Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

Supplementary Information

Hierarchical $MnCo_2O_4$@$NiMoO_4$ as Free-Standing Core-Shell Nanowire Arrays with Synergistic Effect for Enhanced Supercapacitor Performance

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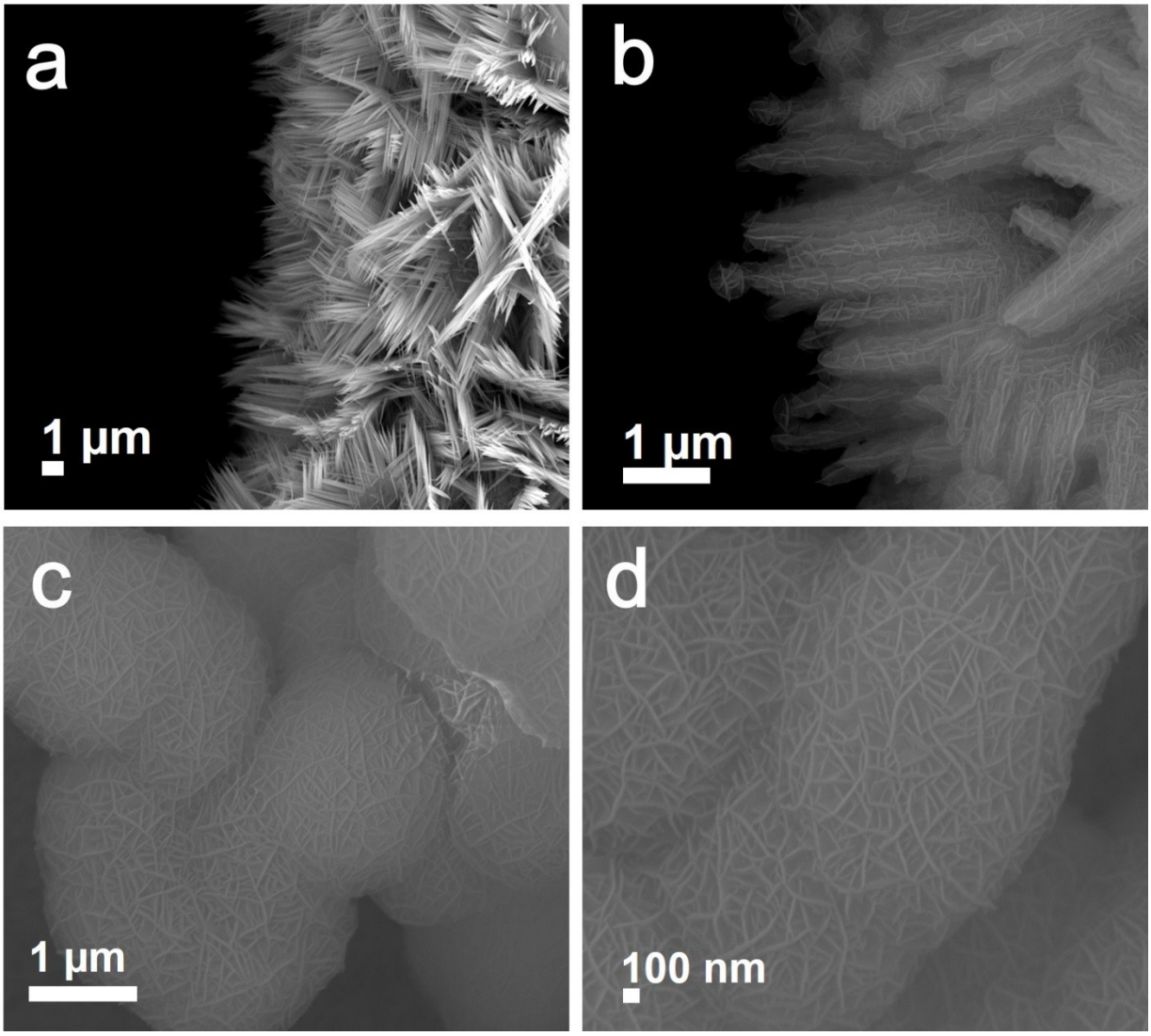

Figure S1. (a) typical SEM image of $MnCo_2O_4$ NWAs in a low magnification, (b) SEM image of $MnCo_2O_4$@$NiMoO_4$ core-shell NWAs in low magnification, (c) and (d) typical SEM images of pure $NiMoO_4$ grown directly over the NF with high and low magnification.

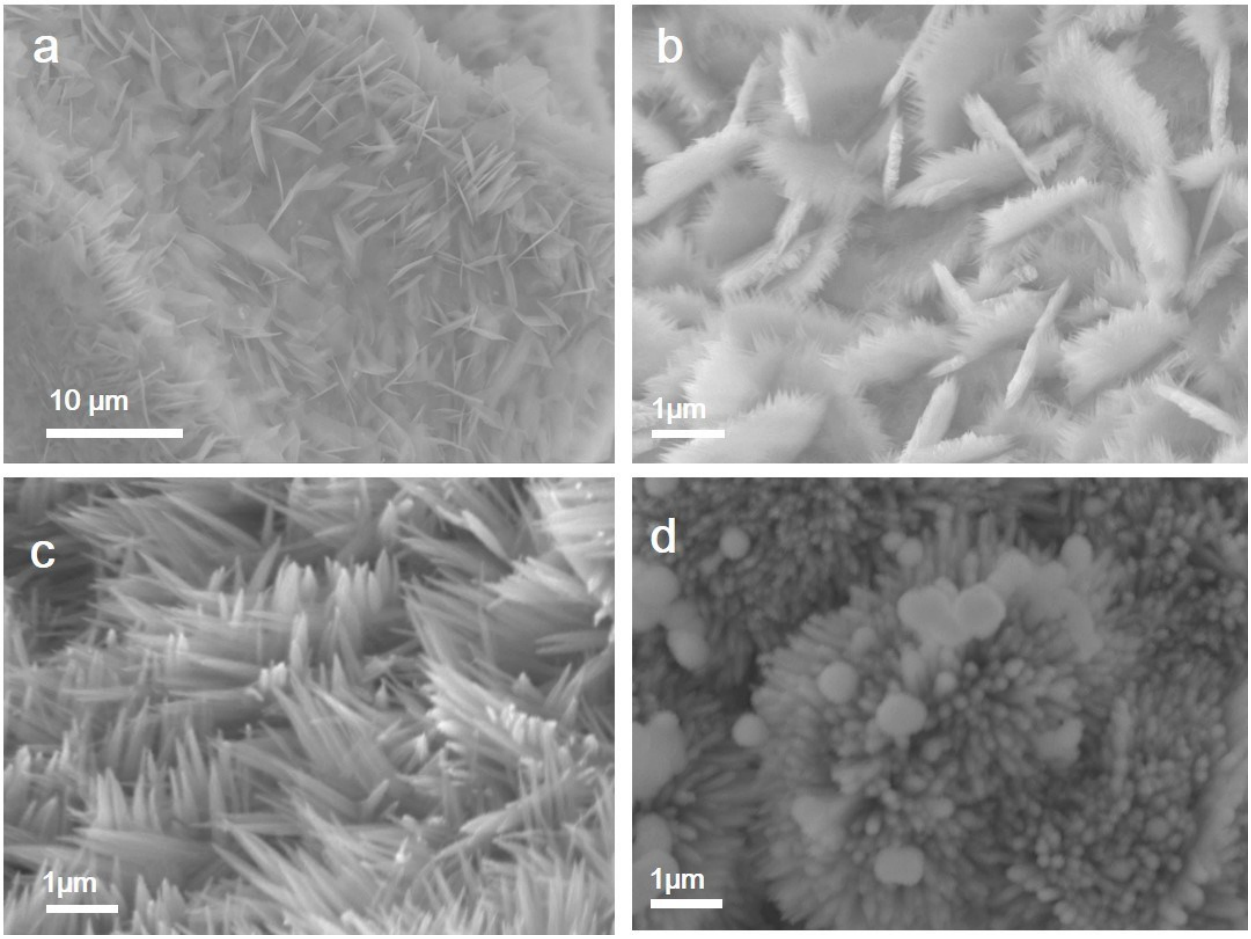

Figure S2. Typical (a) and (b) SEM images of $MnCo_2O_4$ nanowires growth procedure with different reaction time duration (1 hour and 2 hours), respectively. (c) and (d) typical SEM images of $MnCo_2O_4$@$NiMoO_4$ core-shell structure with different hydrothermal reaction duration (3 hours and 12 hours), respectively.

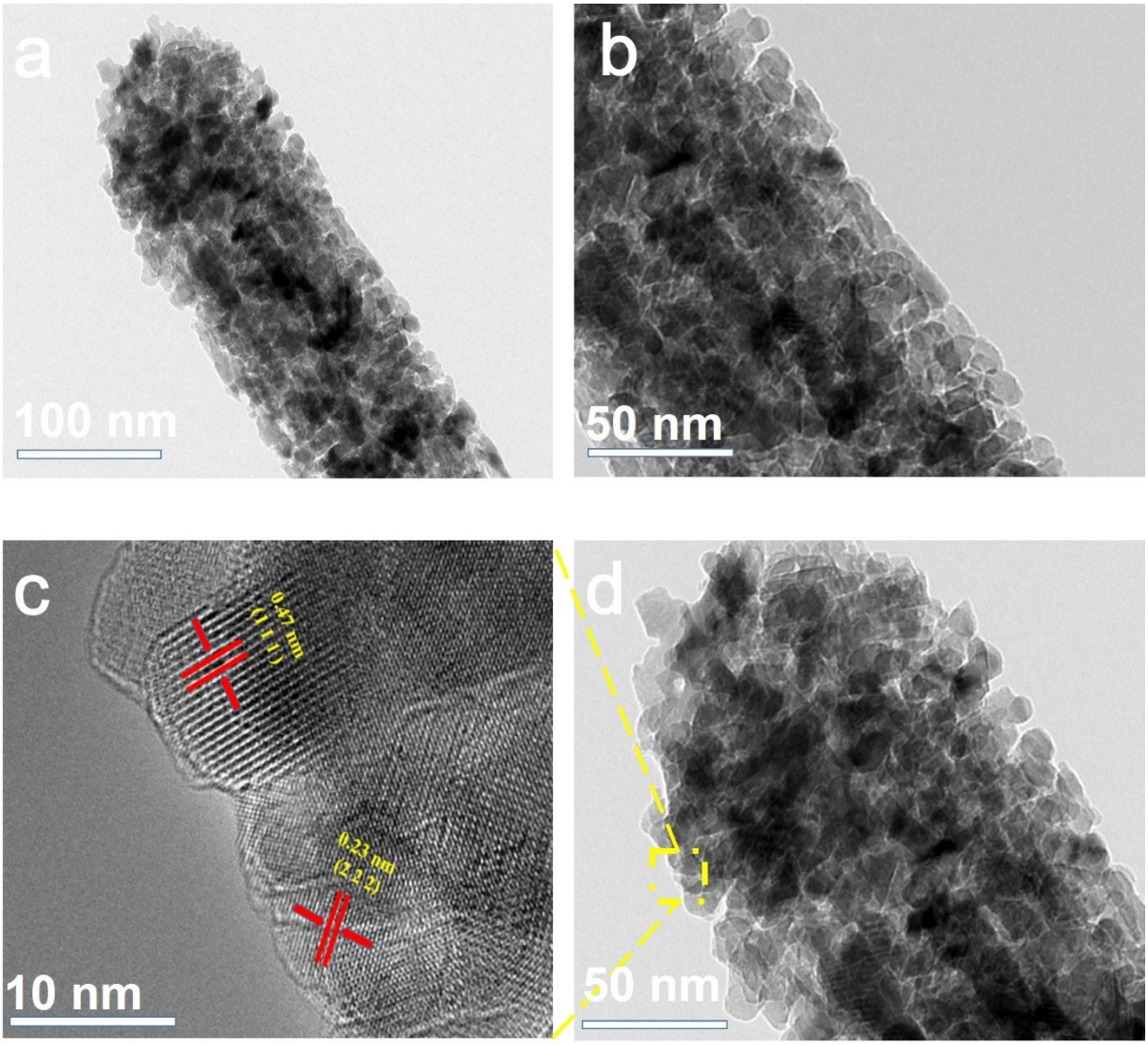

Figure S3. Typical (a),(b) and (d) TEM images of a single $MnCo_2O_4$ nanowire, (c) HRTEM image of single $MnCo_2O_4$ nanowire.

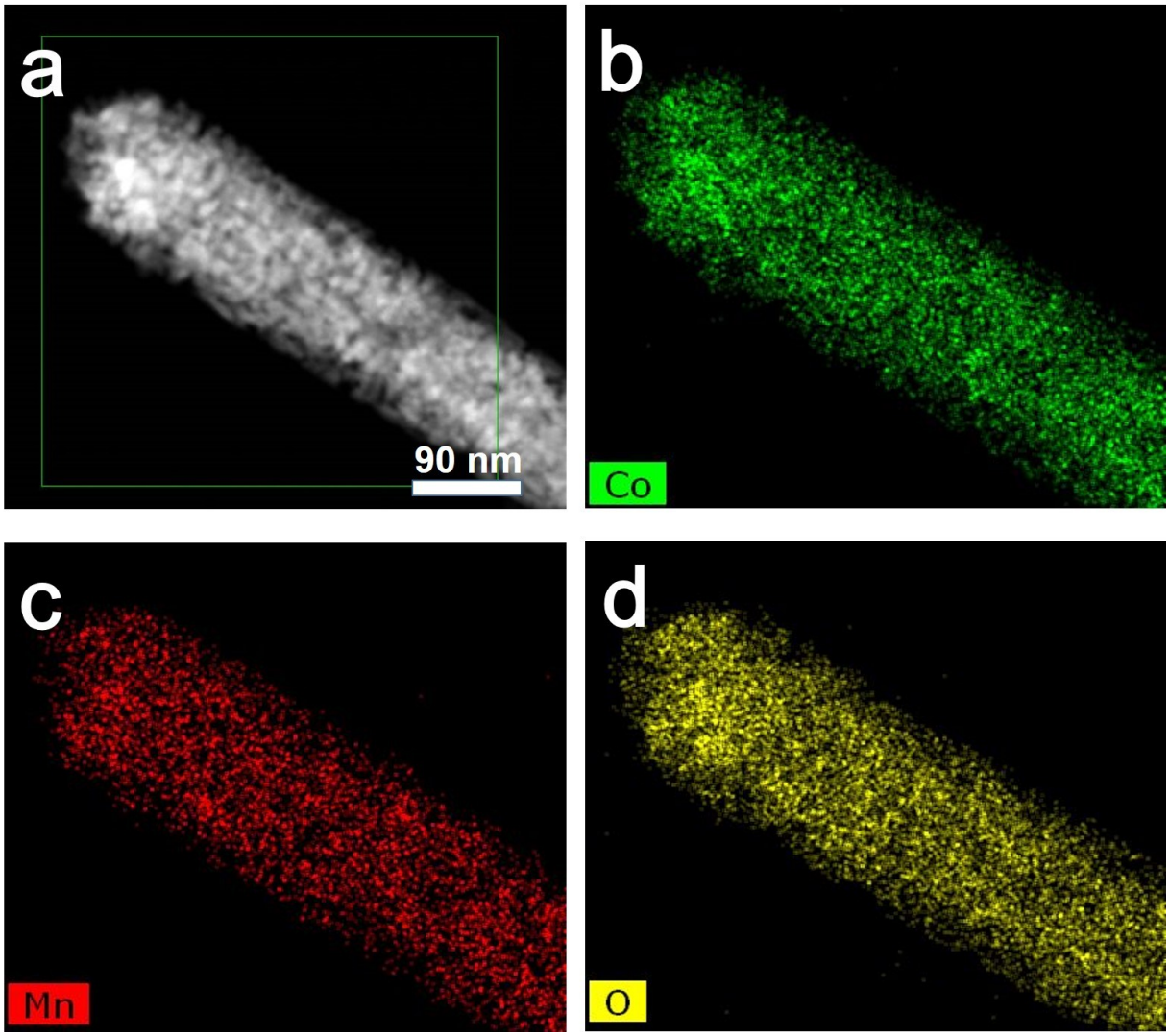

Figure S4. (a) Demonstrating $MnCo_2O_4$ hierarchical structure of a single nanowire, (b-d) corresponding EDS mapping.

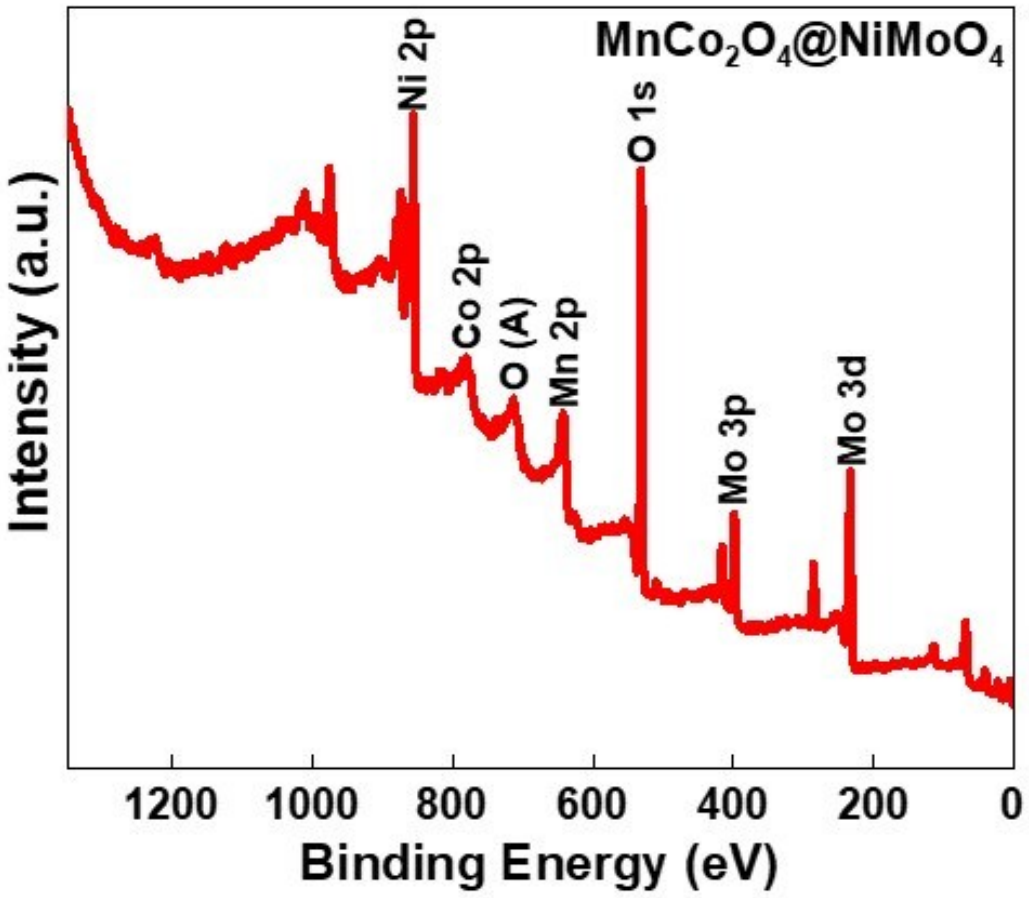

Figure S5. XPS spectra of as-synthesized $MnCo_2O_4$@$NiMoO_4$ NWAs.

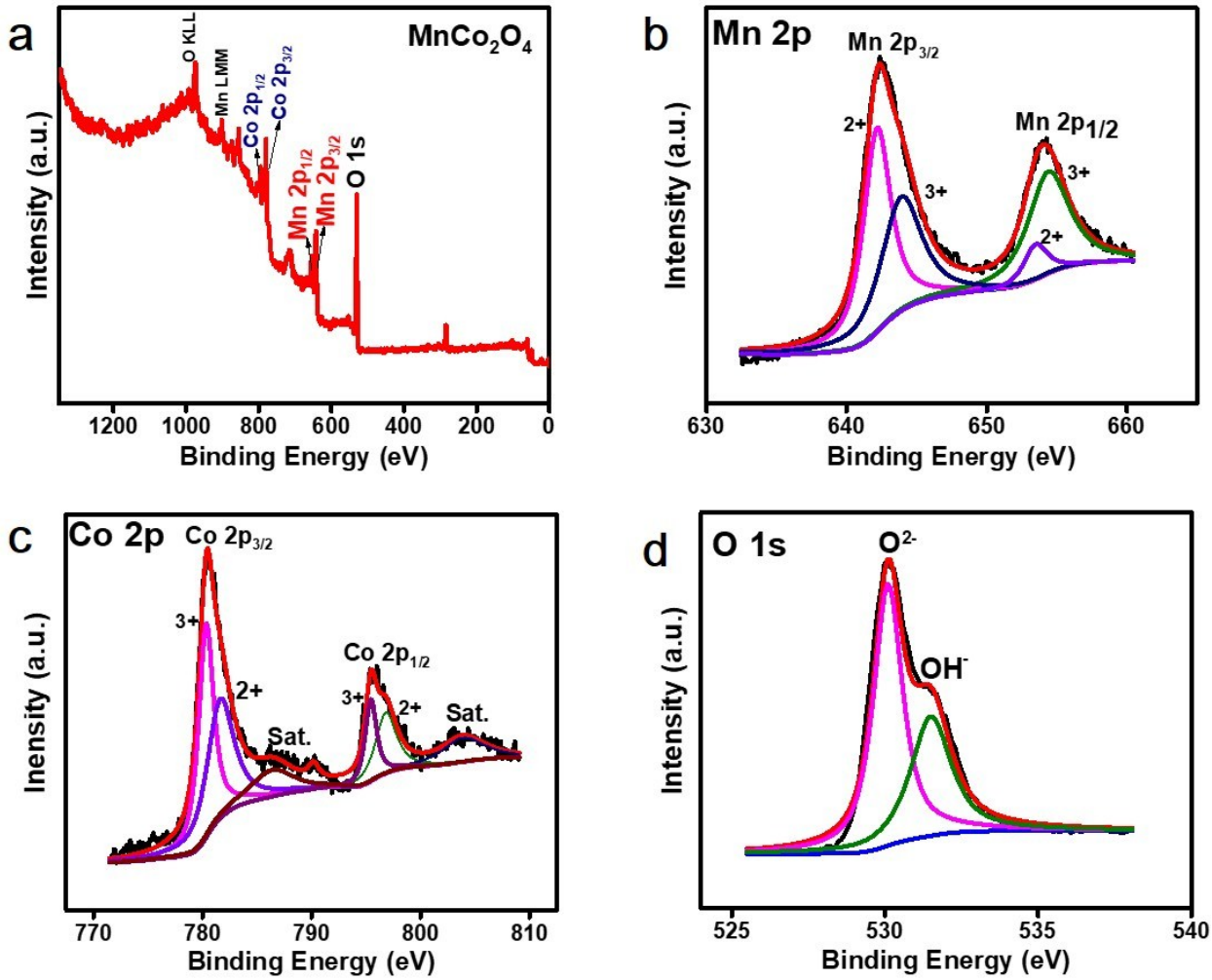

Figure S6. (a) XPS spectra of as-synthesized $MnCo_2O_4$ NWAs, (b-d) XPS survey scan of Mn 2p, Co 2p and O 1s regions, respectively.

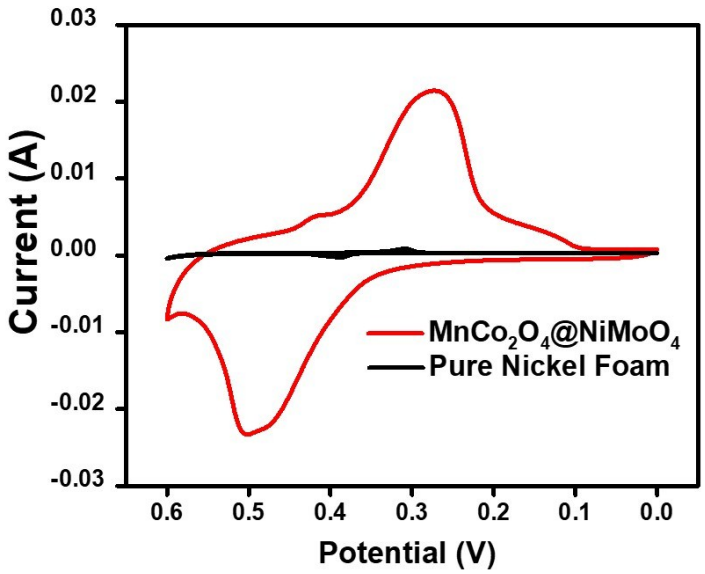

Figure S7. CV curves comparison of $MnCo_2O_4$@$NiMoO_4$ and nickel foam current collector at scan rate of 1 mV s^{-1}.

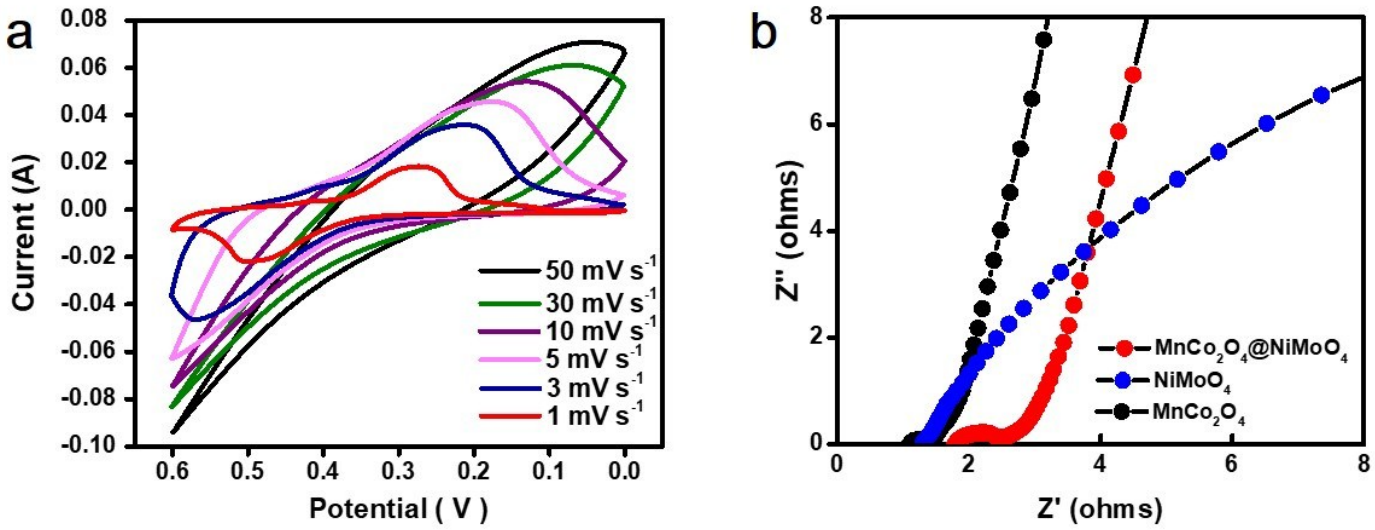

Figure S8. (a) CV curves of $MnCo_2O_4$@$NiMoO_4$ obtained at different scanning rates, (b) EIS measurements of $MnCo_2O_4$, $NiMoO_4$ and $MnCo_2O_4$@$NiMoO_4$ electrodes.

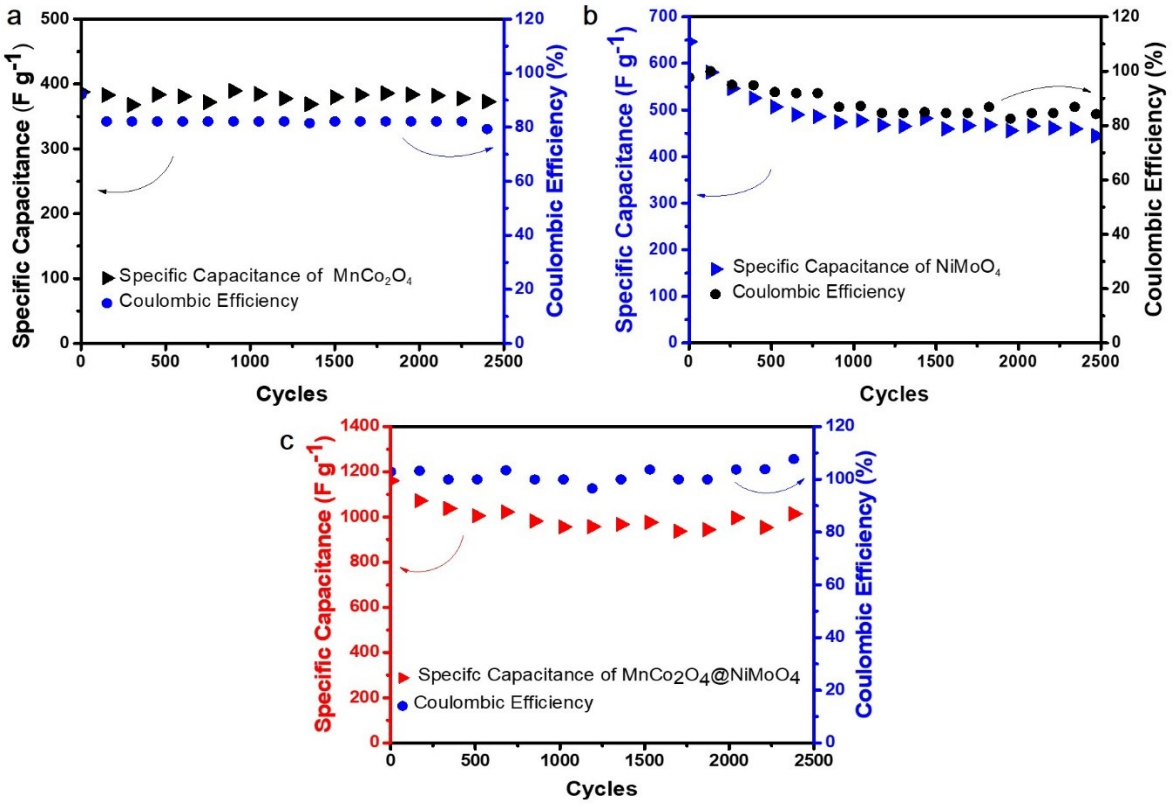

Figure S9. Coulombic efficiency profiles of (a) $MnCo_2O_4$, (b) $NiMoO_4$ and (c) $MnCo_2O_4$@$NiMoO_4$ during 2500 successive cycles at 5 A g^{-1}.

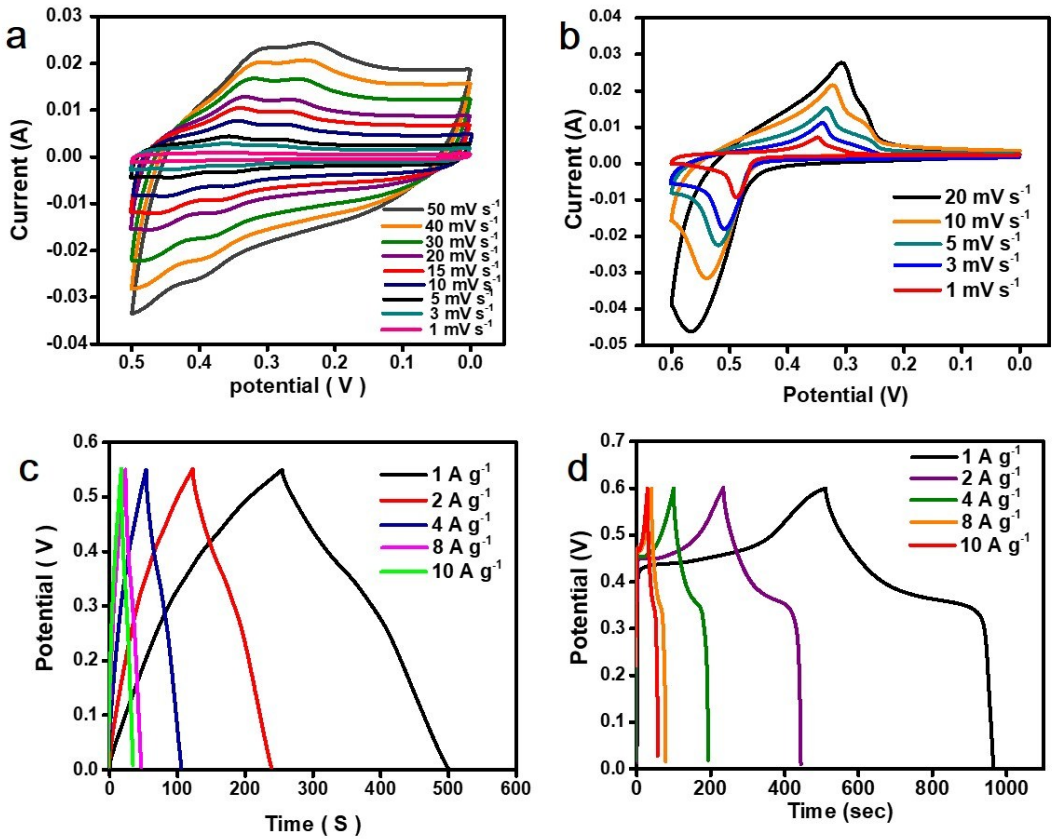

Figure S10. (a) CV curves of $MnCo_2O_4$ at different scanning rates, (b) CV curves of $NiMoO_4$ at different scanning rates, (c) and (d) GCD of $MnCo_2O_4$ and $NiMoO_4$, respectively at different current densities.

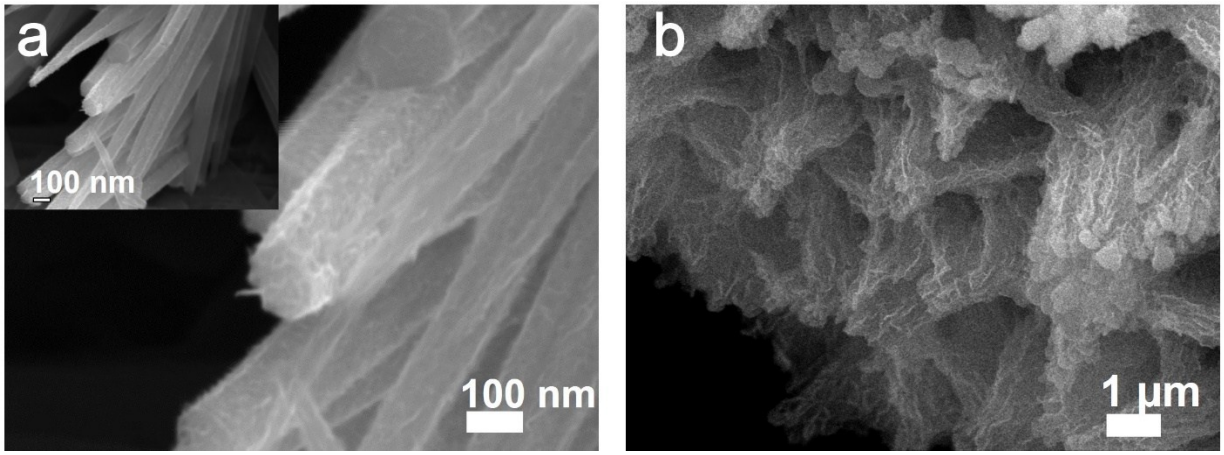

Figure S11. (a) Typical SEM images of $MnCo_2O_4$ after cycling (b) $MnCo_2O_4$@$NiMoO_4$ SEM images after cycling.

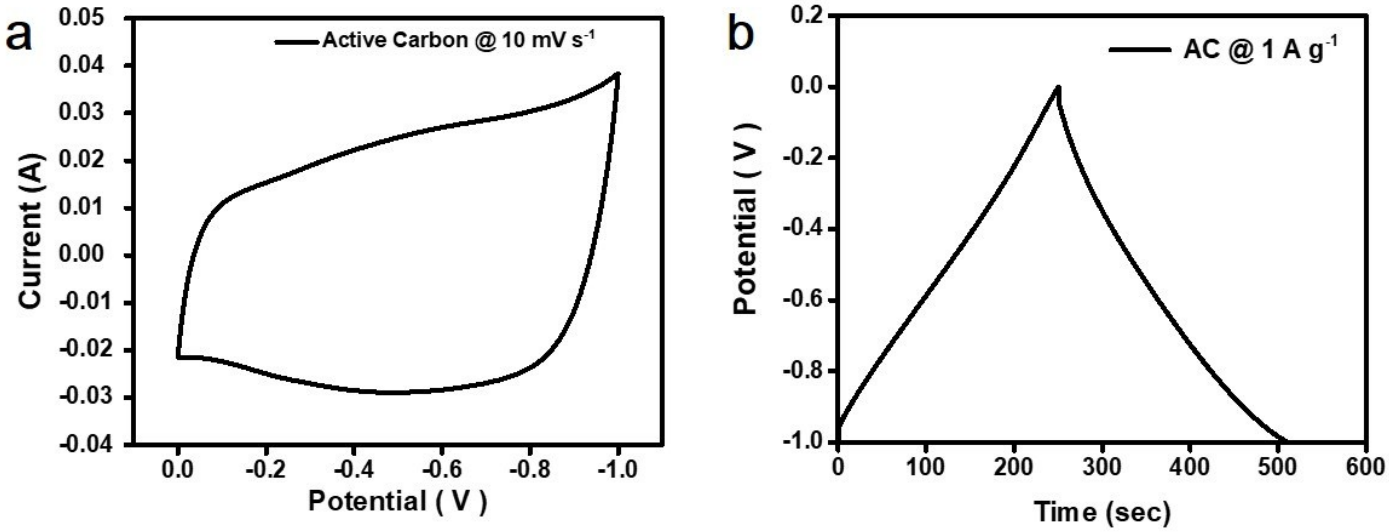

Figure S12. (a) CV curve of AC at a scanning rate of 10 mV s^{-1}. (b) Galvanostatic charge-discharge of AC at a current density of 1 A g^{-1}.

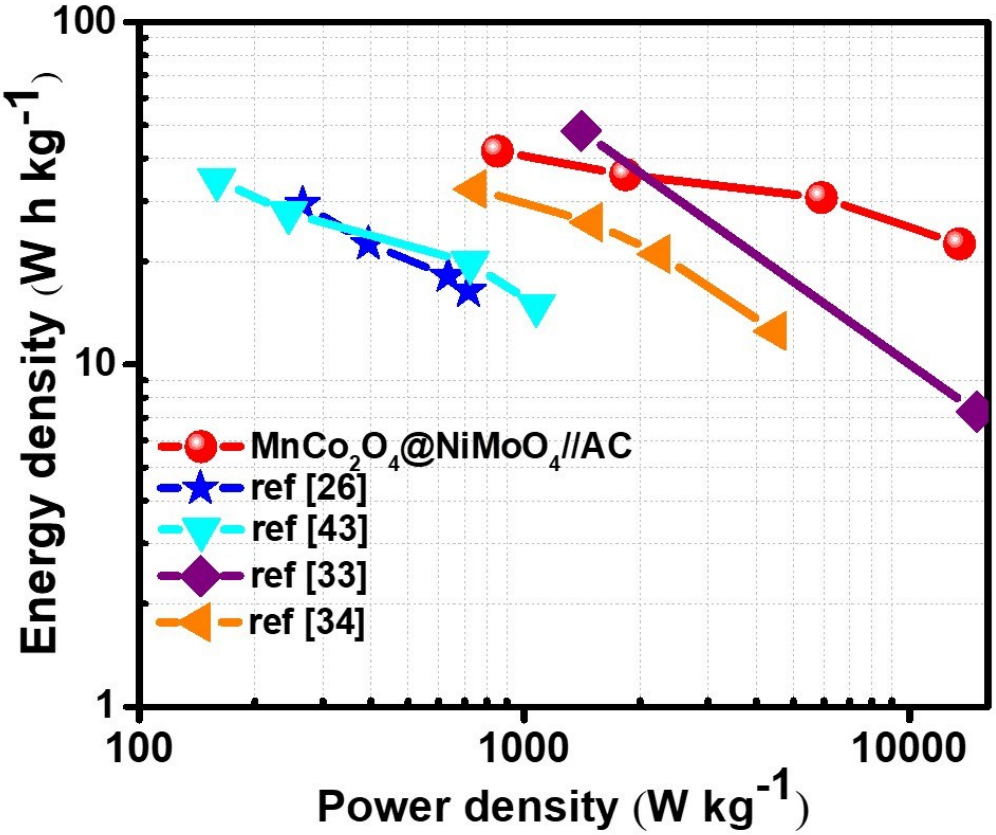

Figure S13. Ragone plot of $MnCo_2O_4$@$NiMoO_4$//AC device.

Table S1. Comparison of the maximum C_s of some reported manganese or cobalt oxide/hydroxide based composites as pseudocapacitor electrode material and the present work.

Electrodes based on material	*Electrolyte*	*Specific capacitance*	*Reference*
$MnCo_2O_4$ Nanowire arrays	**1 M KOH**	**349.8 F g^{-1} @ 1 Ag^{-1}**	[1]
$MnCo_2O_4$ Nanosheet films	**-**	**400 F g^{-1} @ 1 Ag^{-1}**	[2]
Urchin like $MnCo_2O_{4.5}$	**-**	**129.2 F g^{-1} @ 0.1 Ag^{-1}**	[3]
$MnCo_2O_4$ nanosheets	**6 M KOH**	**420 F g^{-1} @ 1 Ag^{-1}**	[4]
$MnCo_2O_4$@$Ni(OH)_2$ hierarchical structure	**2 M KOH**	**2154 F g^{-1} @ 5 Ag^{-1}**	[5]
$MnCo_2O_4$@MnO_2 hierarchical structure	**3 M KOH**	**858 F g^{-1} @ 1 Ag^{-1}**	[6]
MnO_2@$NiMoO_4$ core-shell hierarchical structure	**2 M KOH**	**582.2 F g^{-1} @ 1 Ag^{-1}**	[7]
Nanosheet-based $CoMoO_4$-$NiMoO_4$ nanotubes	**3 M KOH**	**751 F g^{-1} @ 1 Ag^{-1}**	[8]
$NiCo_2O_4$-rGO composite	**2 M KOH**	**1222 F g^{-1}@ 0.5 Ag^{-1}**	[9]
$MnCo_2O_4$@$NiMoO_4$ core-shell heterostructure	**1 M KOH**	**1244 F g^{-1}@ 1 Ag^{-1}**	**This work**

References

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