Supporting Information

Engineering carbon layer on yolk-shell bimetallic selenide microsphere boosts lithium storage as a high-performance anode

Wenzhe Wang[a], Shuting Qiu[a], Tianqi Gao[a], Hua He[a], Xiaojun Zhao[b,*], Zhi-Hong Liu[a,*]

[a]Key Laboratory for Macromolecular Science of Shaanxi Province, School of Chemistry and Chemical Engineering, Shaanxi Normal University, Xi'an 710062, P. R. China (liuzh@snnu.edu.cn).

[b]School of Metallurgical Engineering, Xi'an University of Architecture and Technology, Xi'an 710055, P. R. China (x.j.zhao@hotmail.com; xjzhao@xauat.edu.cn).

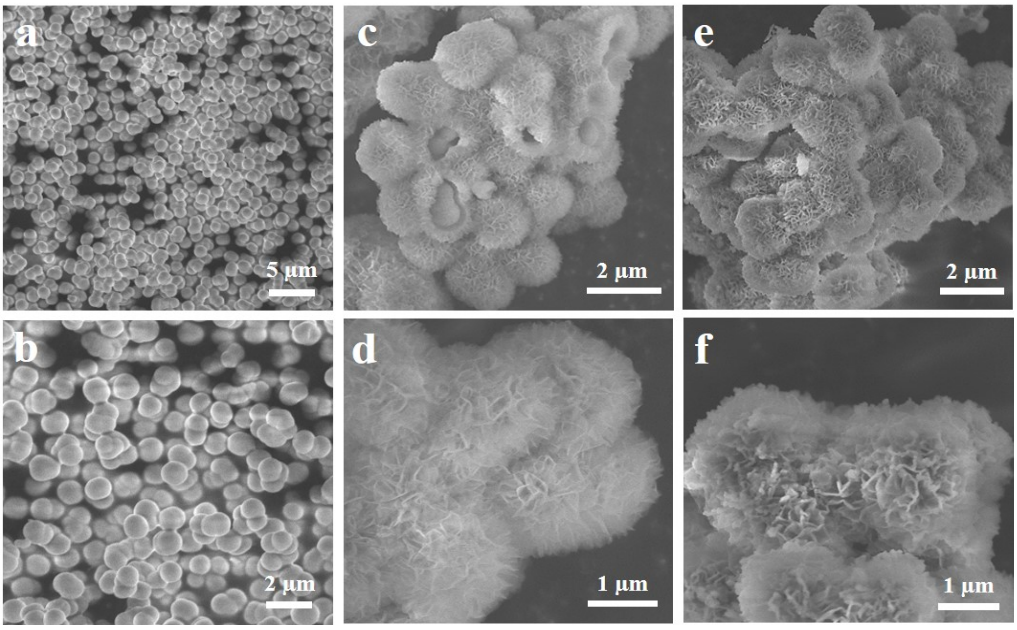

Fig. S1 SEM images of (a, b) CoNi-glycerate, (c, d) CoNi-OH and (e, f) CoNi-OH@PDA.

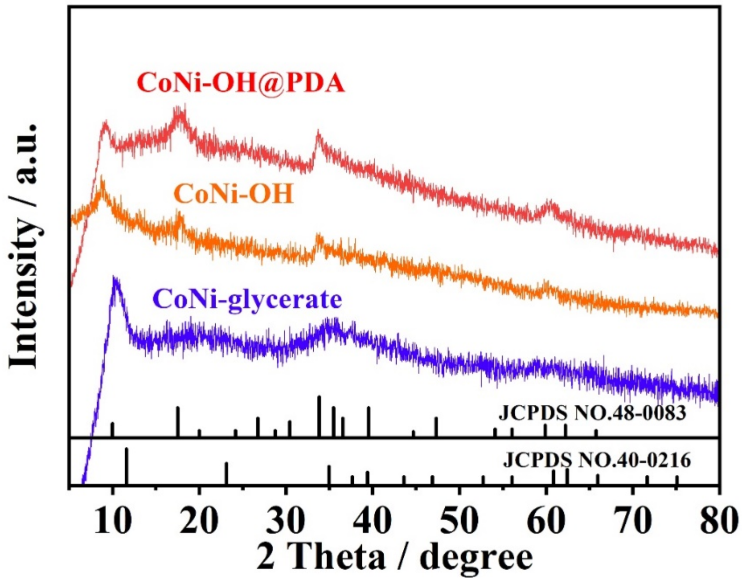

Fig. S2 XRD patterns of CoNi-glycerate, CoNi-OH and CoNi-OH@PDA yolk shell structure.

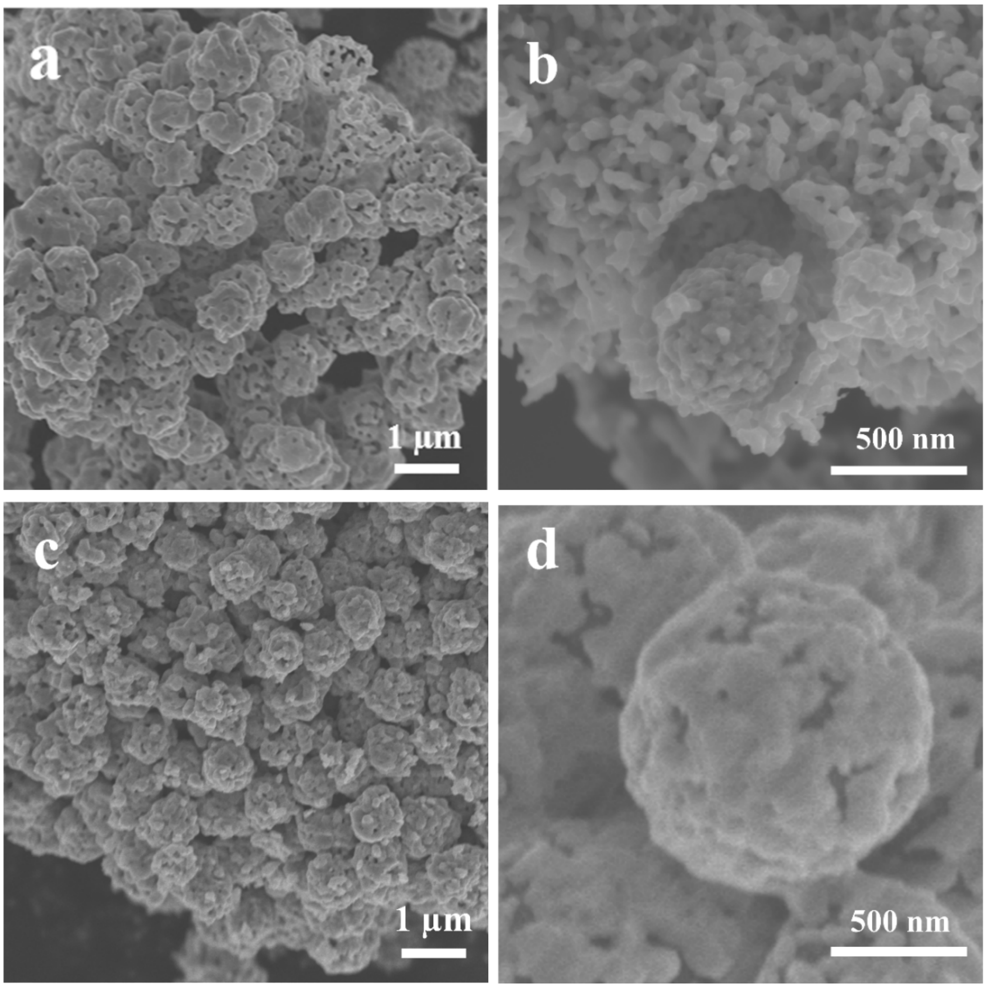

Fig. S3 SEM images of (a, b) $CoSe_2/Ni_3Se_4$ and (c, d) s-$CoSe_2/Ni_3Se_4$.

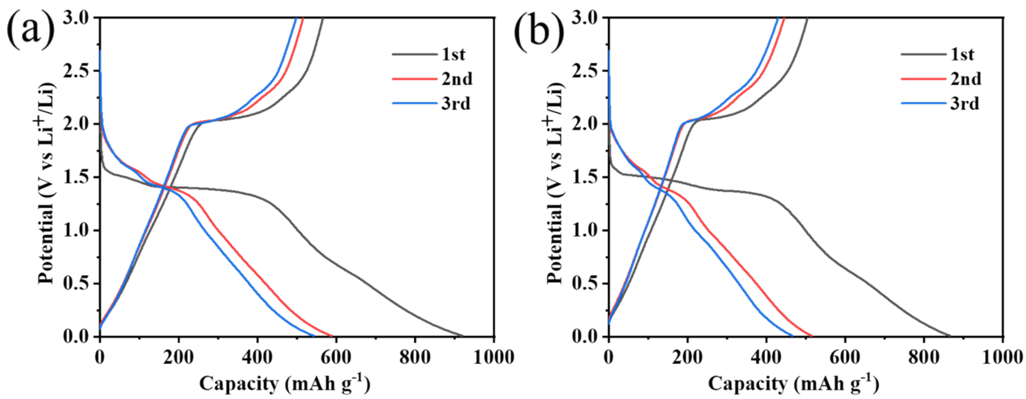

Fig. S4 Galvanostatic charge/discharge curves of (a) $CoSe_2/Ni_3Se_4$ and (b) s-$CoSe_2/Ni_3Se_4$.

Table S1. Comparison of electrochemical properties of Co-based and Ni-based selenides carbon materials on LIBs

Electrode materials	Cycling performance	Rate Performance ($mA\ h\ g^{-1}$ @ $A\ g^{-1}$)	Ref.
$NiSe_2/CoSe_2$/Graphene	< 245.6 $mA\ h\ g^{-1}$ after 500 cycles at 1 $A\ g^{-1}$	544 @ 0.2 184 @ 2.0	Colloid. Surface. A, 2024, **688**, 133685.
CoSe-MS	156 $mA\ h\ g^{-1}$ after 100 cycles at 0.5 $A\ g^{-1}$	-	ACS Appl. Mater. Interfaces, 2019, **11,** 11292-11297.
ZnSe-CoSe@NC/MX	469 $mA\ h\ g^{-1}$ after 80 cycles at 0.2 $A\ g^{-1}$	477 @ 0.1 444 @ 0.2 335 @ 2.0	Electrochim. Acta, 2024, **487**, 144148.
CoSe/NC	310 $mA\ h\ g^{-1}$ after 500 cycles at 1 $A\ g^{-1}$	-	Nanoscale Res. Lett., 2019, **14**, 385.
$CoSe_2$@C	-	521 @ 0.1 468 @ 0.2 321 @ 1.0	Appl. Surf. Sci., 2019, **483**, 85-90.
NiSe/rGO	378 $mA\ h\ g^{-1}$ after 50 cycles at 0.05 $A\ g^{-1}$	364 @ 0.2 110@ 3.2	Materials, 2019, **12,** 3709.
NiSe/C	428 $mA\ h\ g^{-1}$ after 50 cycles at 0.1 $A\ g^{-1}$	384 @ 0.2 299 @ 0.5	Electrochim. Acta, 2016, **208**, 238.
$CoSe_2/Ni_3Se_4$@NC	518 $mA\ h\ g^{-1}$ after 100 cycles at 0.2 $A\ g^{-1}$ 319 $mA\ h\ g^{-1}$ after 500 cycles at 1 $A\ g^{-1}$	564 @ 0.2 129 @ 4.0	**This Work**

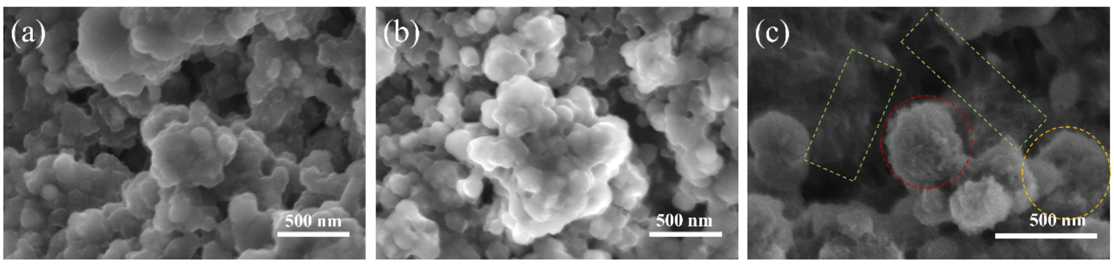

Fig. S5 SEM images of (a) s-$CoSe_2/Ni_3Se_4$, (b) $CoSe_2/Ni_3Se_4$ and (c) $CoSe_2/Ni_3Se_4$@NC after 100 cycles at 200 $mA\ g^{-1}$.

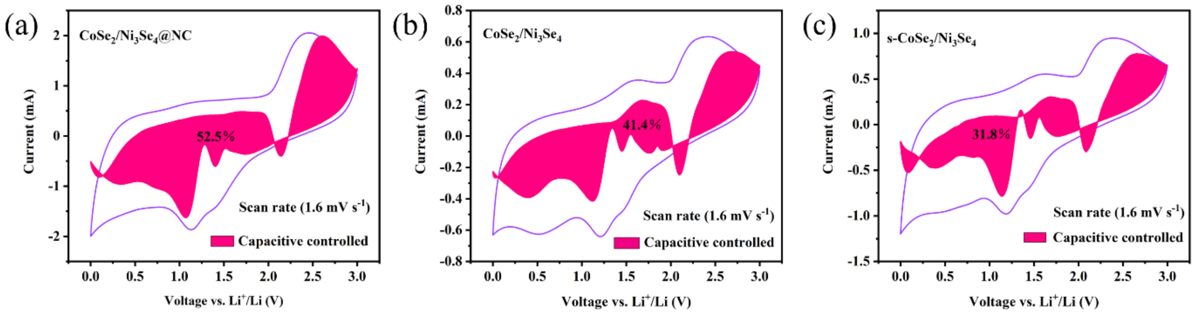

Fig. S6 CV curve with the pseudocapacitive fraction at a scan rate of 1.6 mV s^{-1} of (a) $CoSe_2/Ni_3Se_4$@NC, (b) $CoSe_2/Ni_3Se_4$ and (c) s-$CoSe_2/Ni_3Se_4$.

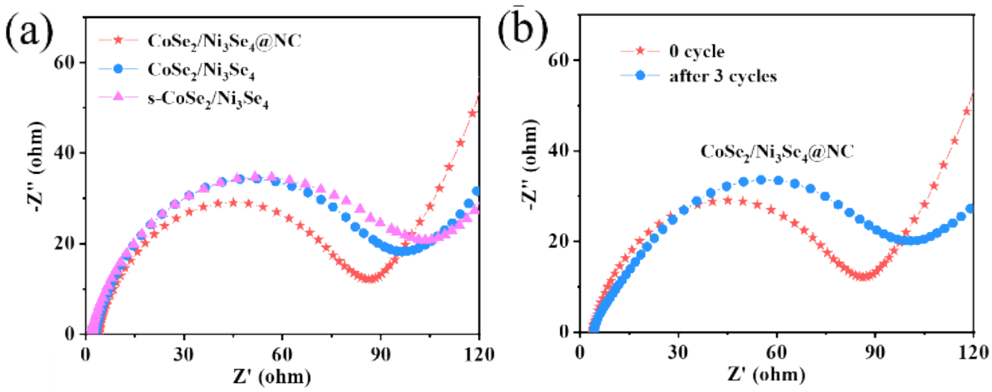

Fig. S7 (a) The EIS plots of $CoSe_2/Ni_3Se_4$@NC, $CoSe_2/Ni_3Se_4$ and s-$CoSe_2/Ni_3Se_4$ before cycling. (b) The EIS plots of $CoSe_2/Ni_3Se_4$@NC before and after 3 cycles.

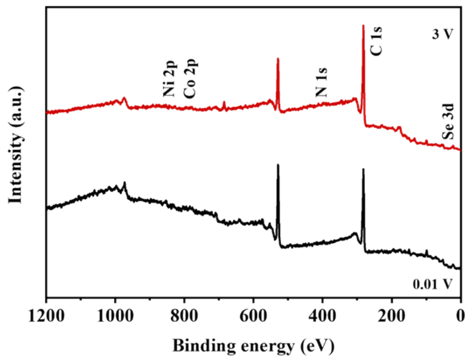

Fig. S8 The survey spectrum of XPS spectra for $CoSe_2/Ni_3Se_4$@NC at different states (initial fully charge and discharge).