Supporting Information

Selenium-Rich Nickel Cobalt Bimetallic Selenide with Core-Shell Architecture Enables Superior Hybrid Energy Storage Device

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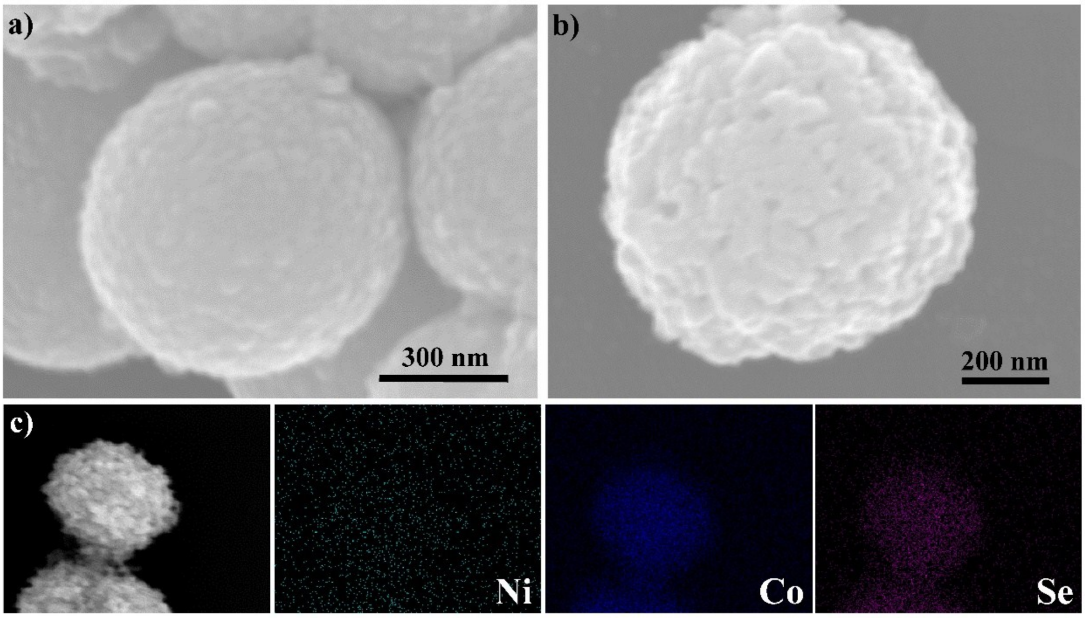

Figure S1. SEM images of the $Co_9Se_8/Co_{0.85}Se$-1 at a) and b) low magnification; c) The corresponding EDS elemental mappings of Ni, Co and Se.

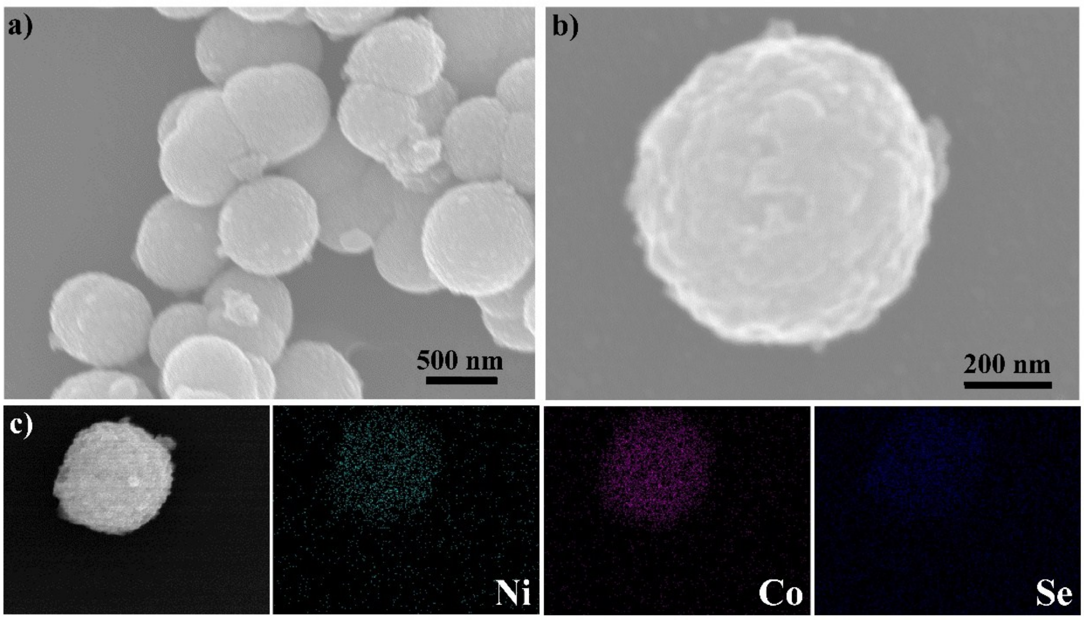

Figure S2. SEM images of the $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-0.5 at a) and b) low magnification; c) The corresponding EDS elemental mappings of Ni, Co and Se.

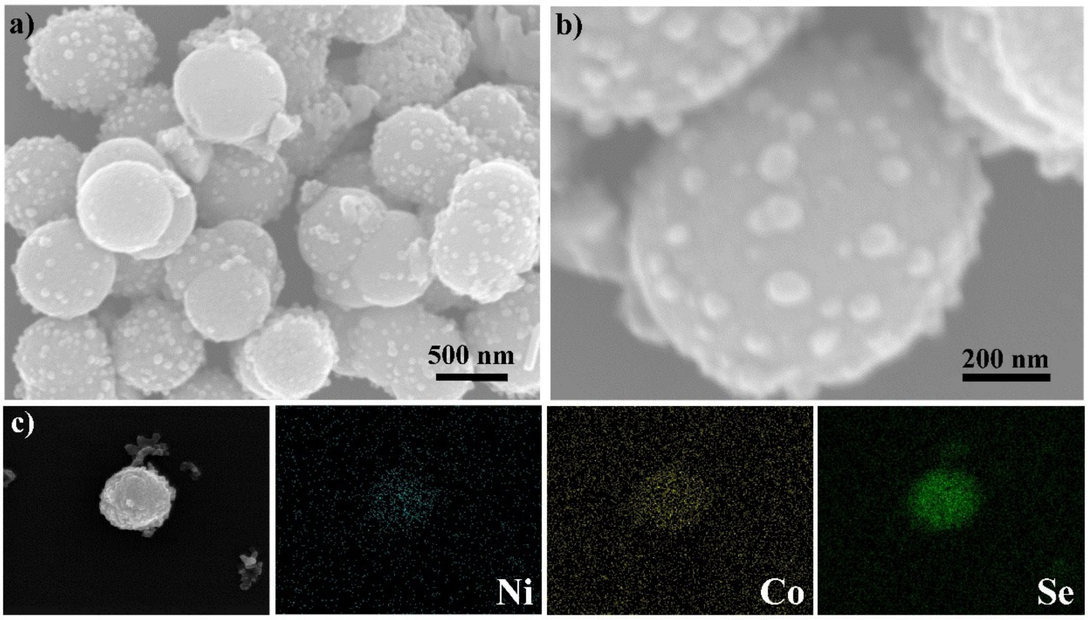

Figure S3. SEM images of the $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-2 at a) and b) low magnification; c) The corresponding EDS elemental mappings of Ni, Co and Se.

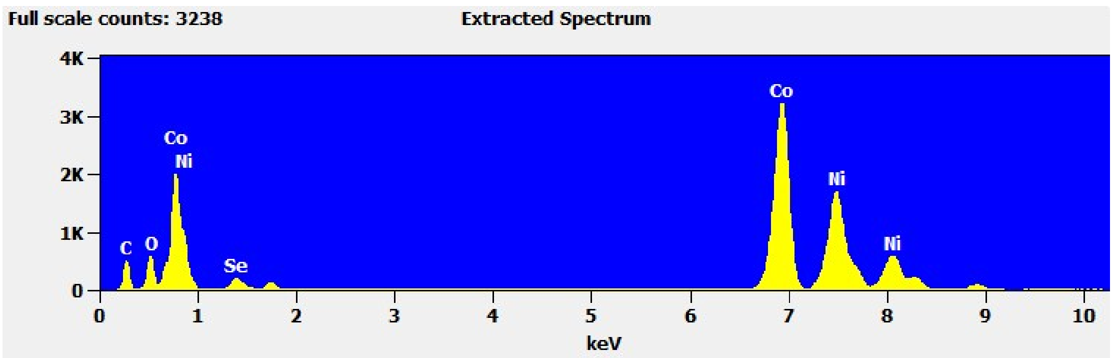

Figure S4. The EDS spectrum of the $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-1 core-shell sphere.

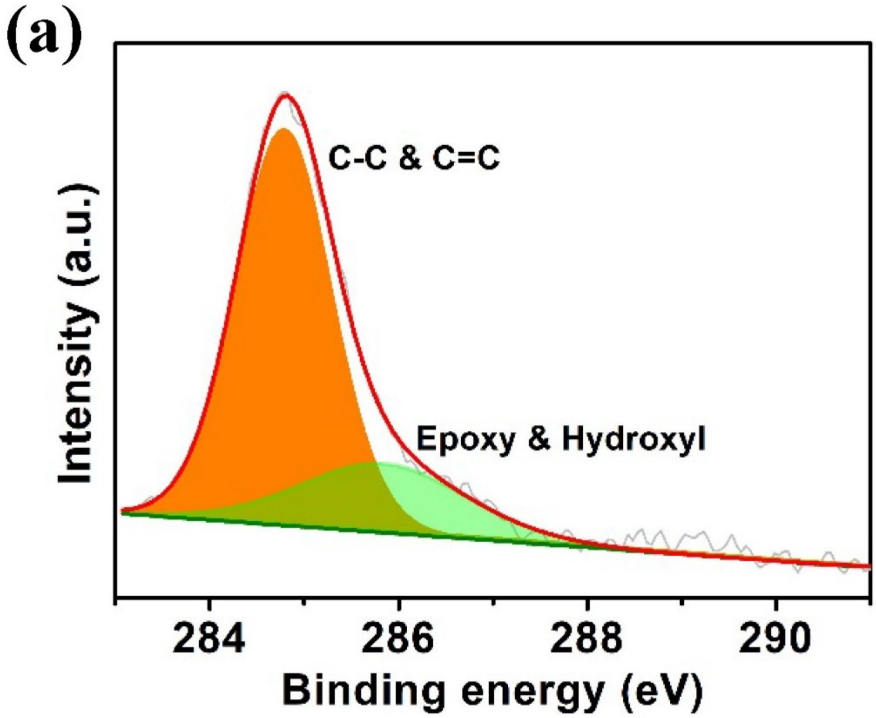

Figure S5. XPS spectra of the as-synthesized $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-1 core-shell sphere: C 1s.

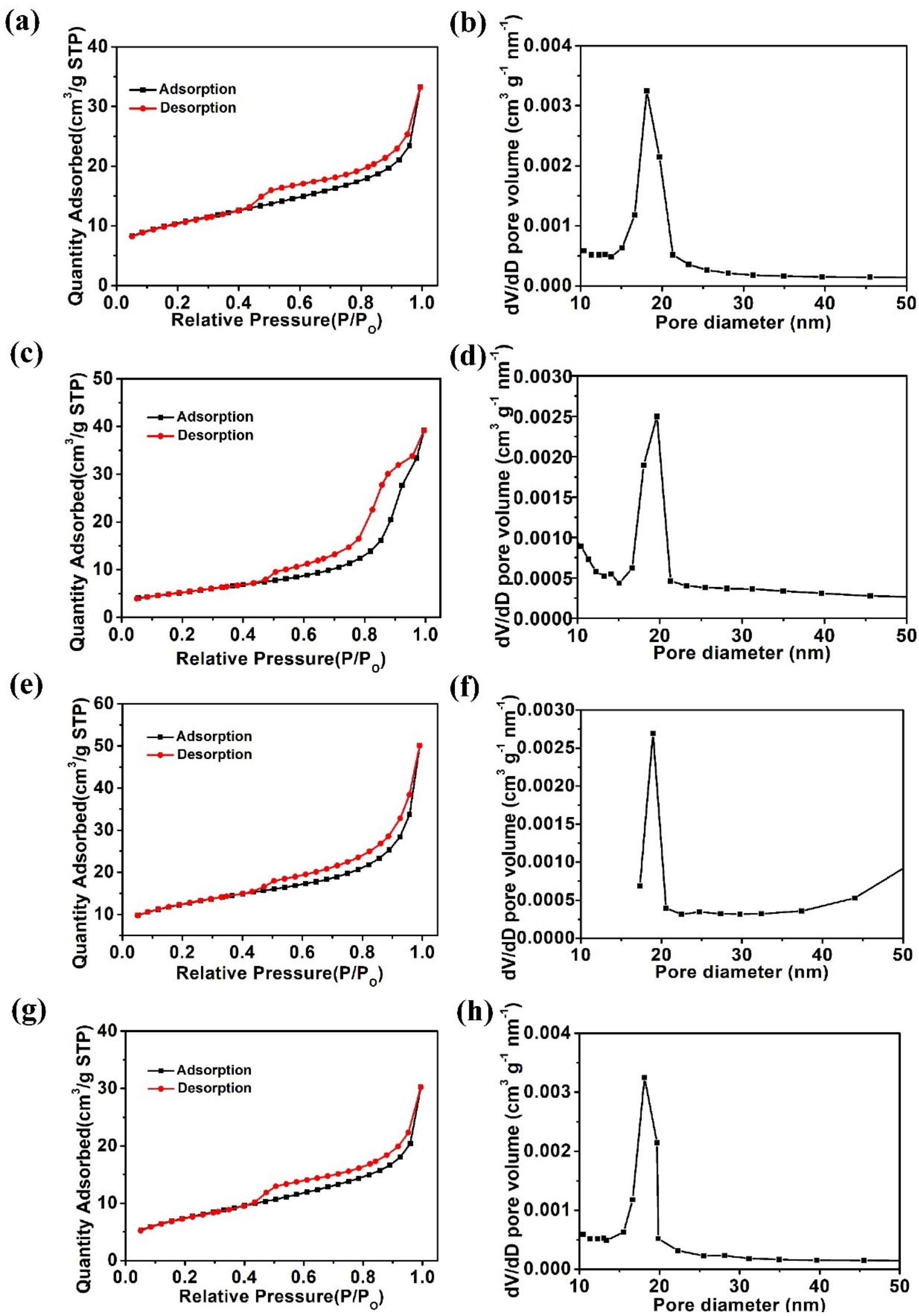

Figure S6. BET test: Nitrogen adsorption/desorption isotherms and the pore-size distribution. a-b) $Co_9Se_8/Co_{0.85}Se$-1; c-d) $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-0.5; e-f) $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-1; g-h) $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-2.

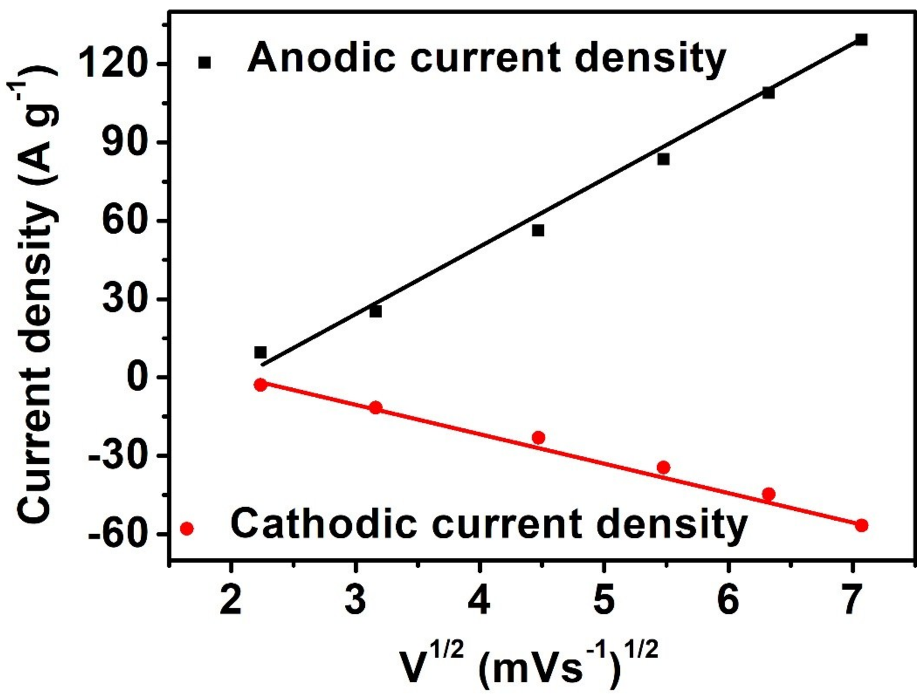

Figure S7. Correlation between peak current density and square roots of scan rates of Ni-Co-Se-1

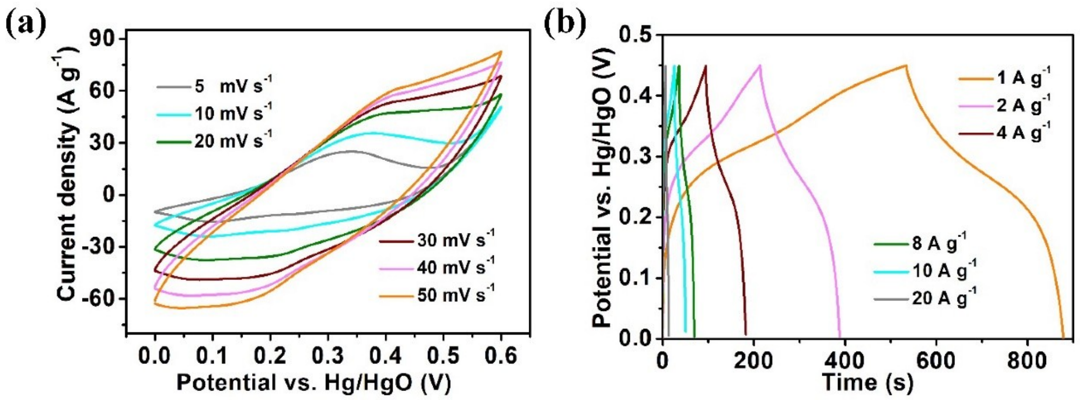

Figure S8. The electrochemical performance of the $Co_9Se_8/Co_{0.85}Se$-1: (a) The CV curves; (b) The GCD curves.

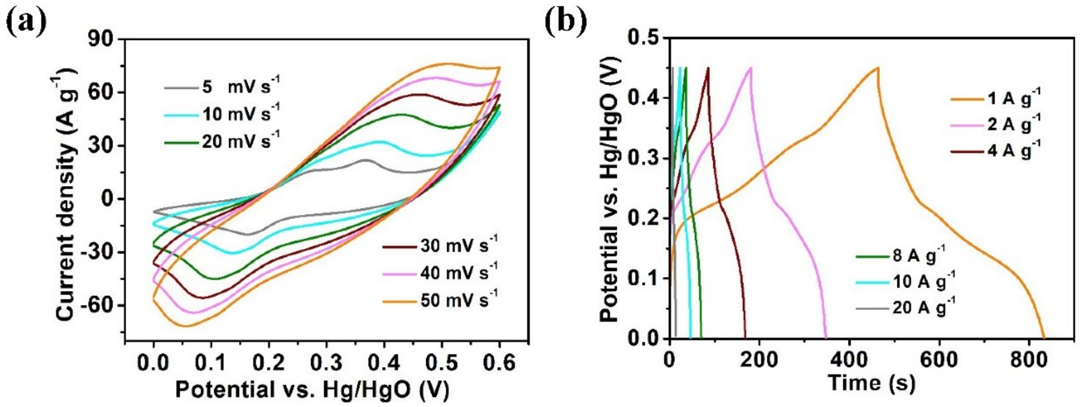

Figure S9. The electrochemical performance of the $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-0.5: (a) The CV curves; (b) The GCD curves.

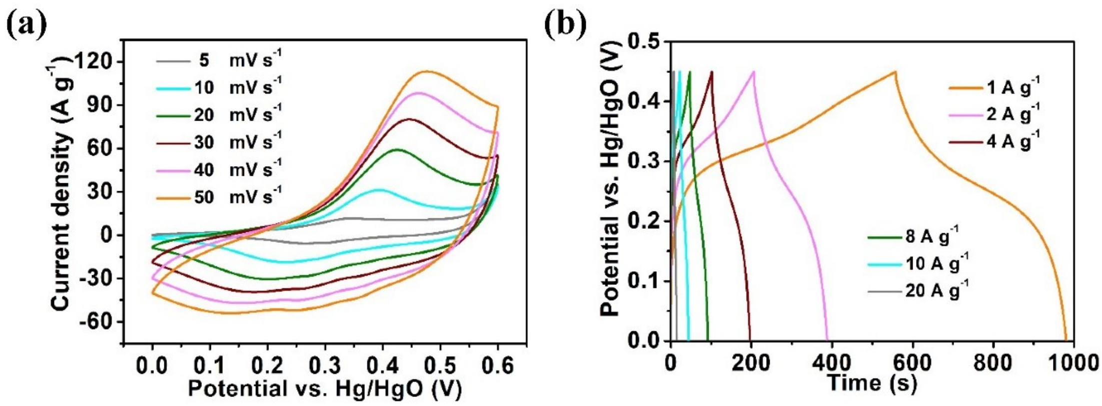

Figure S10. The electrochemical performance of the $(NiCo)_9Se_8/(NiCo)_{0.85}Se$-2: (a) The CV curves; (b) The GCD curves.

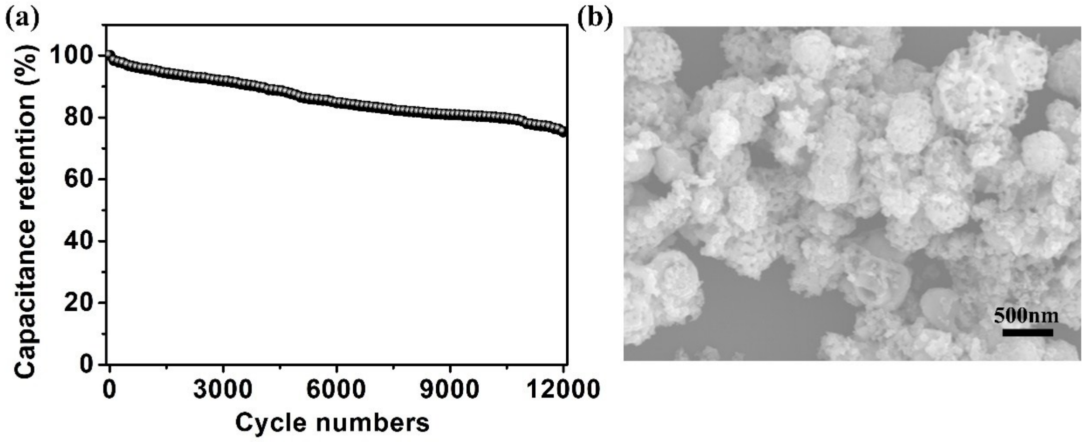

Figure S11. Electrochemical properties of the Ni-Co-Se-1: (a) The cycling performance; (b) SEM images of Ni-Co-Se-1 after 12000 cycles.

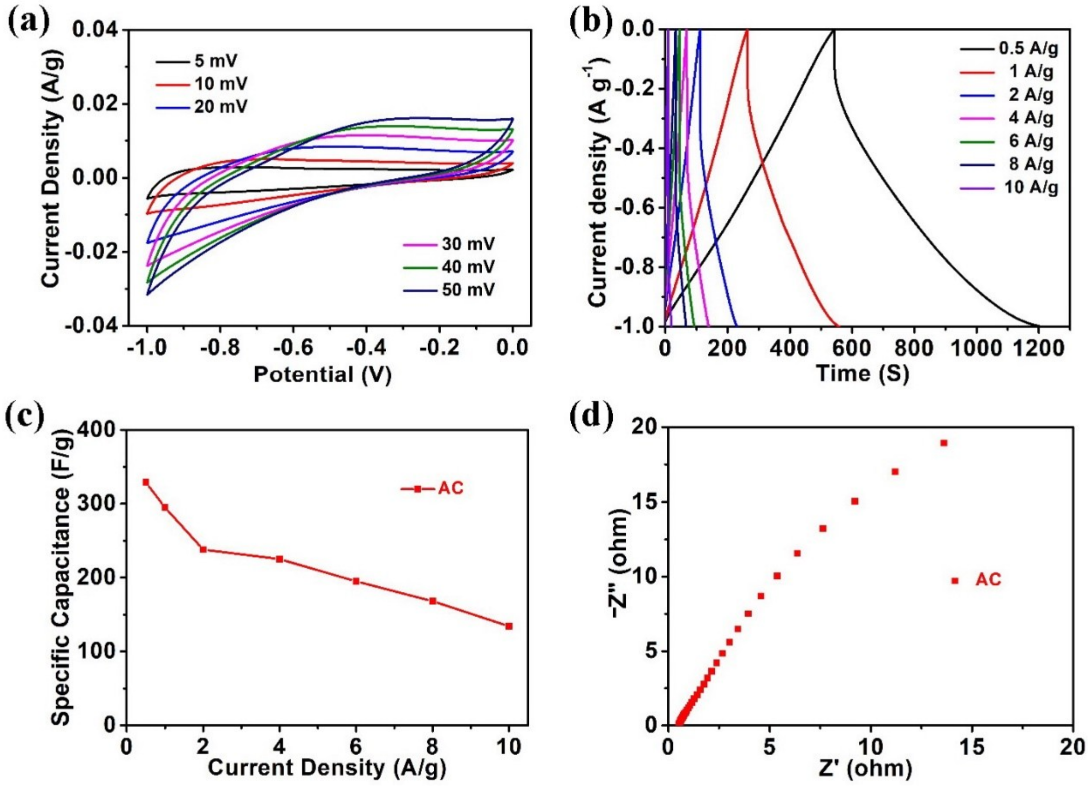

Figure S12. The electrochemical performance of AC: (a) The CV curves; (b) The GCD curves; (c) Rate performance; (d) EIS curves.

Table S1. Comparison of electrochemical performance between various hybrid pseudocapacitive electrodes and our work.

Electrode composition	Electrolyte	Specific capacitance	Counter electrode	Cyclic stability	Ref.
$(NiCo)_9Se_8$ /$(NiCo)_{0.85}Se$	1M KOH	164.44 mAh g^{-1} at 1 A g^{-1} (1315.52 F g^{-1} at 1 A g^{-1}/ 591 C g^{-1} at 1 A g^{-1})	Hg/HgO electrode	85.72 % after 5000 cycles	This work
$Ni_{0.67}Co_{0.33}Se$[1]	6M KOH	535 C g^{-1} at 1 A g^{-1}	Hg/HgO electrode	63 % after 2000 cycles	S1
NiSe-CoSe[2]	6M KOH	584 C g^{-1} at 1 A g^{-1}	Hg/HgO electrode	83.8 % after 1000 cycles	S2
$(Ni_{0.33}Co_{0.67})Se_2$[3]	3M KOH	827.9 F g^{-1} at 1 A g^{-1}	saturated calomel electrode	78.1 % after 2000 cycles	S3
$Co_{0.85}Se$ nanosheet[4]	2M KOH	422 F g^{-1} at 1 A g^{-1}	saturated calomel electrode	93 % after 2000 cycles	S4
$NiCoSe_2$[5]	6M KOH	750 F g^{-1} at 3 A g^{-1}	saturated calomel electrode	92.1 % after 5000 cycles	S5
$NiSe_2$ nanosheet[6]	1M KOH	466 F g^{-1} at 3 A g^{-1}	Hg/HgO electrode	81.3 % after 1000 cycles	S6
$NiCo_{2.1}Se_{3.3}$/Graphene[7]	6M KOH	742.4 F g^{-1} at 1 mA cm^{-2}	Hg/HgO electrode	83.8 % after 1000 cycles	S7

$CoSe_2$ Nanoarrays[8]	3M KOH	759.5 F g^{-1} at 1 mA cm^{-2}	saturated calomel electrode	94.5 % after 5000 cycles	S8
$Ni_{0.9}Co_{1.92}Se_4$[9]	3M KOH	1021.1 F g^{-1} at 2 mA cm^{-2}	Hg/HgO electrode	88.39 % after 5000 cycles	S9
$Ni_{0.5}Co_{0.5}Se_2$[10]	6M KOH	524 C g^{-1} at 1 A g^{-1}	Hg/HgO electrode	91 % after 3500 cycles	S10
$CoSe_2$/C[11]	2M KOH	726 F g^{-1} at 2 A g^{-1}	saturated calomel electrode	85.1 % after 2000 cycles	S11
$NiCo_2S_{2.2}Se_{1.8}$/CC[12]	6M KOH	870 C g^{-1} at 2.5 A g^{-1}	Hg/HgO electrode	83 % after 5000 cycles	S12
NiSe nanorod[13]	6M KOH	6.81 F g^{-1} at 5 mA cm^{-2}	Hg/HgO electrode	78.9% after 2000 cycles	S13
$NiSe_2$[14]	4 M KOH	1044 F g^{-1} at 3 A g^{-1}	Ag/AgCl electrode	67 % after 2000 cycles	S14
CoSe[15]	1M KOH	510 F g^{-1} at 1 A g^{-1}	saturated calomel electrode	91% after 5000 cycles	S15

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