Supporting Information

Facile fabrication of WS_2 nanocrystals confined in chlorella-derived N,P co-doped bio-carbon for sodium-ion batteries with ultra-long lifespan

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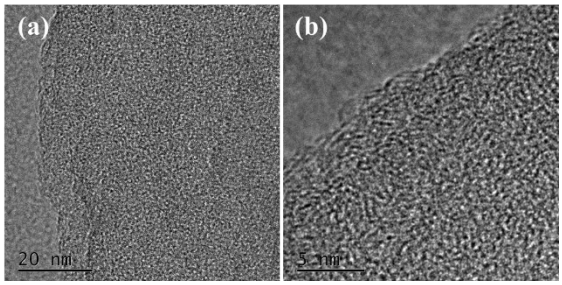

Fig.S1 (a-b) HRTEM images of the NPC sample.

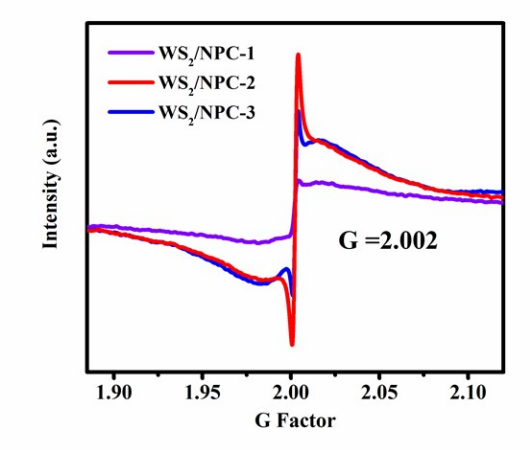

Fig. S2 The EPR spectra of WS_2/NPC-1, WS_2/NPC-2 and WS_2/NPC-3.

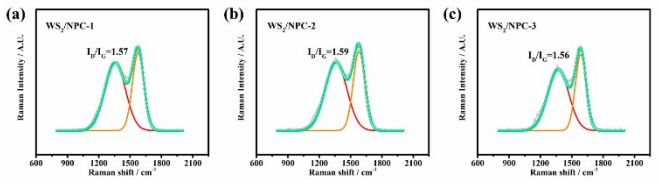

Fig. S3 Fitted raman spectra curve of (a) WS_2/NPC-1, (b) WS_2/NPC-2 and (c) WS_2/NPC-3 samples.

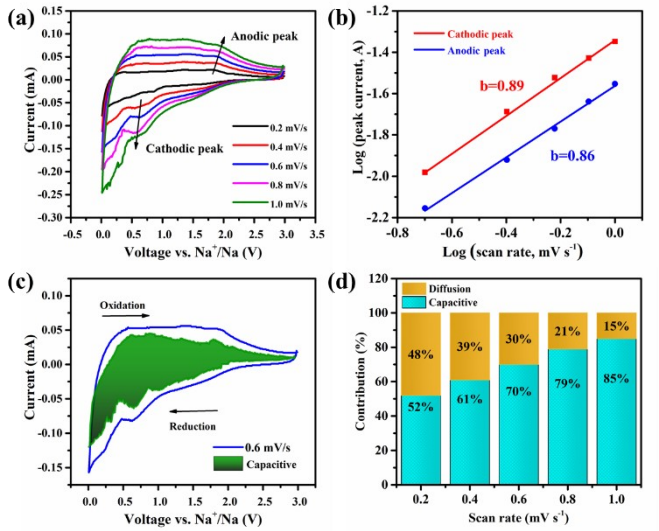

Fig. S4 (a) Cyclic voltammentry profiles of WS_2/NPC-2 electrode at ramping sweep rates from 0.2 to 1.0 mV s^{-1}. (b) log(i) versus log(v) plots at different oxidation and reduction peaks. (c) Capacitive contribution (green region) of WS_2/NPC-2 at 0.6 mV s^{-1}. (d) The diffusion controlled and capacitive proportion of WS_2/NPC-2 at different scan speeds.

Table S1 The integral areas values of D and G peaks of the prepared samples measured from Raman results.

Sample	I_D	I_G	I_D/I_G
WS_2/NPC-1	70121.8	44627	1.57
WS_2/NPC-2	74213.3	46602	1.59
WS_2/NPC-3	63992	40895	1.56

Table S2 Summary of electrochemical behaviors of previous reports about WS_2 related anode materials for SIBs.

Electrode materials	Cycling capacity (mAh g^{-1})	Current density (A g^{-1})	Cycle numbers	References
WS_2/CFC@C-P	297	2	500	56
Co_9S_8/WS_2@NC	355	2	120	24
WS_2/ZnS	170.8	5	5000	28
WS_2@CNFs	381	0.2	100	29
High crystallinity WS_2	240	5	250	47
PCS/WS_2/NG	205	0.5	900	23
H-WS_2@NC	473	0.1	200	57
WS_2@S/N–C nanofibers	319	0.1	100	42
	174	5	1000	
WS_2 hollow microspheres	285	2	2000	26
WS_2 nanofibers	363	0.2	400	48
	226.5	1	800	
NGQDs-WS_2/3DCF	392.1	0.2	1000	58
	436	**0.1**	**100**	
WS_2/NPC-2	**302**	**1**	**2800**	**This work**
	154	**5**	**6000**	

Table S3 Impedance values fitted from an equivalent circuit model.

Sample	R_s (Ω)	R_f (Ω)	R_{ct} (Ω)
WS_2/NPC-1	6.6	76.1	148.9
WS_2/NPC-2	5.6	61.7	104.4
WS_2/NPC-3	7.7	88.3	165.2