Supporting Information

High Performance Red Phosphorus/Carbon Nanofibers/Graphene Free-standing Paper Anode for Sodium Ion Batteries

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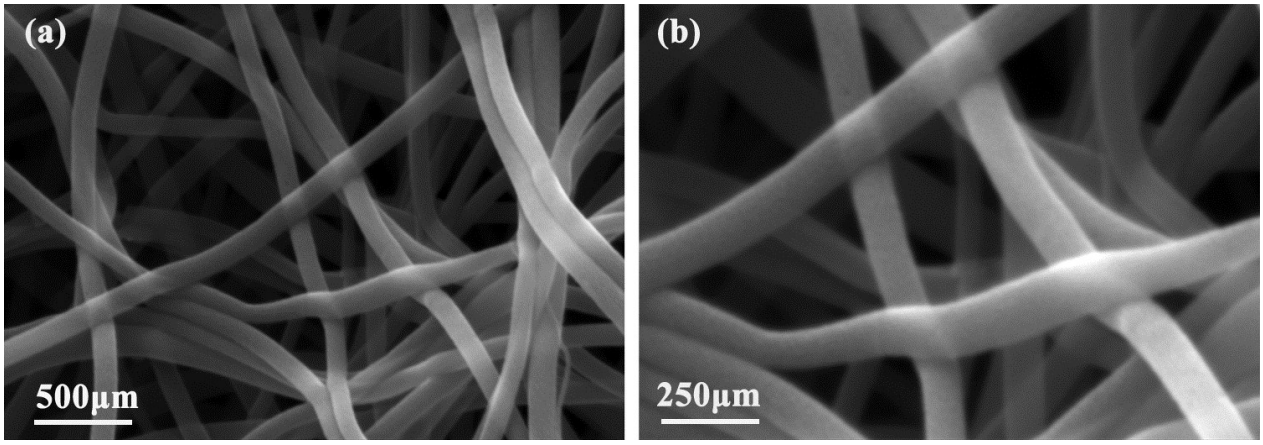

Figure S1. SEM image of (a) & (b) as-synthesized electrospun CFs.

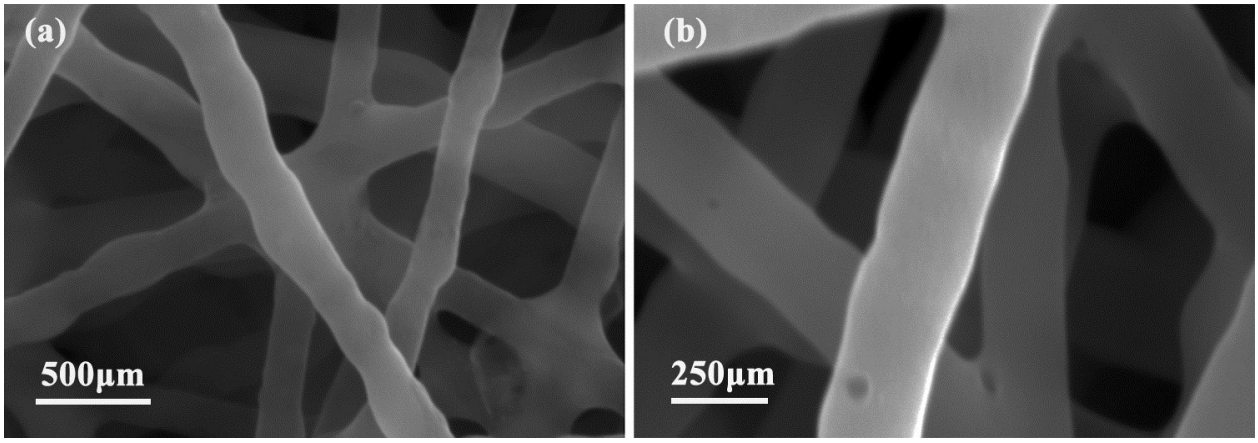

Figure S2. SEM image of (a) & (b) P/CFs composite.

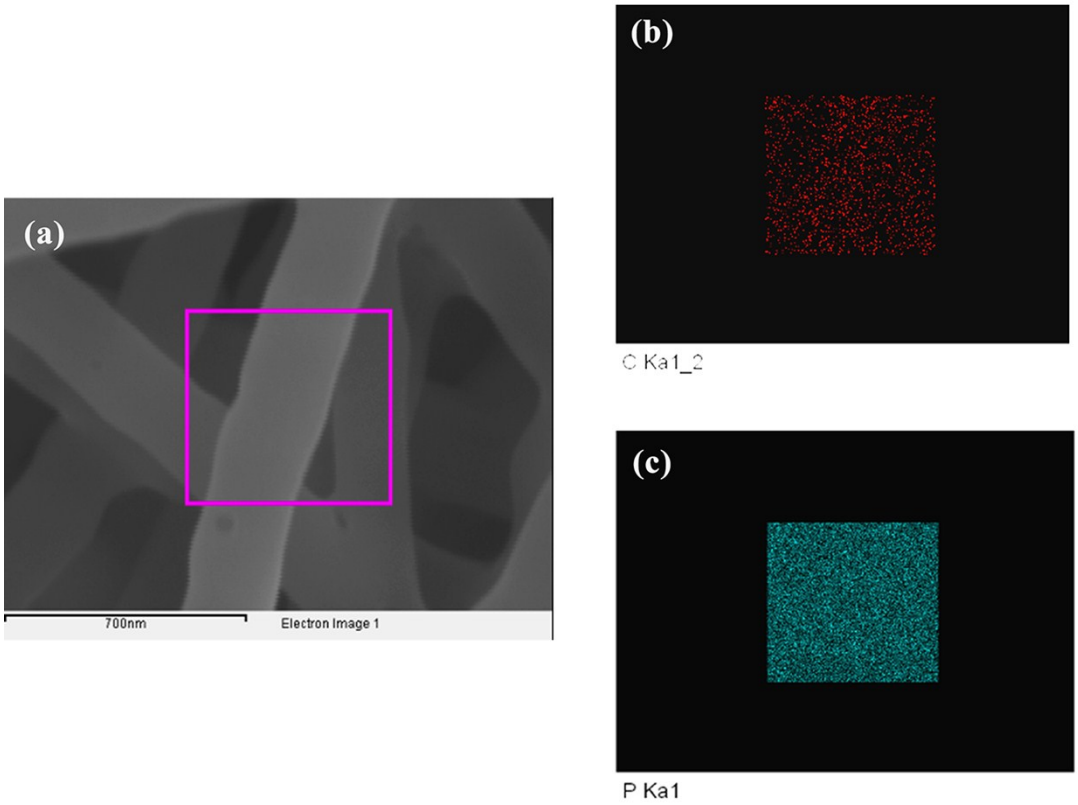

Figure S3. (a) High resolution SEM image of P/CFs composite. EDS elemental mapping of (b) carbon, and (c) phosphorus.

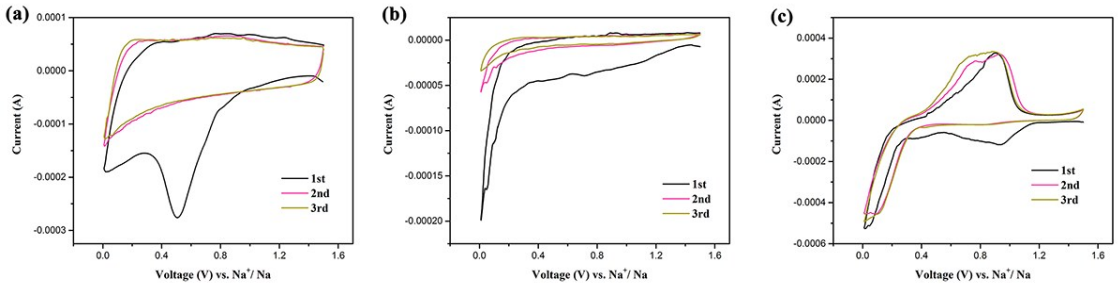

Figure S4. Cyclic voltammograms for the first three cycles of (a) CFs, (b) pure red P, and (c) the P/CFs electrode.

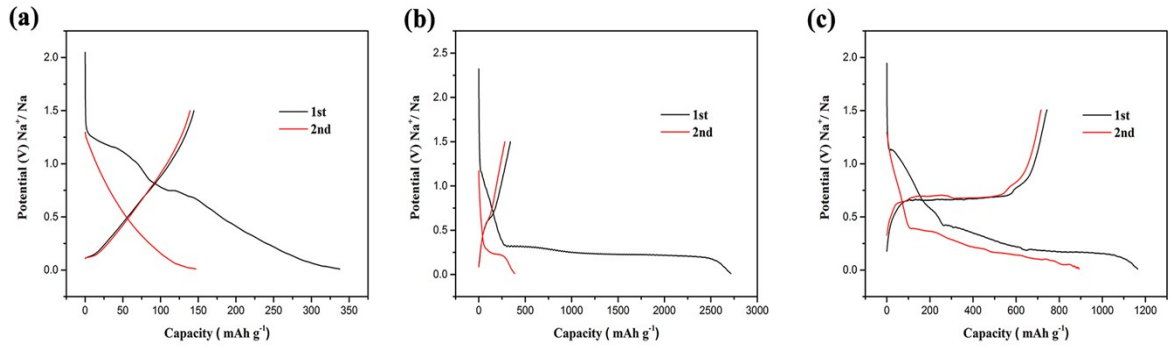

Figure S5. Galvanostatic charge-discharge profiles of the first two cycles for (a) CFs, (b) pure red P, and (c) the P/CFs electrode at the current density of 50 mA g^{-1}

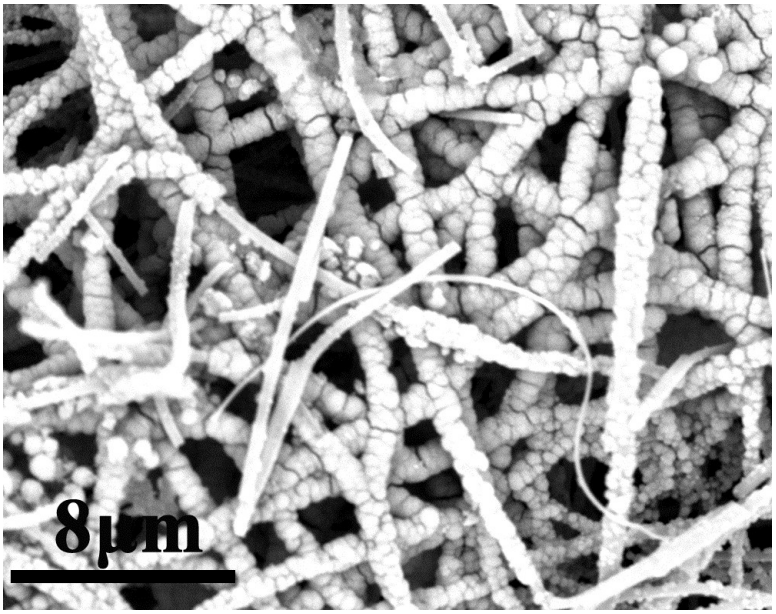

Figure S6. SEM image of the P/CFs electrode after first discharge process under 50 mA g^{-1}.

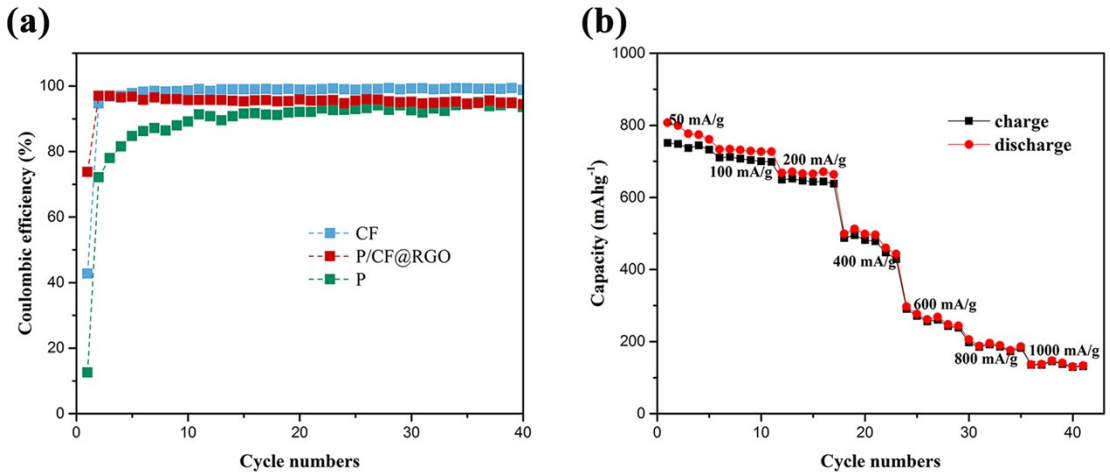

Figure S7. (a) Coulombic efficiency of the CFs, red P and P/CFs@RGO, (b) Rate capability of the P/CFs electrode.

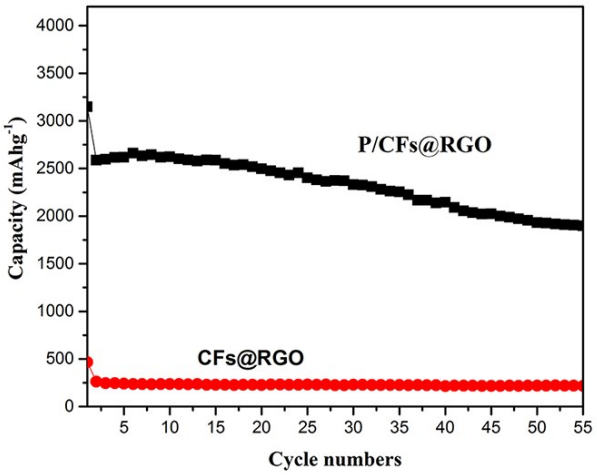

Figure S8. Cycling performance of P/CFs@RGO and CFs@RGO, the specific capacity of the P/CFs@RGO is based on the mass of P.

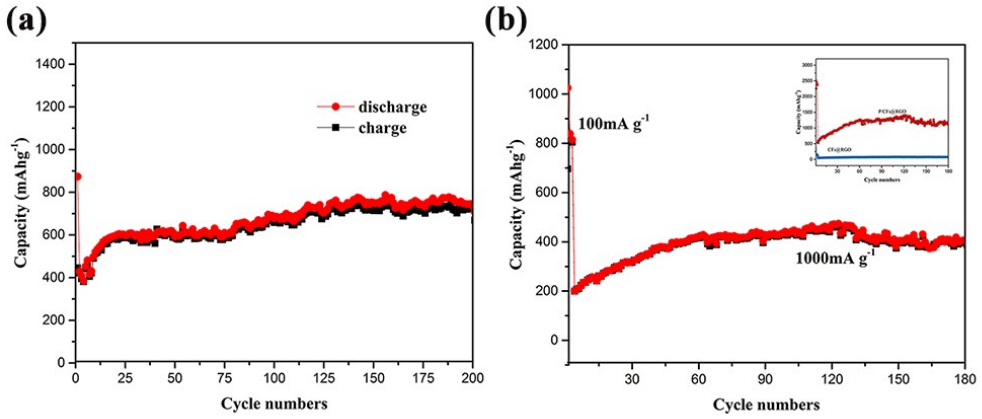

Figure S9. Cycling performance of P/CFs@RGO composites at (a) 200 mA g^{-1} and (b) 1000 mA g^{-1} .

	Reversible capacity (mAh g^{-1})	Retention rate	
P/CNT	500 at 20th cycle (60 mA g^{-1})	28%	Ref 23
a-P/C	1200^{P} at 60th cycle(250mA g_p^{-1})	68%	Ref 24
aP/c-BN/pGra	947^{P} at 100th cycle (50mA g_p^{-1})	78.2%	Ref 46
P/C- C-1	187 at 50thcycle (100mA g^{-1})	14.1%	Ref 13
C/P/GA	1867^{P} at 100th cycle (0.1C mA g_p^{-1})	89.5%	Ref 29
Red P / N-doped carbon	731 at 55th cycle (100mA g^{-1})	57.3%	Ref 26
P/CFs/RGO	725.9 at 55th cycle (50mA g^{-1})	75.7%	This work

Table S1. Comparison of electrochemical performance between the P/CFs@RGO and other previous works about P/C composite as anode materials in SIB. The subscript and superscript P in table represent that the current densities and capacities are calculated based on the mass of P.

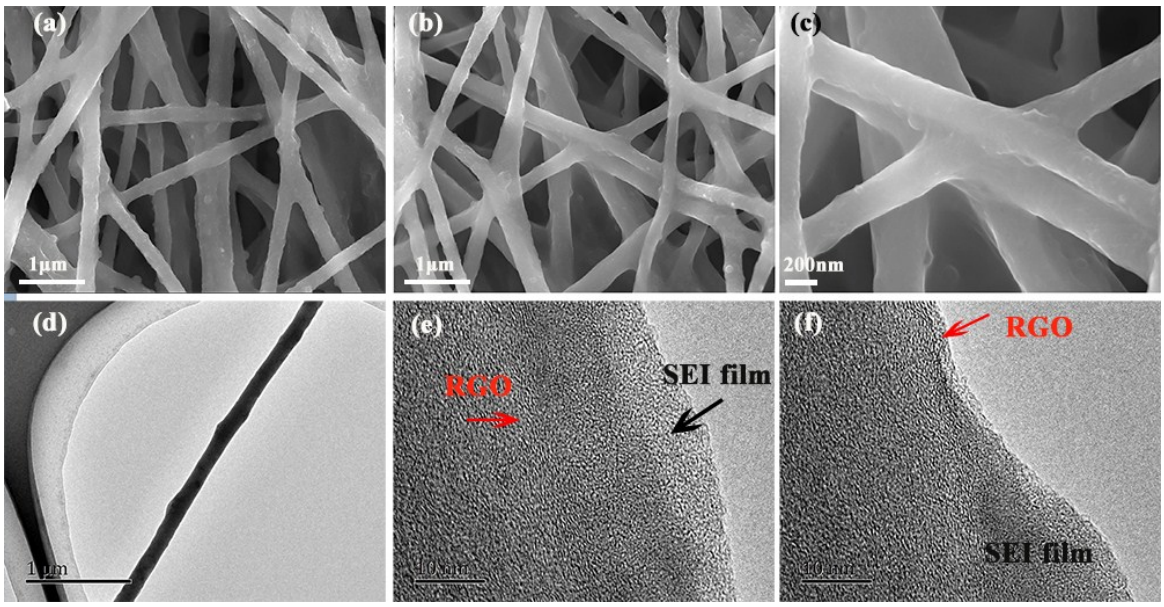

Figure S10. SEM image (a), (b) & (c) of P/CFs@RGO electrode after 50 cycles under 50 mA g^{-1}, high magnitude TEM images (d) , (e) & (c) of P/CFs@RGO electrode after 50 cycles under 50 mA g^{-1}.

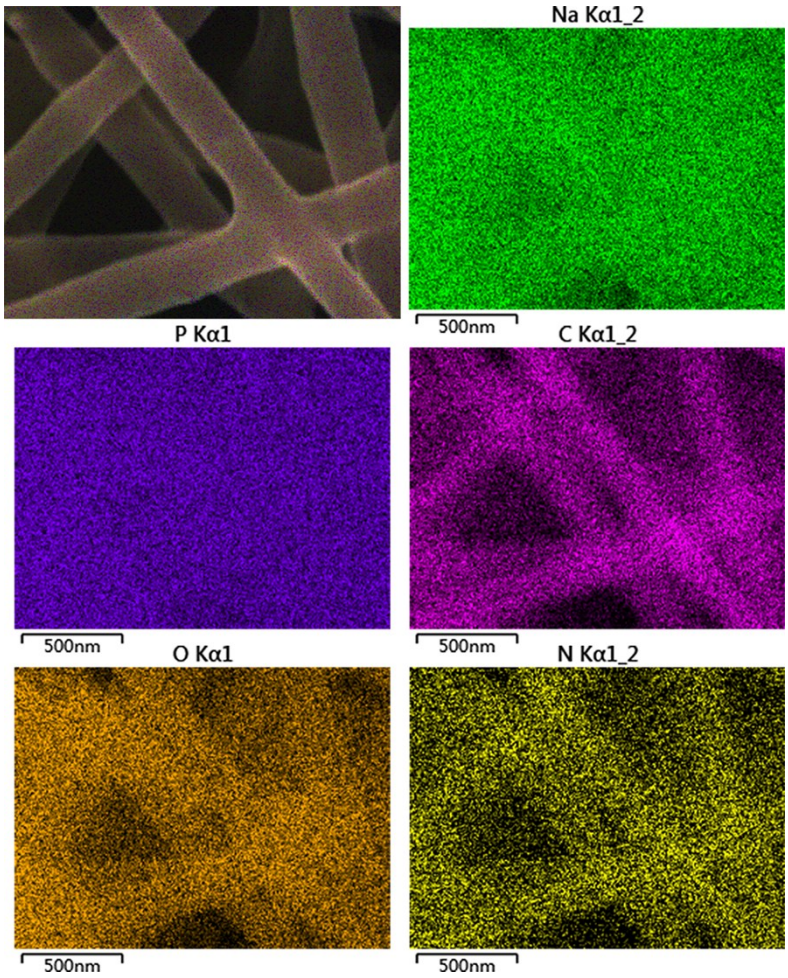

Figure S11. High resolution SEM image of P/CFs@RGO electrode after 50 cycles under 50 mA g^{-1}, EDS elemental mapping of Na, P, C, O, N.

$$C_P = \frac{C_{P/CFs@RGO} - C_{CFs@RGO} * W_{CFs@RGO}}{W_P}$$

$C_{p;}$ Capacity contribution of phosphorus in P/CFs@RGO.
$C_{p/CFs@RGO;}$ Capacity of the P/CFs@RGO composite.
$C_{CFs@RGO;}$ Capacity of CFs@RGO composite.
$W_{p;}$ Weight ratio of phosphorus in P/CFs@RGO.

Table S2. Calculation formula for capacity normalization.