

## Supporting Information

### **Multifunctional sulfate-assistant synthesis of seaweed-like N,S-doped carbons as high-performance anodes for K-ion capacitors**

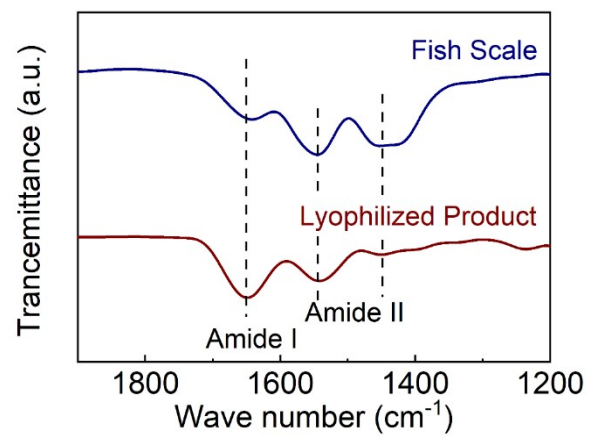
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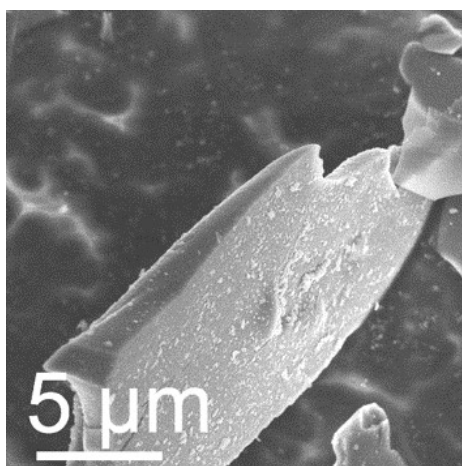
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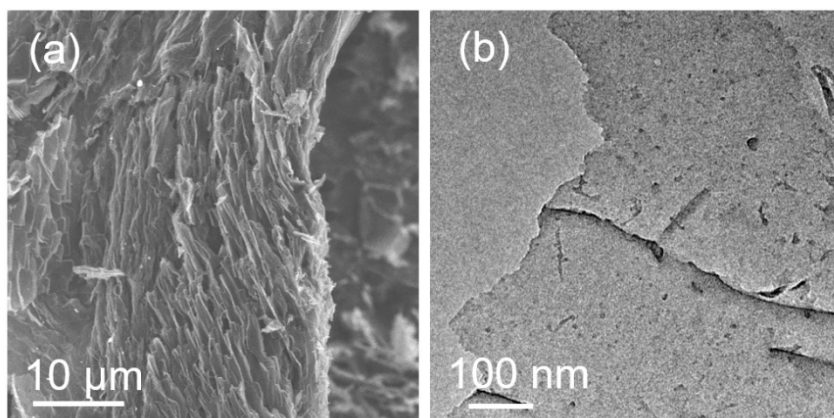
E-mail: wangpengfei@qxslab.cn; niujin@mail.buct.edu.cn



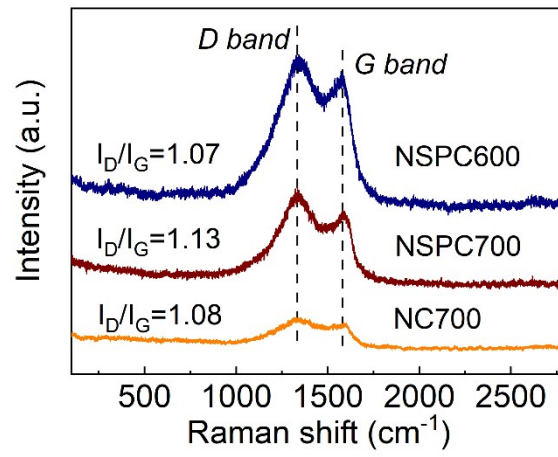
**Fig. S1** FTIR patterns of fish scale and lyophilized product after K<sub>2</sub>SO<sub>4</sub> solution extraction.



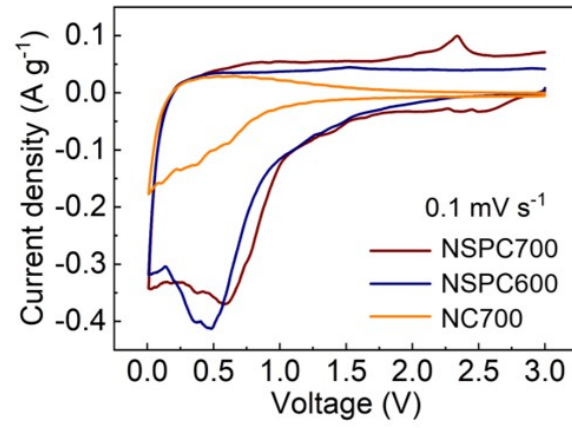
**Fig. S2** SEM images of NC700.



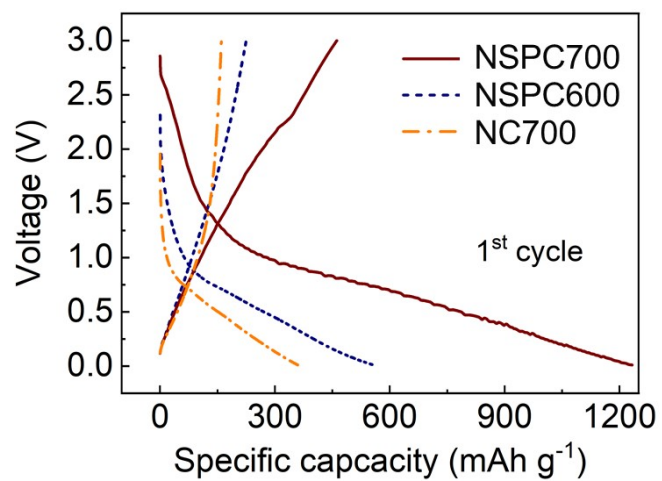
**Fig. S3** (a) SEM image and (b) TEM image of NSPC600.



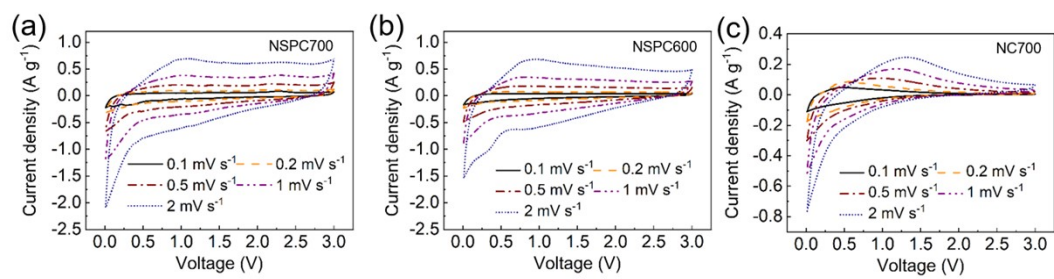
**Fig. S4** Raman spectra of NSPC600, NSPC700, and NC700.



**Fig. S5** CV curves at the scan rate of 0.1 mV s<sup>-1</sup> of the NSPC700, NSPC600, and NC700 anodes in the first cycle.

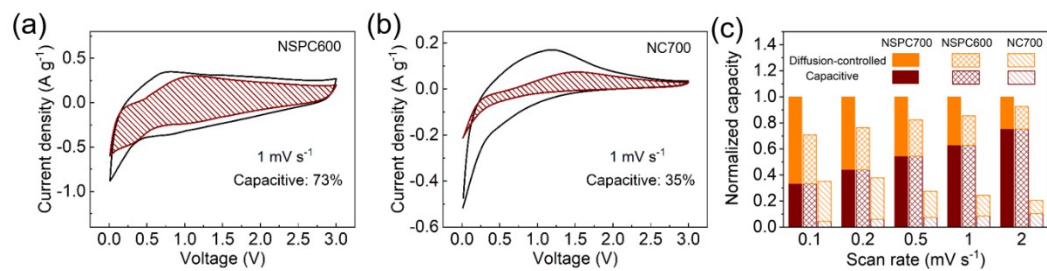


**Fig. S6** GCD curves of the NSPC700, NSPC600, and NC700 anodes in the first cycle at the current density of 0.05 A g<sup>-1</sup>.



**Fig. S7** CV curves at various scan rates of the (a) NSPC700, (b) NSPC600, and (c) NC700 anodes.





**Fig. S8** Storage contributions from the capacitive process and diffusion-controlled process of the (a) NSPC600 and (b) NC700 anodes at 1 mV s<sup>-1</sup>. (c) Normalized capacities of the NSPC600, NSPC700, and NC700 anodes derived from capacitive process and diffusion-controlled process at various scan rates.

**Table S1** Simulation results of the kinetic parameters for NSPC600, NSPC700, and NC700.

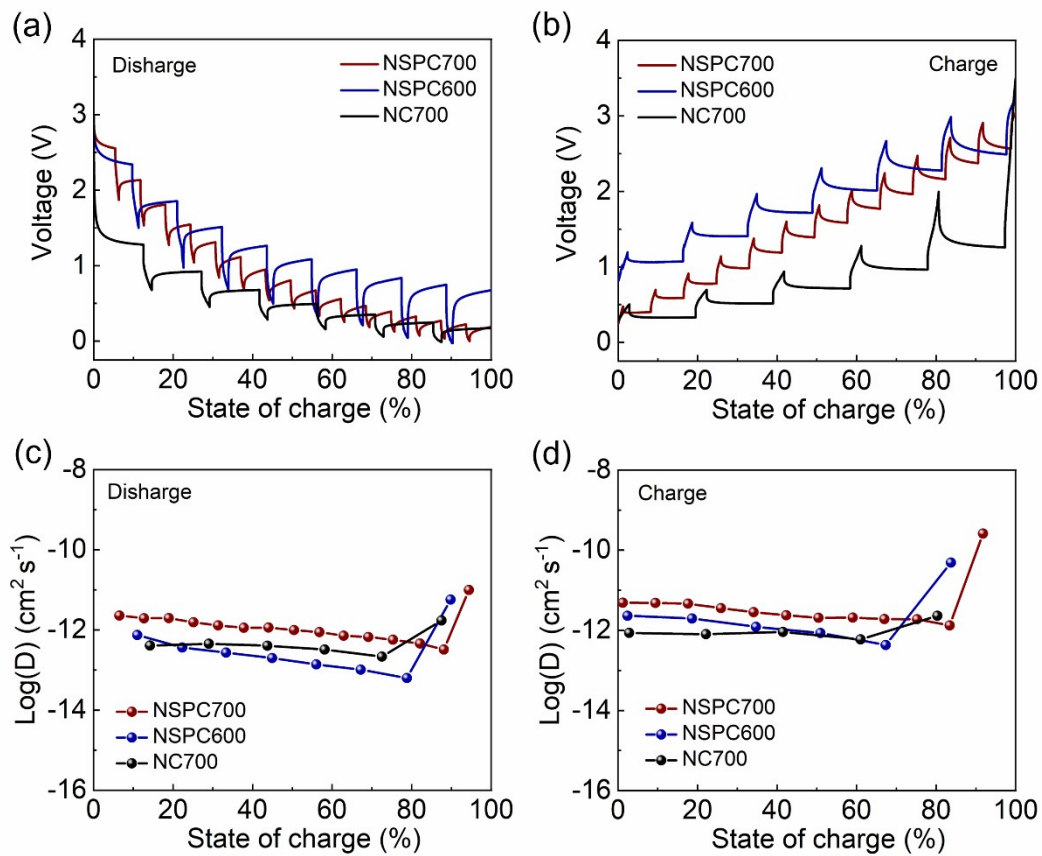
Sample	$R_e^a$ ( $\Omega$ )	$R_f^b$ ( $\Omega$ )	$R_{ct}^c$ ( $\Omega$ )	$\sigma^d$
NSPC600	5.767	15.61	2586	458.15
NSPC700	5.738	14.14	1532	362.49
NC700	8.483	54.23	8641	2123.34

<sup>a</sup> The electrolyte resistance

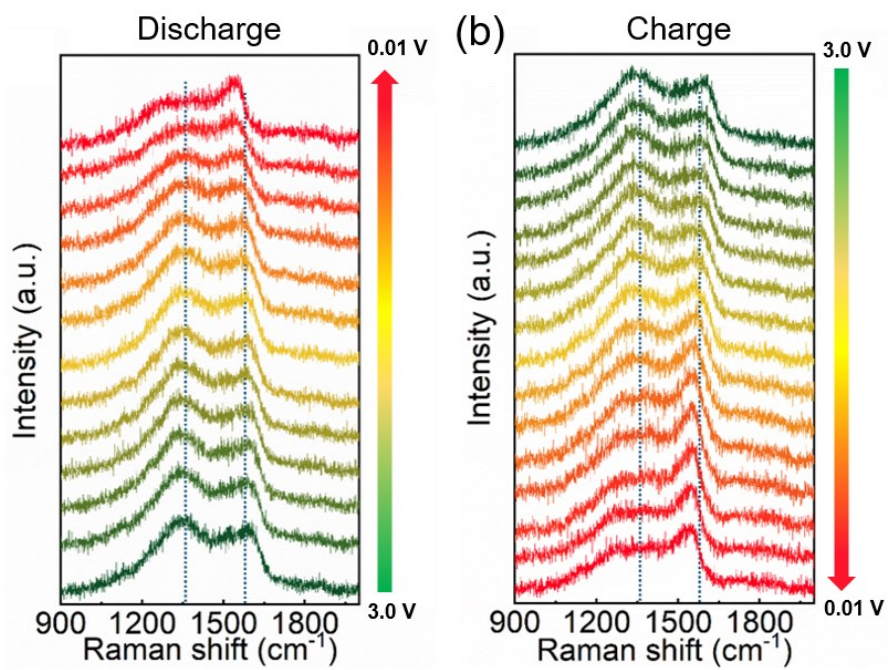
<sup>b</sup> The resistance of the SEI

<sup>c</sup> The charge-transfer resistance

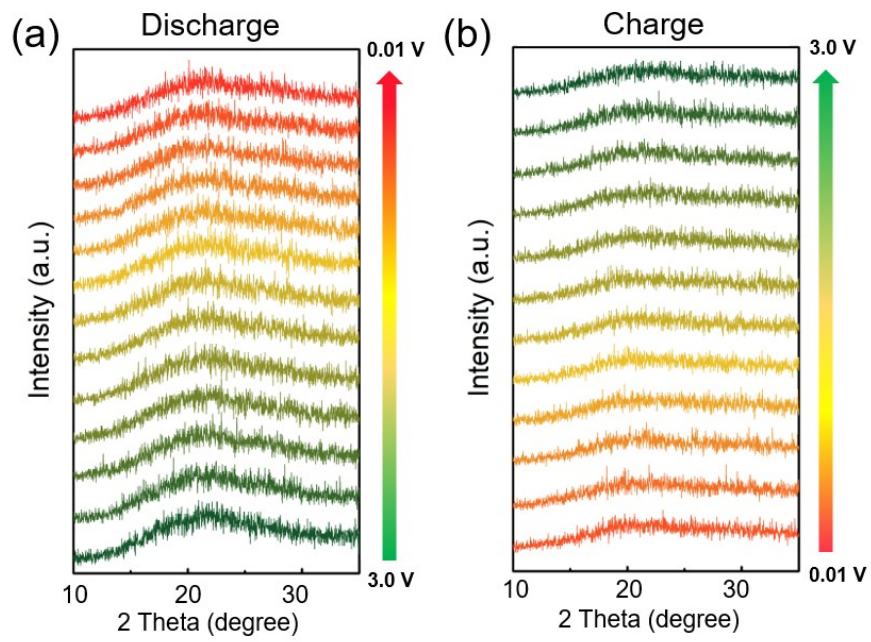
<sup>d</sup> Warburg coefficient



**Fig. S9** GITT potential plots of the anodes in the (a) potassiation and (b) depotassiation processes. The  $K^+$  diffusion coefficients of the anodes in the (c) potassiation and (d) depotassiation processes.



**Fig. S10** *In-situ* Raman spectra of the NSPC700 anode during the discharge/charge processes.



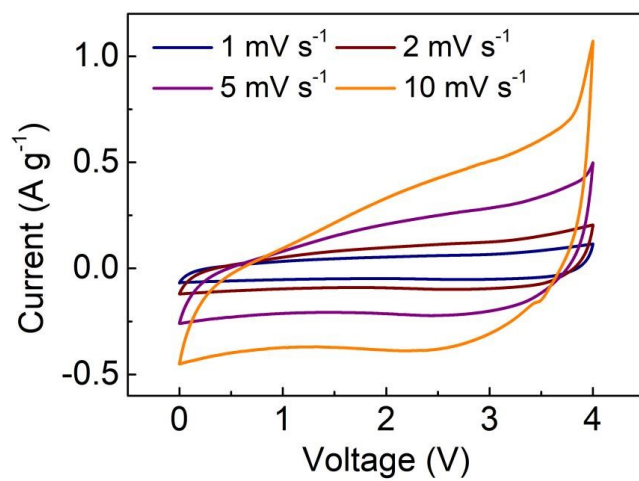
**Fig. S11** *In-situ* XRD patterns of the NSPC700 anode during the discharge/charge processes.

**Table S2** The near-surface N species of NSPC700 anode after discharge and charge processes.

	N-Q	N-5	N-6	N-Q-K	N-5-K	N-6-K
After discharge	-	-	-	37.03%	24.25%	38.73%
After charge	9.74%	12.06%	16.35%	14.47%	12.72%	34.67%

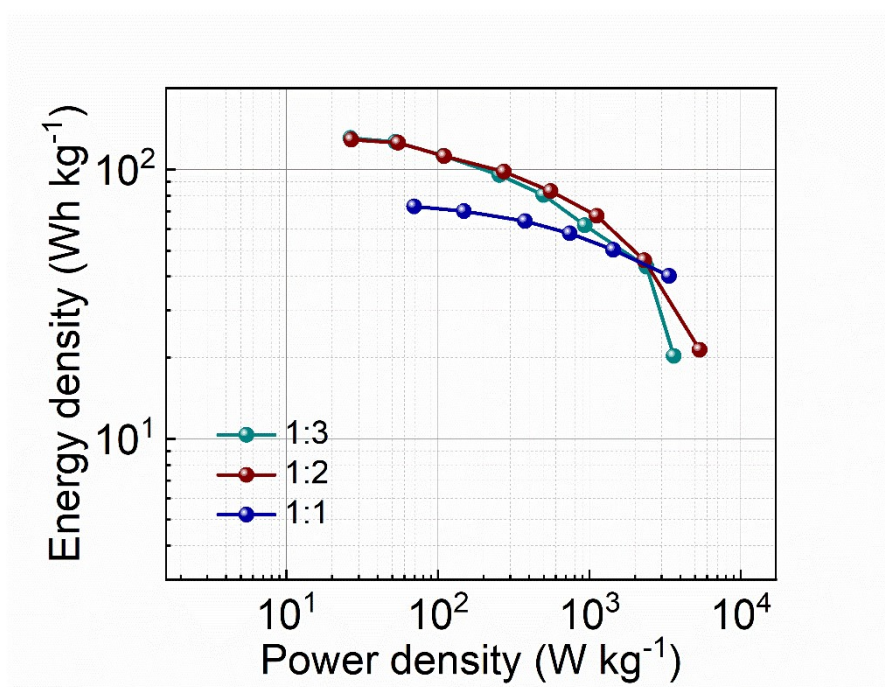
**Table S3** The near-surface S species of NSPC700 anode after discharge and charge processes.

	C-SO <sub>x</sub> -C	C-S-C	-K <sub>2</sub> S <sub>x</sub>
After discharge	14.19%	8.44%	77.37%
After charge	15.65%	21.23%	63.12%



**Fig. S12** CV curves of the NSPC700||HPC800 KIC at different scan rates.





**Fig. S13** Ragone plots of the NSPC700||HPC800 KICs with different mass ratio of anode to cathode materials.