Supporting Information

Metal chelate induced in-situ wrapping of Ni_3S_2 nanoparticles into N, S-codoped carbon networks for highly efficient sodium storage

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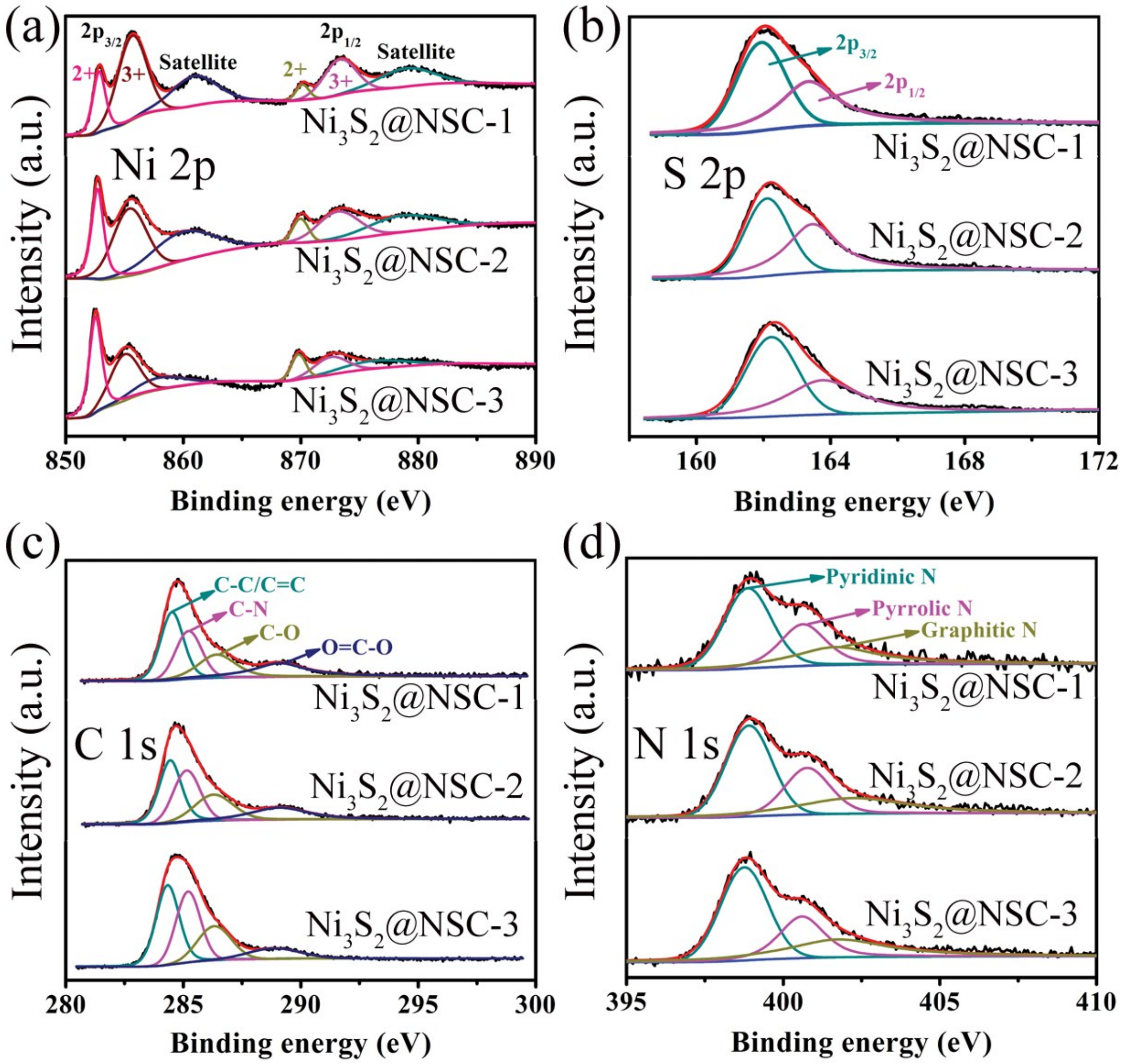

Fig. S1 High-resolution XPS spectra of Ni 2p (a), S 2p (b), C 1s (c) and N 1s (d) for Ni_3S_2@NSC-1, Ni_3S_2@NSC-2 and Ni_3S_2@NSC-3.

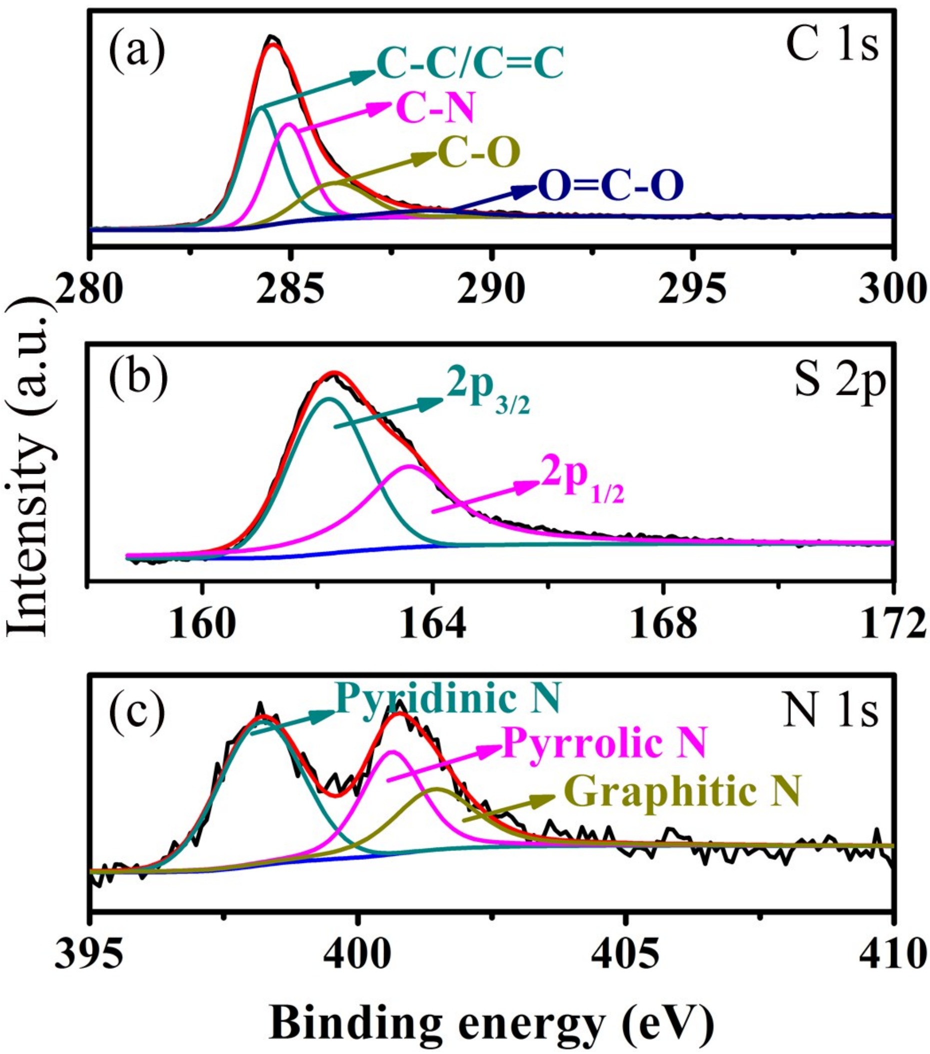

Fig. S2 High resolution C 1s (a), S 2p (b) and N 1s (c) spectra of NSC.

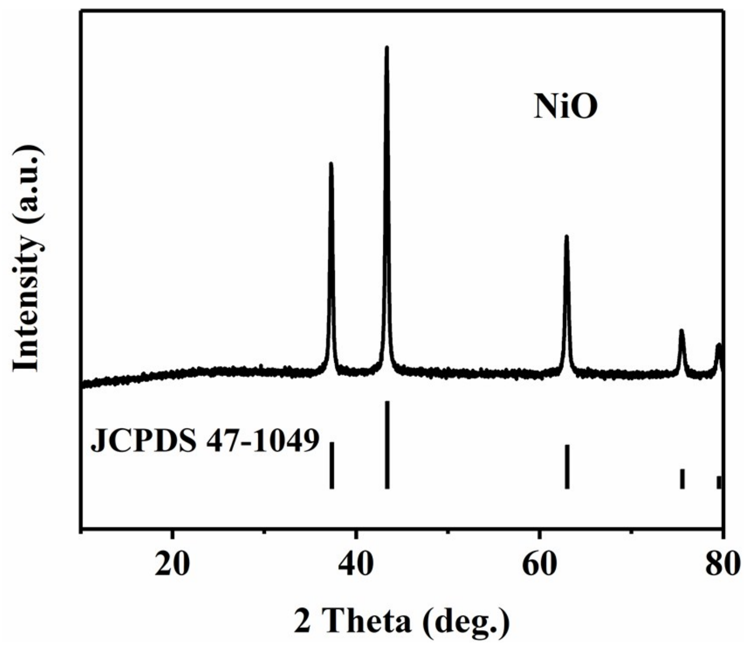

Fig. S3 XRD pattern of Ni_3S_2@NSC-1 after TG measurement from room temperature to 1000 °C with a heating rate of 10 °C min^{-1}, demonstrating the conversion of Ni_3S_2@NSC to NiO (JCPDS No. 47-1049).

The NSC contents in Ni_3S_2@NSC can be calculated based on the following formula:

$$a = \left[1 - \left(\frac{b}{M_1} \div 3 \times M_2\right)\right] \times 100\%$$

where a is the NSC content; b represents the percentage of original mass maintained after TG test; M_1 and M_2 correspond to the mole molecular mass of NiO and Ni_3S_2, respectively.

The NSC content in Ni_3S_2@NSC-1:

$$a_1 = \left[1 - \left(\frac{0.713}{74.68} \div 3 \times 240.19\right)\right] \times 100\% = 23.5\ wt.\%$$

The NSC content in Ni_3S_2@NSC-2:

$$a_2 = \left[1 - \left(\frac{0.619}{74.68} \div 3 \times 240.19\right)\right] \times 100\% = 33.6\ wt.\%$$

The NSC content in Ni_3S_2@NSC-3:

$$a_3 = \left[1 - \left(\frac{0.542}{74.68} \div 3 \times 240.19\right)\right] \times 100\% = 41.9\ wt.\%$$

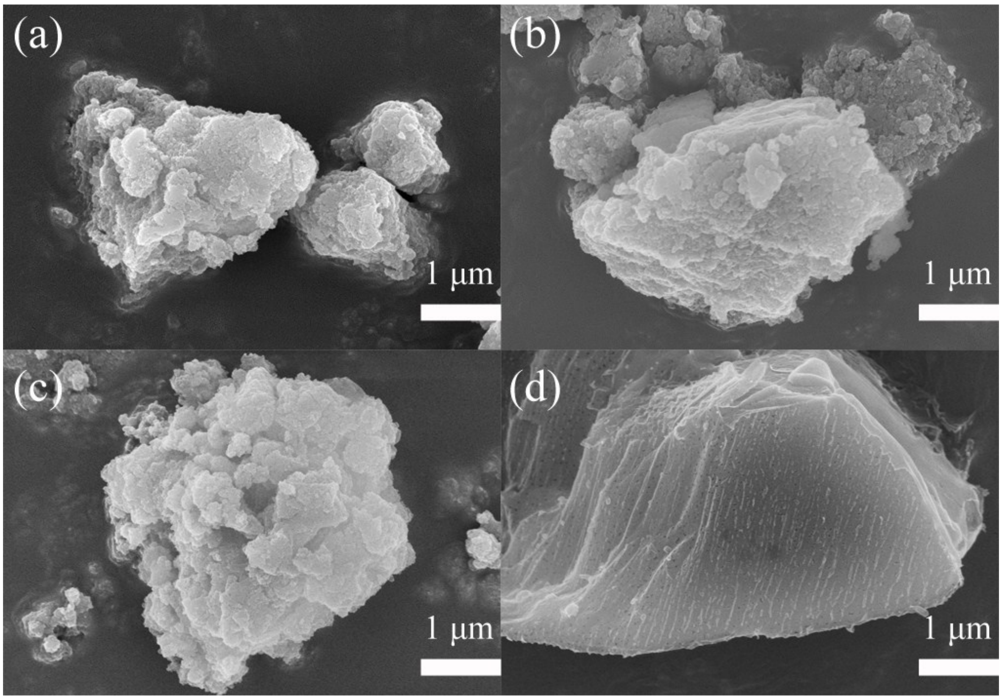

Fig. S4 FESEM images of Ni-MDC-1 (a), Ni-MDC-2 (b), Ni-MDC-3 (c) and DTO (d).

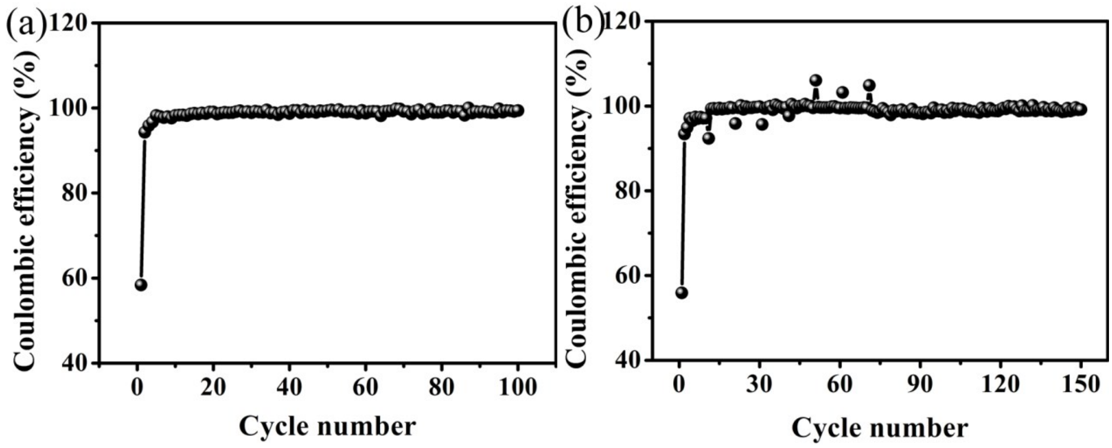

Fig. S5 Coulombic efficiencies of NSC at 0.1 A g^{-1} (a) and different rates (b).

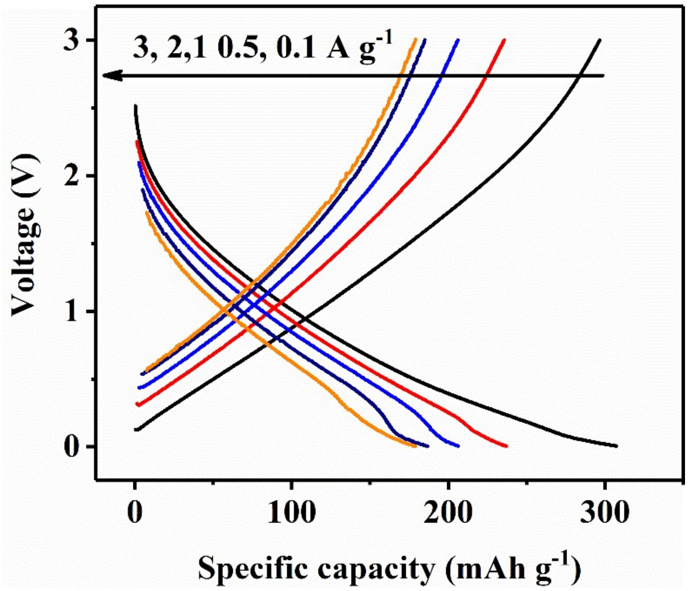

Fig. S6 Rate profiles of NSC.

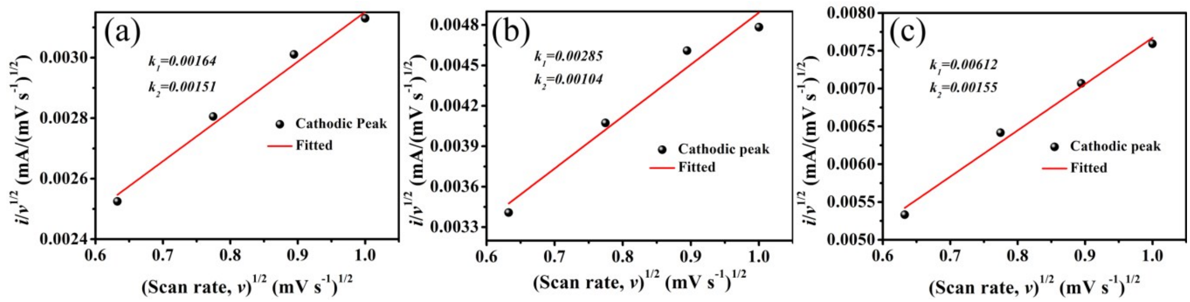

Fig. S7 $i/v^{1/2}$ versus $v^{1/2}$ plots for Ni_3S_2@NSC-1 (a), Ni_3S_2@NSC-2 (b) and Ni_3S_2@NSC-3 (c) to calculate k_1 and k_2.

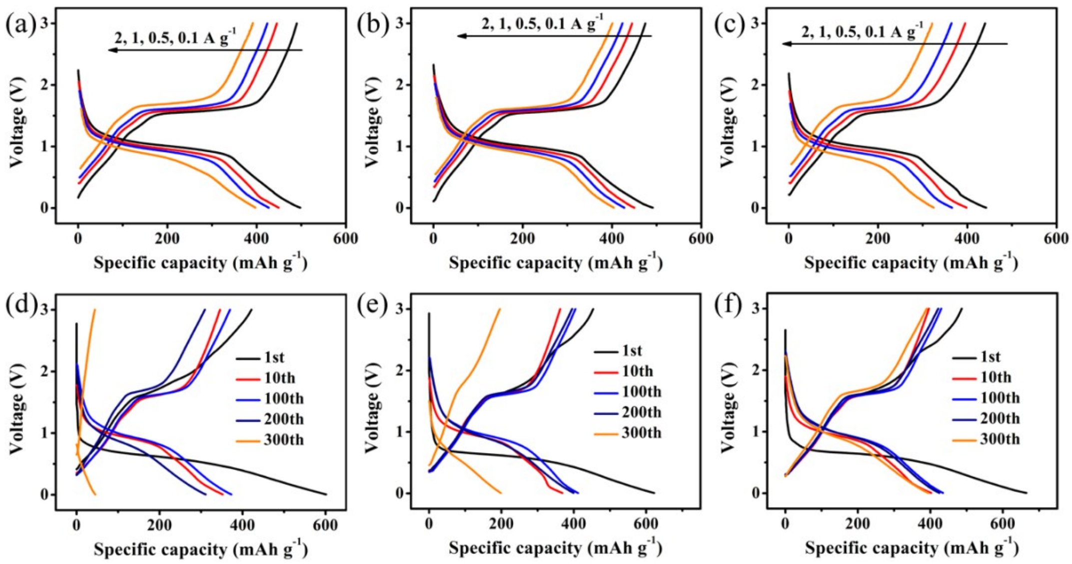

Fig. S8 Rate profiles of Ni_3S_2@NSC-1 (a), Ni_3S_2@NSC-2 (b) and Ni_3S_2@NSC-3 (c). Discharge/charge profiles of Ni_3S_2@NSC-1 (d), Ni_3S_2@NSC-2 (e) and Ni_3S_2@NSC-3 (f) at 0.5 A g^{-1}.

Table S1 Comparison of sodium storage performance of Ni_3S_2@NSC-3 in this work and nickel sulfide based electrodes reported in the literatures.

Sample	Voltage range (V)	Initial Coulombic efficiency	Cycling performance at low current density	Cycling performance at high current density	Ref.
NiS hollow spheres	0.01-3.0	54.7%	499.9 mAh g^{-1} after 50 cycles at 0.1 A g^{-1}	/	1
NiS nanorods/graphene	0.005-3.0	74.7%	160 mAh g^{-1} after 20 cycles at 0.2 A g^{-1}	/	2
NiS nanoplates	0.005-3.0	49.9%	166 mAh g^{-1} after 100 cycles at 1A g^{-1}	/	3
NiS_2/graphene	0.01-2.8	65%	313.3 mAh g^{-1} at 0.1 A g^{-1} after 200 cycles	/	4
Ni_3S_2 nanoparticles/carbon networks	0.01-3.0	59%	453 and 430 mAh g^{-1} after 100 cycles at 0.1 and 0.4 A g^{-1}	408 mAh g^{-1} after 200 cycles at 2 A g^{-1}	5
NiS_x/graphene	0-3.0	about 40 %	516 mAh g^{-1} after 200 cycles at 0.2 A g^{-1}	/	6
Ni_3S_2/Ni composites	0.1-3.0	about 75%	338 mAh g^{-1} after 100 cycles at 0.17 A g^{-1}	/	7
Layered nickel sulfide/graphene	0.005-3.0	77.1%	391.6 mAh g^{-1} after 50 cycles at 0.1 A g^{-1}	/	8

Durian-like NiS_2	0.01-3.0	76.2%	280.6 mAh g^{-1} after 60 cycles at 0.1 A g^{-1}; 142.4 mAh g^{-1} after 100 cycles at 0.5 A g^{-1}	/	9
NiS_x/carbon nanotube@carbon	0.01-3.0	59.2%	340 mAh g^{-1} after 200 cycles at 0.1 A g^{-1}	/	10
Ni_3S_2@NSC-3	0.005-3.0	78.8%	458.1 mAh g^{-1} after 100 cycles at 0.1 A g^{-1}	392.6 mAh g^{-1} after 300 cycles at 0.5 A g^{-1}	This work

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