Efficient Polysulfide Trapper of Nitrogen and Nickel Decorating Amylum Scaffold coated Separator for Ultrahigh Performance Lithium-Sulfur Batteries

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$$5nNiCl_2(s)+(C_6H_5O_5)_n(s)\rightarrow 5nNiO(s)+10nHCl(g)+6nC(s) \quad (1)$$

$$NiO(s)+C(s)\rightarrow C'(s)+Ni(s)+CO(g) \quad (2)$$

$$CO(g)+NiO(s)\rightarrow Ni(s)+CO_2(g) \quad (3)$$

Fig. S1. The involved plausible reactions between $NiCl_2 \cdot 6H_2O$ and amylum

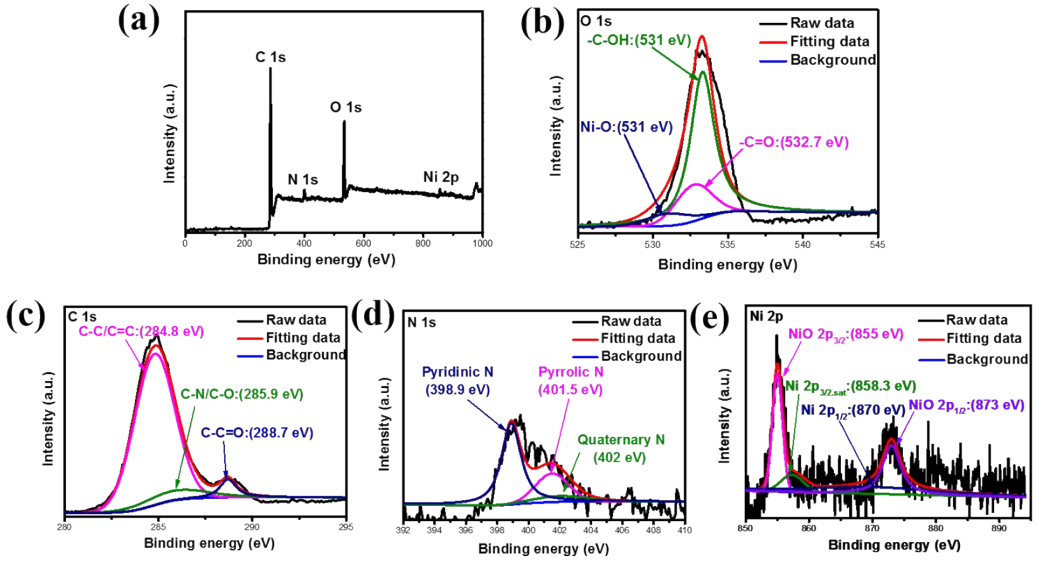

Fig. S2. (a) XPS analysis of AC/Ni/N composites and high-resolution spectrum of (b)O 1s; (c)C 1s; (d)N 1s; and (e)Ni 2p; respectively.

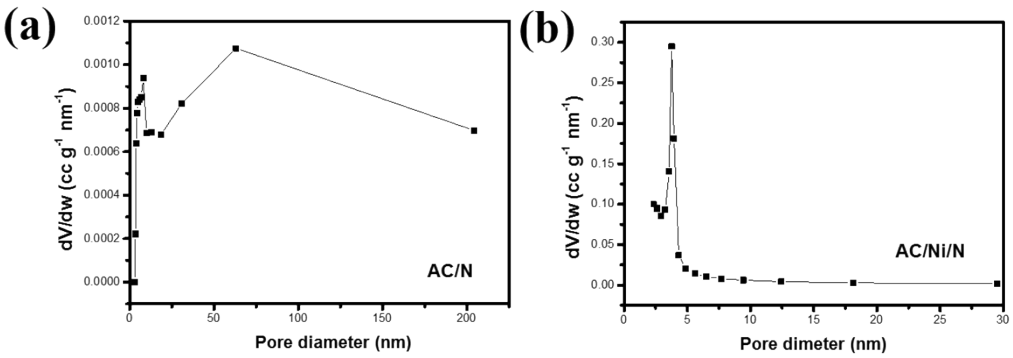

Fig. S3. The pore size distributions of AC/N and AC/Ni/N hybrids.

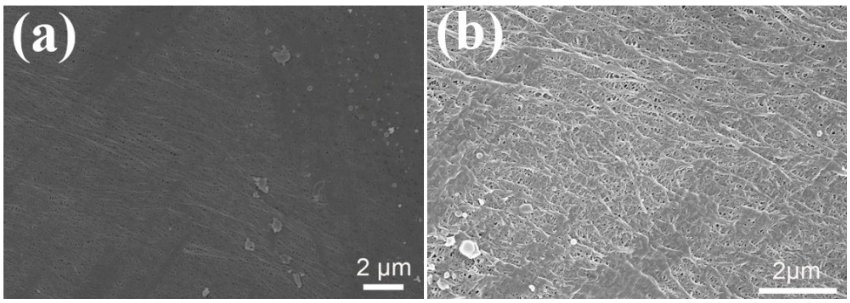

Fig. S4. SEM images of pristine separator.

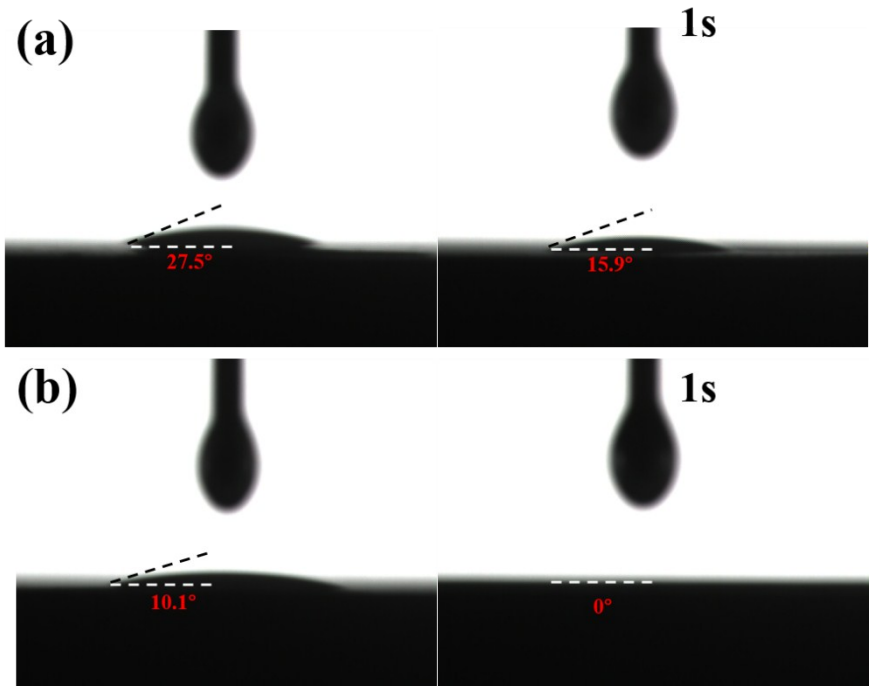

Fig. S5. Contact angle measurements of (a) pristine separator; and (b) AC/Ni/N coated separator for the electrolyte.

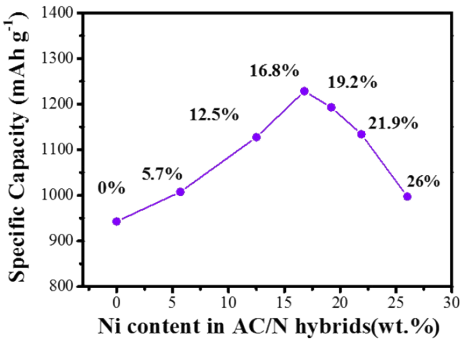

Fig. S6. Capacity optimization of Ni content in the AC/Ni/N hybrids.

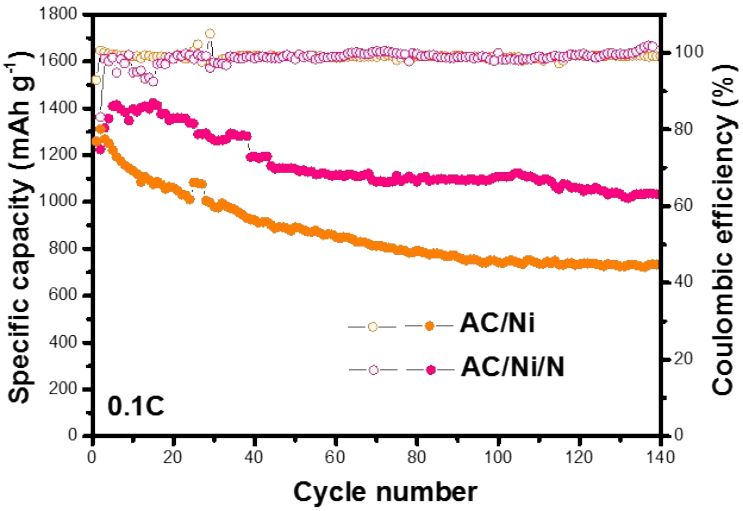

Fig. S7. The cycle performance of the cell of AC/Ni and AC/Ni/N modified separator.

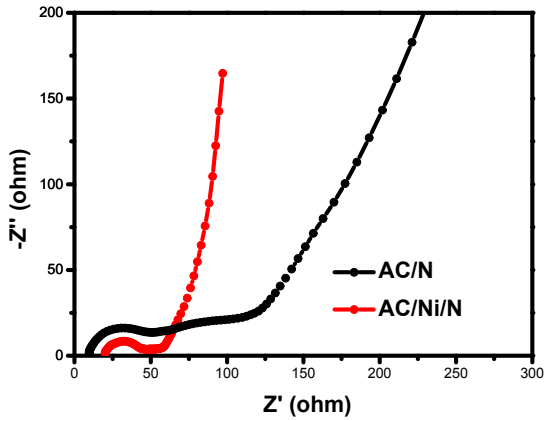

Fig. S8. Nyquist plots of cells with AC/N and AC/Ni/N modified separator after cycling at 1.5C.

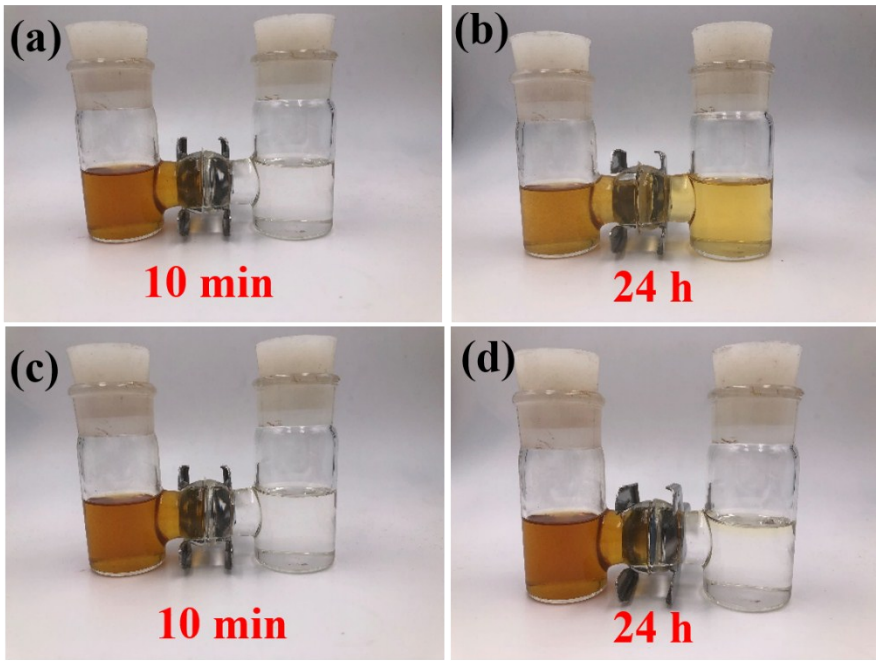

Fig. S9. Permeation experiments with an H-type permeation device with (a, b) a pristine separator; and (c, d) an AC/Ni/N coated separator after 24 h.

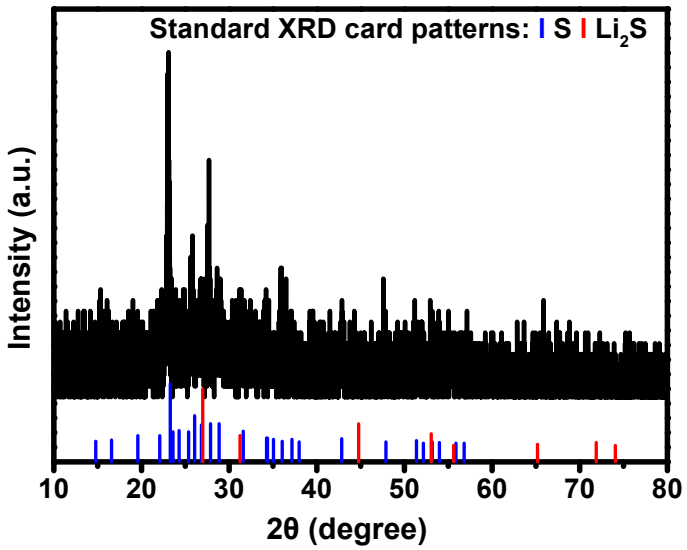

Fig. S10. XRD patterns of AC/Ni/N coated separator after cycling and standard XRD patterns sulfur and Li2S powder.

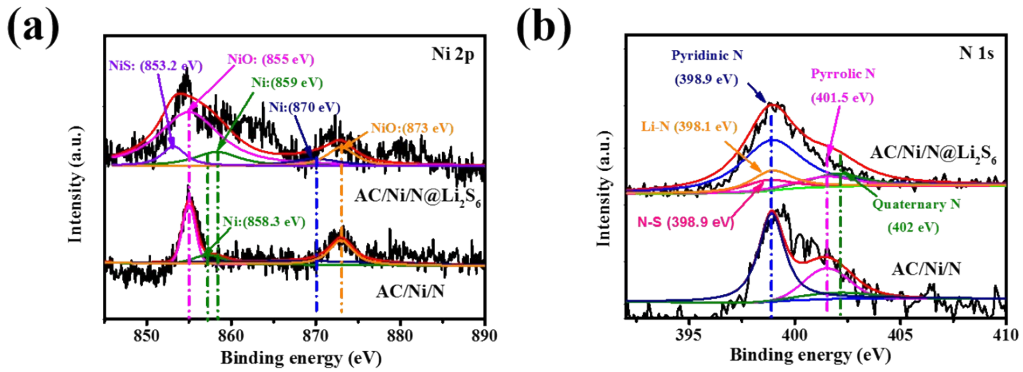

Fig. S11 (a) High-resolution XPS spectra for Ni 2p and (b) N 1s before and after cycling.

Table S1. The impedance parameters simulated from the equivalent circuit fitting of different cells

Sample	$R_o(\Omega)$	$R_{ct}(\Omega)$
Cell with AC/Ni/N modified separator	2.05	53
Cell with AC/N modified separator	3.20	115

Table S2. Comparison of electrochemical properties functional separators in Li–S cells

Coating or interlayer	Sulfur loading	Sulfur content	Cathode	Discharge Capacity	Areal capacity (mAh cm^{-2})	E/S ratio	Ref
MoO_3@CNT	1.0	60%	Super P/S	~755 mAh g^{-1}, 200_{th}, 0.3 C	<2.0	N/A	S1
EUC-CNF	1.5	70%	Super P/S	1038 mAh g^{-1}, 50_{th}, 0.2 C	<2.0	N/A	S2
SSNS/CNT	1.0	65%	KB/S	680 mAh g^{-1}, 100_{th}, 0.2 C	<2.0	N/A	S3
GO@MoS_2	3.64	70%	CB/S	~600 mAh g^{-1}, 95_{th}, 0.2 C	2.2	14	S4
TiO_2/C	1.1	54%	AB/S	~1000 mAh g^{-1}, 60_{th}, 0.1 C	<2.0	36	S5
Sb_2S_3	1.0	65%	KB/S	680 mAh g^{-1} 100_{th}, 0.2 C	<2.0		S6
rGO@SL	3.8	75%	CB/S	700 mAh g^{-1} 50_{th}, 0.05 C	2.7	8	S7
TiN	1.3	70%	Super P/S	744 mAh g^{-1} 200_{th}, 0.5 C	<2.0	46	S8
MnO_2	1.5-2.5	66%	KB/S	~603 mAh g^{-1}, 500_{th}, 0.5 C	<2.0	8.8	S9
AC/Ni/N	7.0	80%	CB/S	~714 mAh g^{-1}, 100_{th}, 0.1 C	7	7.8	This work

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