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Supporting Information

Design of pomegranate-like clusters with NiS_2 nanoparticles anchored on nitrogen-doped porous carbon for improved sodium ion storage performance

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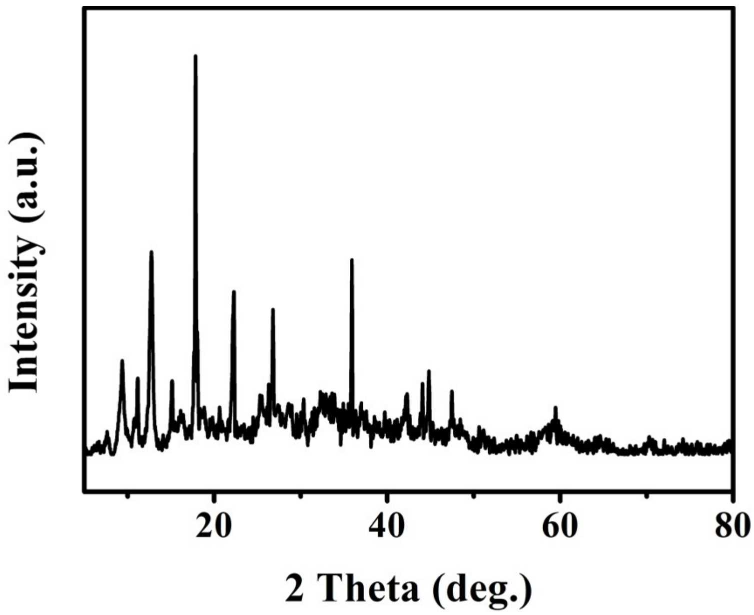

Fig. S1 XRD pattern of as-synthesized Ni-MOFs.

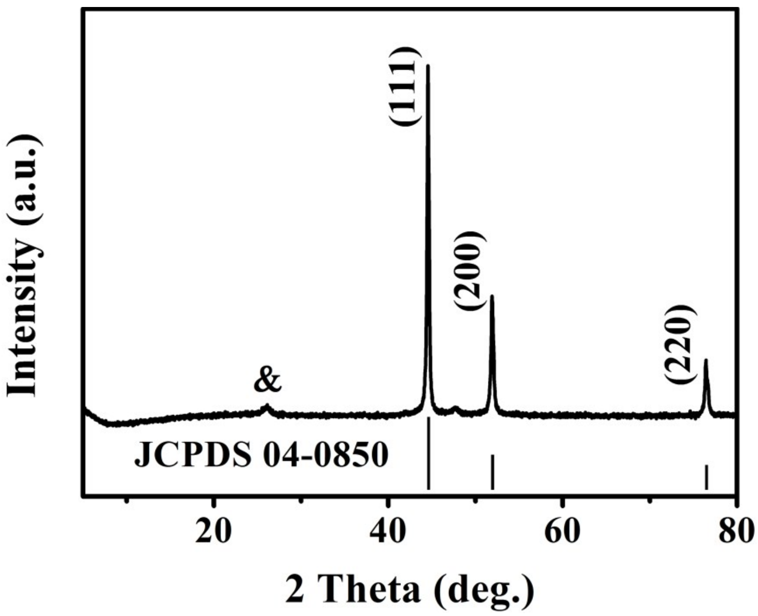

Fig. S2 XRD pattern of carbonized sample (Ni/C).

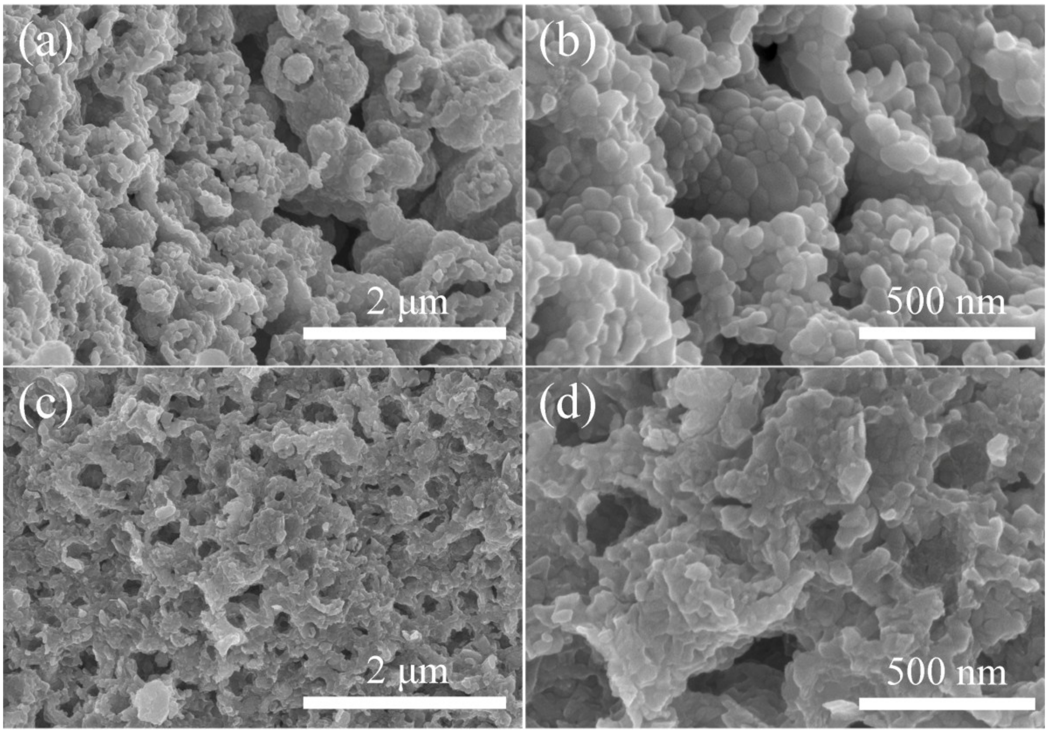

Fig. S3 FESEM images of NiO generated after calcination of Ni-MOFs in electrical furnace (a and b) and pure NiS_2 (c and d).

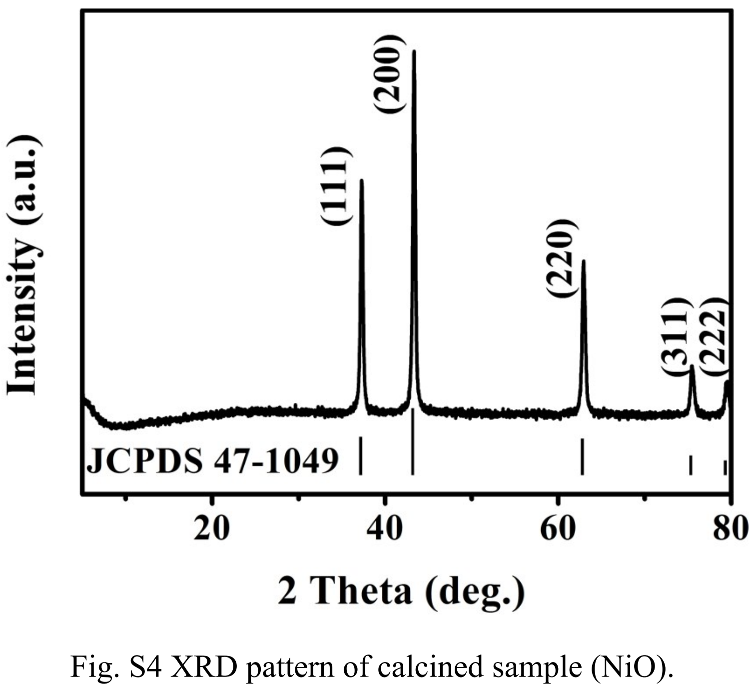

Fig. S4 XRD pattern of calcined sample (NiO).

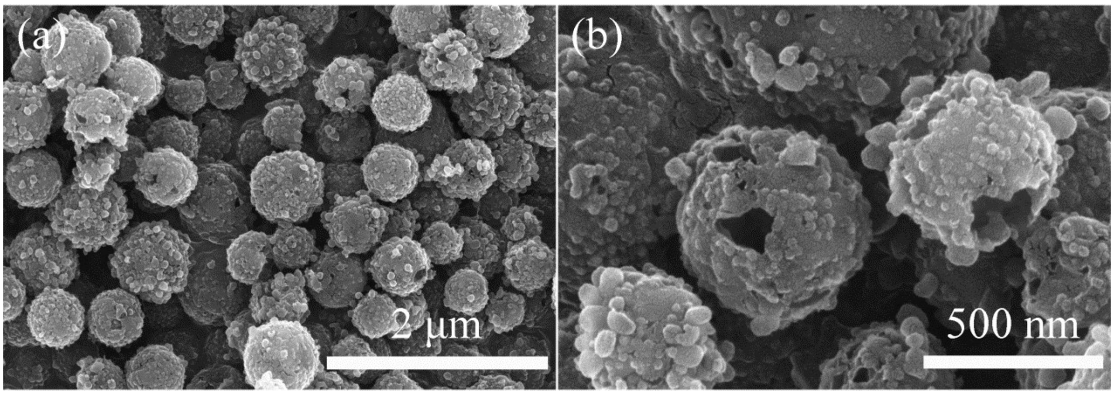

Fig. S5 FESEM images of Ni-MOFs derived NC (a and b).

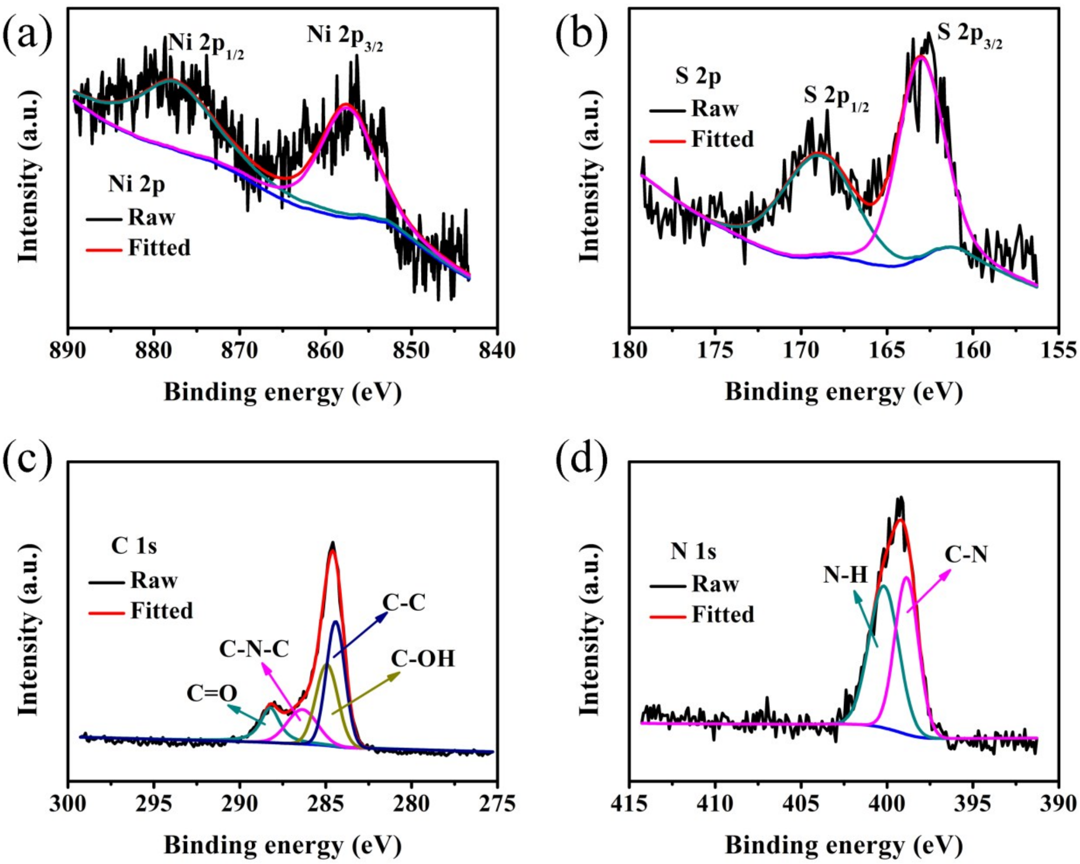

Fig. S6 High-resolution XPS spectra of NiS_2/NC: (a) Ni 2p; (b) S 2p; (c) C 1s; (d) N 1s.

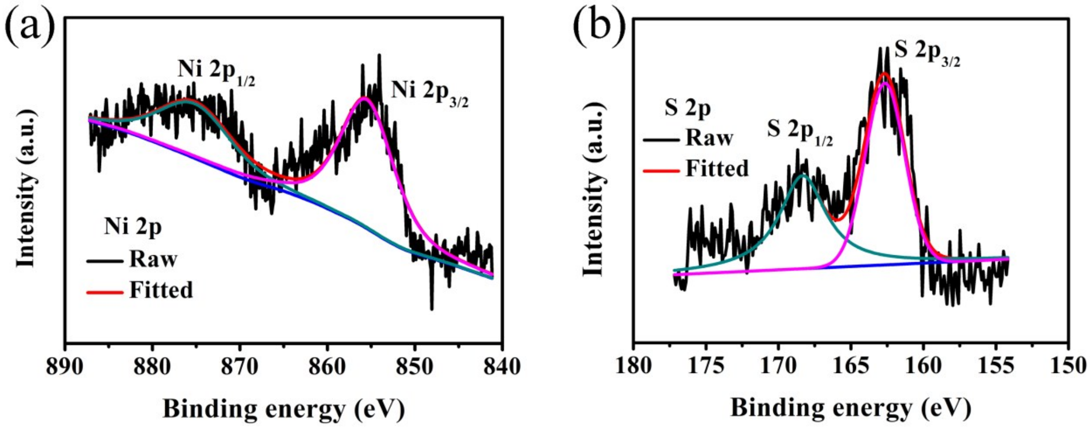

Fig. S7 High-resolution XPS spectra of NiS_2: (a) Ni 2p; (b) S 2p.

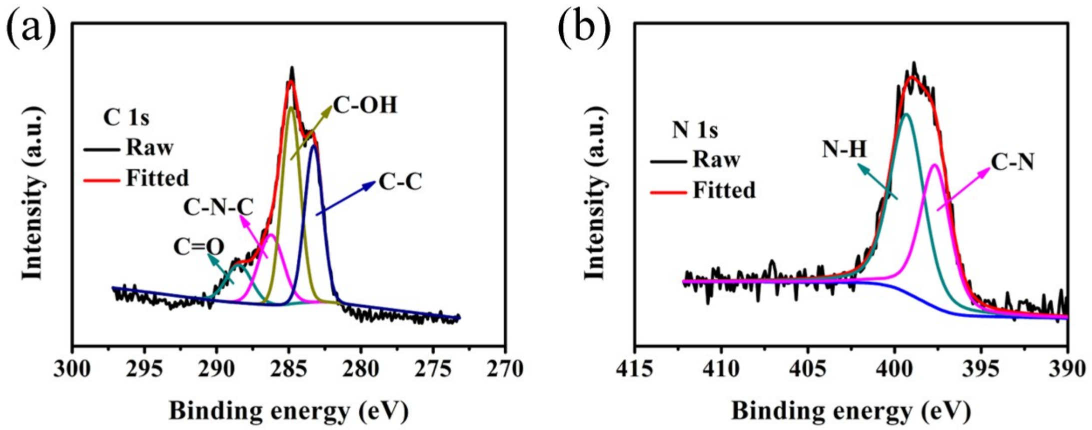

Fig. S8 High-resolution XPS spectra of NC: (a) C 1s; (b) N 1s.

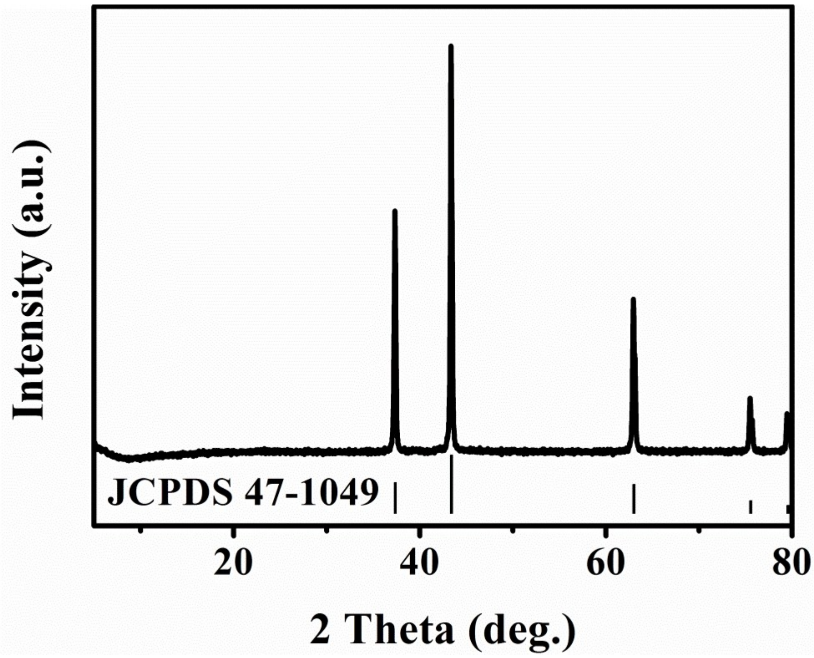

Fig. S9 XRD pattern of NiS_2/NC after the TGA measurement in air (from room temperature to 800 °C, ramping rate: 10 °C min^{-1}), demonstrating the conversion of NiS_2/NC to NiO (JCPDS 47-1049). During the TGA analysis in the, the NC is burnt out, while the NiS_2 is converted into NiO with 45.2 wt.% of original mass retained. Based on the following chemical reaction (1), the contents of NiS_2 and carbon are calculated to be 74.3 wt.% and 25.7 wt.%, respectively.

$$2NiS_2\ (s) + 5O_2\ (g) = 2NiO\ (s) + 4SO_2\ (g)$$

$$NiS_2 \text{ content: } 0.452 \div 74.69 \times 122.81 = 0.743$$
$$NC \text{ content: } 1 - 0.743 = 0.257$$

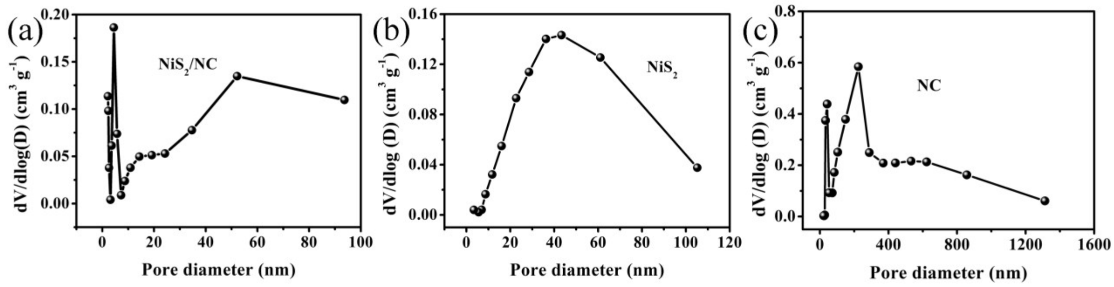

Fig. S10 Pore size distribution curves of NiS_2/NC, NiS_2 and NC.

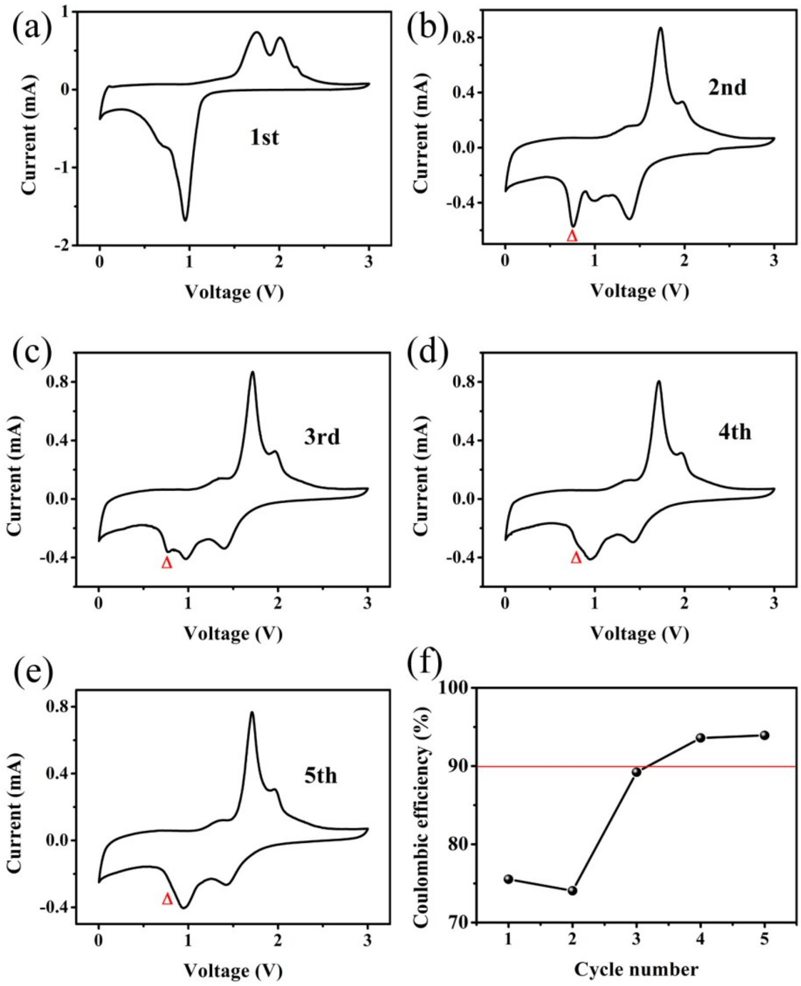

Fig. S11 First (a), second (b), third (c), fourth (d) and fifth (e) CV curves of pure NiS_2 at a scan rate of 0.2 mV s^{-1}, and Coulombic efficiencies of NiS_2 (f) during the initial five cycles.

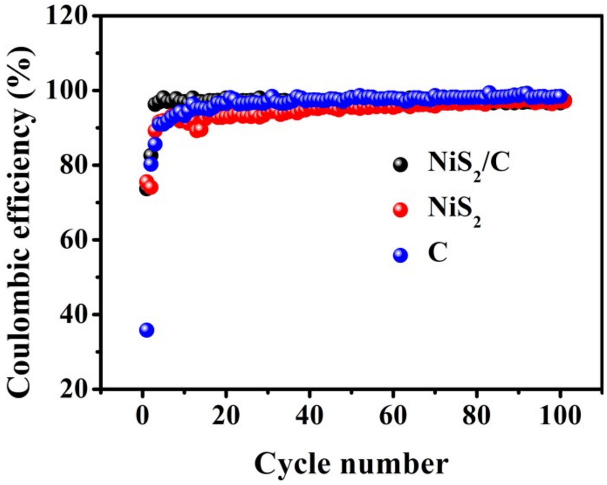

Fig. S12 Coulombic efficiencies of NiS_2/NC, NiS_2 and NC at a current density of 0.1 A g^{-1}.

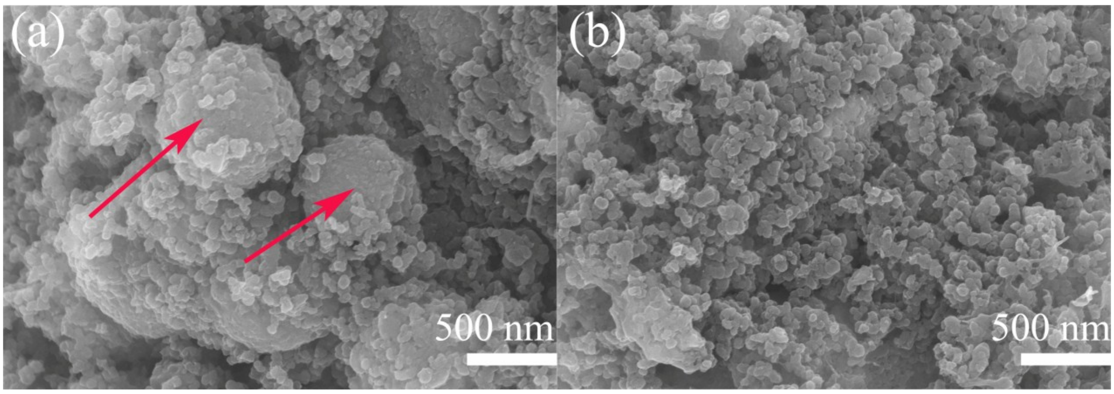

Fig. S13 FESEM images of NiS_2/NC (a) and NiS_2 (b) after 100 cycles at 0.1 A g^{-1}.

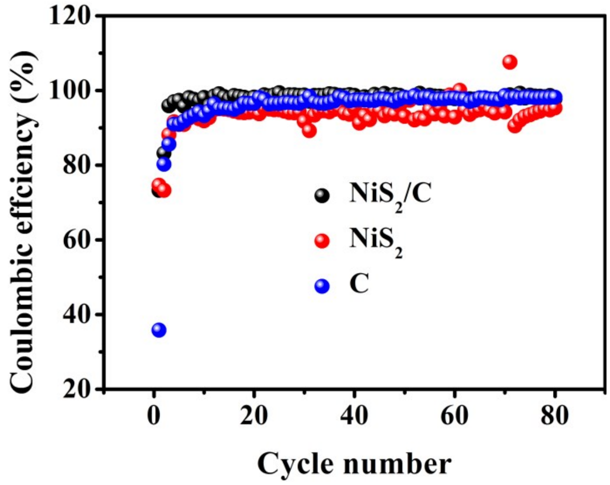

Fig. S14 Coulombic efficiencies of NiS_2/NC, NiS_2 and NC at different rates.

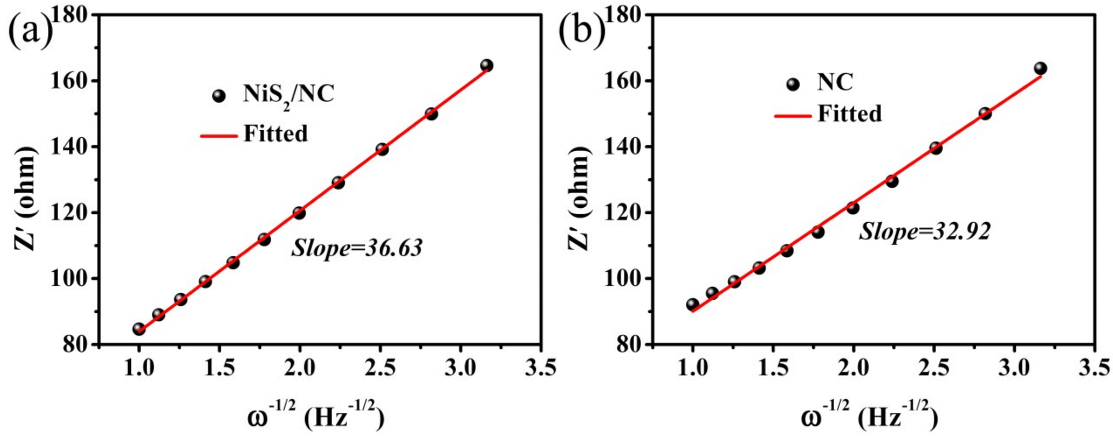

Fig. S15 Fitted straight lines of Z' vs. $\omega^{-1/2}$ at low frequency for NiS_2/NC (a) and NC (b) electrodes.

Table S1 Atomic concentration (at.%) of elements detected from the XPS characterization for NiS_2/NC, NiS_2 and NC.

Sample	Ni	S	N	C	O
NiS_2/NC	16.06	32.14	16.44	34.73	0.63
NiS_2	32.89	65.14	-	0.85	1.12
NC	-	-	16.06	82.93	1.01

Table S2 Summary of nickel sulphide based anode materials for SIBs applications.

Sample	Voltage range (V)	Initial Coulombic efficiency	Cycling performance at low current density	Cycling performance at high current density	Ref.
NiS_2/graphene composites	0.01-2.8	65%	313 mAh g^{-1} after 200 cycles at 0.087 A g^{-1}	/	1
NiS nanoplates	0.005-3.0	49.9%	/	166 mAh g^{-1} after 100 cycles at 1 A g^{-1}	2
NiS hollow spheres	0.1-3.0	54.7%	499 mAh g^{-1} after 50 cycles at 0.1 A g^{-1}	283 mAh g^{-1} after 50cycles at 0.5 A g^{-1}	3

NiS nanorods/graphene composites	0.005-3.0	74.7%	160 mAh g^{-1} after 10 cycles at 0.2 A g^{-1}	/	4
Ni_3S_2/carbon composites	0.1-3.0	59%	453 mAh g^{-1} after 100 cycles at 0.1 A g^{-1}	430 mAh g^{-1} after 100 cycles at 0.4 A g^{-1}	5
NiS_x/graphene	0-3.0	about 44%	516 mAh g^{-1} after 100 cycles at 0.2 A g^{-1}	/	6
Layered NiS_x /graphene	0.005-3.0	77.1%	391.6 mAh g^{-1} after 50 cycles at 0.1 A g^{-1}.	/	7
NiS_x/carbon nnaotube@carbon	0.01-3.0	59.2%	340 mAh g^{-1} after 200 cycles at 0.1 A g^{-1}	/	8
Pomegranate-like clusters with NiS_2 nanoparticles anchored on nitrogen-doped graphitic carbon	0.005-3.0	73.6%	505.7 mAh g^{-1} after 100 cycles at 0.1 Ag^{-1}	356.2 mAh g^{-1} after 300 cycles at 0.5 A g^{-1}	This work

Notes and References

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