

## Supporting Information

### **Yolk-shell N-doped carbon coated FeS<sub>2</sub> nanocages as a high-performance anode for sodium-ion batteries**

Rui Zang<sup>a</sup>, Pengxin Li<sup>a</sup>, Xin Guo<sup>b\*</sup>, Zengming Man<sup>a</sup>, Songtao Zhang<sup>c</sup> Chengyin Wang<sup>c\*</sup> and Guoxiu Wang<sup>b\*</sup>

<sup>a</sup>College of Material Science and Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing, 210006, P.R. China

<sup>b</sup>Centre of Clean Energy Technology, School of Mathematics and Physics, Faculty of Science, University of Technology Sydney, NSW 2007, Australia.

<sup>c</sup>Testing Center, Yangzhou University, Yangzhou, 225009 Jiangsu, P.R. China

\*Email: xin.guo@uts.edu.au; wangcy@yzu.edu.cn; Guoxiu.Wang@uts.edu.au.

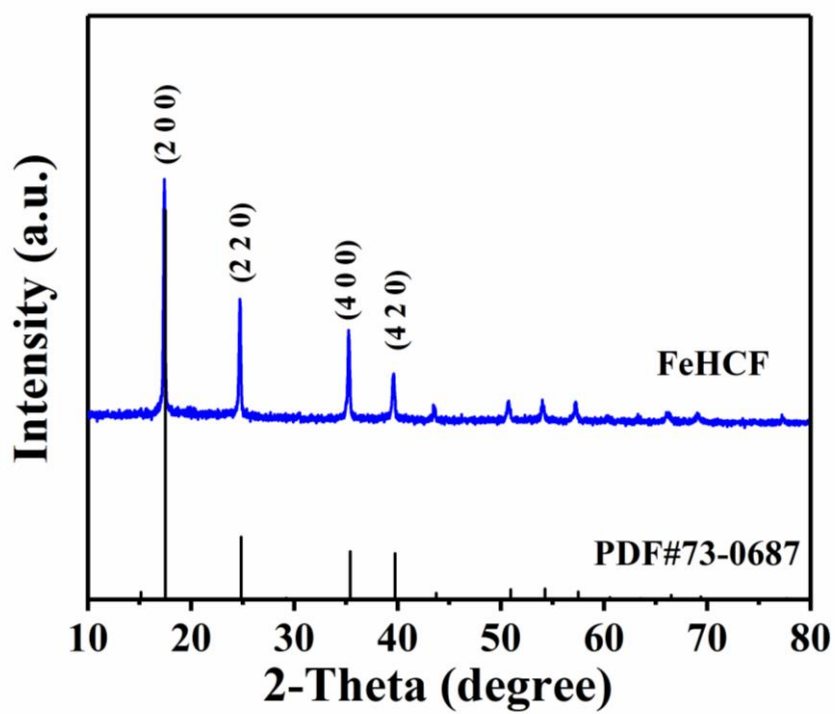


Figure S1 XRD patterns of the FeHCF.

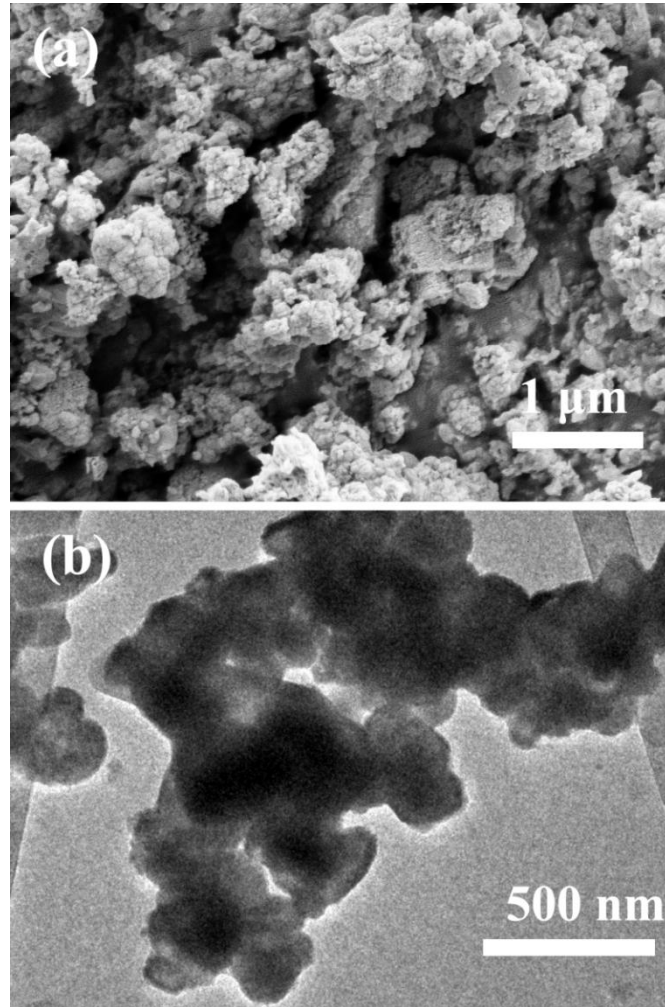


Figure S2 (a) SEM and (b) TEM images of the PFS.

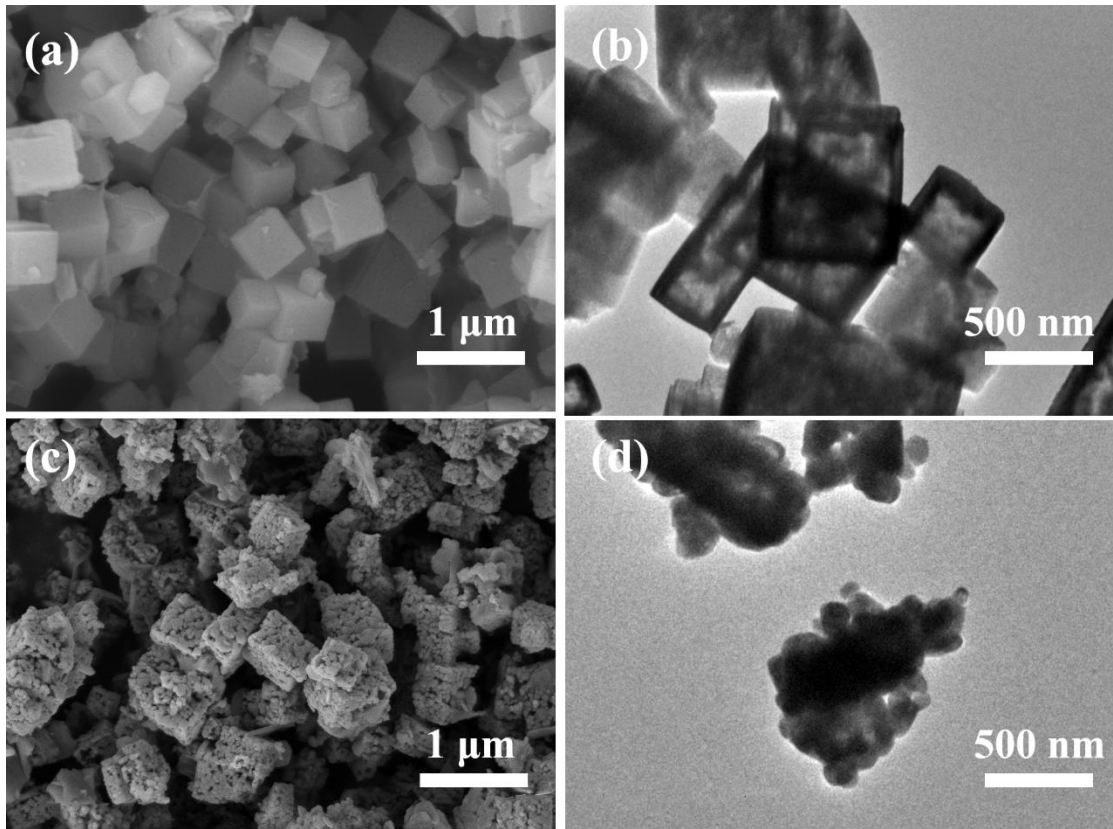


Figure S3 SEM and TEM images of (a, b)  $\text{Fe}_2\text{O}_3$  nanoboxes and (c, d) FS.

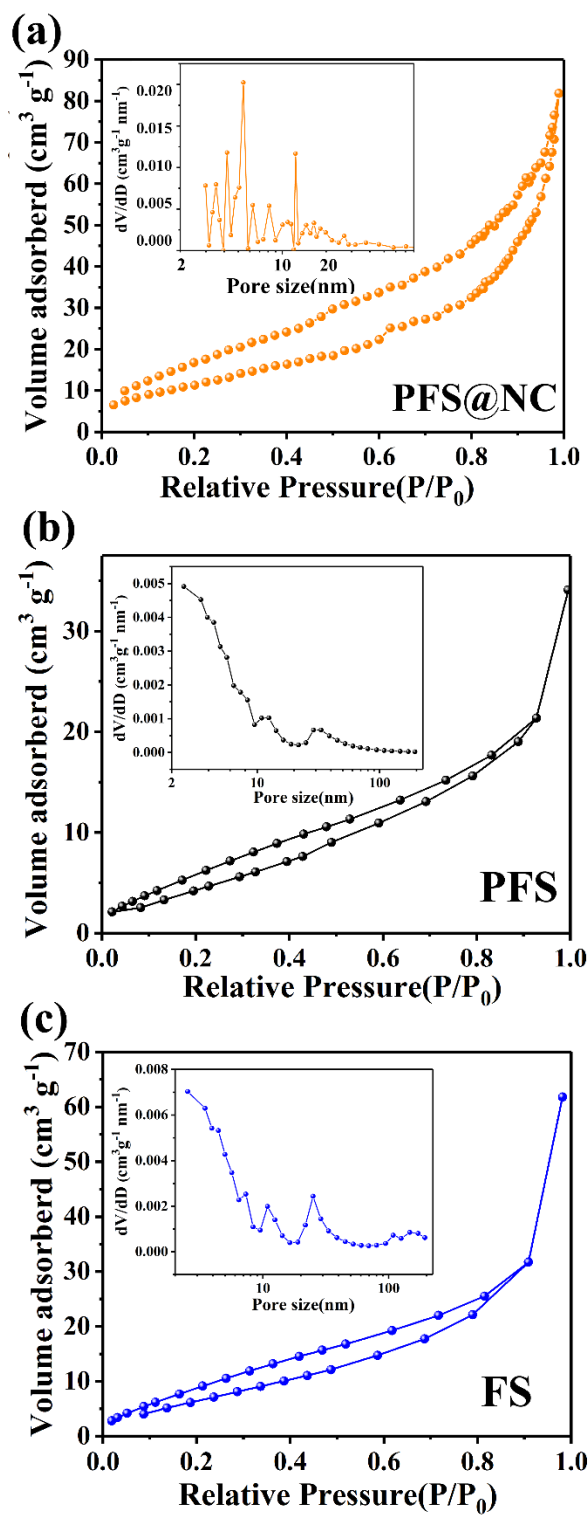


Figure S4 Nitrogen adsorption/desorption isotherms and pore size distribution of (a) PFS@NC, (b) PFS and (c) FS.

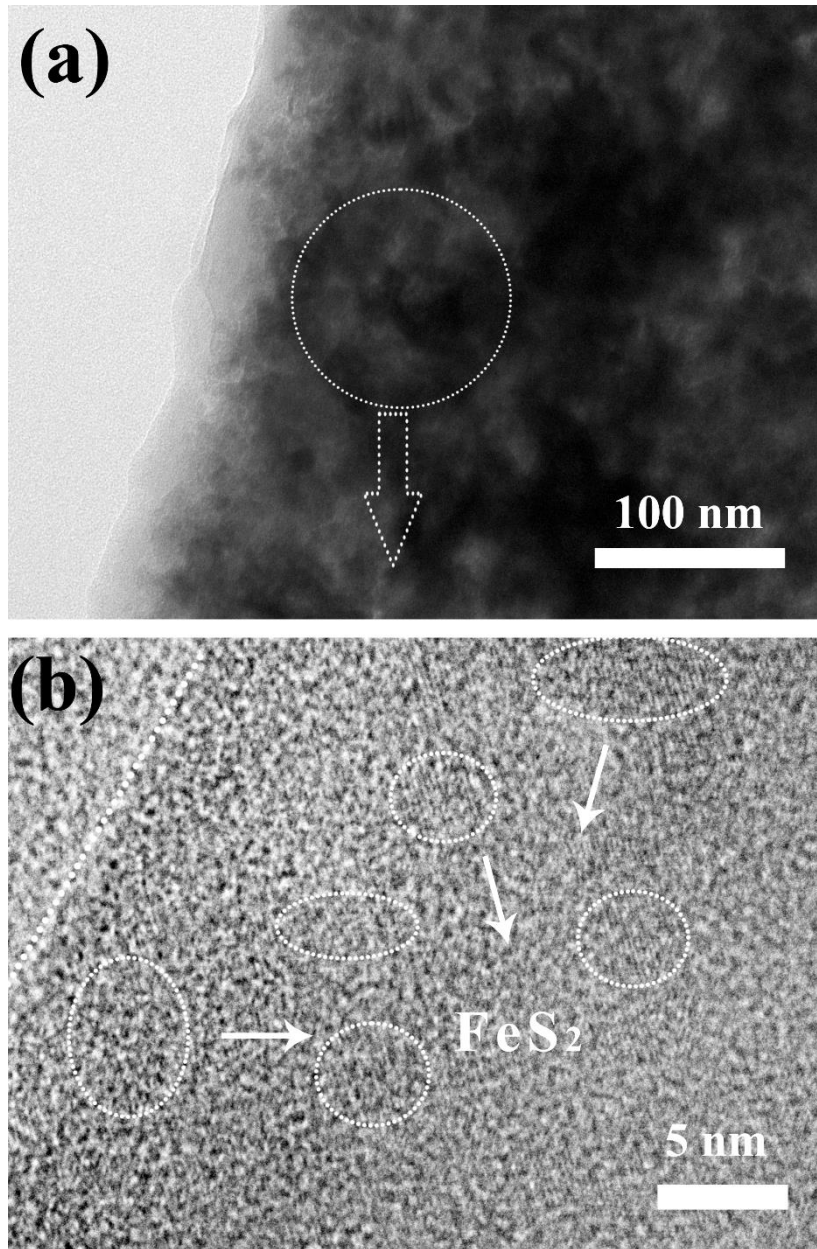


Figure S5 (a) TEM image and (b) HRTEM image of PFS@NC.

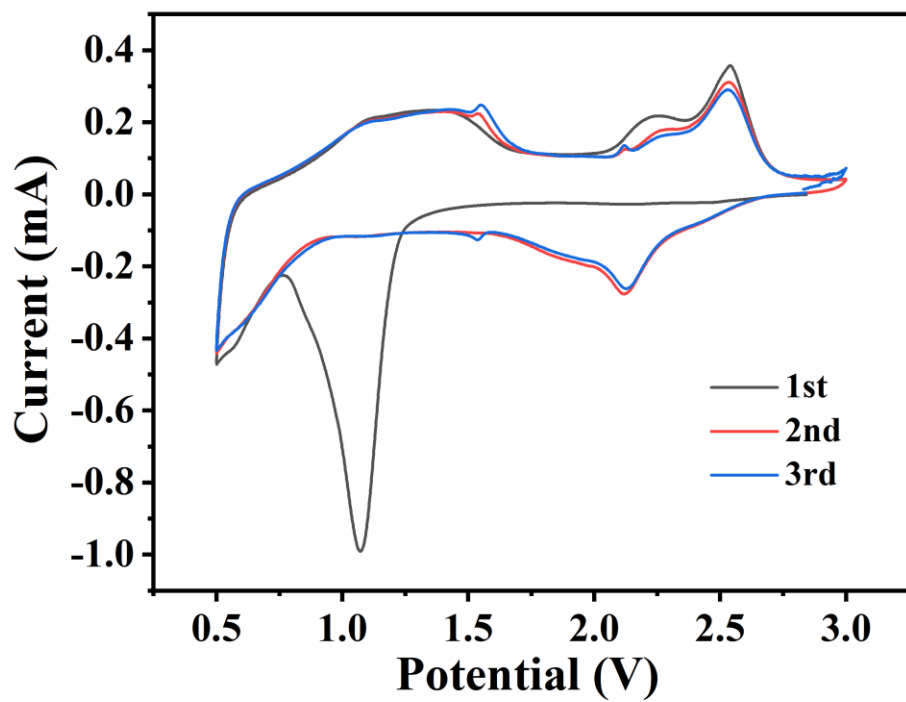


Figure S6 Cyclic voltammograms of the PFS@NC electrode.

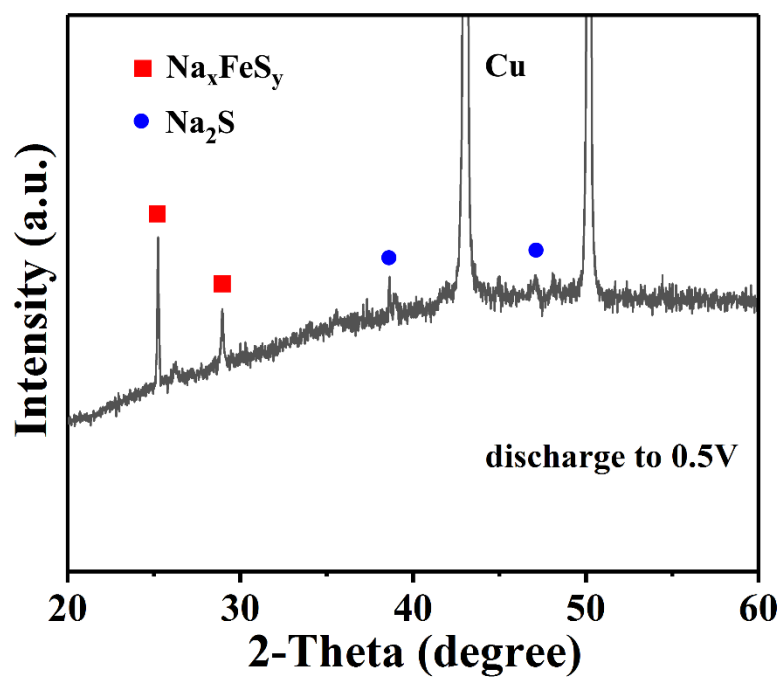


Figure S7 XRD pattern of the PFS@NC electrode discharged to 0.5V.



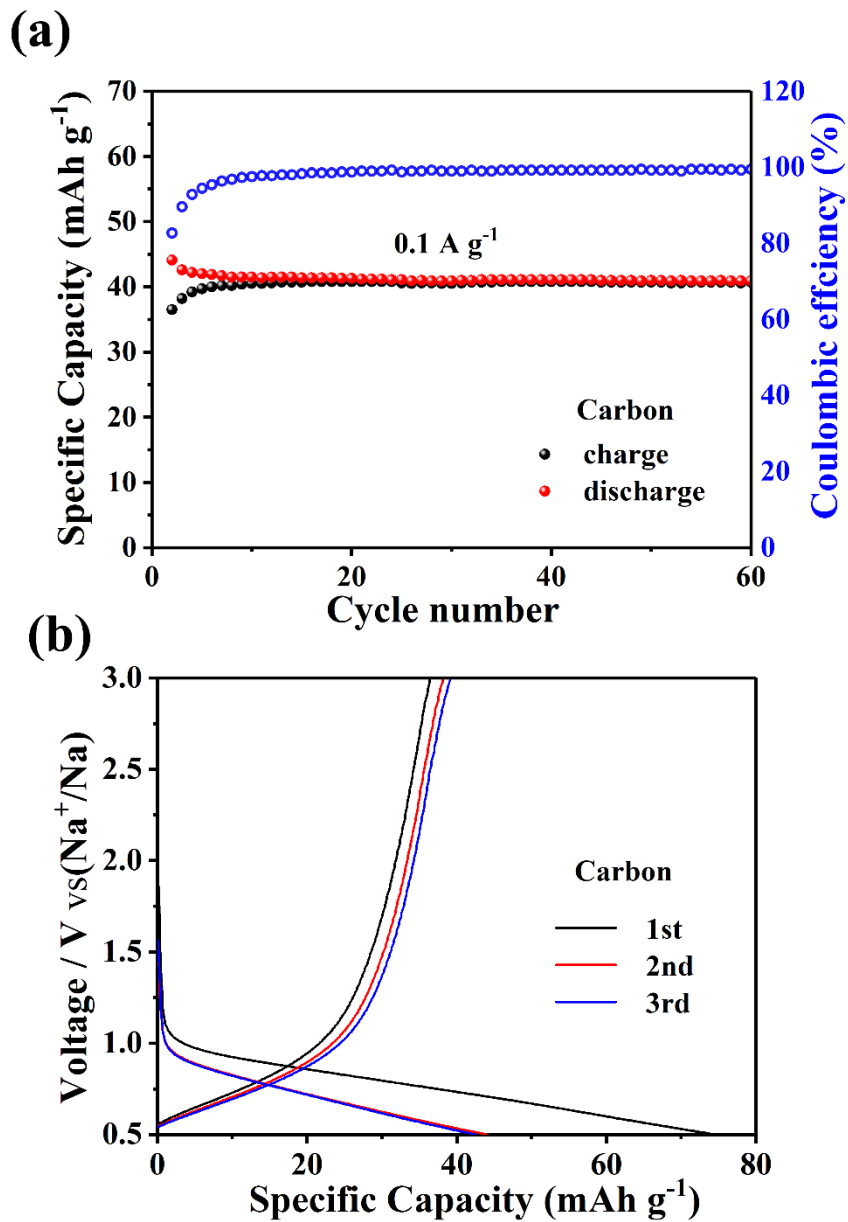


Figure S8 (a) Cycle performances of the pure carbon nanocages. (b) Charge and discharge curves of the carbon nanocages.

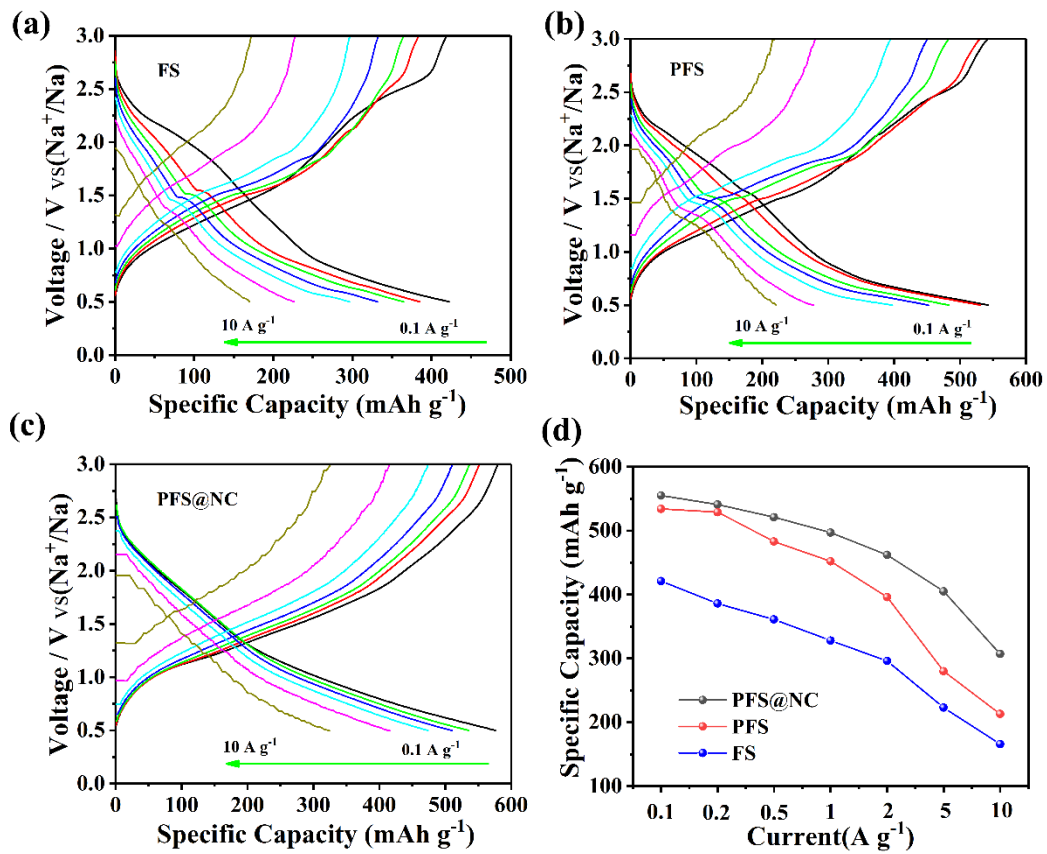


Figure S9 Charge and discharge curves of (a) FS, (b) PFS and (c) PFS@NC at various current densities. (d) Comparison of rate capabilities of all samples.

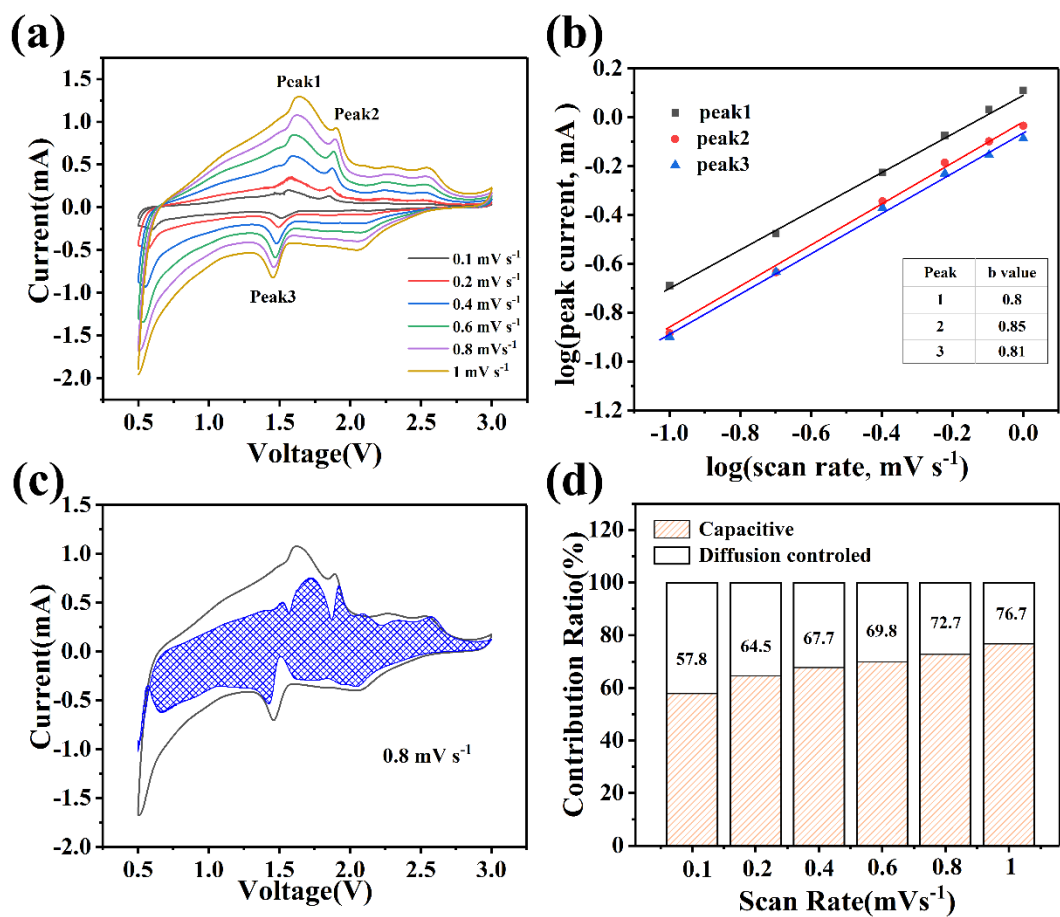


Figure S10 Kinetic analysis of PFS electrode. (a) CV curves at different scan rates; (b)  $\log(i)$  vs  $\log(v)$  for different redox peaks. (c) An illustration of capacitive contribution at  $0.8 \text{ mV s}^{-1}$ . (d) Capacitive contribution ratios chart of PFS at different scan rates.

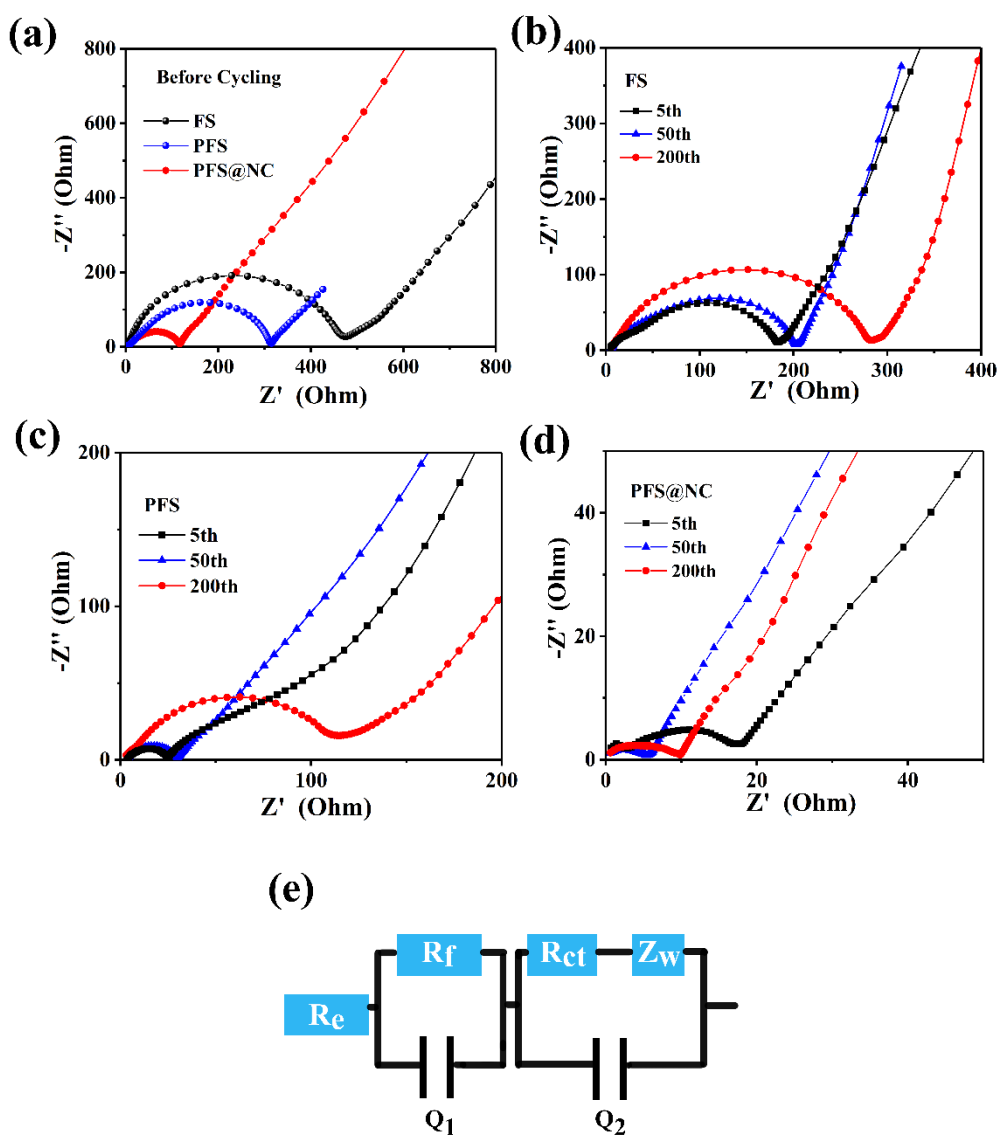


Figure S11 Nyquist impedance plots of the FS, PFS and PFS@NC electrodes (a) before cycling (b, c, d) after the 5, 50 and 200 cycles. (e) Simulated equivalent circuit of two samples.

Table S1  $R_{ct}$  values of PFS and PFS@NC composites before cycling and after 5, 50 and 200 cycles.

samples	$R_{ct}$ ( $\Omega$ )			
	Before cycling	5 <sup>th</sup>	50 <sup>th</sup>	200 <sup>th</sup>
FS	417.21	180.45	200.21	282.56
PFS	301.45	17.62	23.95	85.07
PFS@NC	89.27	10.25	4.51	7.64

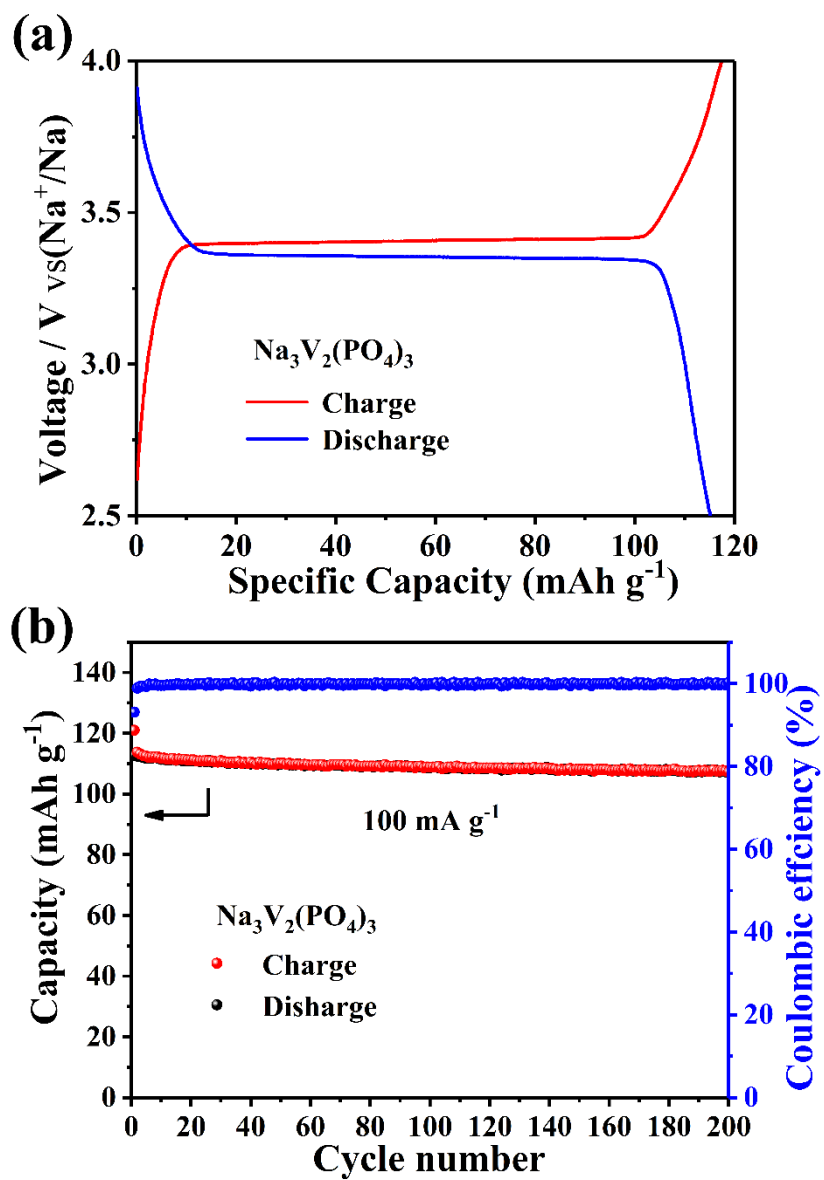


Figure S12 (a) Charge-discharge profiles and (b) cycling performance of  $\text{Na}_3\text{V}_2(\text{PO}_4)_3$  (vs  $\text{Na}/\text{Na}^+$ ) between 2.5 and 4 V at  $100 \text{ mA g}^{-1}$  C.

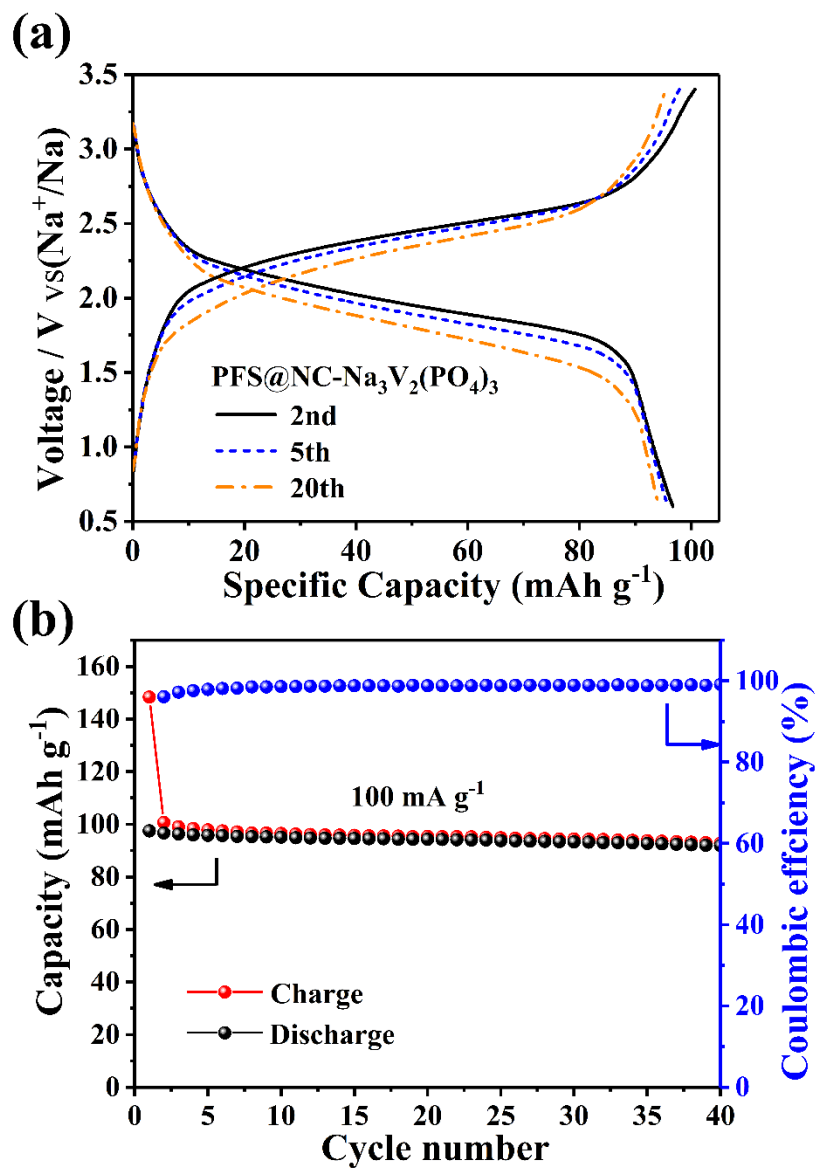


Figure S13 (a) Charge-discharge profiles and (b) cycling performance of PFS@NC-Na<sub>3</sub>V<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub> full-cell between 0.6 and 3.4 V at 100 mA g<sup>-1</sup>.