Electronic Supplementary Material (ESI) for RSC Advances.

Preparation of ZnS@N-doped-carbon composites *via* a ZnS-amine precursor vacuum pyrolysis route

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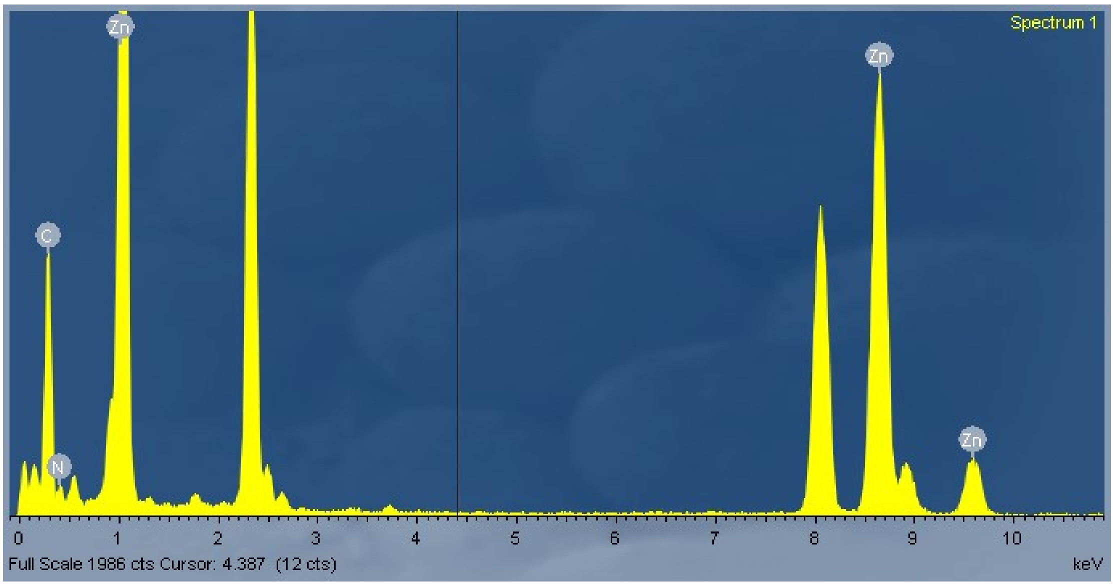

Fig.S1. EDS spectrum of ZnS@NC-*H*

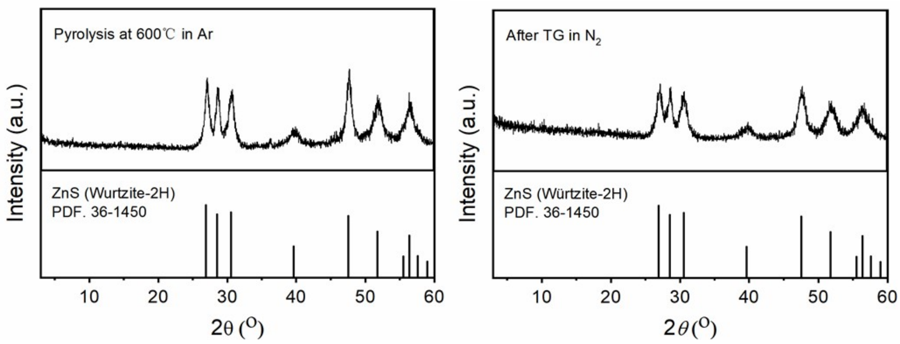

Fig. S2. XRD of Exp-ZnS(*ba*) pyrolysis at 600 °C in Ar atmosphere (left) and in N_2 atmosphere during TG test (right).

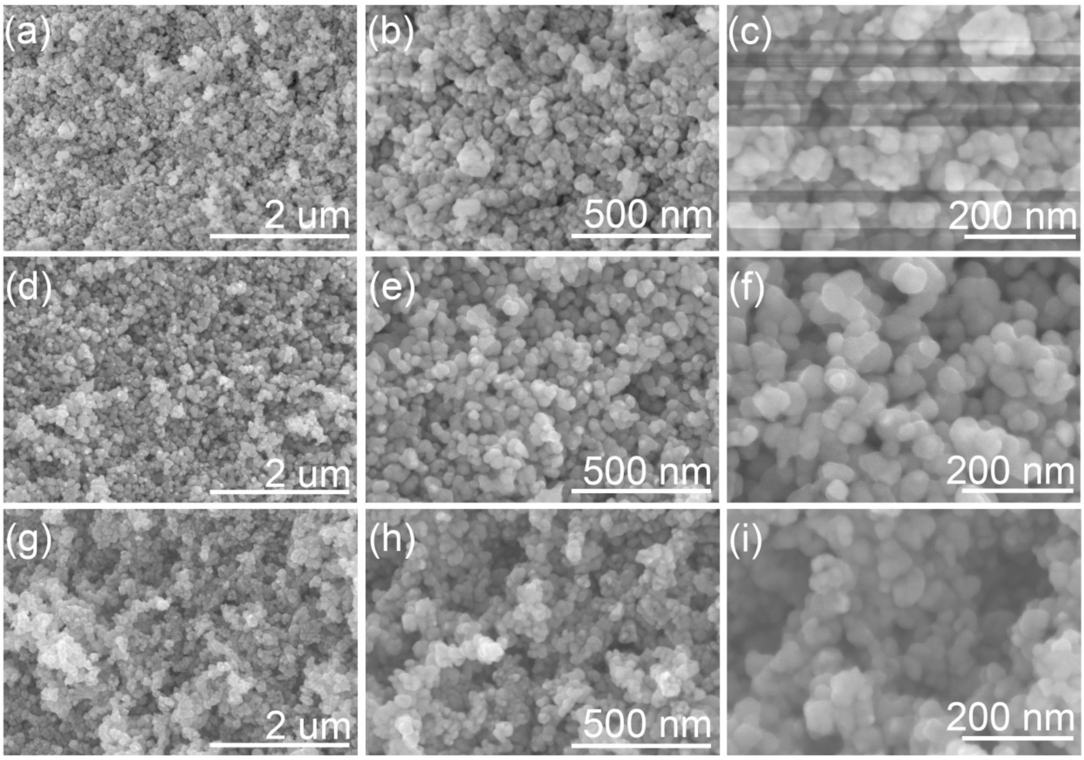

Fig. S3. SEM image of (a-c) ZnS@NC-*L*, (d-f) ZnS@NC-*M*, (g-h)ZnS@NC-*H*.

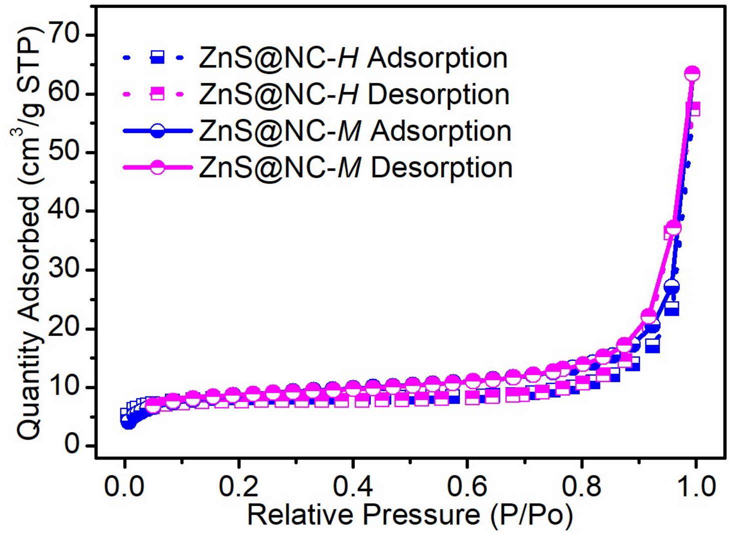

Fig. S4. N_2 adsorptiondesorption isotherm of ZnS@NC-*M* and ZnS@NC-*H*.

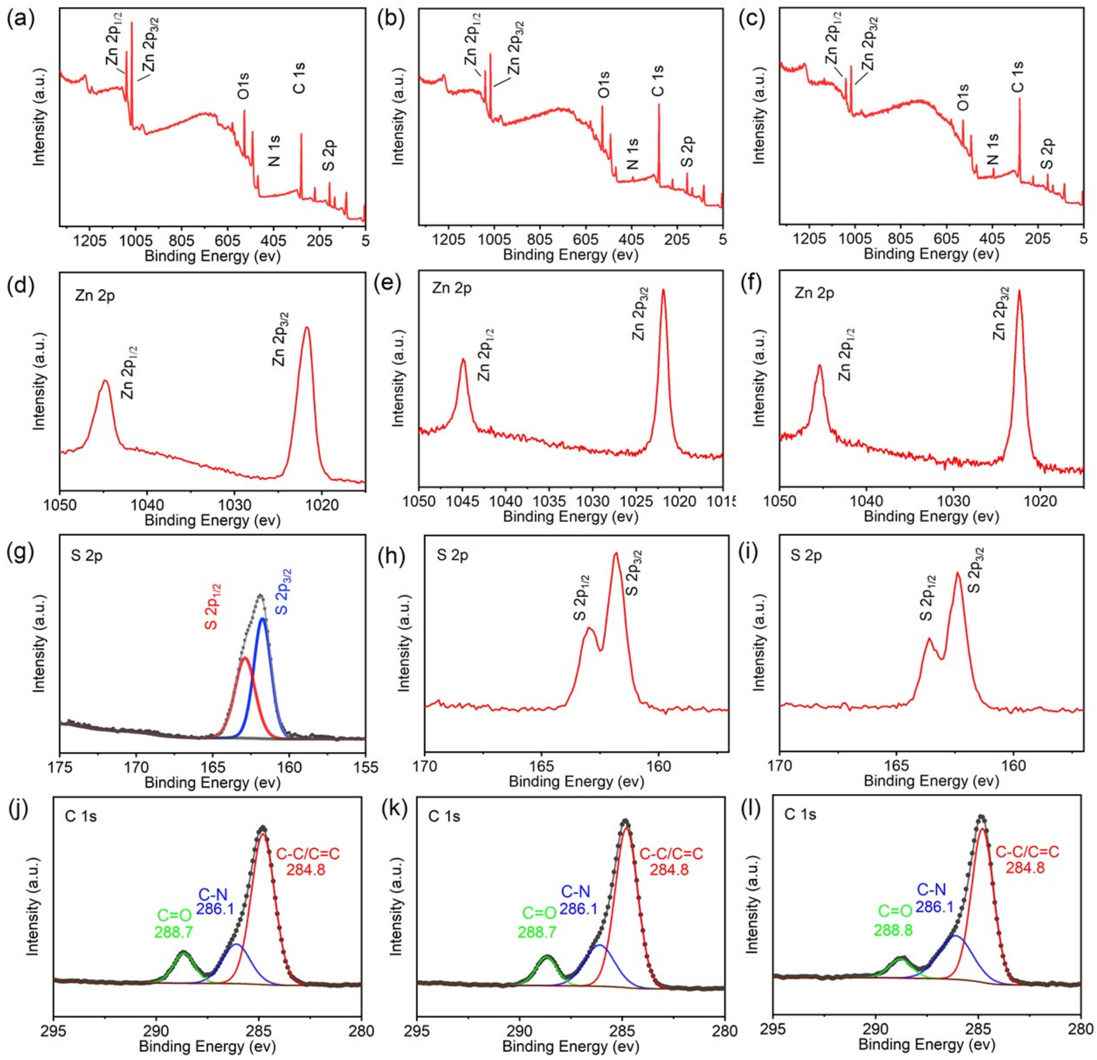

Fig. S5. XPS spectra of ZnS@NC-*L* (a, d, g, j), ZnS@NC-*M* (b, e, h, k) and ZnS@NC-*H* (c, f, i, l).

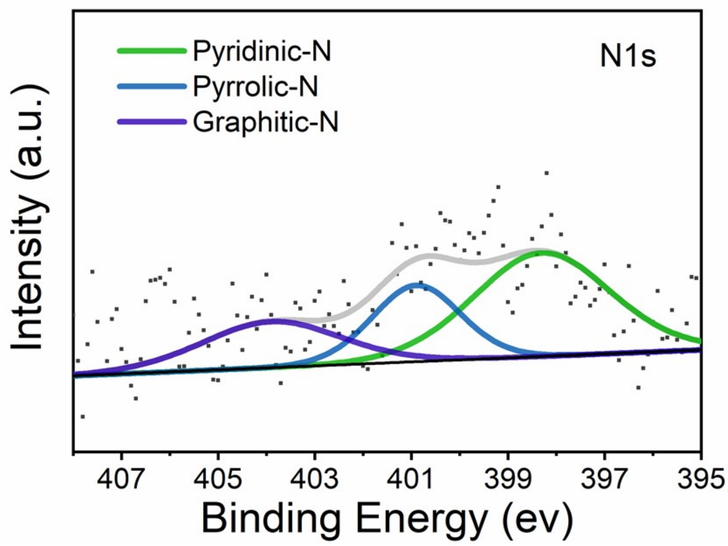

Fig. S6. XPS spectra of three types of nitrogen atoms of ZnS@NC-*L*

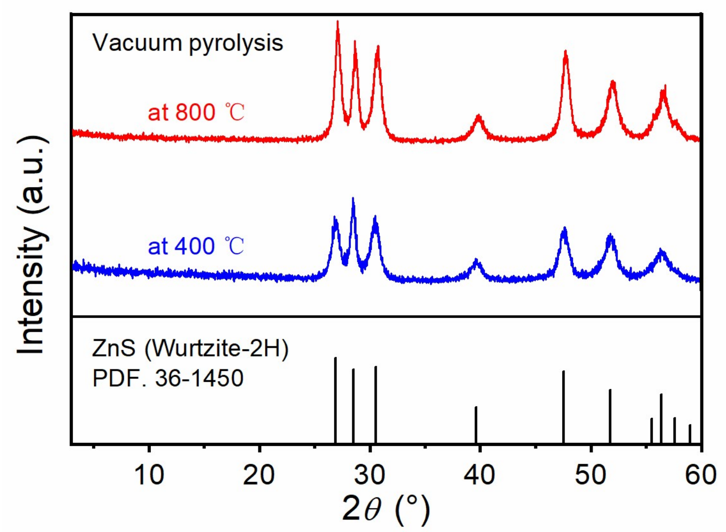

Fig. S7. XRD of Exp-ZnS(*ba*) vacuum pyrolysis at 400 and 800 ℃.

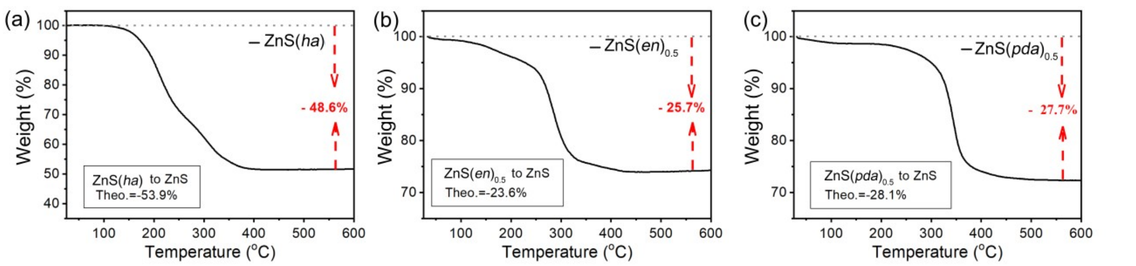

Fig. S8. TGA curves of preparation procedures of (a) Exp-ZnS(*ha*), (b)Exp-ZnS(*en*)$_{0.5}$ and (c) Exp-ZnS(*pda*)$_{0.5}$ by reflux method.

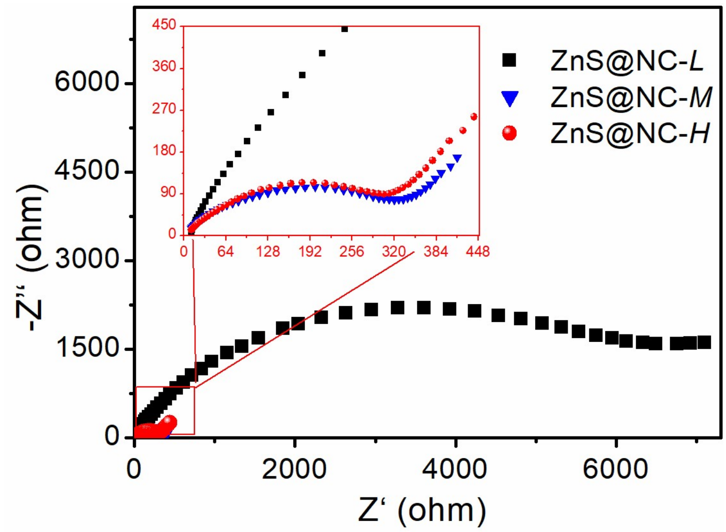

Fig. S9. The EIS plots of ZnS@NC-*L*, ZnS@NC-*M* and ZnS@NC-*H*.

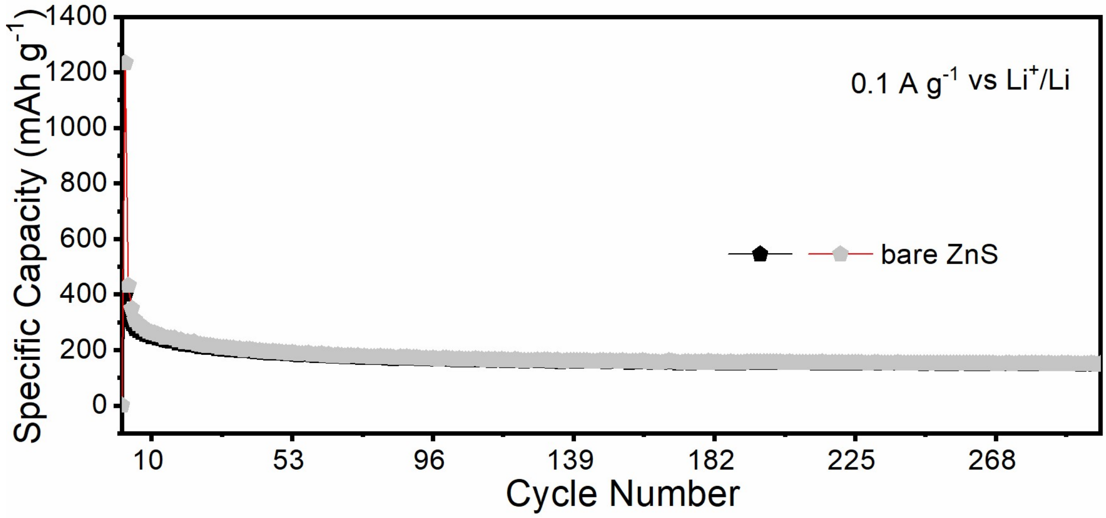

Fig. S10. Long cycling performances of bare ZnS at a current density of 0.1 A g^{-1}.

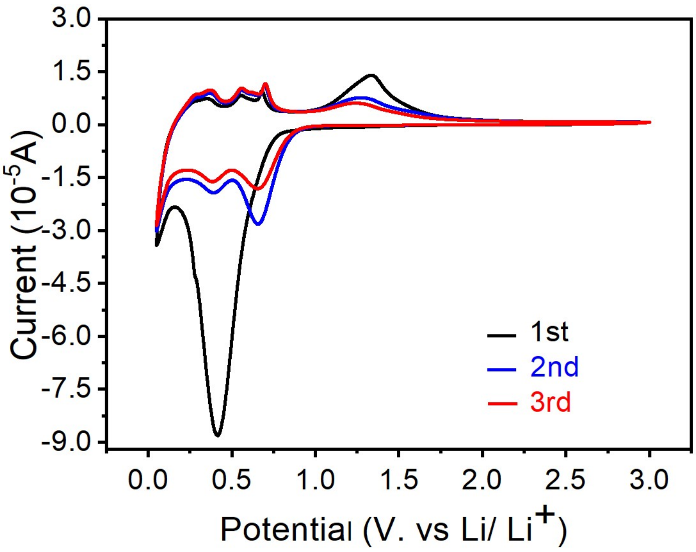

Fig. S11. Initial three cycle CV curves of bare ZnS at a scan rate of 0.2 mV s^{-1} between 0.05 and 3.0 V vs Li/Li^{+}.

Table S1. Elemental analysis results of different materials.

Sample	C wt%	N wt%	H wt%
ZnS(*ba*) prepared by the reflux method	26.17	7.70	5.88
ZnS(*ba*) pyrolysis at 600 °C of Ar atmosphere	0.31	<0.3	<0.3
ZnS(*ba*) pyrolysis at 400 ℃ by vacuum pyrolysis	3.69	0.56	0.39
ZnS(*ba*) pyrolysis at 800 ℃ by vacuum pyrolysis	12.32	2.10	<0.3

Preparation of ZnS(*ba*) pyrolysis at 400 ℃ and 800 ℃ by vacuum pyrolysis:

The obtained ZnS(*ba*) is encapsulated in a quartz glass tube after being evacuated. Then, the ZnS@NC materials are obtained by pyrolysis of ZnS(*ba*) at 400 and 800 ℃

for 2 h with the heating rate of 2 °C min^{-1}, respectively.

Table S2. Different synthesis strategy of ZnS/NC materials.

Materials	Method	Additional carbon source	Additional nitrogen source	Ref.
ZnS@NC	ZnS-amine, Vacuum pyrolysis	--	--	This literature
ZnS@C nanoparticles anchored on 3D N-doped carbon foam	Annealing in N_2	MA sponge	MA sponge	1
ZnS@N.f-MWCNTs@rGO	Hydrothermal method	Pre-prepared N-doped functionalized multiwall carbon nanotubes and reduced graphene oxide	Pre-prepared N-doped functionalized multiwall carbon nanotubes	2
Mesoporous ZnS@N-doped carbon composites	In-situ sulfuration, Carbonization in N_2	Methionine	Methionine	3
N-doped carbon coating mesoporous ZnS nanospheres	Dopamine polymerization, Thermal treatment in Ar	Polydopamine	Polydopamine	4
ZnO/ZnS@N-C	Nitrogen-rich MOF, Annealing in Ar	CNT	--	5
ZnS quantum dots@multilayered N-doped carbon matrix	Nitrogen-rich MOF, Vacuum pyrolysis, Sulfuration	--	--	6
ZnS/N-doped carbonaceous fibers	Pyrolyzed in N_2	Aspergillus niger	Aspergillus niger	7
ZnS nanoparticles wrapped in N-doped mesoporous carbon nanosheets	Nitrogen-rich MOF, Annealing in N_2, Sulfuration	--	--	8
ZnS-N/C nanocomposites	Nitrogen-rich MOF, Annealing in N_2	--	--	9

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