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Supporting Information

Carbon nanofibers by pyrolysis of self-assembled perylene diimide derivative gels as supercapacitor electrode materials

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Table S1. Elemental analysis of the carbonized samples.

sample	C (%)	H (%)	N (%)
K + GdL	44.33	0.79	1.72
N + GdL	65.57	1.36	6.81
T + GdL	88.09	1.64	2.86
K + MM + GdL	42.74	1.14	3.72
N + MM + GdL	65.02	0.92	4.97
T + MM + GdL	84.84	1.27	4.06

Table S2. Comparison of specific capacitance with different scan rates by CV testing for the F-127-templated CNF electrode with the CNF area loading of 0.14 mg cm^{-2} and 1.13mg cm^{-2}.

Scan rate (mV s^{-1})	Capacitance (F g^{-1})	
	0.14 mg cm^{-2}	1.13 mg cm^{-2}
2	320	210
5	244	200
10	215	186
20	172	177
50	144	161
100	122	142
200	118	107

Table S3. Comparison of specific capacitance with different current densities by Galvanostatic charge/discharge testing for the F-127-templated CNF electrode with the CNF area loading of 0.14 mg cm^{-2} and 1.13 mg cm^{-2}.

Current density (A $g^{-1)}$	Capacitance (F g^{-1})	
	0.14 mg cm^{-2}	1.13 mg cm^{-2}
1	192	180
2	164	170
5	148	157
10	131	143
20	105	121

Table S4. Comparison of the specific capacitance of the CNF-based eletrodes in the literature.

Electrode	Electrolyte	Current density or scan rate	Electrode system	Capacitance (F g^{-1})	Ref
Graphene oxide - CNT/CNF	0.5 M $NaSO_4$	0.5 A g^{-1}	three-electrode cell	120.5	1
Polygonal carbon nanofibers	1 M $NaSO_4$	3 A g^{-1}	three-electrode cell	186	2
Nitrogen-doped hollow activated carbon nanofibers	6.0 M KOH	0.2 A g^{-1}	three-electrode cell	197	3
Mesoporous carbon nanofibers	6.0 M KOH	0.5 A g^{-1}/5 A g^{-1}	three-electrode cell	276/206	4
Mesoporous CNFs	6.0 M KOH	0.5 A g^{-1}	three-electrode cell	280	5
nitrogen-doped porous nanofibers	6.0 M KOH	1 A g^{-1}	three-electrode cell	202	6
N-rich composite of CNTs and carbon derived from melamine	1.0 M H_2SO_4	0.05 A g^{-1}	three-electrode cell	167	7
N-enriched carbon from melamine_mica	1.0 M H_2SO_4	0.05 A g^{-1}	two-electrode cell	115	8
Polyaniline-Graphene Oxide Composites materials	2.0 M H_2SO_4	1 A g^{-1}	three-electrode cell	210	9
polyacrylonitrile-based carbon nanofiber paper	1.0 M H_2SO_4	0.5 A g^{-1}	two-electrode cell	200	10
F-127-templated CNFs	2.0 M H_2SO_4	4 A g^{-1}	three-electrode cell	226	This work

Reference

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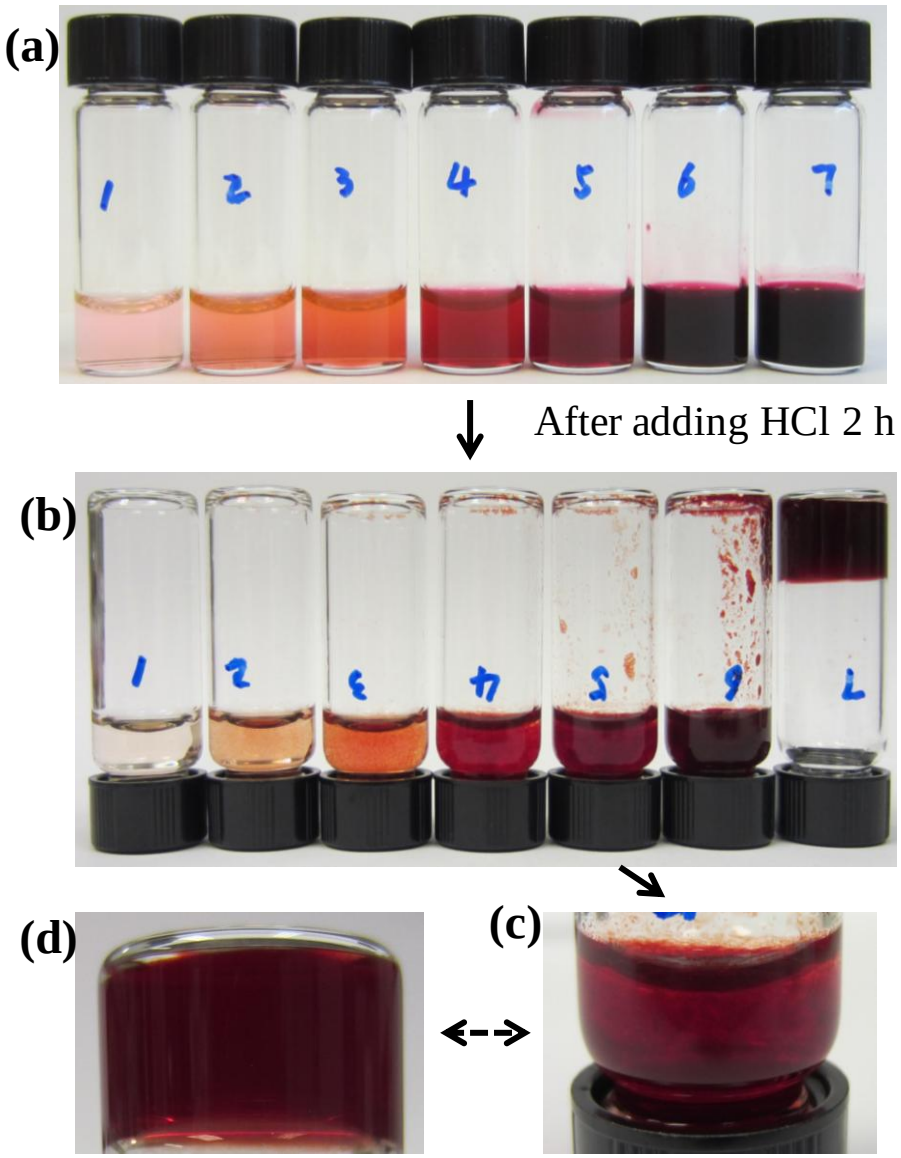

Fig. S1. (a) The photos of PI dissolved in TEA solutions (PI:TEA = 1:6) with different PI concentrations (from left to right: 0.01, 0.05, 0.1, 0.5, 1, 5, 20 mM). (b) Brittle gels formed for some of the solutions after adding 120 µl 4 M HCl for 2 h. (c) The enlarged photo for the sample 5 (1 mM PI) to show pieces of the gels formed. (d) The photo shows a uniform gel formed with sample 5 after adding 13 mg cm^{-3} GdL for 2 h.

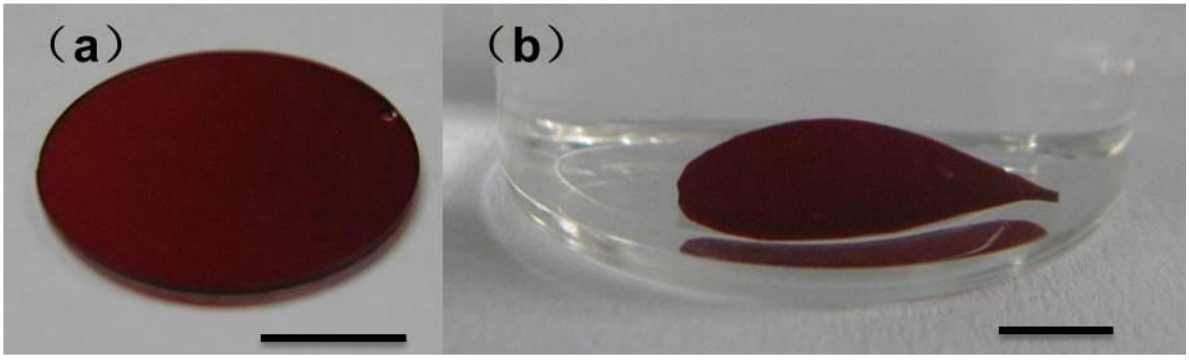

Fig. S2. (a) The photo of the hydrogel film on the glass slide and (b) the photo of the hydrogel film in water. The hydrogel film was fabricated by dropping 50 μL the mixture solution of PI solution and 13 mg/ml GdL between two glass slides (diameter 1.3 cm). The scale bar of inset photos represents 5 mm.

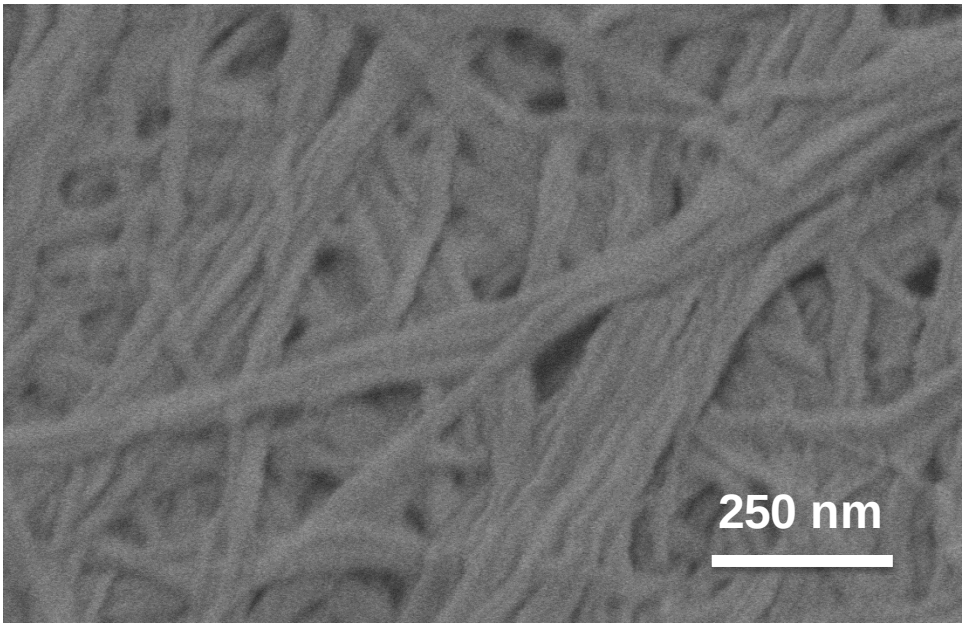

Fig. S3. The nanofibers observed for freeze-dried T + GdL sample.

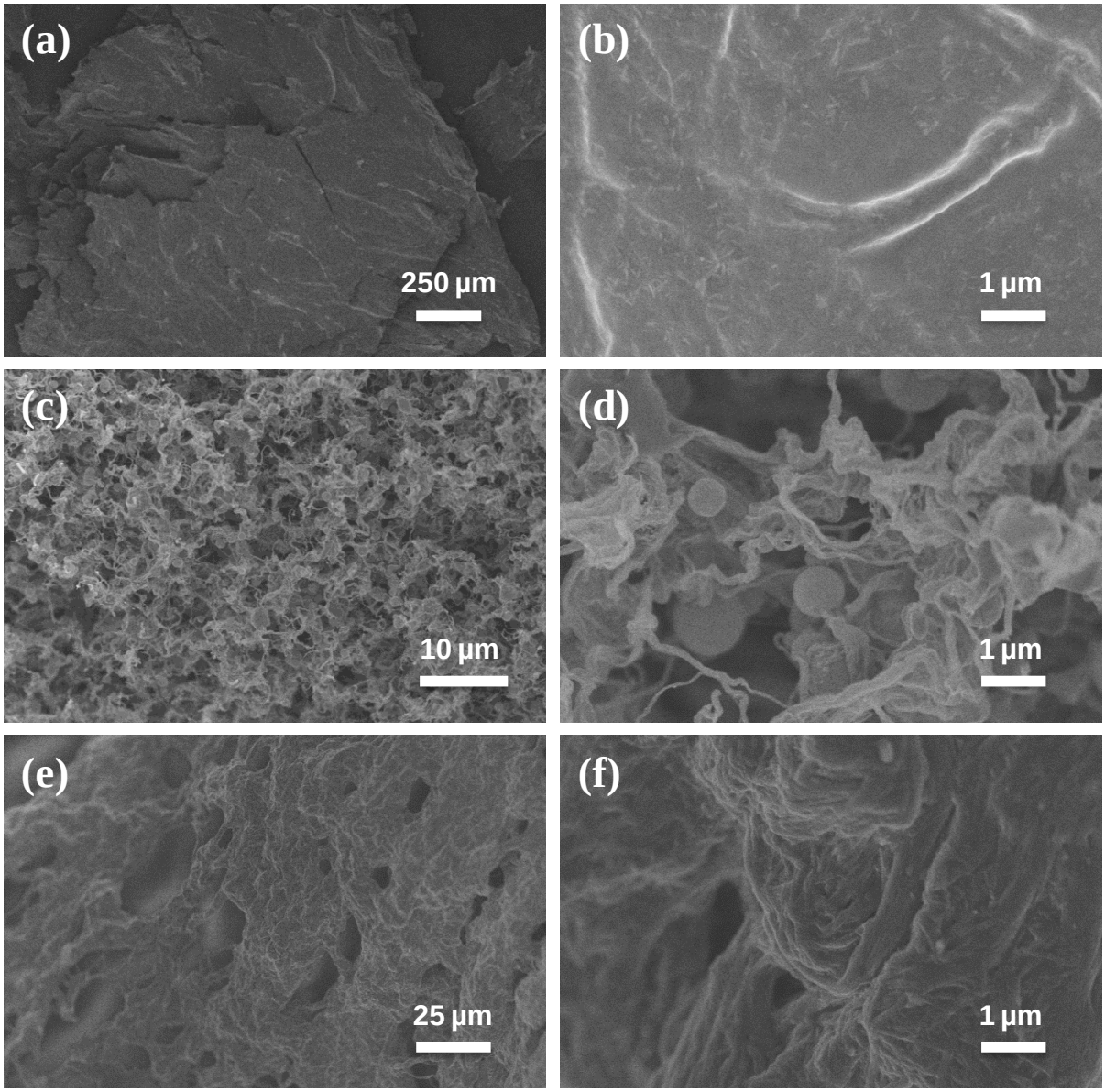

Fig. S4. SEM images of carbonized samples for N + GdL (a/b), K + GdL (c/d), T + GdL (e/f).

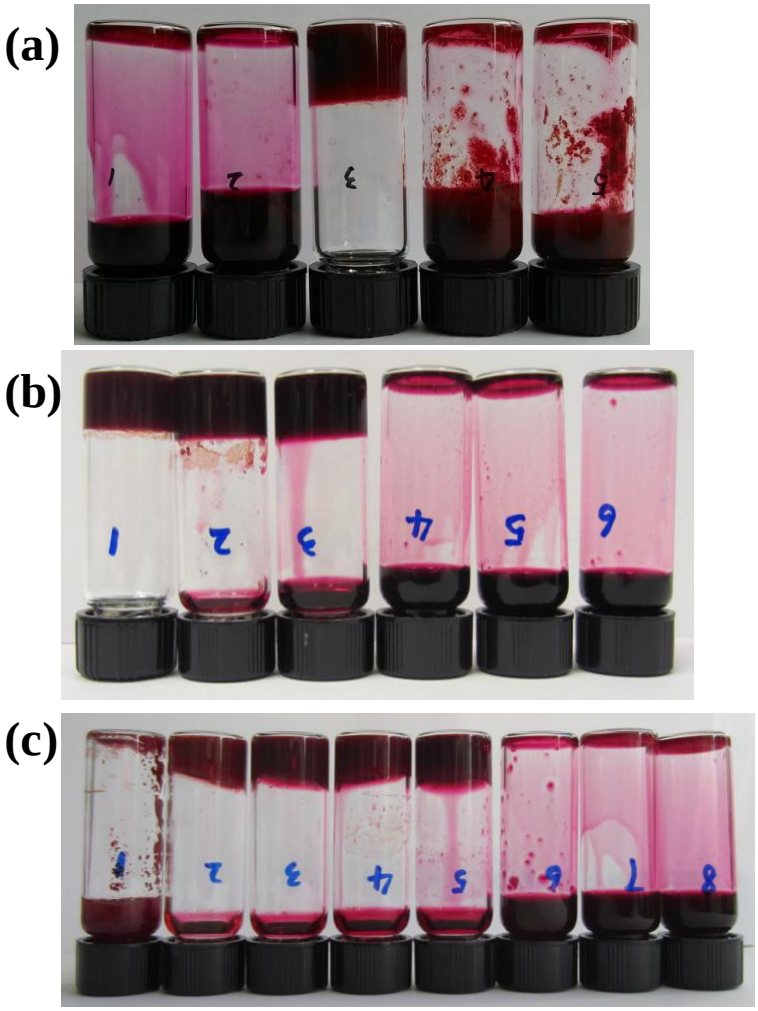

Fig. S5. Photos showing the gel formation of PI in different base solution, by mixing equal volume of PI (20 mM) and MM (40 mM) solutions after 24 hours. (a) PI dissolved in K_2SnO_3 solution with different concentrations (from left to right: 12, 9, 6, 4, 3 mg cm^{-3}). The gels formed with 4 mg cm^{-3} and 3 mg cm^{-3} K_2SnO_3-PI solutions were very brittle, weak, and could not hold to the bottle bottom. (b) TEA solution with different concentrations (from left to right PI:TEA=1:1, 1:2, 1:3, 1:4, 1:5, 1:6). (c) NaOH solution with different concentrations (from left to right: 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08 M).

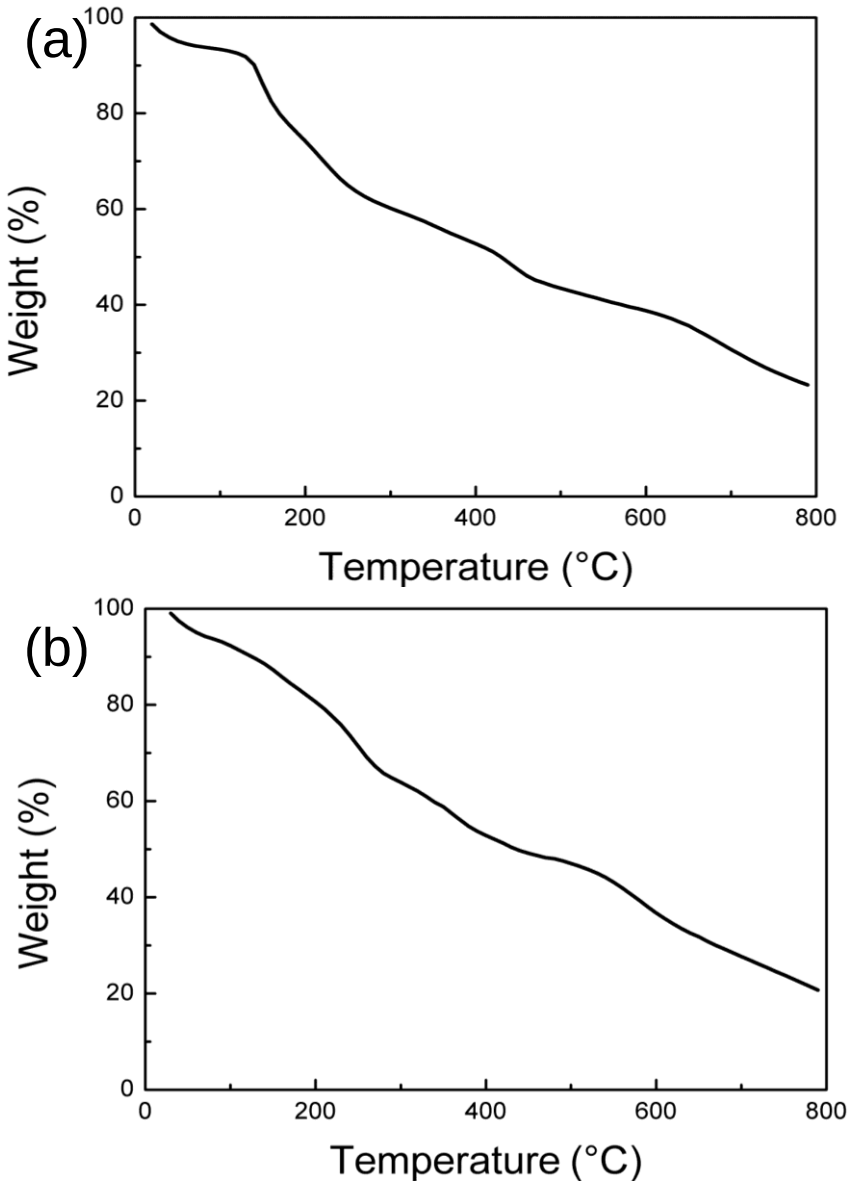

Fig. S6. TGA curves of samples K + MM + GdL (a) and T + MM + GdL (b), which were washed using water, acetone and cyclohexane. (heating rate = 5 ℃ min^{-1} under a nitrogen atmosphere).

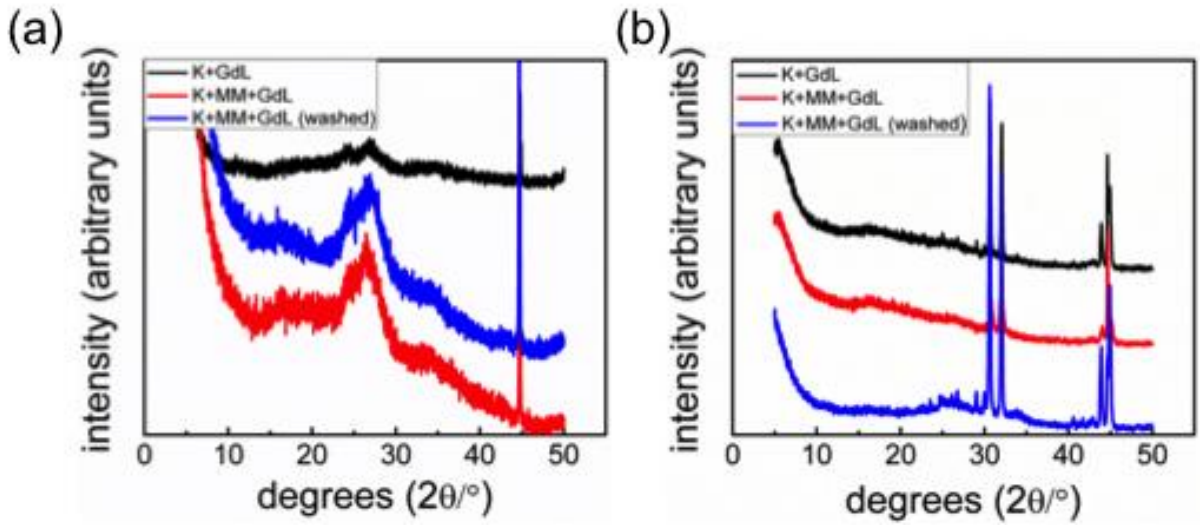

Fig. S7. PXRD patterns of K + GdL, K + MM + GdL and K + MM + GdL after washing treatment before (a) and after (b) carbonization.

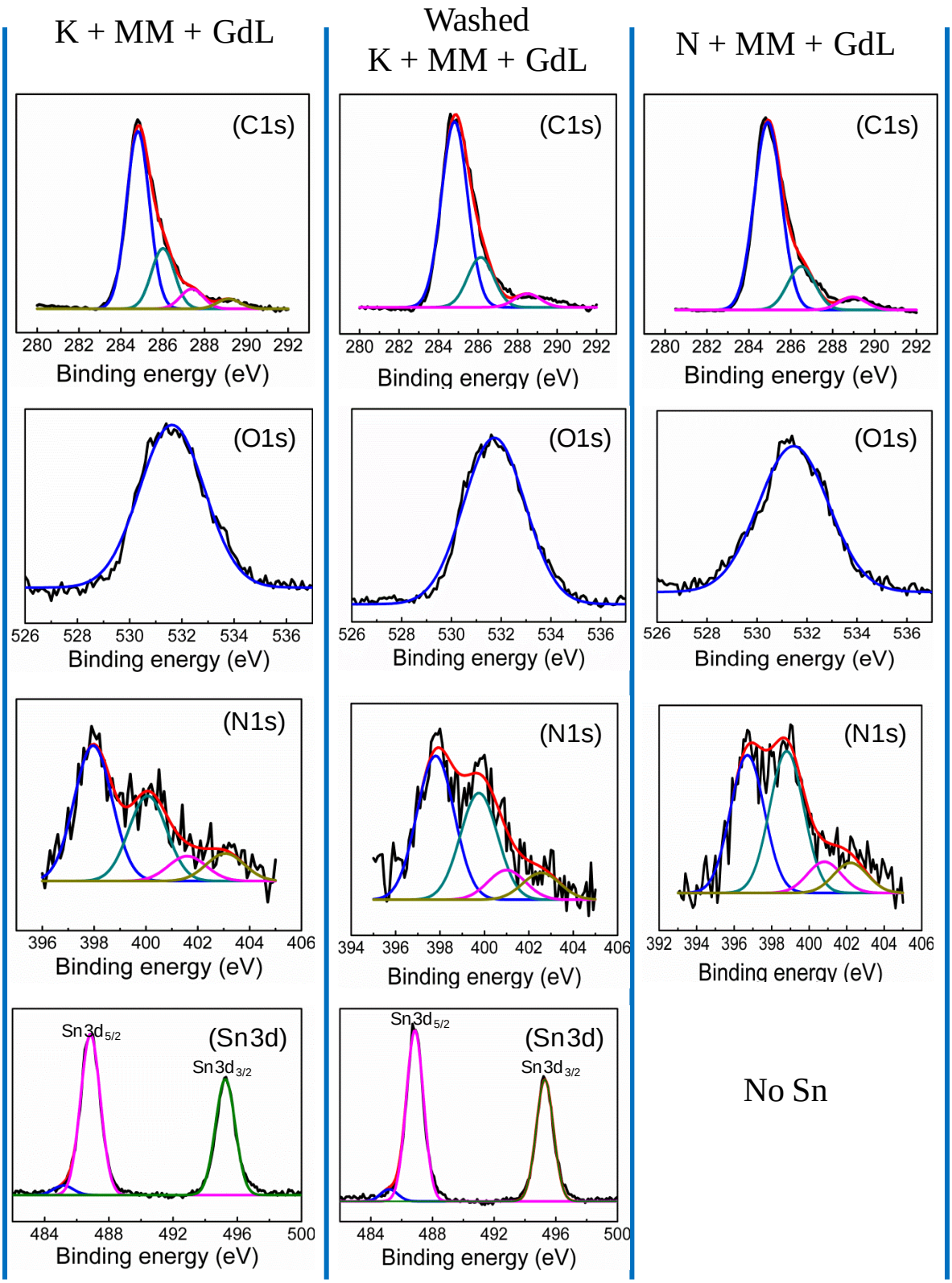

Fig. S8. XPS data comparison of the calcined samples K + MM + GdL, washed K + MM + GdL, and N + MM + GdL for the closer view and peak fittings for C1s, O1s, N1s, and Sn3d.

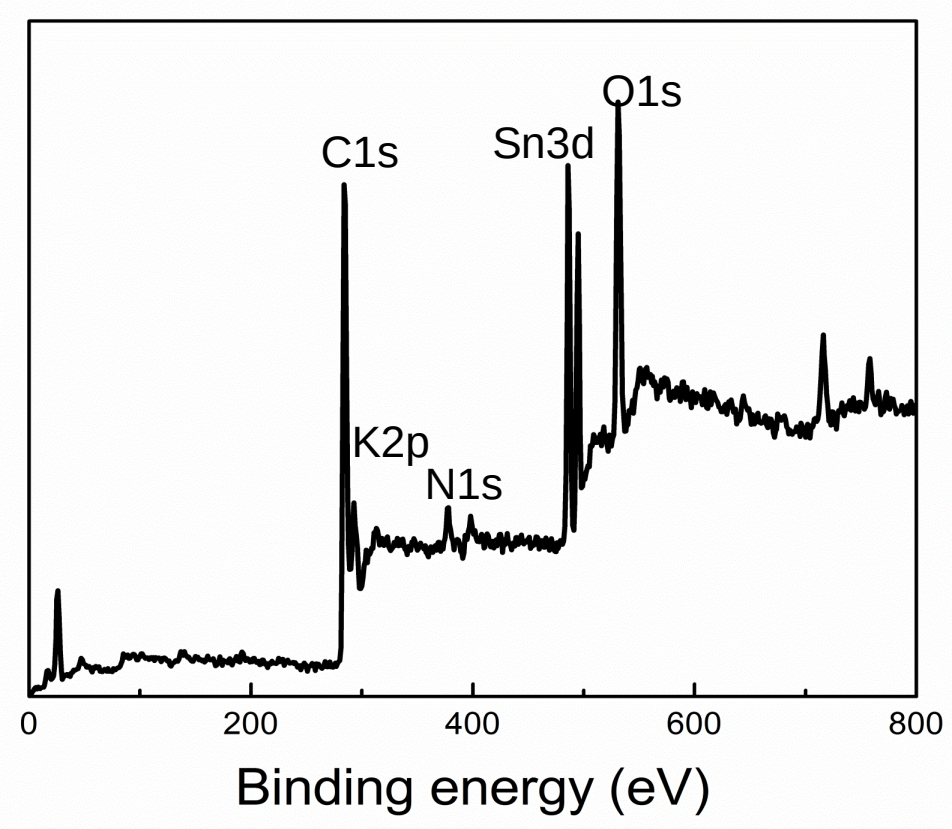

Fig. S9. XPS spectrum of the sample K + MM + GdL after washing treatment.

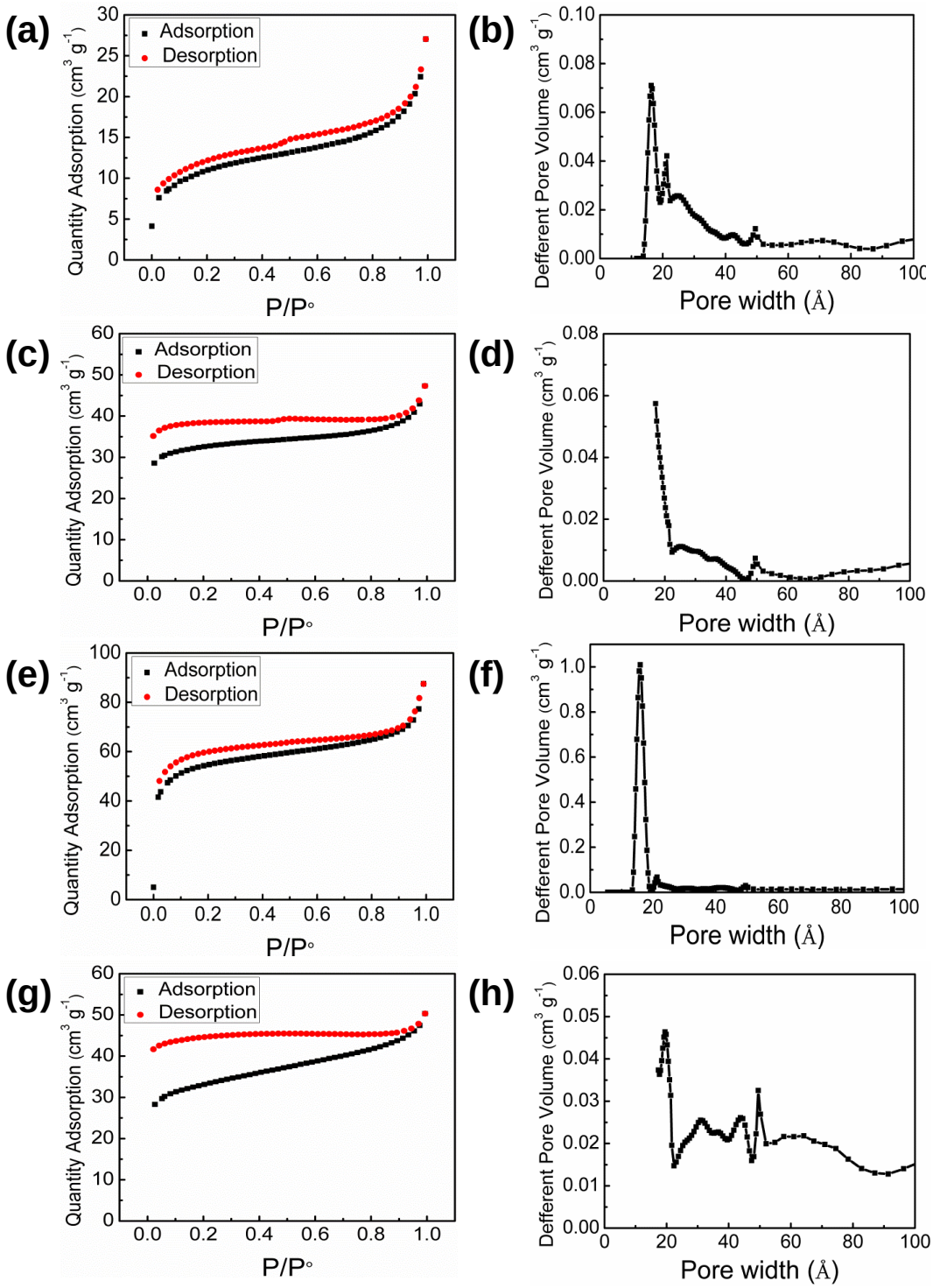

Fig. S10. N_2 gas sorption isotherm curves and the corresponding DFT pore size distribution for the carbonized sample K + GdL (a, b), K + MM + GdL (c, d), N + MM + GdL (e, f) and T + MM + GdL (g, h).

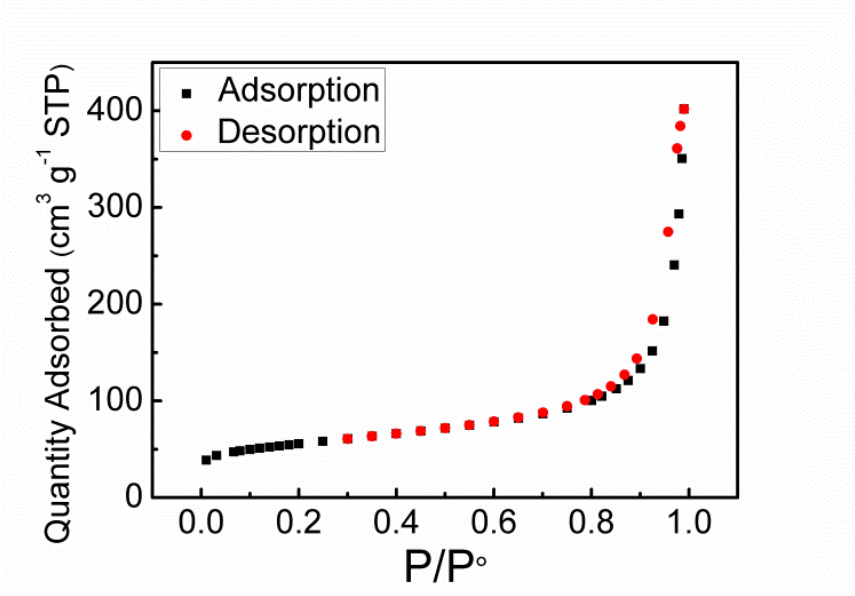

Fig. S11. Here is an example of the N_2 gas sorption isotherm curve of the CNF sample prepared by washing the T+MM+GdL gel and subsequently pyrolyzing. The washed sample has a higher surface area than that of the un-washed sample (178 m^2 g^{-1} vs 124 m^2 g^{-1}).

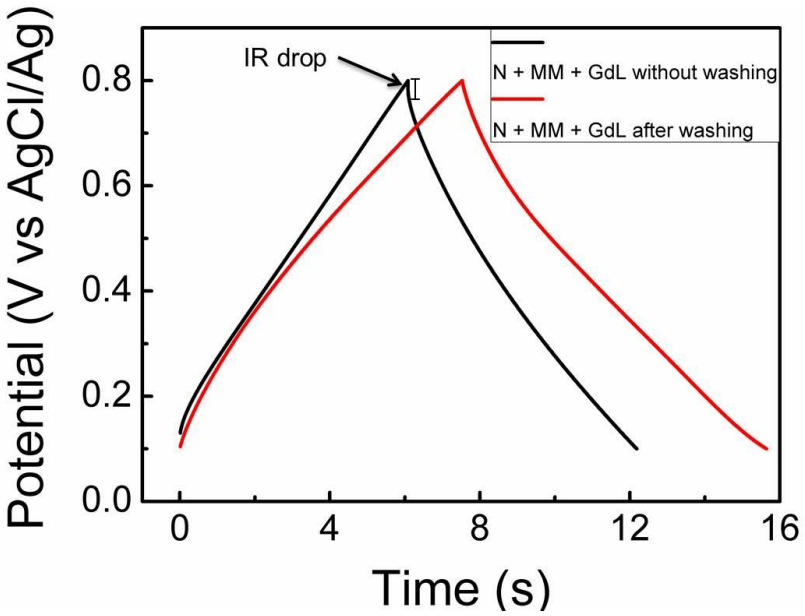

Fig. S12. Constant current charge-discharge curves of sample N+MM+GdL without (black) and with washing process (red). The Nafion-glued CNFs as working electrode, Pt sheet as counter electrode, and Ag/AgCl electrode as reference electrode.

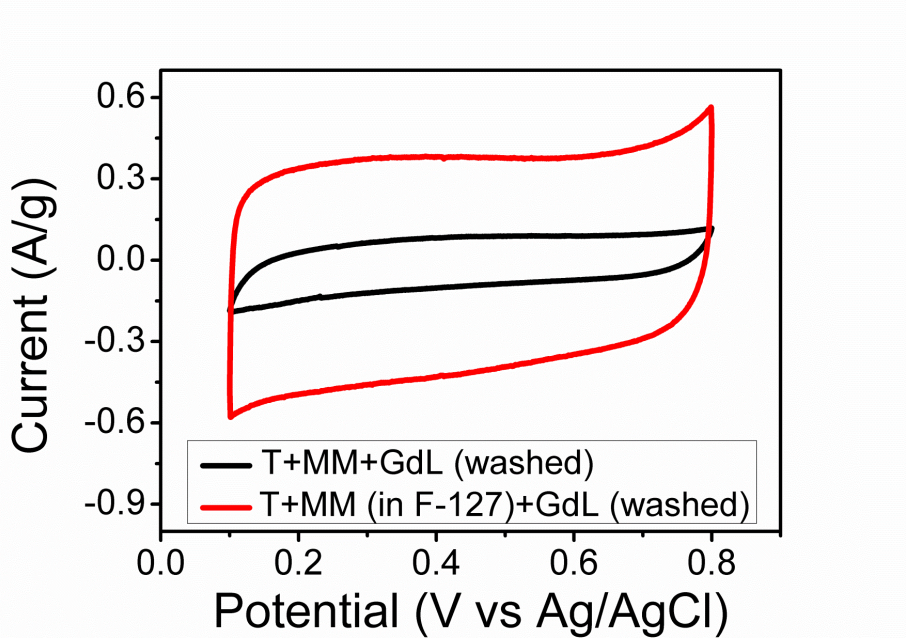

Fig. S13. Comparison of cyclic votammograms for F-127 templated and non-templated CNFs prepared from TEA (T) solution. Cyclic voltammograms recorded in 2 M H_2SO_4 by using the CNFs coated glassy carbon electrode as working electrode with polytetrafluoroethene (PTFE) as glue, Pt wire as counter electrode, and Ag/AgCl electrode as reference electrode. The scan rate is 1 mV s^{-1}.

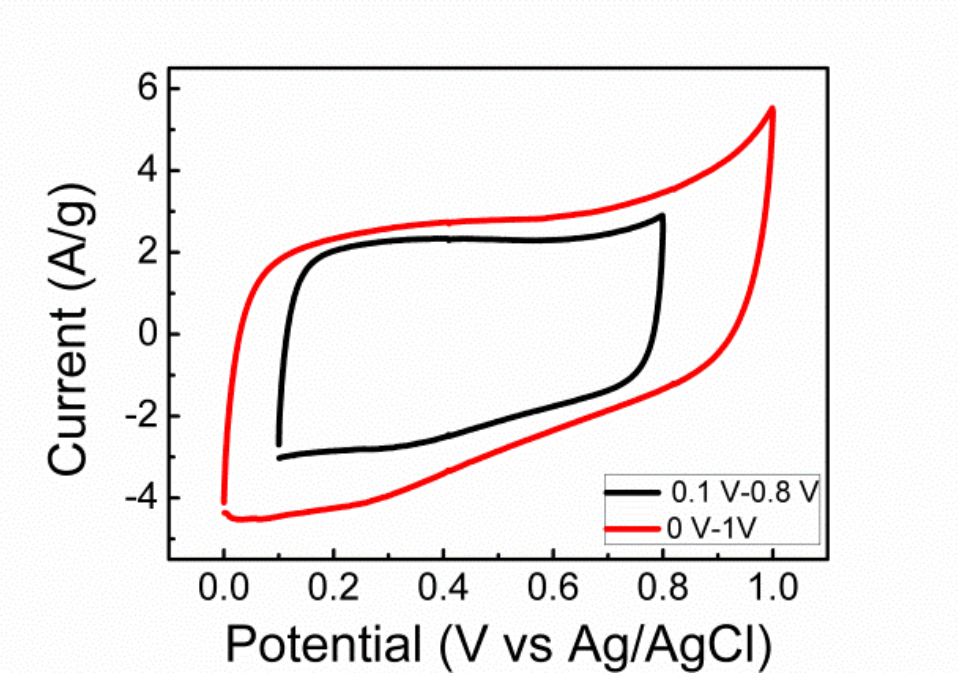

Fig. S14. Cyclic voltammograms recorded in 2 M H_2SO_4 in the 0.1-0.8 V and 0-1 V windows by using CNFs coated glassy carbon electrodes as working electrode, Pt sheet as counter electrode, and Ag/AgCl electrode as reference electrode. The scan rate is 10 mV s^{-1}. After 0.9 V, there is a hump in current, which corresponds to irreversible chemical reactions.

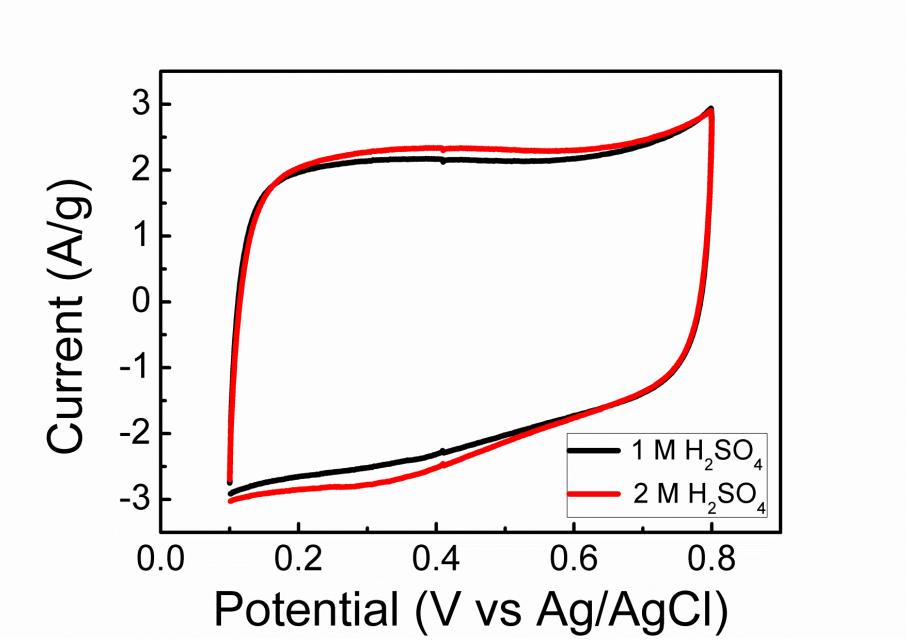

Fig. S15. Cyclic voltammograms recorded in 1 M H_2SO_4 and 2 M H_2SO_4 in the 0.1-0.8 V by using the F-127-templated CNFs coated glassy carbon electrodes as working electrode, Pt sheet as counter electrode, and Ag/AgCl electrode as reference electrode. The scan rate is 10 mV s^{-1}.

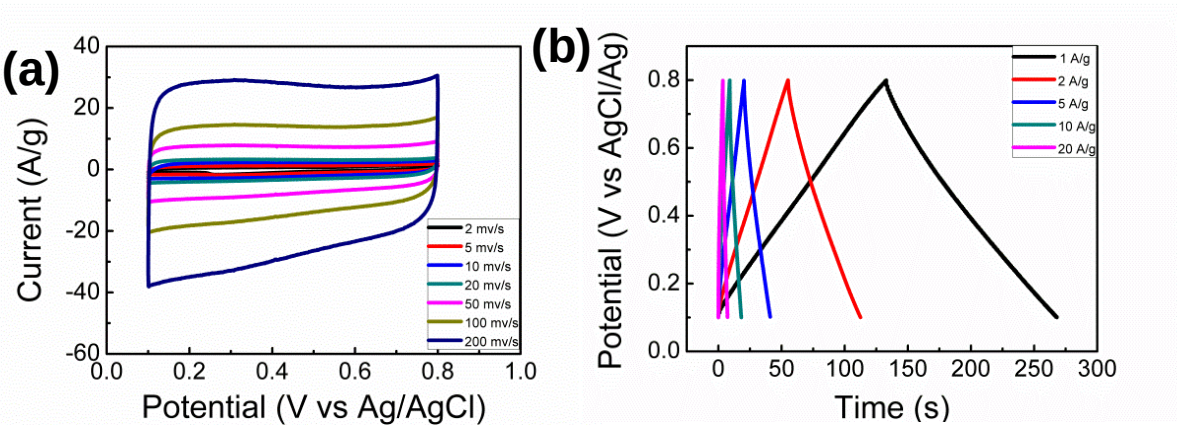

Fig. S16. (a) Cyclic voltammograms at different scanning rates. (b) Constant current charge-discharge curves at different current density. The Nafion-glued CNFs as working electrode with a CNF area loading of 0.14 mg cm^{-2}, Pt sheet as counter electrode, and Ag/AgCl electrode as reference electrode.