Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Supplementary materials

Constructing $NiCo_2Se_4/NiCoS_4$ heterostructures for high-performance aluminum batteries cathode

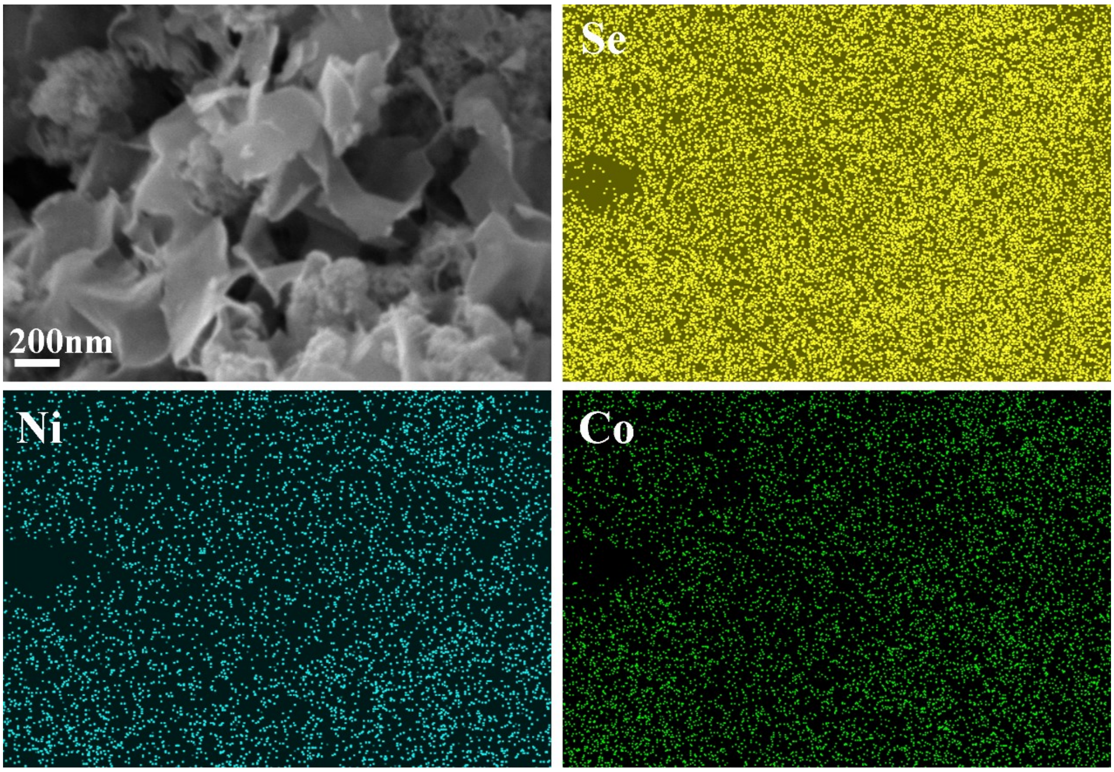

Figure. S1 SEM image and corresponding elemental mapping of pure $NiCo_2Se_4$.

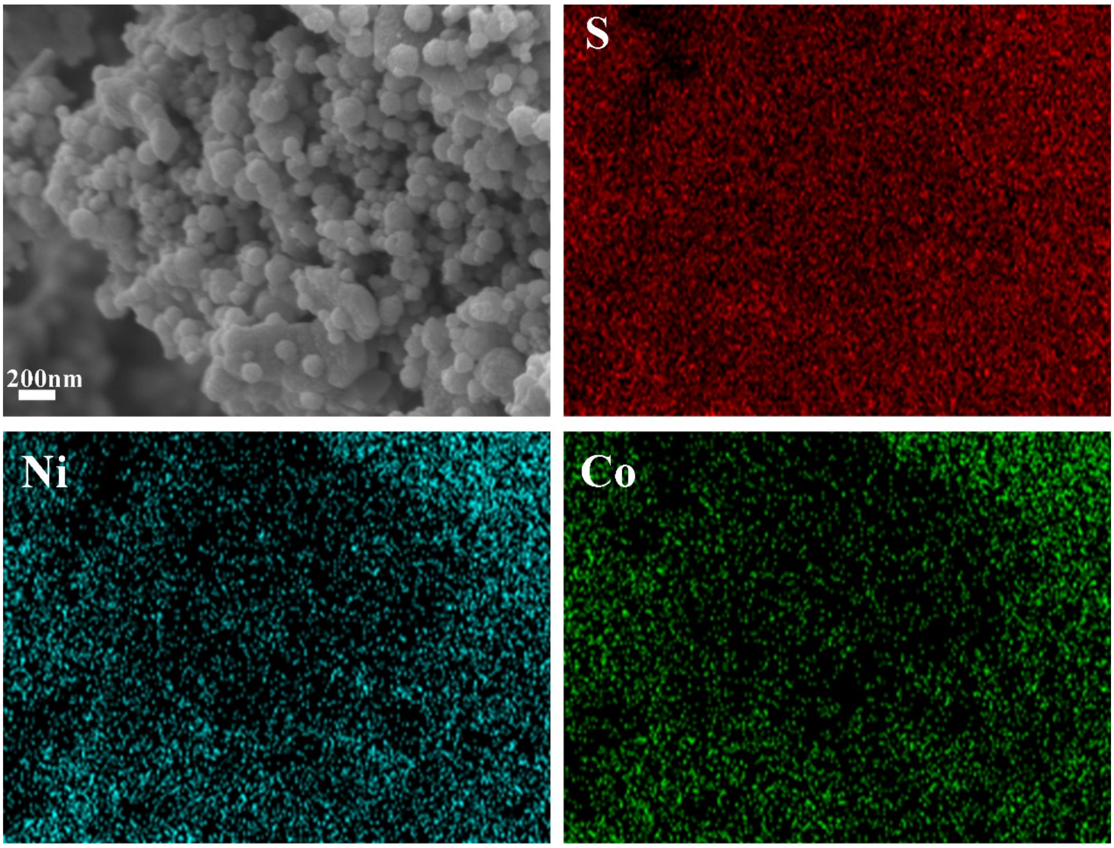

Figure. S2 SEM image and corresponding elemental mapping of heterostructured $NiCoS_4$.

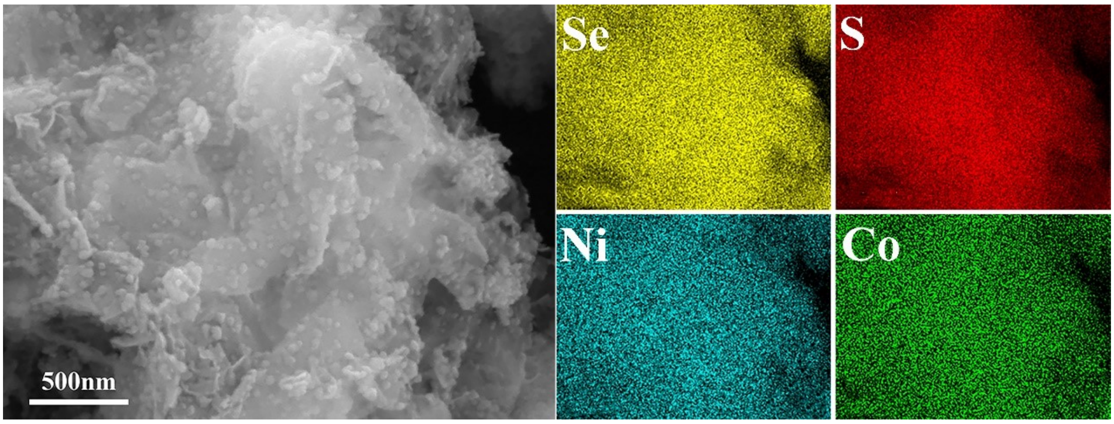

Figure. S3 SEM image and corresponding elemental mapping of heterostructured $NiCo_2Se_4$/ $NiCoS_4$.

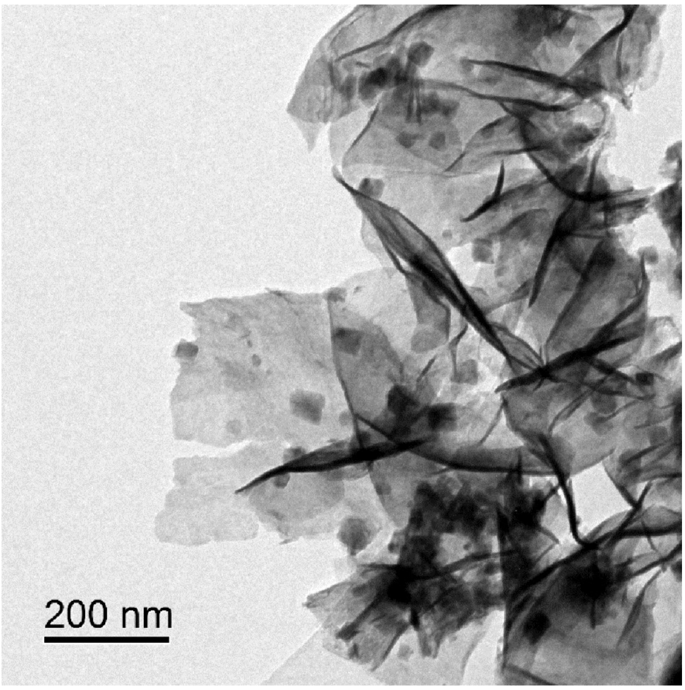

Figure. **S4** TEM image of heterostructured $NiCo_2Se4$/ NiCoS4.

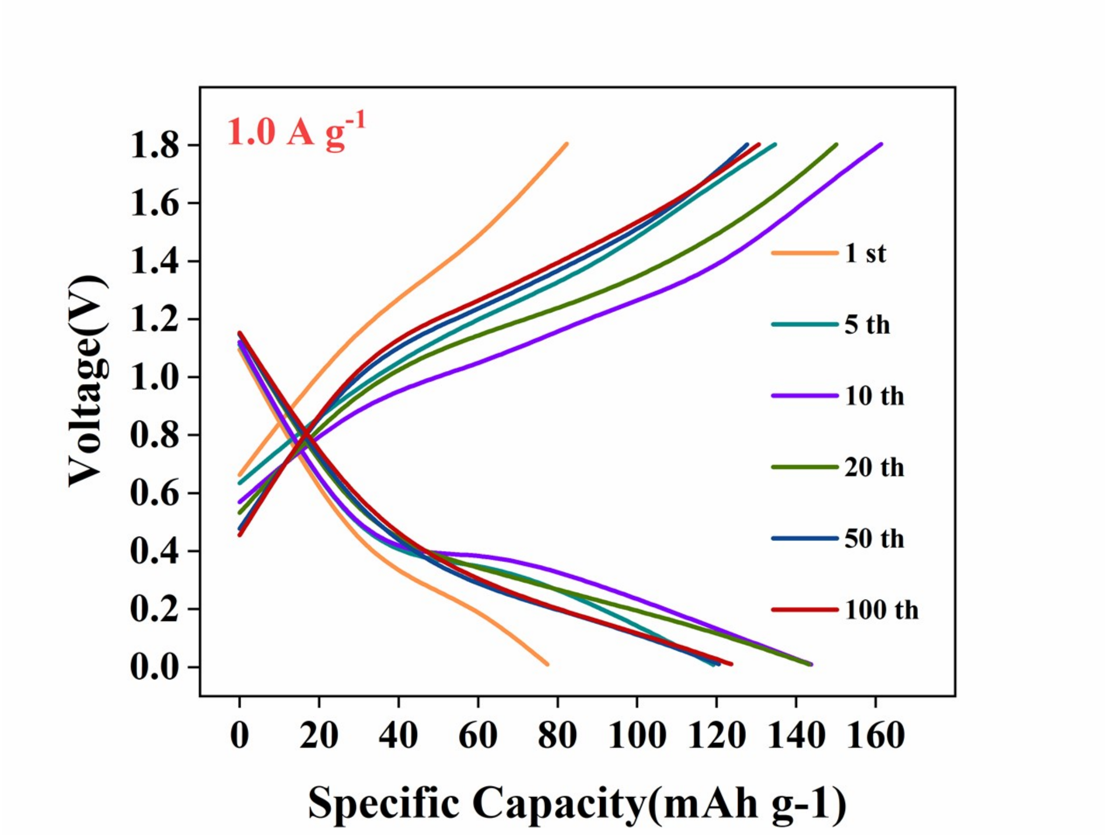

Figure. S5 The charge-discharge curves of heterostructured $NiCo_2Se_4$/ $NiCoS_4$ for different cycles.

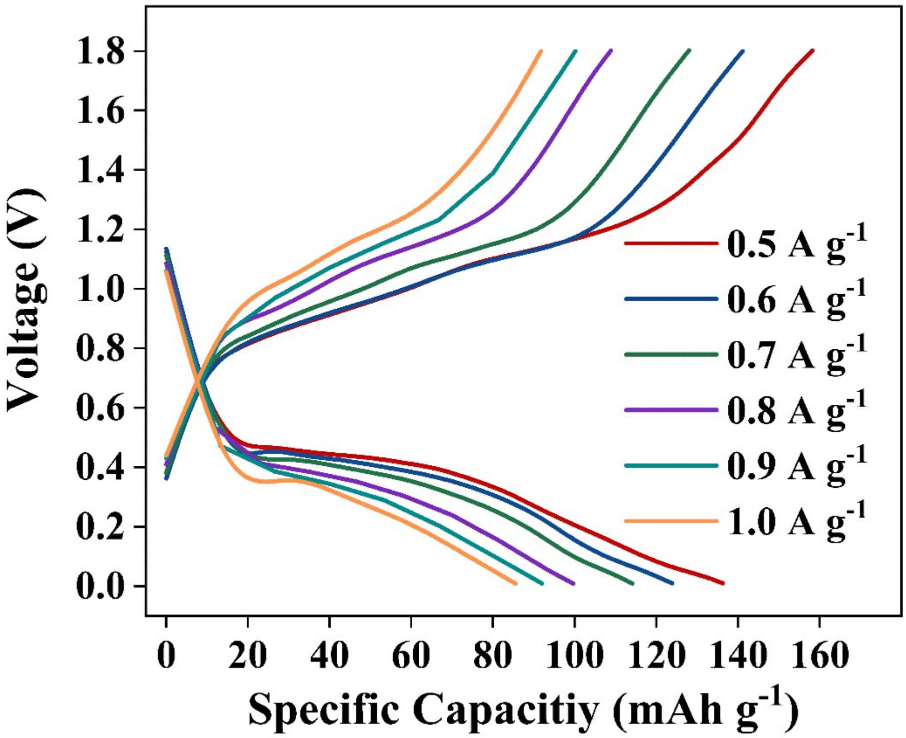

Figure. S6 The charge-discharge curves corresponding to Figure 2c of the heterostructured $NiCo_2Se_4$/ $NiCoS_4$ cathode from 0.5 A g^{-1} to 1 A g^{-1}.

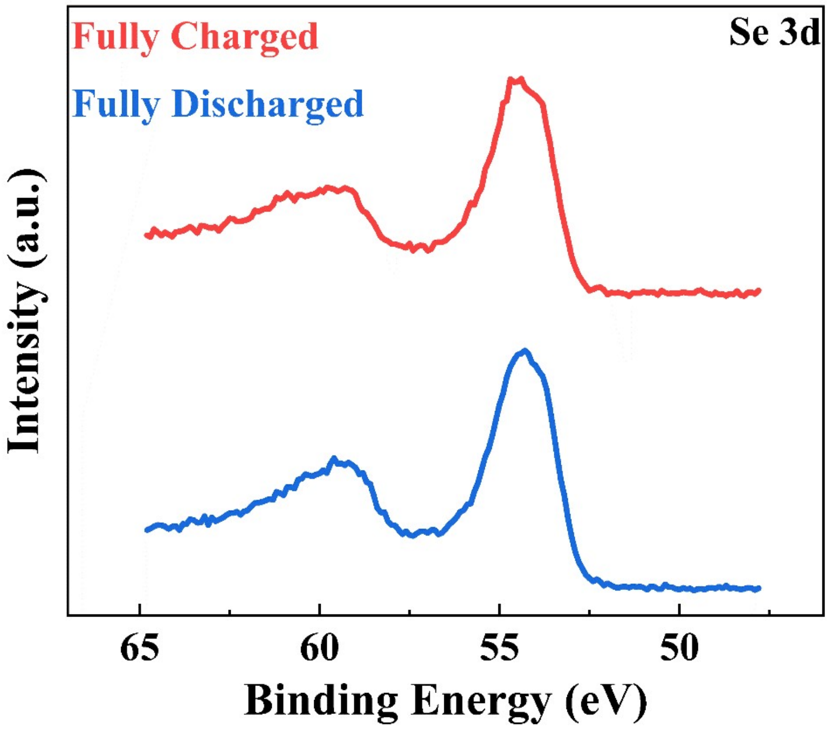

Figure. S7 The XPS spectra of Se 3d at fully charged and discharged states, respectively.

Table. S1 The element content of Se and S in $NiCo_2Se_4/NiCoS_4$ by ICP-OES.

Sample Quantity m_0 (g)	Constant Volume V_0 (mL)	Element	Element Concentration of Solution C_o (mg/L)	Dilution Multiple f	Element Concentration in Digestion Solution C_1 (mg/L)	Element Content C_x (mg/kg)	Element Content W (%)
0.0523	25	S	2.889	100	288.900	138097.51	13.810
0.0523	25	Se	5.019	100	501.900	239913.96	23.991

The element content (*W*) of Se and S was calculated by the following equation:

$$W(\%) = \frac{C_X(mg/kg)}{10^6} * 100\%$$

$$C_X(mg/kg) = \frac{C_0(mg/L) * f * V_0(mL) * 10^{-3}}{m_0(g) * 10^{-3}} = \frac{C_1(mg/L) * V_0(mL) * 10^{-3}}{m_0(g) * 10^{-3}}$$

$$C_1(mg/L) = C_0(mg/L) * f$$

Table. S2 Comparison of energy storage performance between $NiCo_2Se_4/NiCoS_4$ and other AIB cathode materials previously reported.

Cathode materials	Electrolyte	Cycling performance	Ref.
		capacity, current density, cycle number	
$NiCo_2Se_4/NiCoS_4$	**$AlCl_3$: [EMIm]Cl =1.1:1**	**112mAh g^{-1}/1000mA g^{-1}/195cycle**	**This work**
Ni_2P/rGO	$AlCl_3$: [EMIm]Cl =1.3:1	73mAh g^{-1}/100mA g^{-1}/500th	1
graphite nanoflakes	$AlCl_3$: [EMIm]Cl =1.3:1	73mAh g^{-1}/200mA g^{-1}/1000th	2
$Cu_{2-x}Se$	$AlCl_3$: [EMIm]Cl =1.3:1	100mAh g^{-1}/200mA g^{-1}/100th	3
CoSe	$AlCl_3$: [EMIm]Cl= 1.3:1	62.4mAh g^{-1}/5000mA g^{-1}/100th	4
Zn/Co-Se@C	$AlCl_3$: [EMIm]Cl= 1.3:1	79mAh g^{-1}/1000mA g^{-1}/400th	5
Co_3S_4	$AlCl_3$: [EMIm]Cl= 1.3:1	90mAh g^{-1}/50mA g^{-1}/150th	6
SnSe	$AlCl_3$: [EMIm]Cl =1.3:1	107mAh g^{-1}/300mA g^{-1}/100th	7
MoS2	$AlCl_3$: [EMIm]Cl =1.3:1	66.7mAh g^{-1}/40mA g^{-1}/100th	8
Ni_3S_2@graphene	$AlCl_3$: [EMIm]Cl =1.3:1	60 mAh g^{-1} /100 mA g^{-1}/100th	9

References:

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