Electronic Supplementary Information

A Nitrogen-Doped Carbon Nanotubes as Anode for Highly Robust Potassium-Ion Hybrid Capacitor

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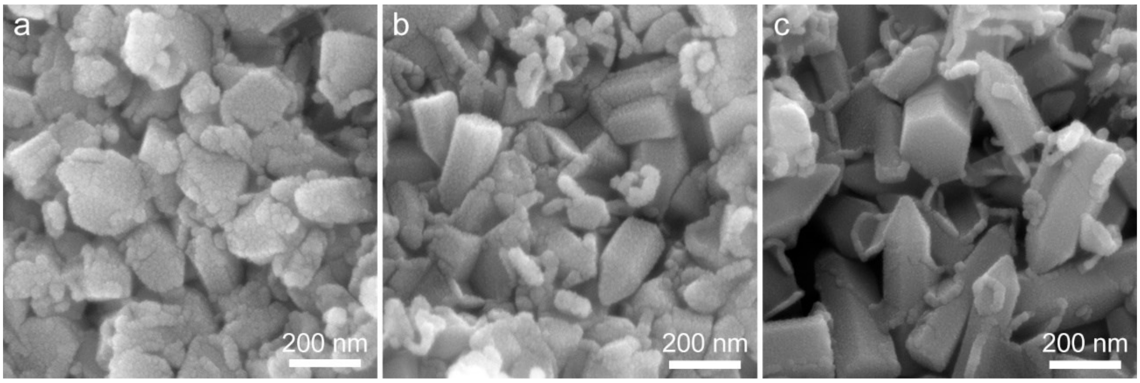

Fig. S1. SEM images of (a) CCNSs (0 g urea), (b) NCNTs (1 g urea) and (c) SNCNTs (3 g urea) taken before HCl washing.

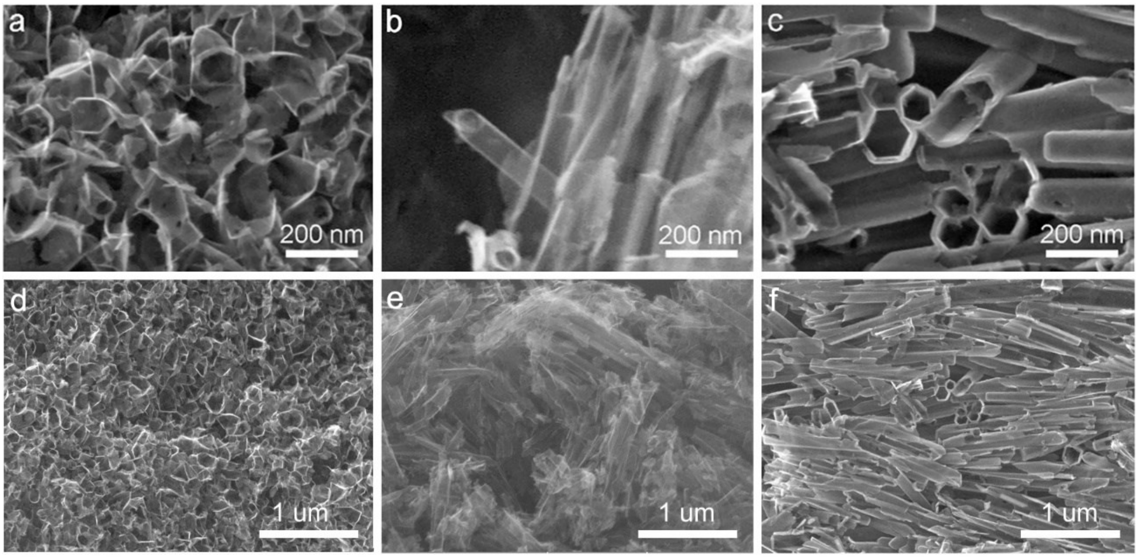

Fig. S2. High-magnification SEM images of (a) CCNSs (0 g urea), (b) NCNTs (1 g urea) and (c) SNCNTs (3 g urea) and low-magnification SEM images of (d) CCNSs (0 g urea), (e) NCNTs (1 g urea) and (f) SNCNTs (3 g urea).

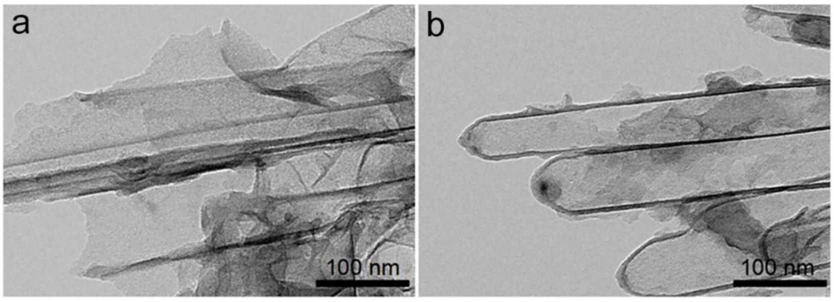

Fig. S3. TEM images of (a) CCNSs and (b) SNCNTs.

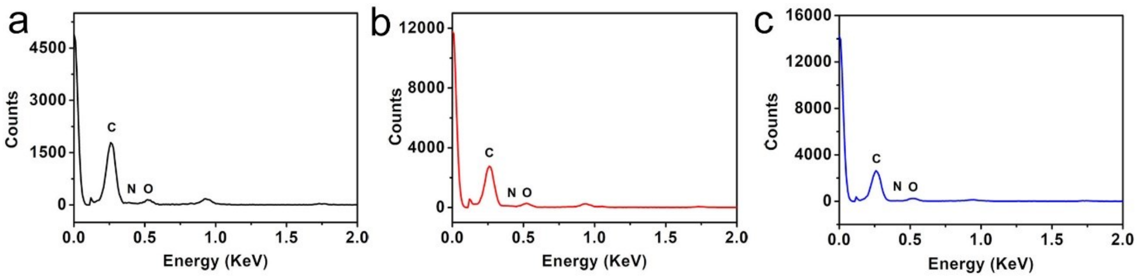

Fig. S4. EDS pattern of (a) CCNSs, (b) NCNTs and (c) SNCNTs.

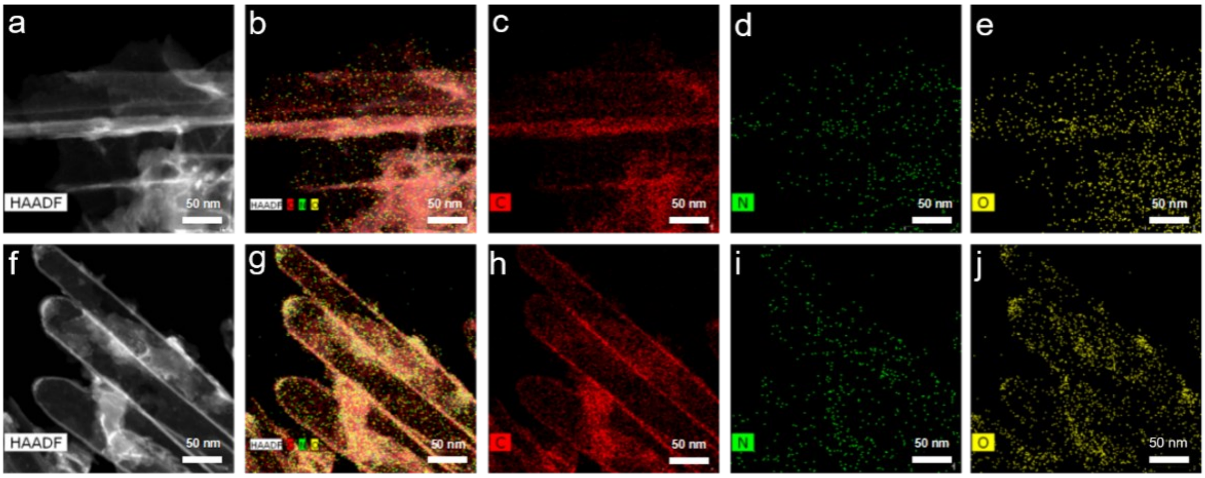

Fig. S5. Images of element mapping of (a-e) CCNSs and (f-j) SNCNTs.

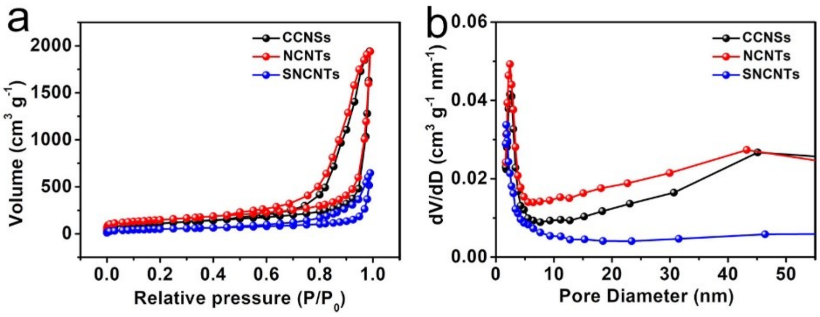

Fig. S6. (a) Nitrogen absorption-desorption isotherms and (b) porous size distributions of CCNSs, NCNTs and SNCNTs.

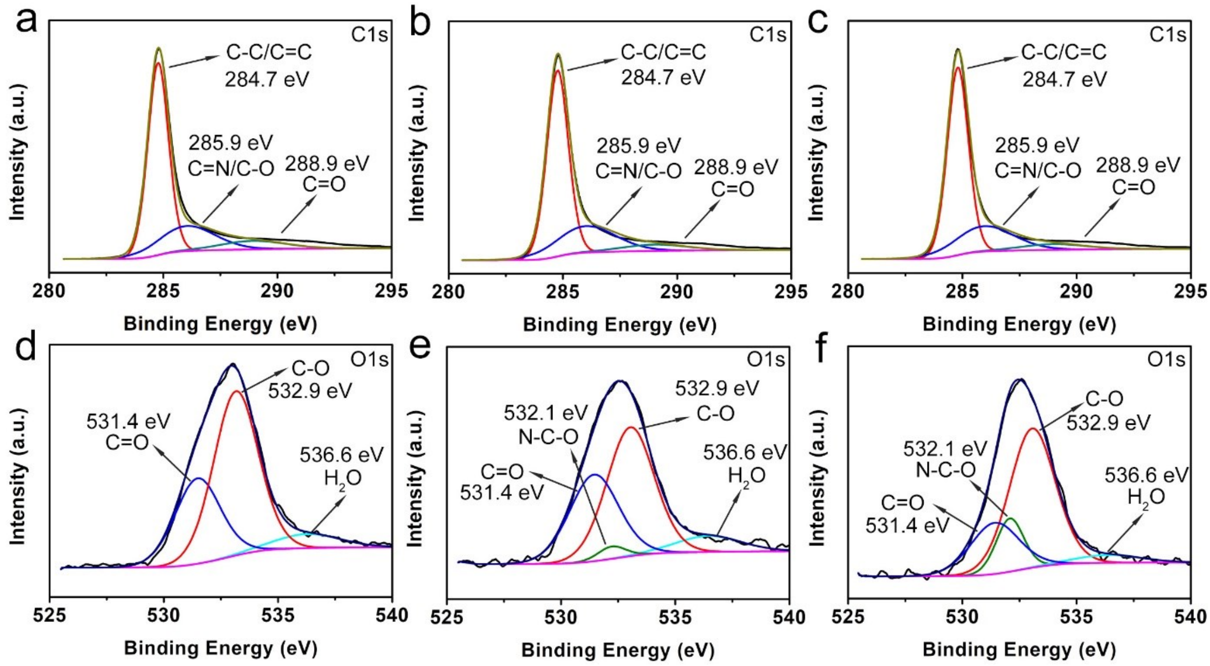

Fig. S7. (a-c) High resolution XPS C1s spectra of CCNSs, NCNTs and SNCNTs. (d-f) High resolution XPS O1s spectra of CCNSs, NCNTs and SNCNTs.

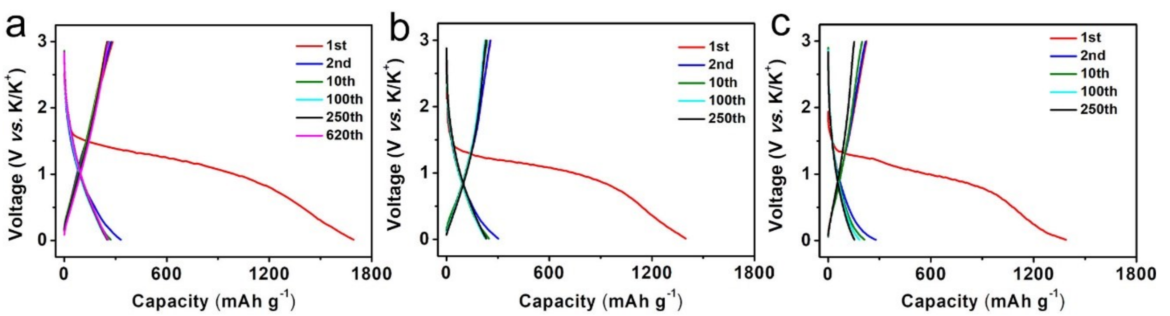

Fig. S8. Charge-discharge curves at a current density of 100 mA g^{-1} of (a) NCNTs, (b) CCNSs and (c) SNCNTs electrodes.

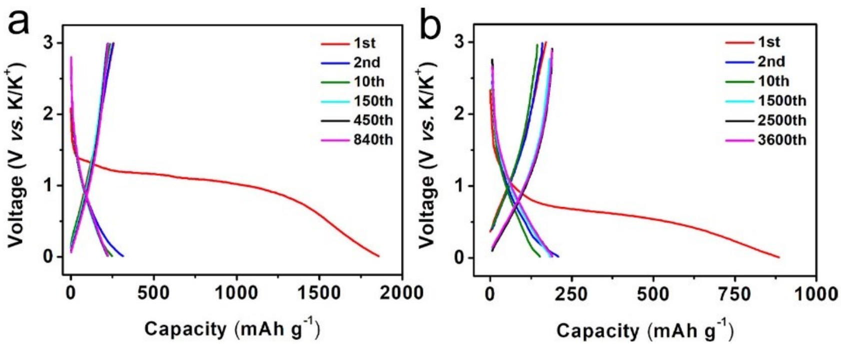

Fig. S9. Charge-discharge curves of NCNTs at current densities of (a) 200 mA g^{-1} and (b) 1 A g^{-1}, respectively.

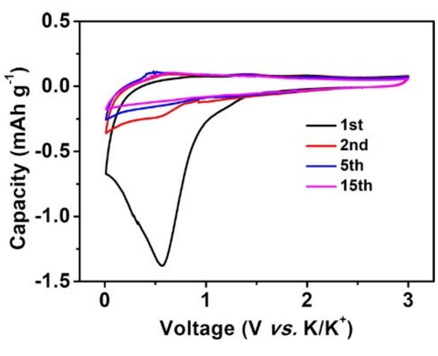

Fig. S10. The CV curves of the NCNTs after activated process collected at a scan rate of 0.5 mV s^{-1}.

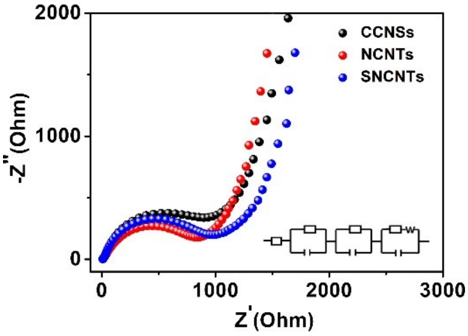

Fig. S11. Electrochemical impedance spectroscopy of CCNSs, NCNTs and SNCNTs.

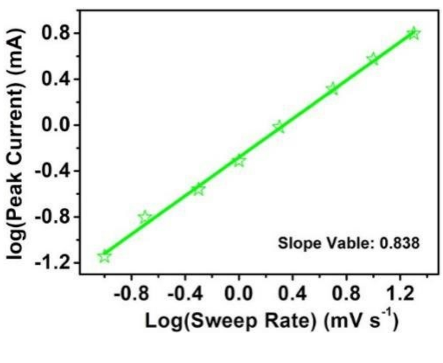

Fig. S12. The relationship between logarithm of peak current and scan rate during the depotassiation process.

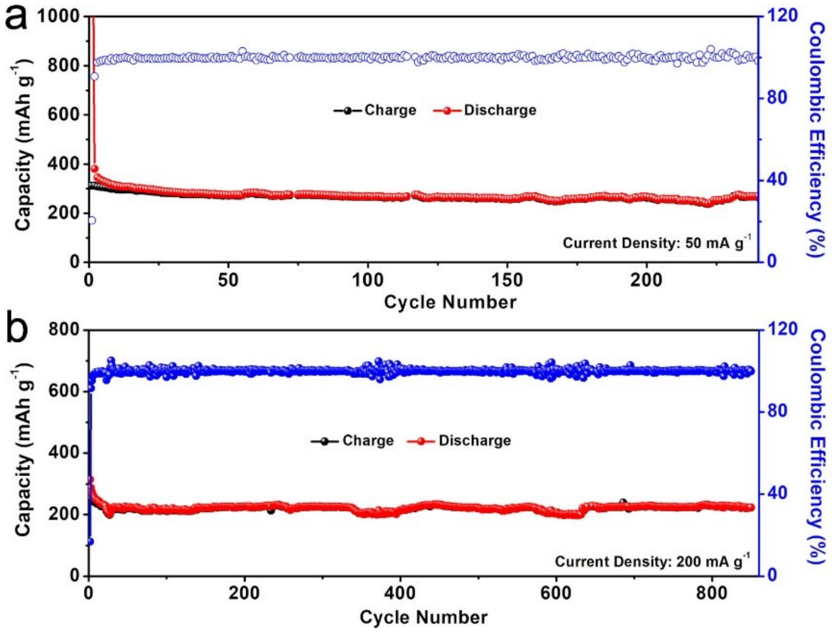

Fig. S13. Cycling performance of NCNTs at a current density of 50 and 200 mA g^{-1}.

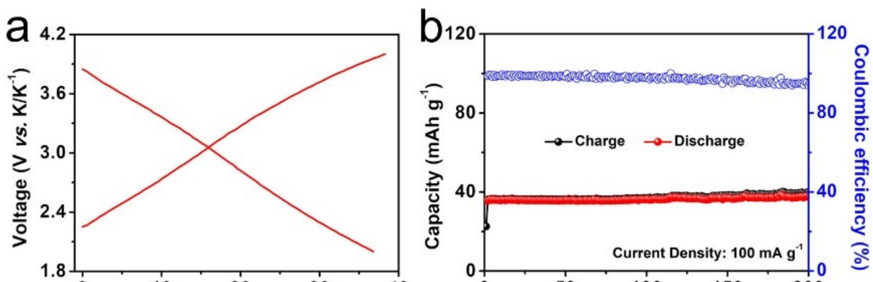

Fig. S14. (a) Charge-discharge profiles and (b) cycling performance of AC cathode at current density of 100 mA g^{-1}.

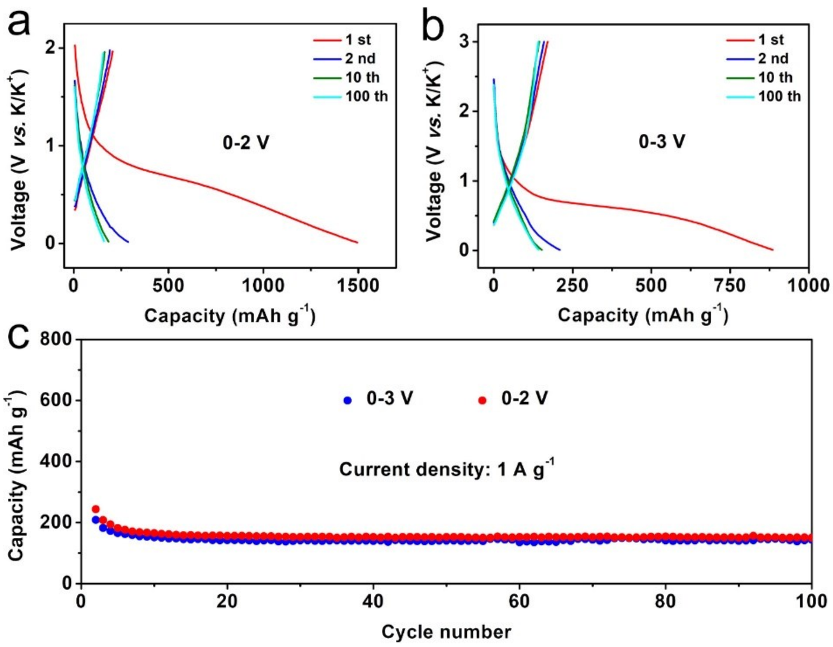

Fig. S15. Charge-discharge curves of NCNTs at voltage windows of (a) 0-2 V and (b) 0-3 V, respectively. (c) Cycling performance of NCNTs at voltage windows of 0-2 V and 0-3 V.

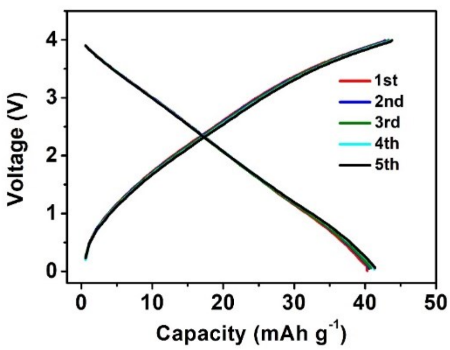

Fig. S16. The charge/discharge curves of the hybrid capacitor during the initial 5 cycles.

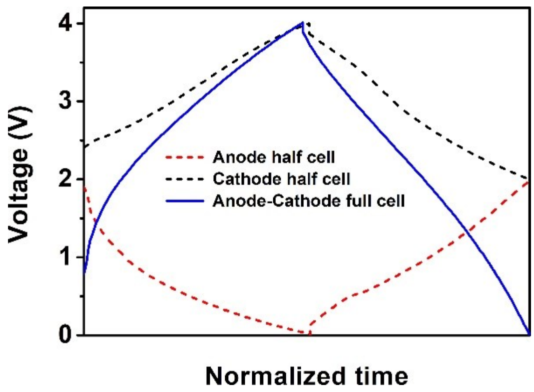

Fig. S17. The normalized voltage-time curves of the half cells and full cell.

Table S1. The element contents of CCNSs (0g), NCNTs (1g) and SNCNTs (3g) by elemental analysis.

Name	CCNSs (PP At. %)	NCNTs (PP At. %)	SNCNTs (PP At. %)
C1s	96.74	95.57	96
O1s	3.26	3.22	2.46
N1s	0	1.21	1.54

Table S2. Summary of potassium-ions storage performance of pure and nitrogen-doped carbon materials.

Materials	Current density (mA g^{-1})	Cycle number	Capacity (mAh g^{-1})	Capacity decay (% per cycle)	Ref.
hollow carbon nanofiber	1000	1600	161.3	~0.024	1
carbon nanosheet	170	300	136.3	~0.158	2
walnut septum	1000	1000	119.9	~0.13	3
pure chitin	2 C	500	105.6	~0.02	4
carbon nanotubes	2000	500	102	~0.044	5
porous carbon	1000	1000	104.6	~0.045	6
honeycomb-like carbon	1000	1000	270.4	~0.033	7
carbon nanofibers	1000	2000	164	~0.0136	8
amorphous carbon network	1000	4000	160	0.008	9
soft carbon frameworks	1000	500	165	~0.029	10
loofah-derived carbon	100	200	150	~0.2	11
hierarchical carbon nanotubes	100	500	232	~0.02	12
sub-20 nm carbon nanoparticles	1000	4000	190	~0.0034	12
hierarchical porous carbon	1000	1000	158	~0.006	13
sub-micro carbon fiber	1 C	300	193	~	14
mesoporous carbon	200	200	158	~0.166	15
S/O co-doped hard carbon	0.72 C	200	180	~0.166	16
polynanocrystalline graphite	0.36 C	300	60	~0.2	17
graphite	0.5 C	50	100	~0.985	18
soft carbon	2 C	50	140	0.372	18
hard carbon	0.1 C	100	216	0.17	19
graphite	200	100	100.3	~0.66	20
porous carbon	10000	1000	185	~0.062	21
biomass porous carbon	500	400	196	0.0312	22
hard carbon	200	150	210	0.053	23
hard-soft composite carbon	1 C	200	180	0.035	24
graphite	100	100	210	0.035	25
NCNTs	50	280	267.9	0.0105	This work
	100	620	257.5	0.0358	
	200	850	223.2	0.0338	
	1000	3600	190.2	0.00238	

(Note: the decay rate is calculated from the second cycle)

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