Supplementary information

A Co_9S_8 microsphere and N-doped carbon nanotube composite host material for lithium-sulfur batteries

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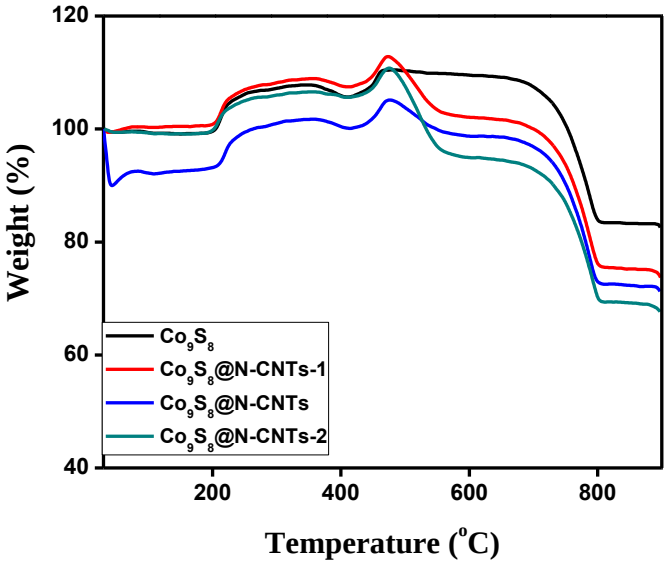

Fig. S1 TG analysis of Co_9S_8, Co_9S_8@N-CNTs-1, Co_9S_8@N-CNTs and Co_9S_8@N-CNTs-2.

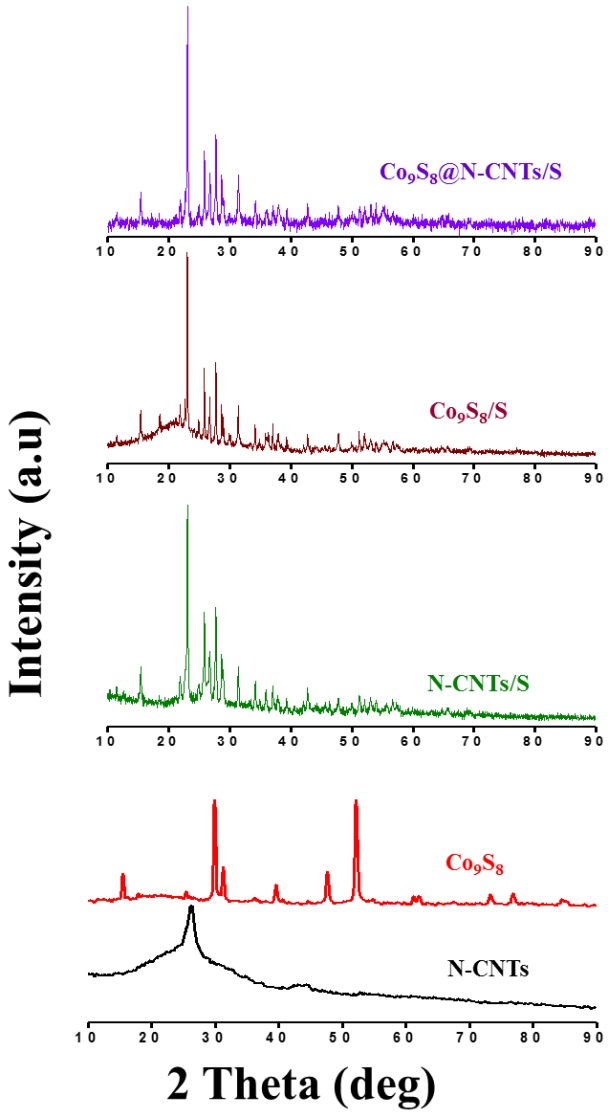

Fig. S2 XRD patterns of N-CNTs, Co_9S_8, N-CNTs/S, Co_9S_8/S and Co_9S_8@N-CNTs/S.

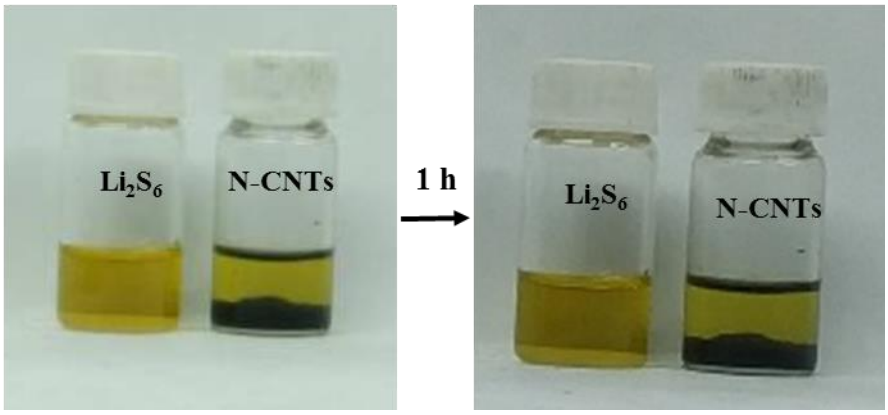

Fig. S3 Optical photographs of Li_2S_6 solution added with N-CNTs.

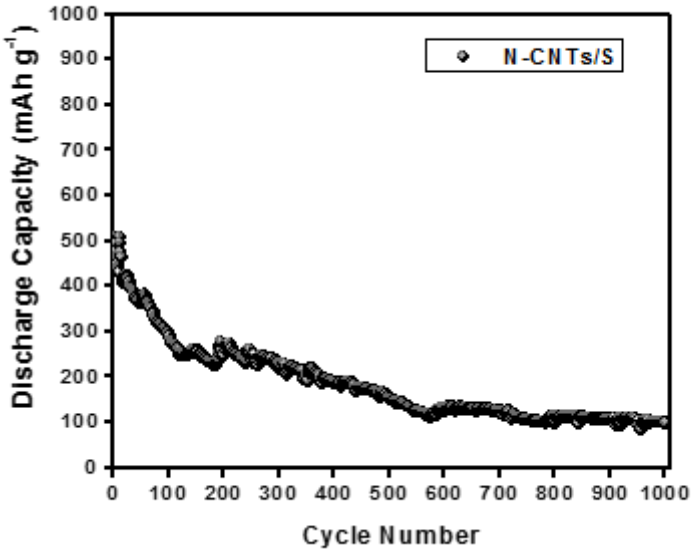

Fig. S4 Cycling performance of N-CNTs/S electrode at 0.5 C rate.

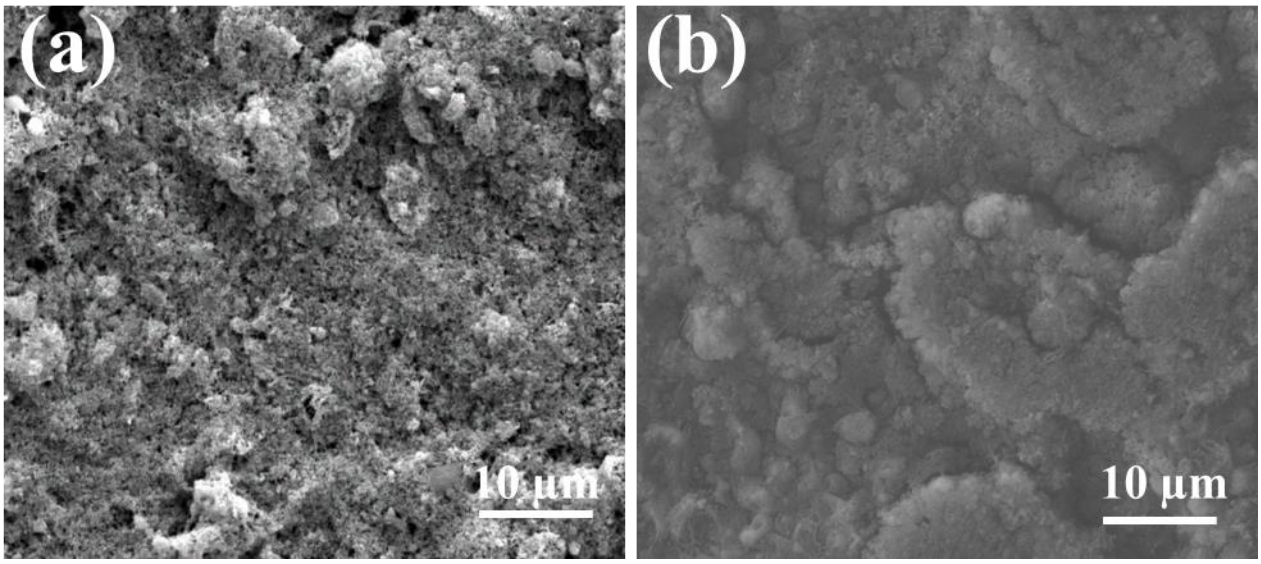

Fig. S5 SEM images of the Co_9S_8@N-CNTs/S electrode before and after cycling.

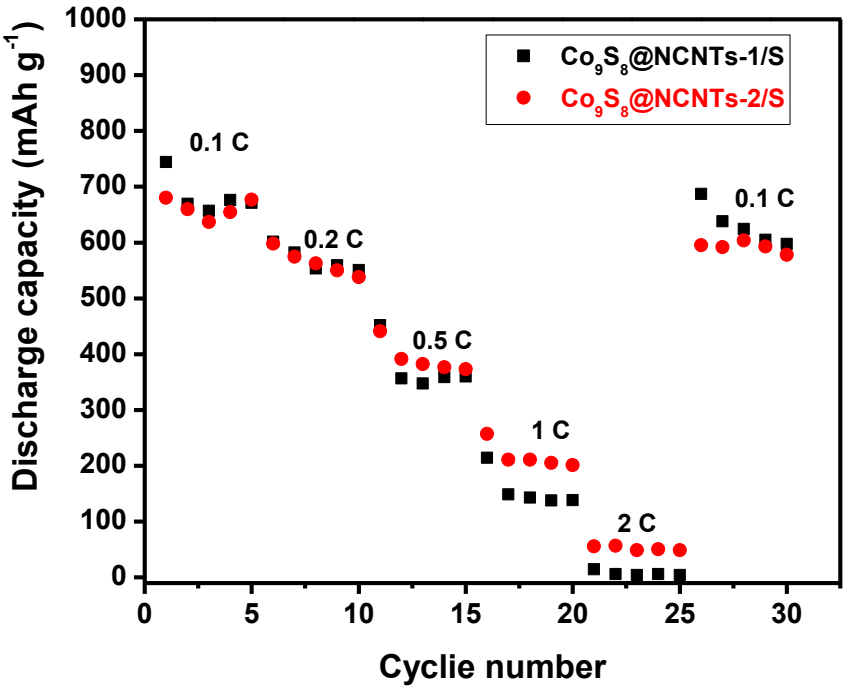

Fig. S6 Discharge capacities *vs* cycle numbers of Co_9S_8@N-CNTs-1/S and Co_9S_8@N-CNTs-2/S at different rates.

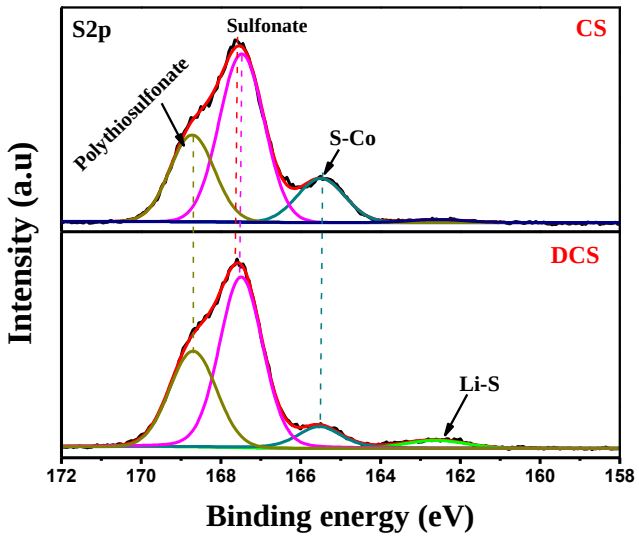

Fig. S7 The core level XPS spectra of S 2p of Co_9S_8@N-CNTs/S at the fully charged state (CS) and discharged state (DCS).

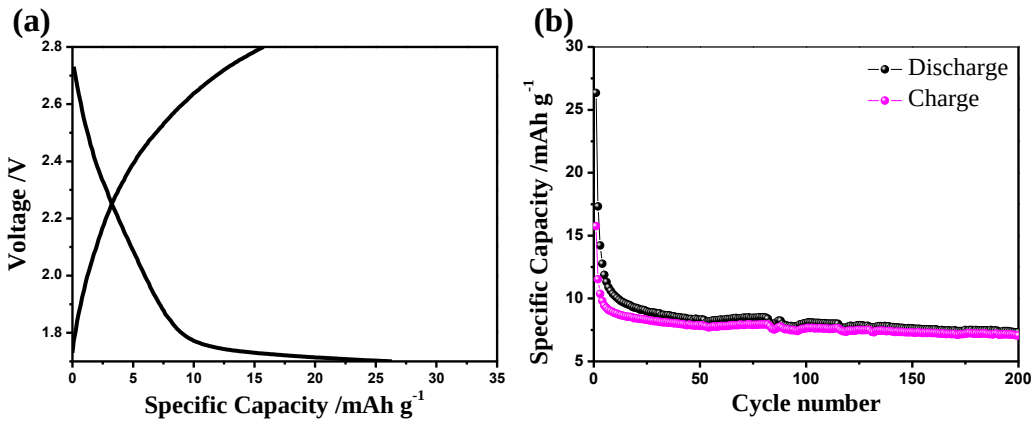

Fig. S8 Discharge-charge profile of N-CNTs electrode (without the impregnation of sulfur) at 0.2 C (a), Cycling performance of N-CNTs electrode (without the impregnation of sulfur) at 0.2 C (b).

Table S1: Performance comparison of the Co_9S_8@N-CNTs composite with previously reported sulfur host materials in the literature as cathode materials for Li-S batteries.

Electrode materials	**Sulfur Loading**	**Rate**	**Discharge capacity (mAh g^{-1})**	**Cycle Number**	**References**
Fe_3O_4/C/S	67.5%	1 C	642	300	[64]
AZO@S/CNT	75%	0.2 C	700	200	[65]
S@TiO_2/PPy	72.4%	0.5 C	<700	200	[66]
SnO_2/CAs@S	75.2%	0.1 C	785	80	[67]
FeS_2	62%	0.15 C	500	150	[68]
CoS_2/Graphene	50%	2 C	700	200	[68]
Graphene like Co_9S_8	70%	0.2 C	554	2000	[69]
Co_9S_8@N-CNTs/S	75%	2 C	652	1000	this work