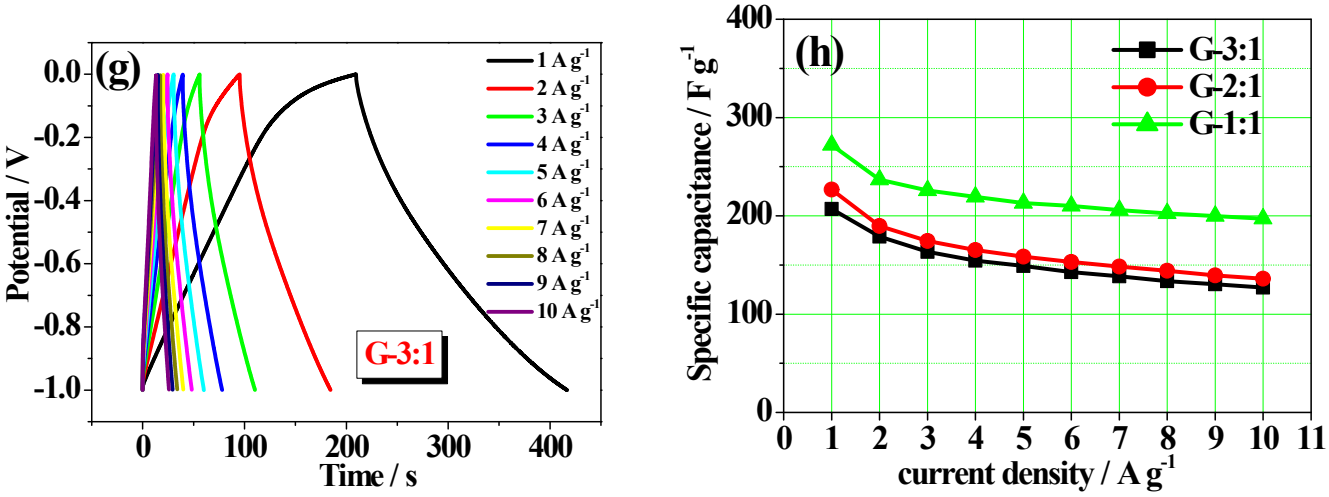


Fig. S5. G-1:1, G-2:1, G-3:1 carbon samples: (a, b, c) CV curves; (d) specific capacitances calculated from CV curves; (e, f, g) GCD curves; (h) specific capacitances calculated from GCD curves.

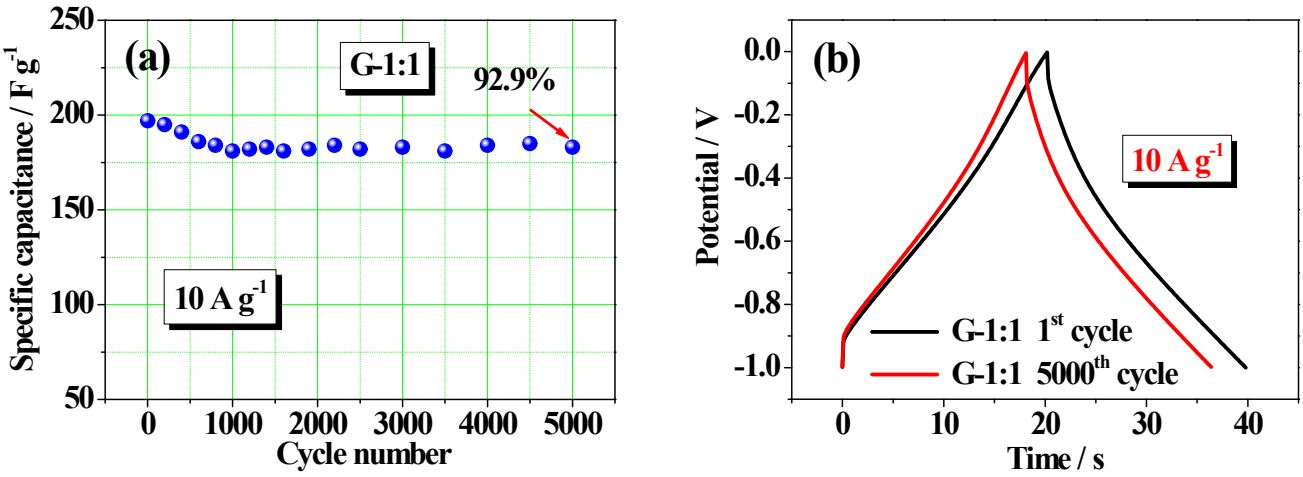


Fig. S6. G-1:1 carbon sample: (a) cycling stability measured at 10 A g^{-1}; (b) GCD curves before/after 5000th cycles cycling stability measured at 10 A g^{-1}.

Specific energy and specific power are two significant electrochemical parameters for calculating the employment of electrochemical supercapacitors. The energy and power densities are calculated based on the following equation:

$$\mathrm{E} = \frac{1}{2} C \Delta V^2$$

$$\mathrm{P} = \frac{E}{\Delta t}$$

Where E (Wh kg^{-1}) is the average energy density, C (F g^{-1}) is the specific capacitance, ΔV (V) is the voltage range, P (W kg^{-1}) is the average power density, and Δt (s) is the discharge time.[1, 2]

Furthermore, the Ragone plots relating the energy density and power density are exhibited in Fig. S7a. To sum up, the **P-3:1-15** sample shows excellent Ragone results than the **P-3:1** sample. The **P-3:1-15** sample can achieve a high energy density of 118.33 Wh kg^{-1} at the power density of 1.0 kW kg^{-1}. The decrease of the energy density (90.56 Wh kg^{-1}) can be experimentally observed when increasing the power density to be 5.0 kW kg^{-1}.

Moreover, Specific energy and specific power are two significant electrochemical parameters and therefore the Ragone plots are exhibited in Fig. S7b. In a nutshell, the **G-1:1-10** sample shows superb Ragone results than the **G-1:1** sample. The **G-1:1-10** sample and the **G-1:1-10** sample can achieve a high energy density of 61.67 and 32.89 Wh kg^{-1} at the power density of 1.0 kW kg^{-1}, respectively. The decrease of the energy density can be experimentally observed when increasing the power density to be 5.0 kW kg^{-1}.

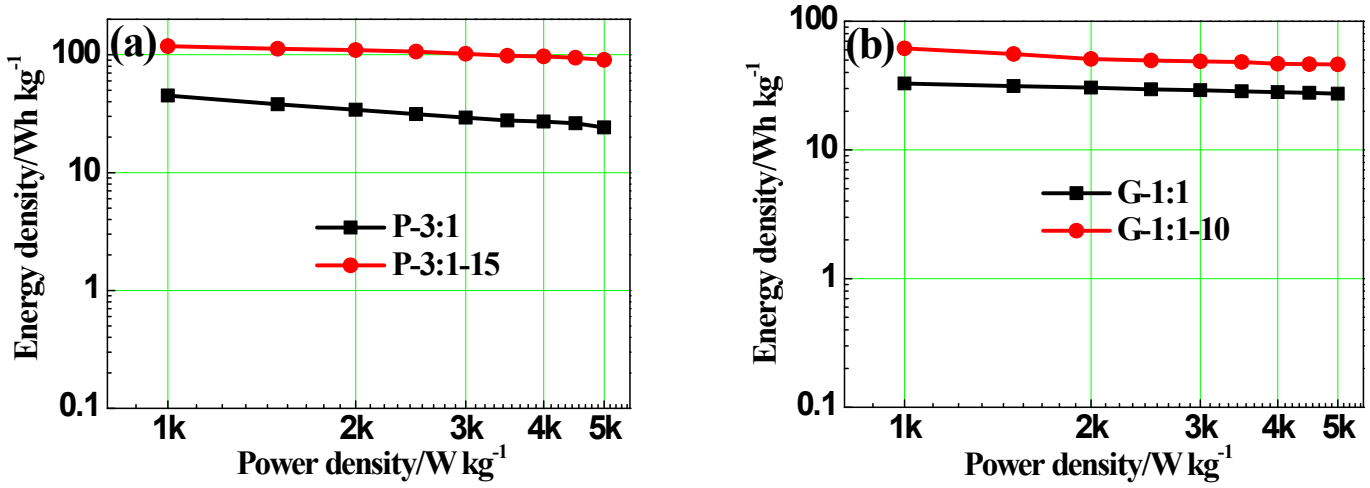


Fig. S7. Ragone plots showing energy density vs. power density: (a) The **P-3:1**, **P-3:1-15** samples; (b) The **G-1:1**, **G-1:1-10** samples.

References

1 Q. Wu, Y. X. Xu, Z. Y. Yao, A. R. Liu and G. H. Shi, *ACS Nano*, 2010, **4**, 1963–1970.

2 J. Yan, J. Liu, Z. Fan, T. Wei and L. Zhang, *Carbon*, 2010, **50**, 2179–2188.