Layered Tungsten-Based Composites and Their Pseudocapacitive and Electrocatalytic Performance

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Supporting Information:

Table S1: Summary of atomic percentage of all samples based on the intensities of W 4f, S 2p, N 1s, C 1s and O 1s determined by XPS analysis.

Samples	Surface composition (Atomic %)					Atomic ratio			
	W 4f	S 2p	N 1s	O 1s	C 1s	N 1S/ C 1s	N (C=N-C)/ N-$(C)_3$	W 4f/ S 2p	WO_3 / WS_2
WS_400	0.85	0.43	17	9.74	71.98	0.24	1.99	1.98	4.62
WS_600	1.18	1.01	11.78	11.35	74.68	0.16	1.78	1.17	1.35
WS_800	0.55	0.21	4.11	31.91	63.22	0.08	0.73	2.61	1.19

Table S2: Performance comparison of different tungsten-based supercapacitors.

Electrode materials	Specific capacitance (F g^{-1})	Performance retention (%)	Reference
W_2C/WS_2	1018	94% @ 5000 cycles	[26]
WS_2@$NiCo_2O_4$	770	86% @ 5000 cycles	[27]
WS_2 QDs	457	81% @ 8000 cycles	[29]
WS_2/PEDOT	71	90.7% @ 5000 cycles	[28]
WS_2/ACF	238	90.5% @ 1000 cycles	[30]
WC@GNF	1010	106% @ 2000 cycles	[32]
WNFs-3	588	95.5% @ 5000 cycles	[31]
WS_600	1156	82% @ 10,000 cycles	This work

Table S3: Comparison of the HER performance for different tungsten-based electrodes.

Electrode materials	Electrolyte concentration (mol L^{-1})	Potential at -10 mA cm^{-2} (V vs. RHE)	Tafel slope (mV dec^{-1})	Reference
W_2C/WS_2	0.5M H_2SO_4	0.130	70	[26]
20WZ-800	0.5M H_2SO_4	0.250	64	[34]
WS_2	0.5M H_2SO_4	0.125	60	[35]
W-CoP	0.5M H_2SO_4	0.048	56	[36]
Pt/def-WO_3@CFC	0.5M H_2SO_4	0.042	60	[37]
WO_xS_y	0.5M H_2SO_4	0.103	54	[38]
20% WSx@OMC	0.5M H_2SO_4	0.213	74	[1]
WS_600	0.5M H_2SO_4	0.170	59	This work

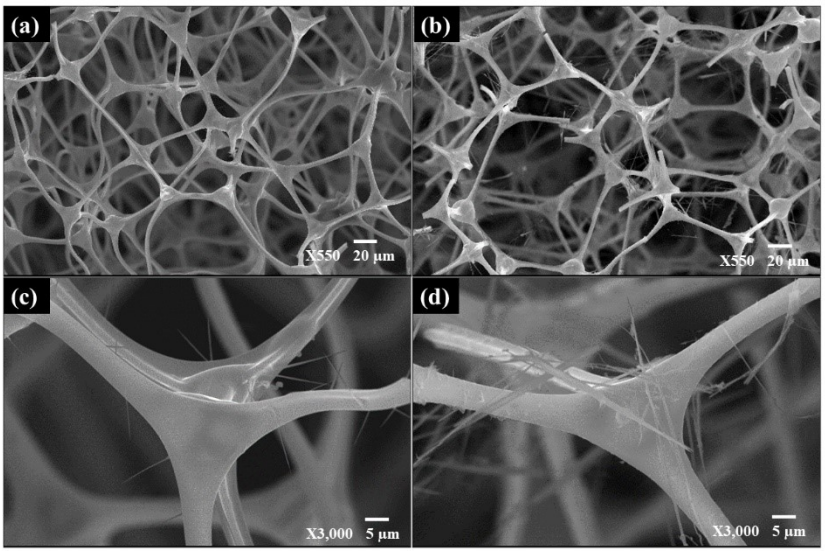


Figure S1: Low magnification SEM images of WS_400 (a, c), and WS_600 (b, d).

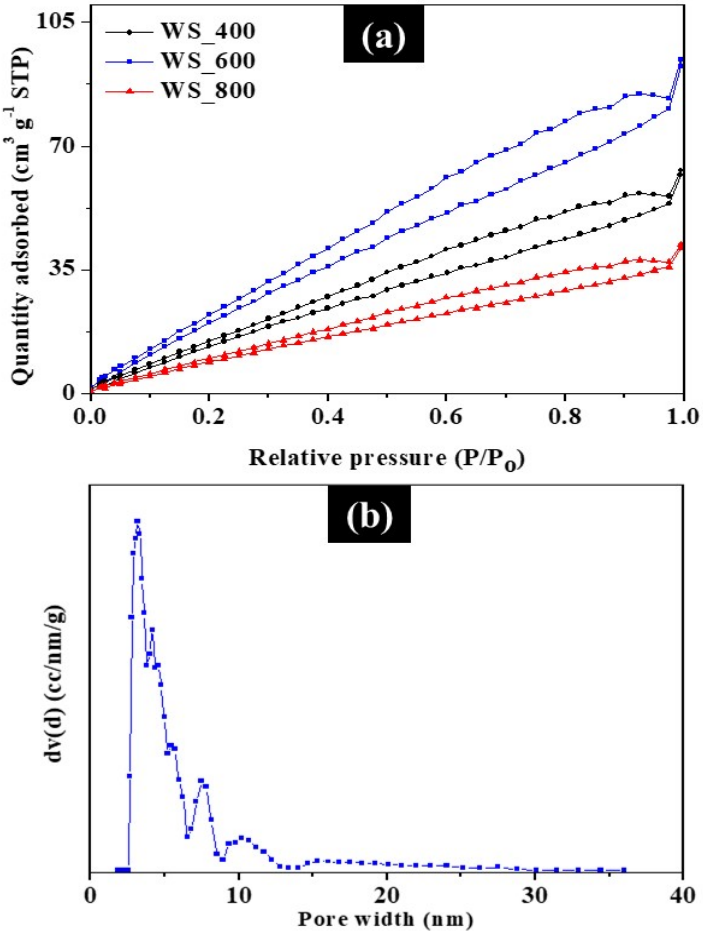
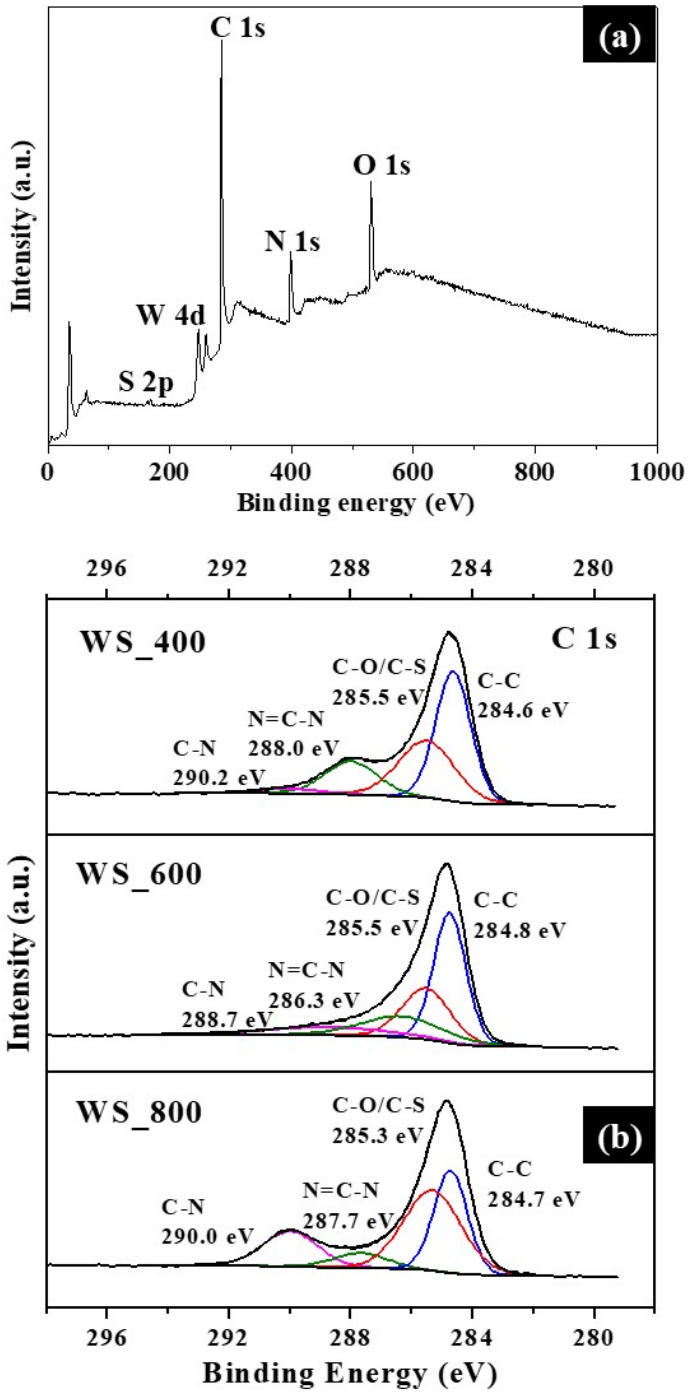


Figure S2. (a) Nitrogen adsorption-desorption isothermal curves of of WS_2 - g-C_3N_4 composites and (b) pore size distribution of WS_600.



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33 Figure S3. (a) XPS survey spectrum of the WS_600 and (b) C 1s spectra of WS_2 - g-C_3N_4 composites.

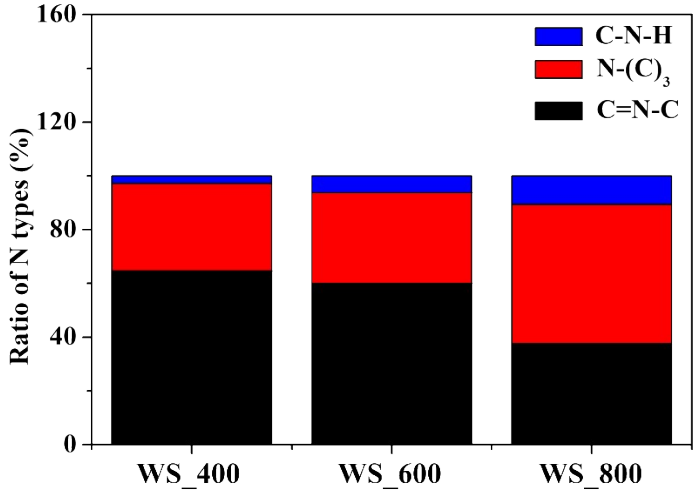

Figure S4. Ratio of different nitrogen types determined from XPS analysis

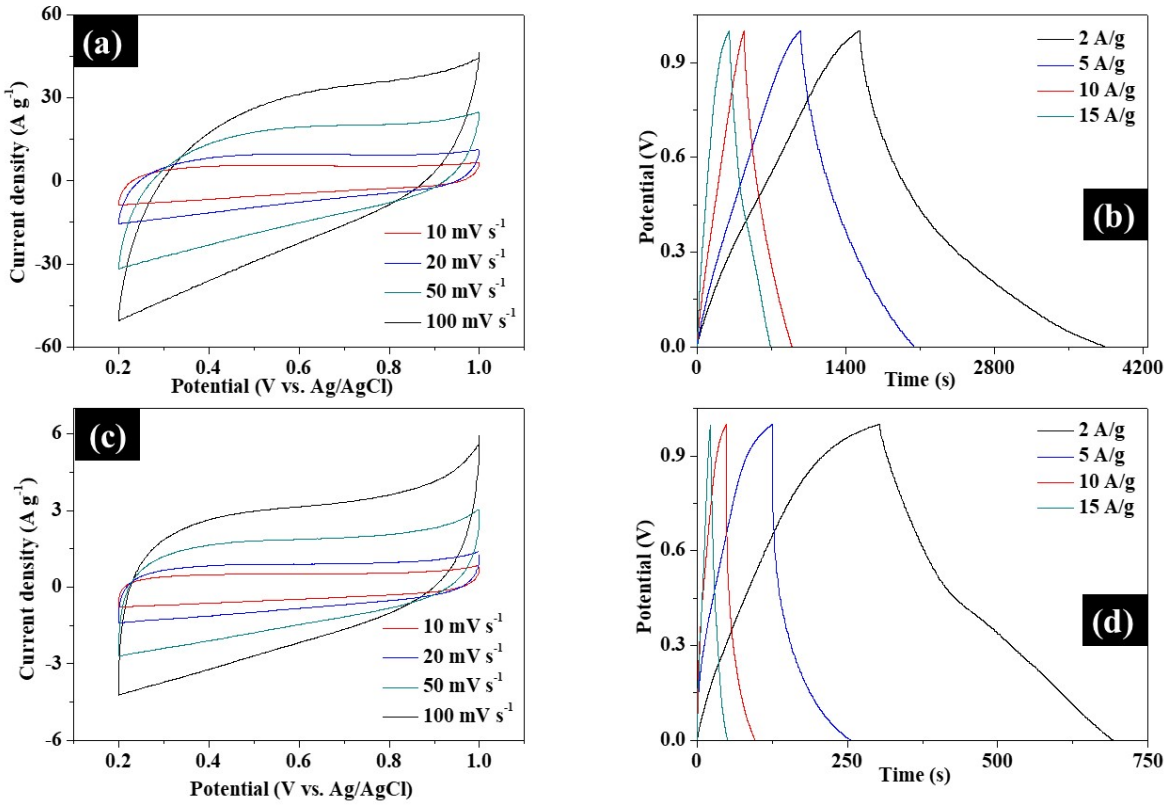

Figure S5. Electrochemical characterization (a) CV curves at various scan rates of WS_800 from 10 to 100 mV s^{-1}, (b) Galvanostatic charge discharge curves of WS_800 at different current densities, c) CV curves at various scan rates of WS_400 from 10 to 100 mV $s^{-1}$and (d) Galvanostatic charge discharge curves of WS_400 at different current densities.

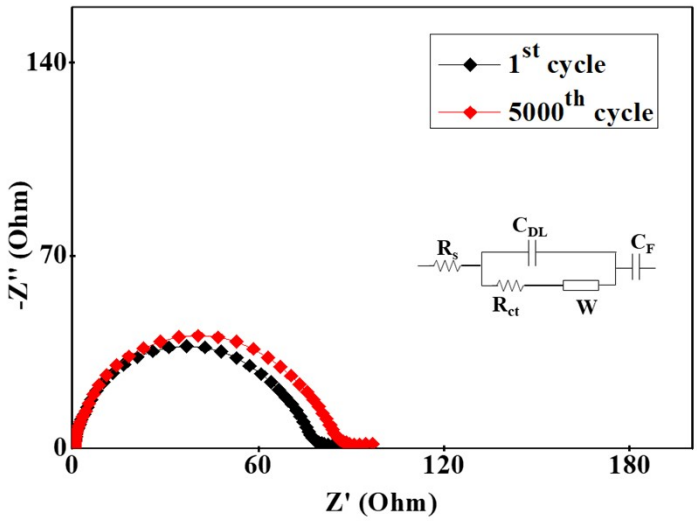

Figure S6. Nyquist plots of WS_600 before and after 5000 cycles with the corresponding equivalent circuit inset (R_{ct} - charge transfer resistance, C_{DL} - electrical double-layer capacitance, R_s - solution resistance, W - Warburg impedance and C_F - Faradaic capacitance).