Electronic Supplementary Information (ESI)

Oriented SnS nanoflakes bound on S-doped N-rich carbon nanosheets with rapid pseudocapacitive response as high-rate anodes for sodium-ion batteries

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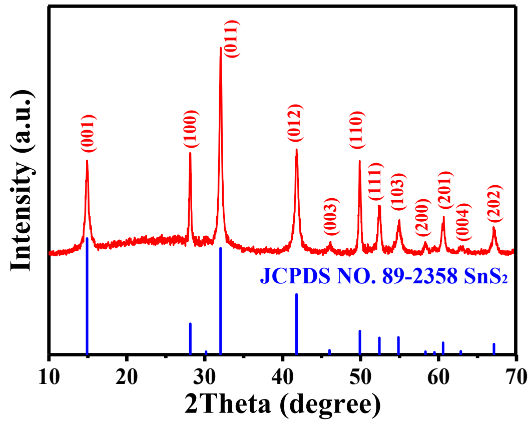

Fig. S1. XRD patterns of the intermediate products SnS_2/CN.

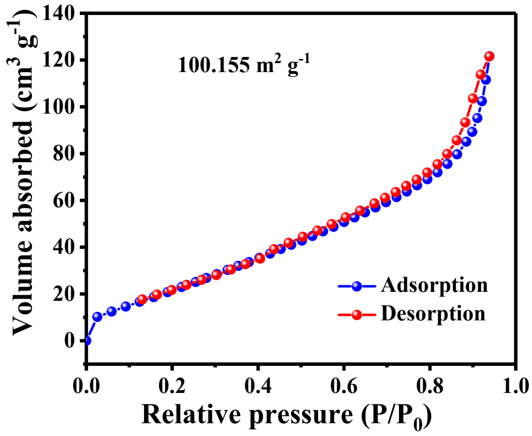

Fig. S2. N_2 adsorption/desorption isotherm of SnS/CNS composite.

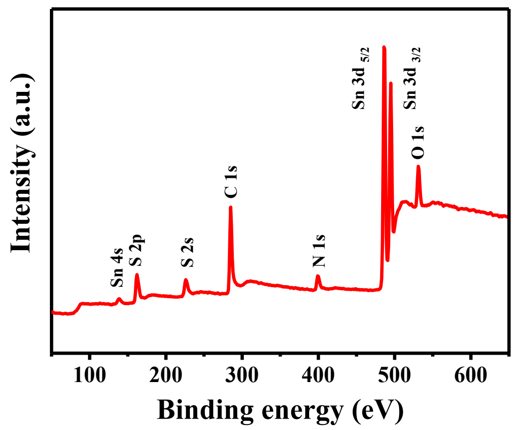

Fig. S3. XPS spectra of the SnS/CNS composite.

Table S1. Elemental composition of SnS/CNS are determined by CHONS Elemental Analyzer.

	N content	S content	C content
SnS/CNS	6.24 wt.%	17.255 wt.%	16.53 wt.%

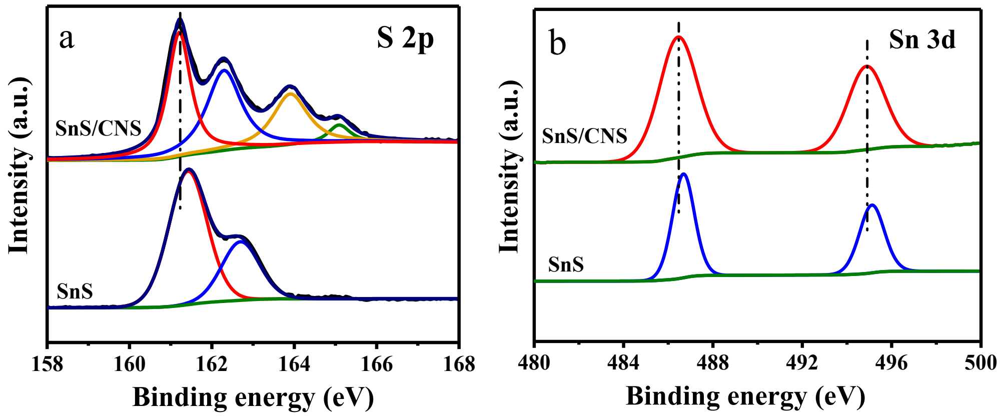

Fig. S4. (a) S2p and (b) Sn3d spectrum of SnS/CNS and SnS.

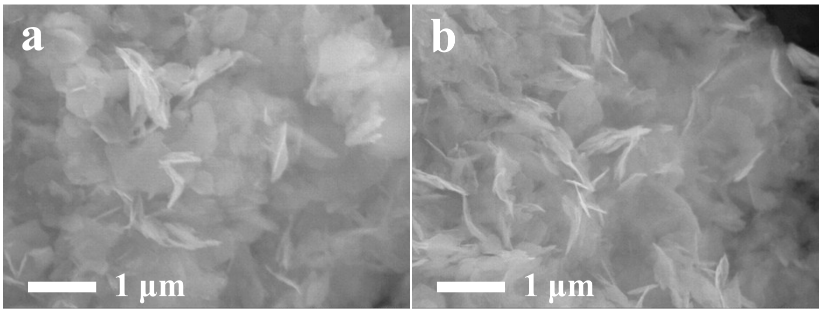

Fig. S5. SEM images of pristine SnS.

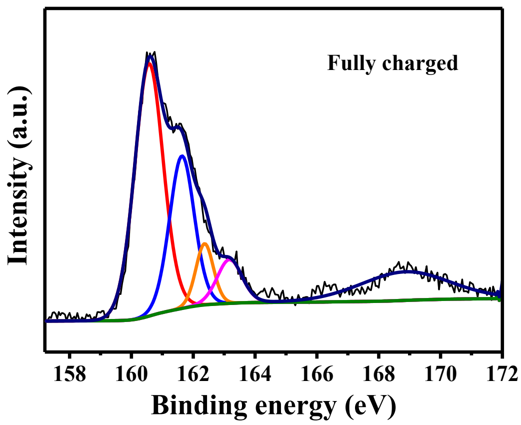

Fig. S6. XPS S2p of SnS/CNS at the fully charged state.

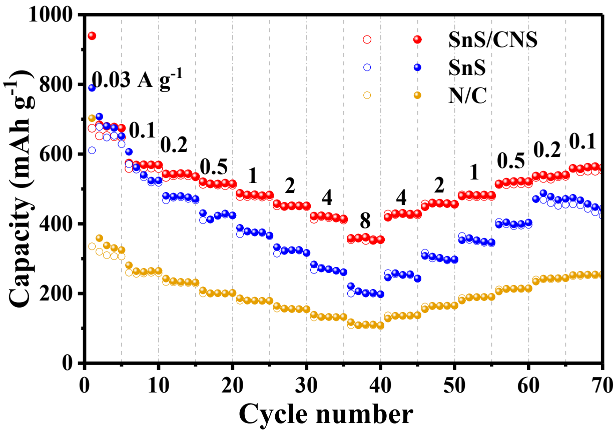

Fig. S7. Rate performance of SnS/CNS, SnS and N/C electrodes

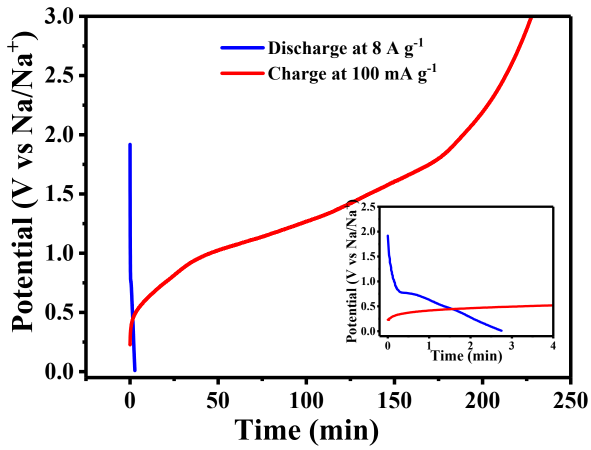

Fig. S8. Fast discharging (discharge at 8 A g^{-1} in 3 min, charge at 100 mA g^{-1} with 230 min) performance of the SnS/CNS electrode

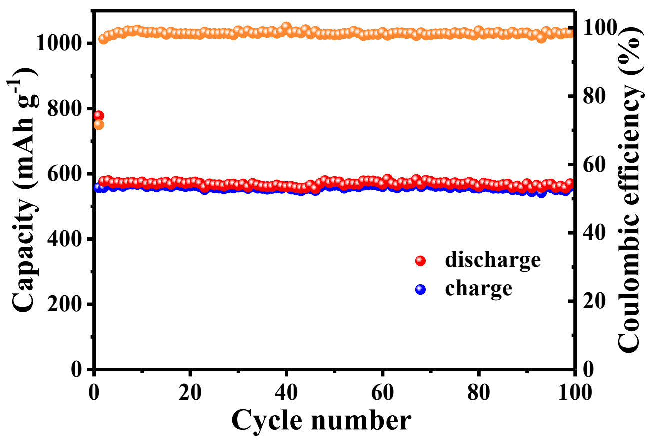

Fig. S9. Cycling performance of SnS/CNS at a current density of 100 mA g^{-1} with coulombic efficiency.

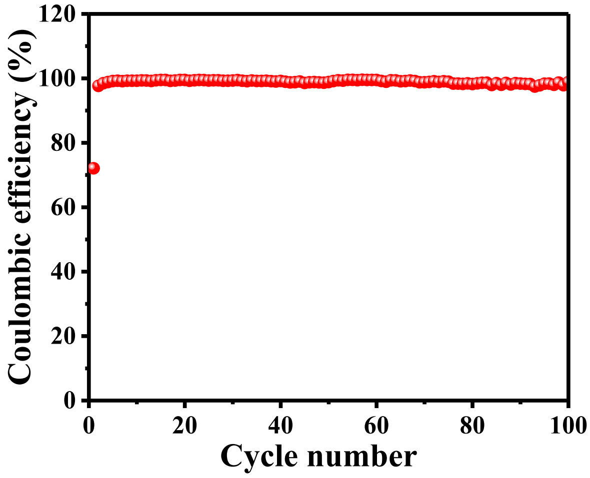

Fig. S10. Coulombic efficiency of the SnS/CNS electrode at 1 A g^{-1} for 100 cycles.

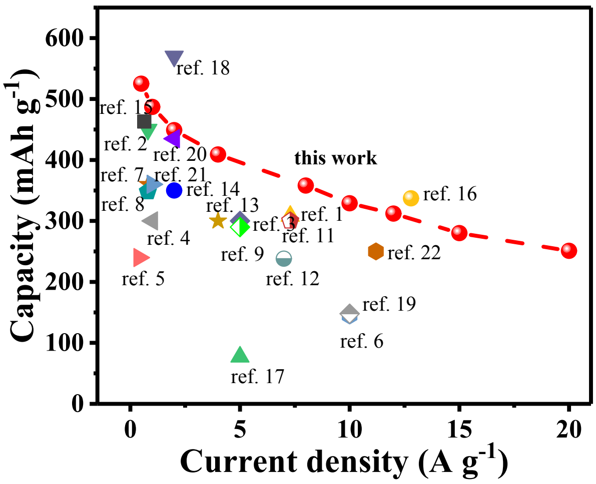

Fig. S11. Rate performance comparison of SnS/CNS and other tin sulfides.

Table S2. A survey of electrochemical performances of tin sulfide anodes in sodium ion batteries.

Materials	Reversible capacity (mAh g^{-1})	Cycling stability (%)	ICE (%)	High rate capability (mAh g^{-1})	Ref.
SnS/CNS	**654 mAh g^{-1} (0.03 A g^{-1}) 483 mAh g^{-1} (1 A g^{-1})**	**98% (100 cycles, 1A g^{-1})**	**72%**	**360 mAh g^{-1} (8 A g^{-1}) 250.2 mAh g^{-1} (20 A g^{-1})**	**This work**
SnS-G	500 mAh g^{-1} (0.81 A g^{-1})	94% (250 cycles, 0.81 A g^{-1})	70%	308 mAh g^{-1} (7.29 A g^{-1})	1
SnS-C	544 mAh g^{-1} (0.1 A g^{-1})	98% (80 cycles, 0.1 A g^{-1})	66%	450 mAh g^{-1} (0.8 A g^{-1})	2

SnS-C	490 mAh g^{-1} (0.5 A g^{-1})	88 % (50 cycles, 0.5 A g^{-1})	63%	300 mAh g^{-1} (5 A g^{-1})	3
SnS	520 mAh g^{-1} (0.125 A g^{-1})	65 % (30 cycles, 0.125 A g^{-1})	60%	300 mAh g^{-1} (1 A g^{-1})	4
SnS-rGO	457 mAh g^{-1} (0.02 A g^{-1})	94% (100 cycles, 0.1 A g^{-1})	56%	240 mAh g^{-1} (0.4 A g^{-1})	5
SnS/C	415 mAh g^{-1} (0.1 A g^{-1})	80% (300 cycles, 1 A g^{-1})	79%	145 mAh g^{-1} (10 A g^{-1})	6
SnS 3D flowers	455 mAh g^{-1} (0.03 A g^{-1})	64% (50 cycles, 0.15 A g^{-1})	none	360 mAh g^{-1} (0.8 A g^{-1})	7
SnS-Sn-C	450 mAh g^{-1} (0.1 A g^{-1})	87% (150 cycles, 0.1 A g^{-1})	59%	348 mAh g^{-1} (0.8 A g^{-1})	8
SnS nanotube	520 mAh g^{-1} (0.05 A g^{-1})	95% (100 cycles, 0.2 A g^{-1})	76%	290 mAh g^{-1} (5 A g^{-1})	9
GF-SnS NH	1100 mAh g^{-1} (0.03 A g^{-1})	92% (200 cycles, 0.03 A g^{-1})	81%	420 mAh g^{-1} (30 A g^{-1})	10
SnS/SnO_2 Heterostr-uctures	729 mAh g^{-1} (0.03 A g^{-1})	73% (500 cycles, 0.81 A g^{-1})	74%	300 mAh g^{-1} (7.29 A g^{-1})	11
SnS-MoS_2	455 mAh g^{-1} (0.5 A g^{-1})	89% (100 cycles, 0.5 A g^{-1})	81%	238 mAh g^{-1} (7 A g^{-1})	12
SnS_2-G	610 mAh g^{-1} (0.2 A g^{-1})	63 % (100 cycles, 0.2 A g^{-1})	67%	300 mAh g^{-1} (4 A g^{-1})	13
SnS_2-GO	580 mAh g^{-1} (0.05 A g^{-1})	95 % (50 cycles, 0.05 A g^{-1}	67%	350 mAh g^{-1} (2 A g^{-1})	14
SnS_2-G	725 mAh g^{-1} (0.02 A g^{-1})	89% (60 cycles, 0.02 A g^{-1})	52%	463 mAh g^{-1} (0.64 A g^{-1})	15
SnS_2-rGO	649 mAh g^{-1} (0.1 A g^{-1})	89% (400 cycles, 0.8 A g^{-1})	64%	337 mAh g^{-1} (12.8 A g^{-1})	16
SnS_2 nanoplates	349 mAh g^{-1} (0.1 A g^{-1})	57 % (80 cycles, 0.5 A g^{-1})	38%	77 mAh g^{-1} (5 A g^{-1})	17
SnS_2-rGO	550 mAh g^{-1} (1 A g^{-1})	91 % (400 cycles, 1 A g^{-1})	79%	570 mAh g^{-1} (2 A g^{-1})	18
SnS_2-NGS	608 mAh g^{-1} (0.2 A g^{-1})	71% (100 cycles, 0.2 A g^{-1})	66%	148 mAh g^{-1} (10 A g^{-1})	19
SnS_2	733 mAh g^{-1} (0.1 A g^{-1})	88% (50 cycles, 0.1 A g^{-1})	59%	435 mAh g^{-1} (2 A g^{-1})	20
SnS_2-C	660 mAh g^{-1} (0.05 A g^{-1})	86% (100 cycles, 0.05 A g^{-1})	60%	360 mAh g^{-1} (1 A g^{-1})	21
SnS_2 NC/EDA-RGO	749 mAh g^{-1} (0.2 A g^{-1}) 480 mAh g^{-1} (1 A g^{-1})	90% (100 cycles, 0.2 A g^{-1})	73%	250 mAh g^{-1} (11.2 A g^{-1})	22

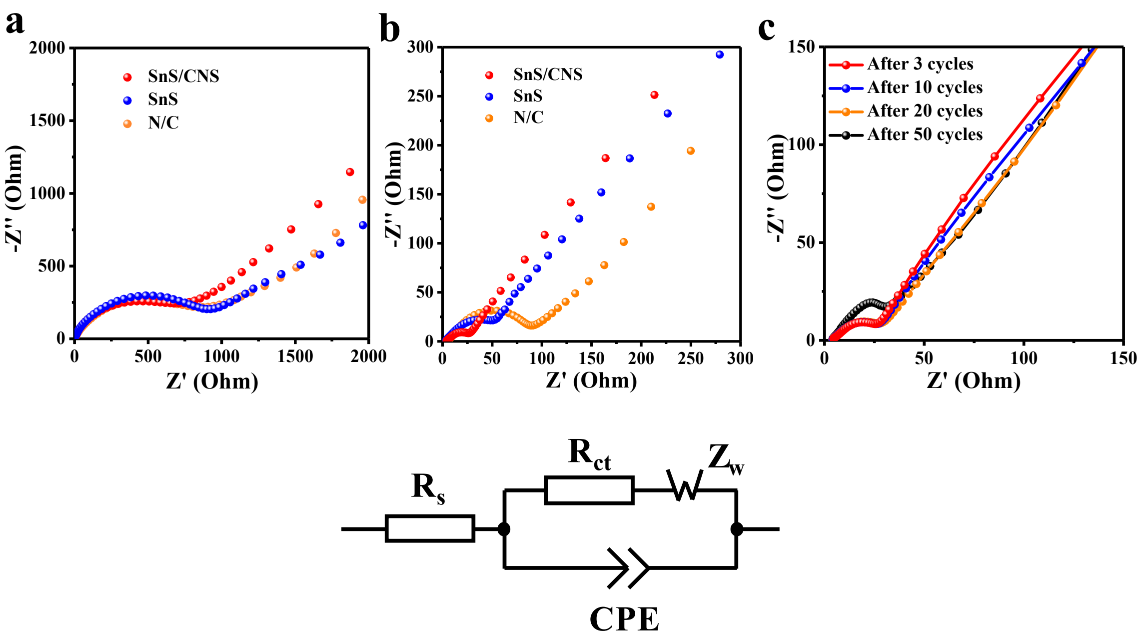

Fig. S12. Electrochemical impedance spectra and equivalent circuit of the SnS/CNS electrode. (a) Nyquist plots of SnS/CNS, pristine SnS and N/C electrodes before cycling and (b) after 10 cycles. (c) Nyquist plots of SnS/CNS electrode after different cycles.

Table S3. Rs and Rct values of SnS/CNS electrodes after different cycles.

	R_s (Ω)	R_{ct} (Ω)
After 3 cycles	4.037	25.48
After 10 cycles	3.989	27.08
After 20 cycles	4.012	29.17
After 50 cycles	3.917	34.39

Supplementary References

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