Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Dual Modulation of Lattice Strain and Charge Polarization Induced by $Co(OH)_2/Ni(OH)_2$ Interfaces for Efficient Oxygen Evolution Catalysis

Lin-Fei Gu, Cheng-Fei Li, Jia-Wei Zhao, Ling-Jie Xie, Jin-Qi Wu, Qian Ren and Gao-Ren Li*

MOE Key Laboratory of Bioinorganic and Synthetic Chemistry, School of Chemistry, Sun Yat-Sen University, Guangzhou 510275, P.R. China

E-mail: ligaoren@mail.sysu.edu.cn

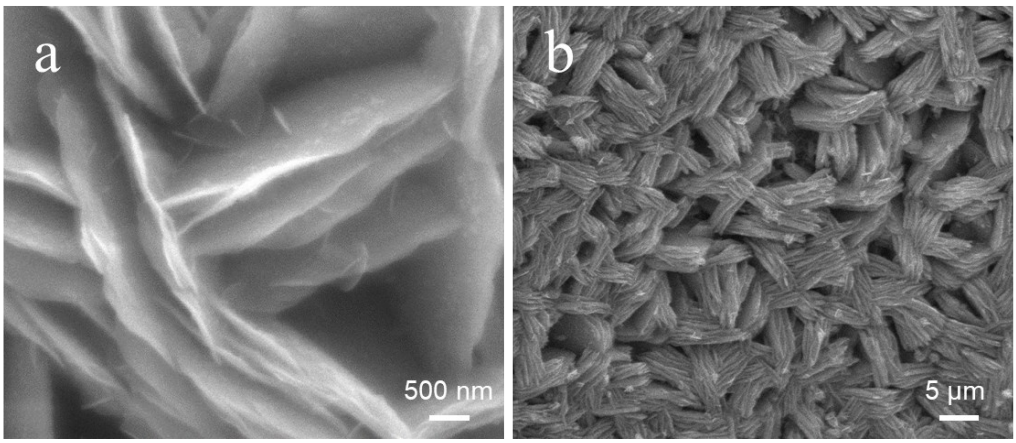

Figure S1. SEM images of $Co(OH)_2$ NSs@NF.

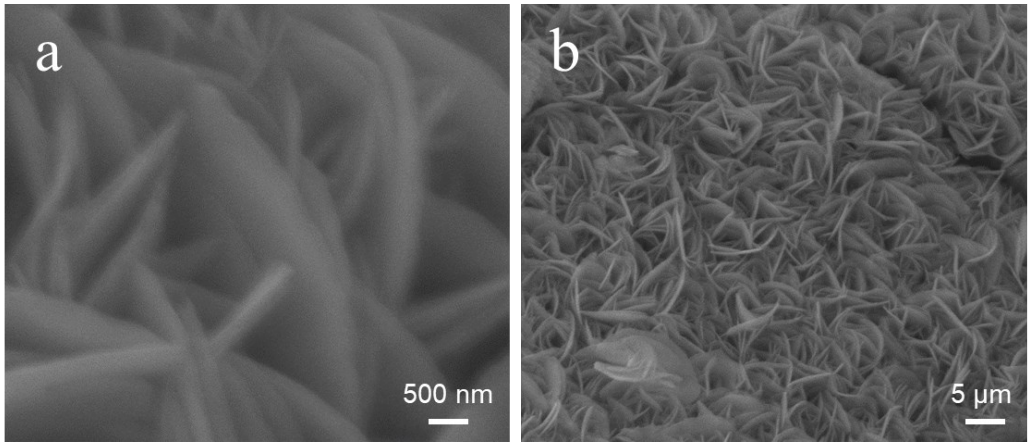

Figure S2. SEM images of $Ni(OH)_2$ NSs@NF.

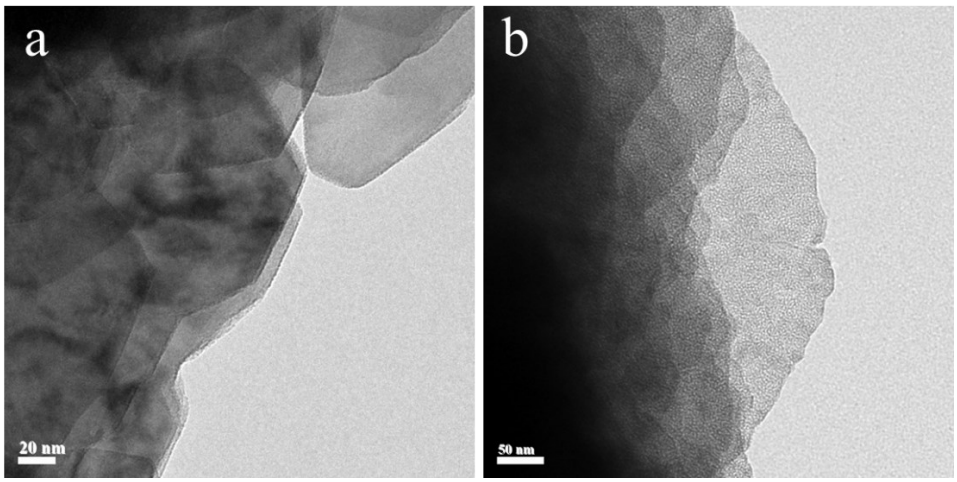

Figure S3. TEM images of $Co(OH)_2$ NSs@NF.

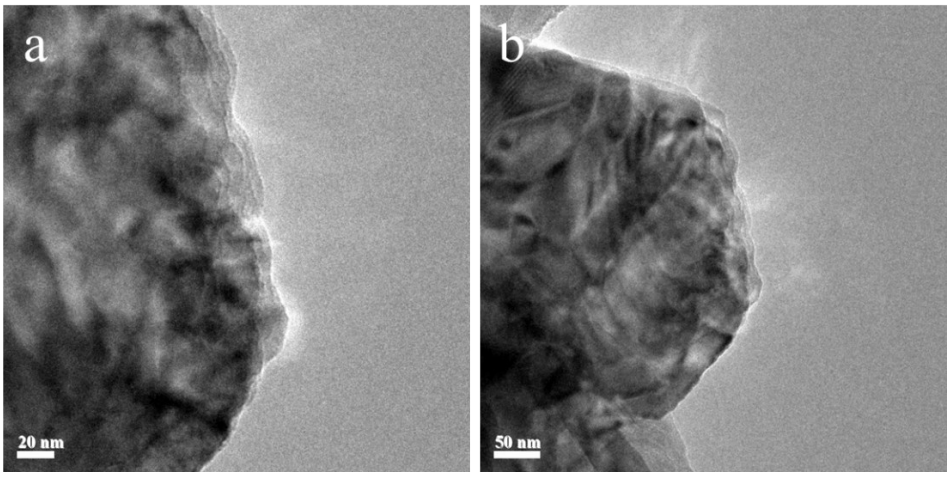

Figure S4. TEM images of $Ni(OH)_2$ NSs@NF.

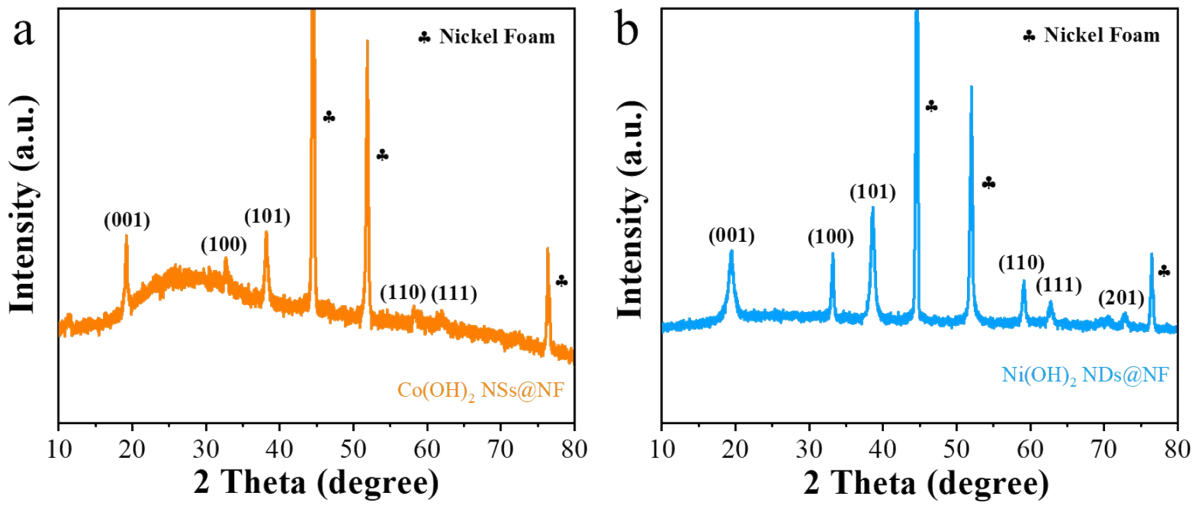

Figure S5. XRD patterns of (a) $Co(OH)_2$ NSs@NF and (b) $Ni(OH)_2$ NSs@NF.

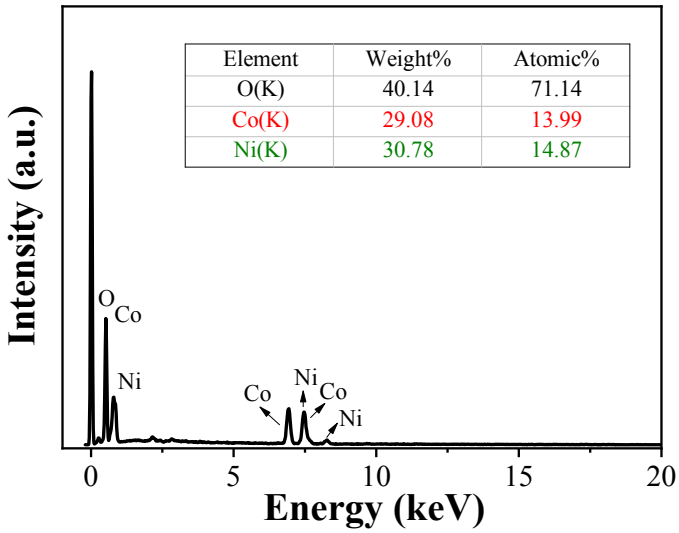

Figure S6. EDS spectrum of $Co(OH)_2/Ni(OH)_2$ NSs (the sample is peeled off from the Nickel Foamed to reduce the influence of nickel in the substrate).

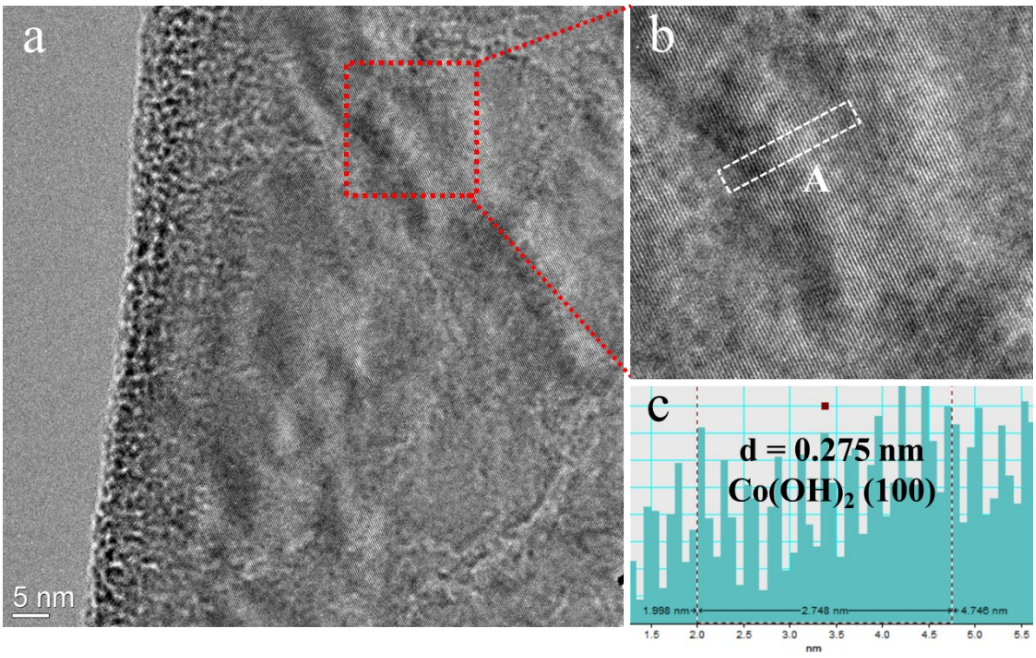

Figure S7. (a) HRTEM images and (b) its partial enlarged view of pure $Co(OH)_2$ nanosheets; (c) the line scans of the areas A in HRTEM image in (b) marked with white rectangles, which indicates a lattice fringe spacing of 0.275 nm, corresponding to $Co(OH)_2$ (100) (PDF#30-0443).

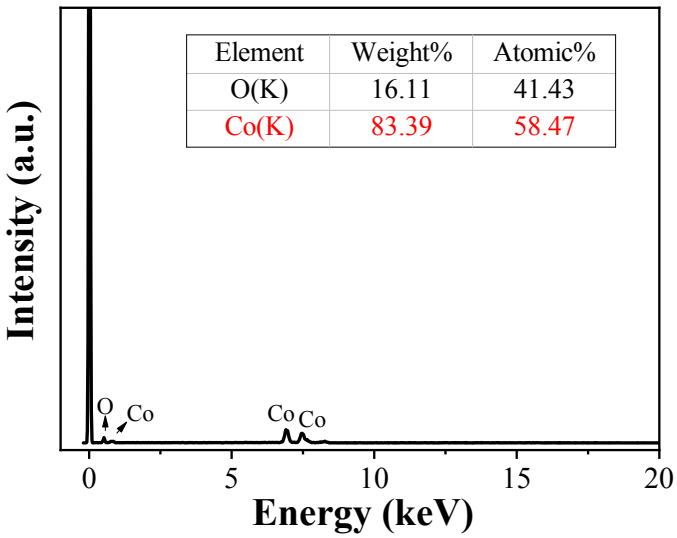

Figure S8. EDS spectrum of $Co(OH)_2$ NSs@NF.

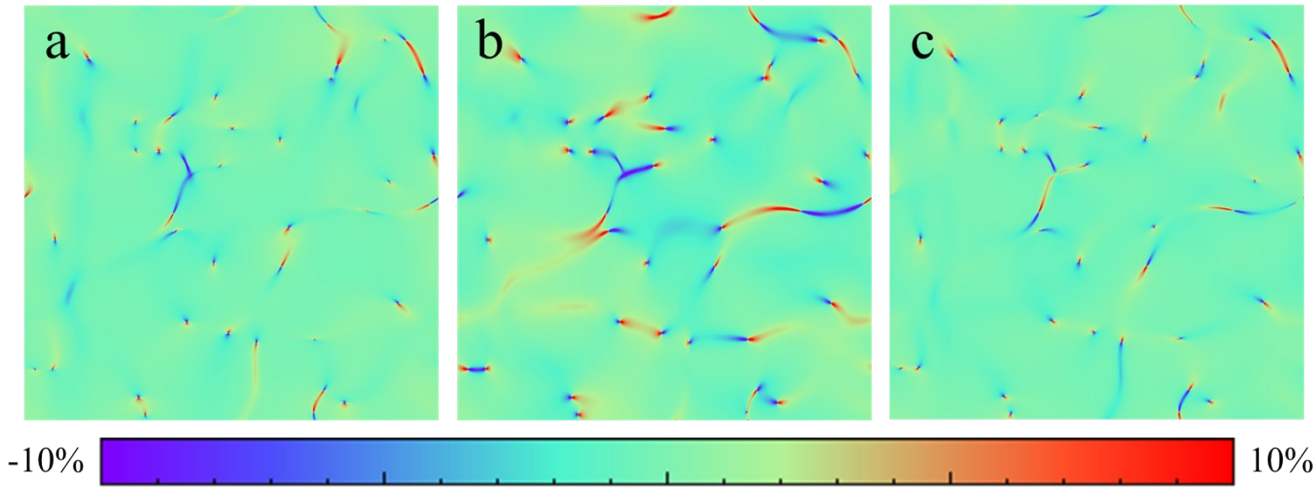

Figure S9. The strain tensor maps of (a) x direction (ε_{xx}), (b) y direction (ε_{yy}) and (c) xy shear (ε_{xy}) generated from the Figure S7a using geometric phase analysis.

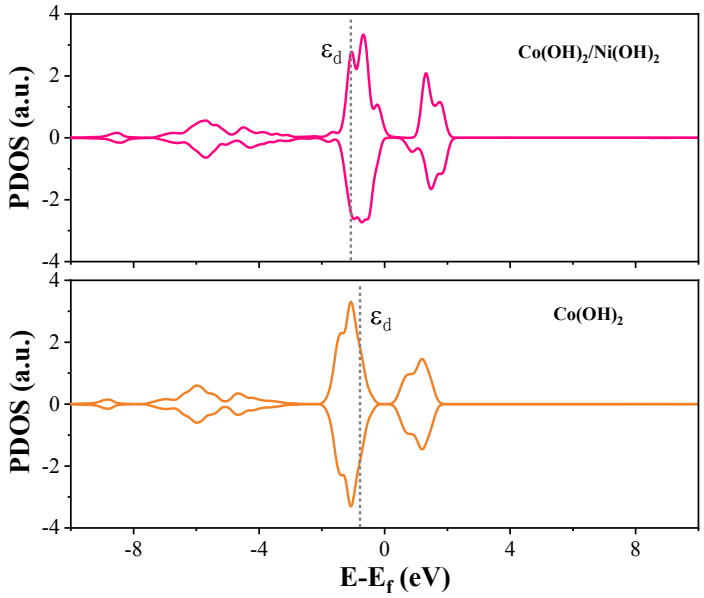

Figure S10. The projected density-of-states of Co d orbitals of $Co(OH)_2/Ni(OH)_2$ and $Co(OH)_2$.

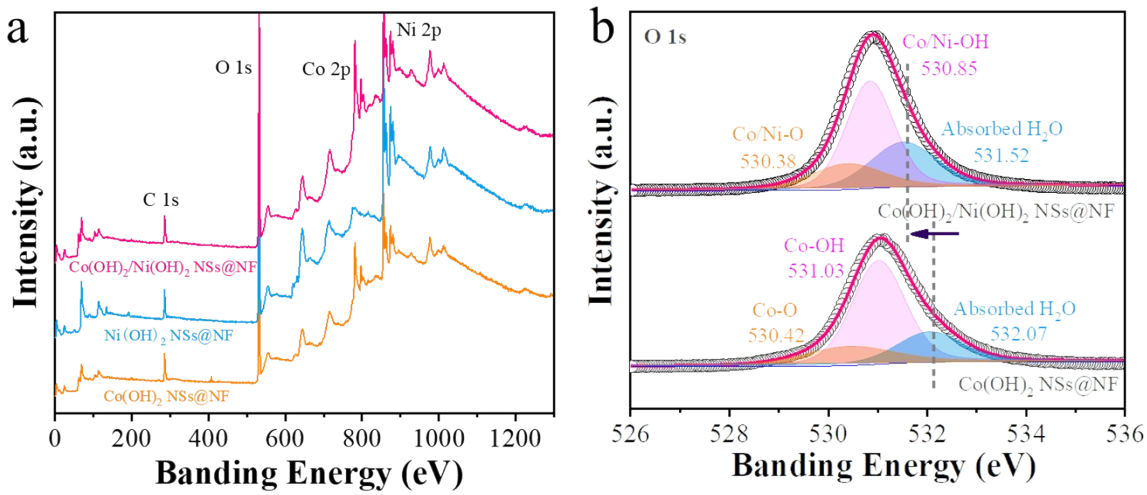

Figure S11. XPS spectra of (a) survey, (b) O 1s of $Co(OH)_2$ NSs@NF, $Ni(OH)_2$ NSs@NF and $Co(OH)_2/Ni(OH)_2$ NSs@NF.

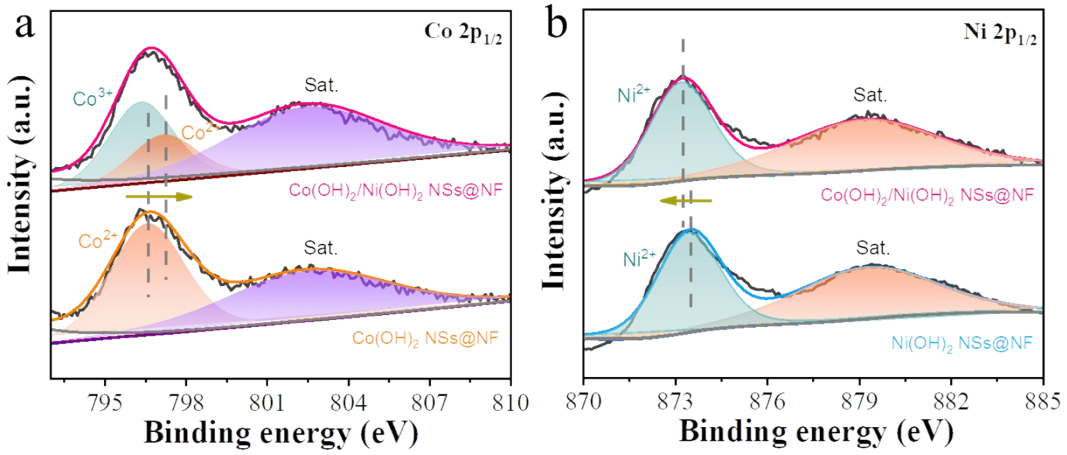

Figure S12. XPS spectra of (a) Co $2p_{1/2}$, (b) Ni $2p_{1/2}$ for $Co(OH)_2$ NSs@NF and $Co(OH)_2/Ni(OH)_2$ NSs@NF.

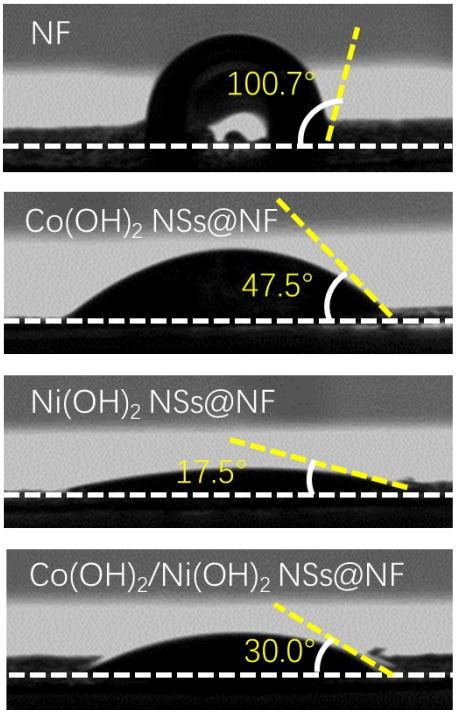

Figure S13. Contact angle measurements of samples NF, $Co(OH)_2$ NSs@NF, $Ni(OH)_2$ NSs@NF and $Co(OH)_2/Ni(OH)_2$ NSs@NF.

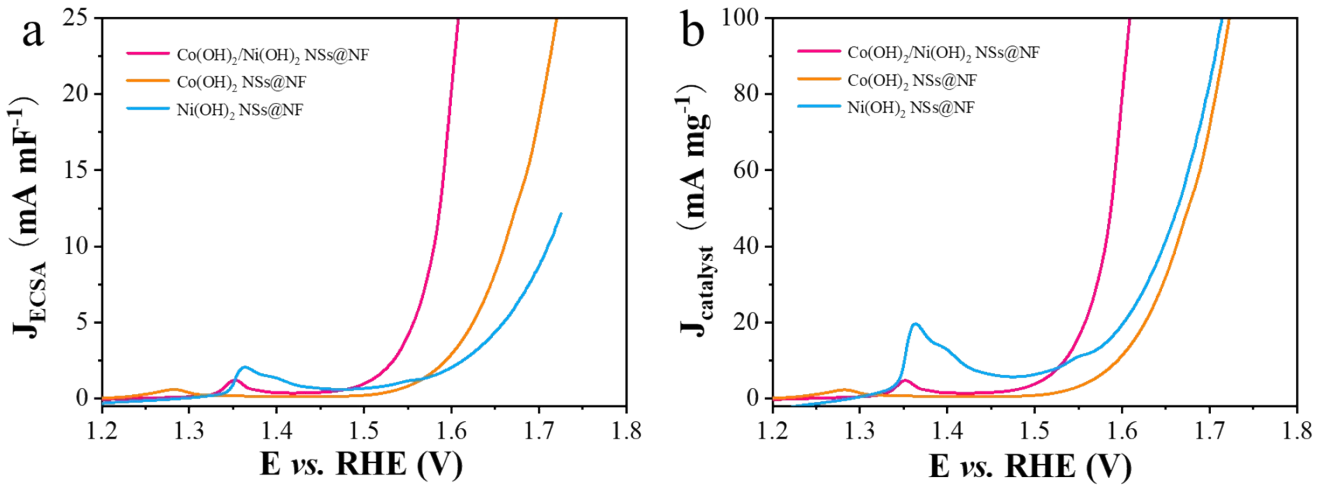

Figure S14. The OER polarization curves of $Co(OH)_2/Ni(OH)_2$ NSs@NF, $Co(OH)_2$ NSs@NF, and $Ni(OH)_2$ NSs@NF in Figure 5(a) normalized by (a) electrochemically active area (ECSA) and (b) the loading mass of catalyst.

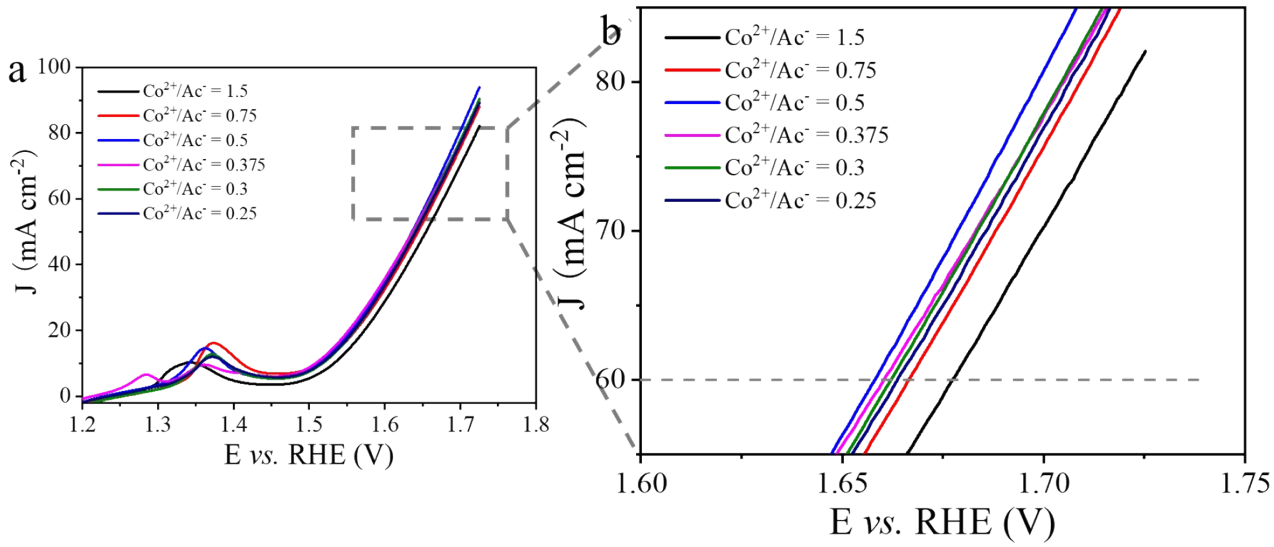

Figure S15. (a) OER polarization curves of $Co(OH)_2/Ni(OH)_2$ NSs@NF based on different ratios of Co^{2+}/Ac^- (Ac^- represents acetate), (b) the partial enlarged view of (a) at 60 mA cm^{-2}.

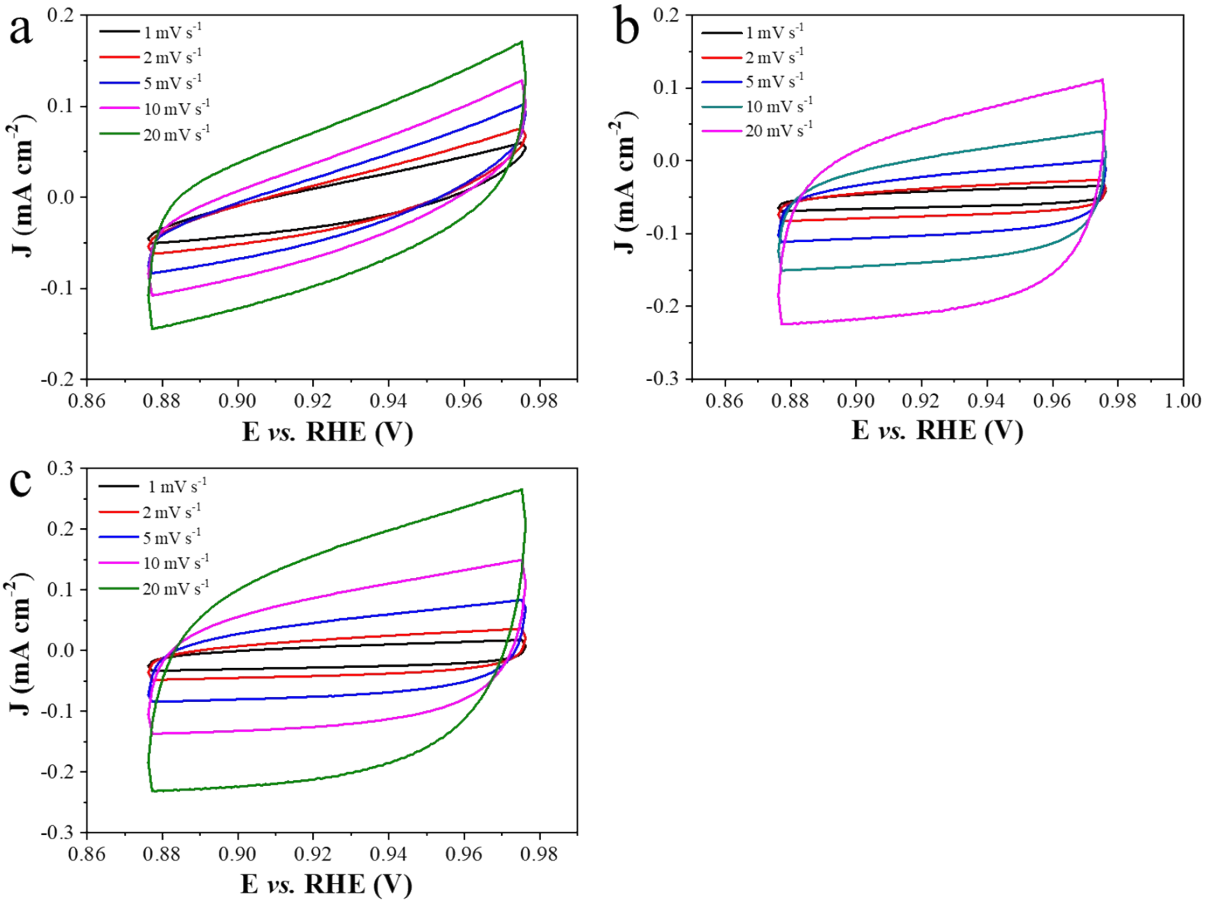

Figure S16. CVs of (a) $Ni(OH)_2$ NSs@NF, (b) $Co(OH)_2$ NSs@NF, (c) $Co(OH)_2/Ni(OH)_2$ NSs@NF in the range of 0.88 ~ 0.98 V *vs.* RHE, measured in 1.0 M KOH solution, respectively.

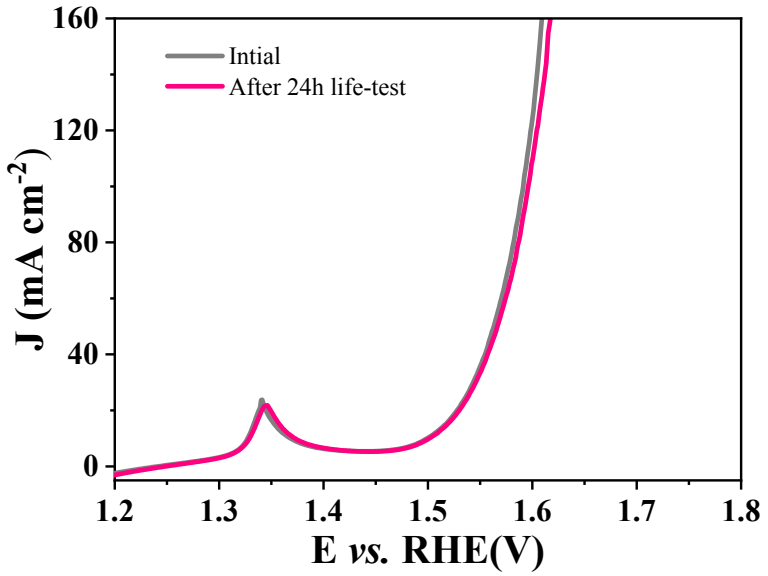

Figure S17. Polarization curves of before and after 24 h durability test at 20 mA cm^{-2} for $Co(OH)_2/Ni(OH)_2$ NSs@NF.

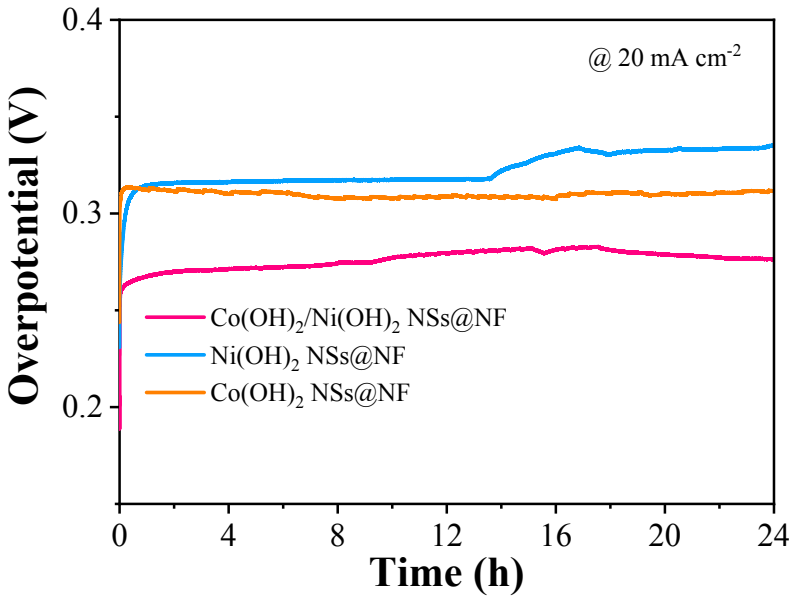

Figure S18. Galvanostatic measurements of $Co(OH)_2/Ni(OH)_2$ NSs@NF, $Co(OH)_2$ NSs@NF and $Ni(OH)_2$ NSs@NF at the current density of 20 mA cm^{-2}.

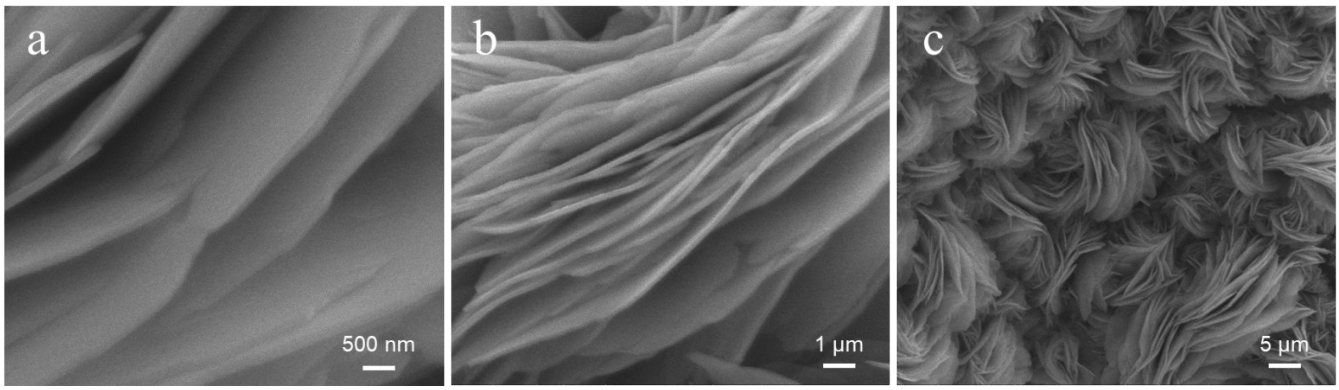

Figure S19. SEM images with different magnifications of $Co(OH)_2/Ni(OH)_2$ NSs@NF after OER at 20 mA cm^{-2} for 24 h.

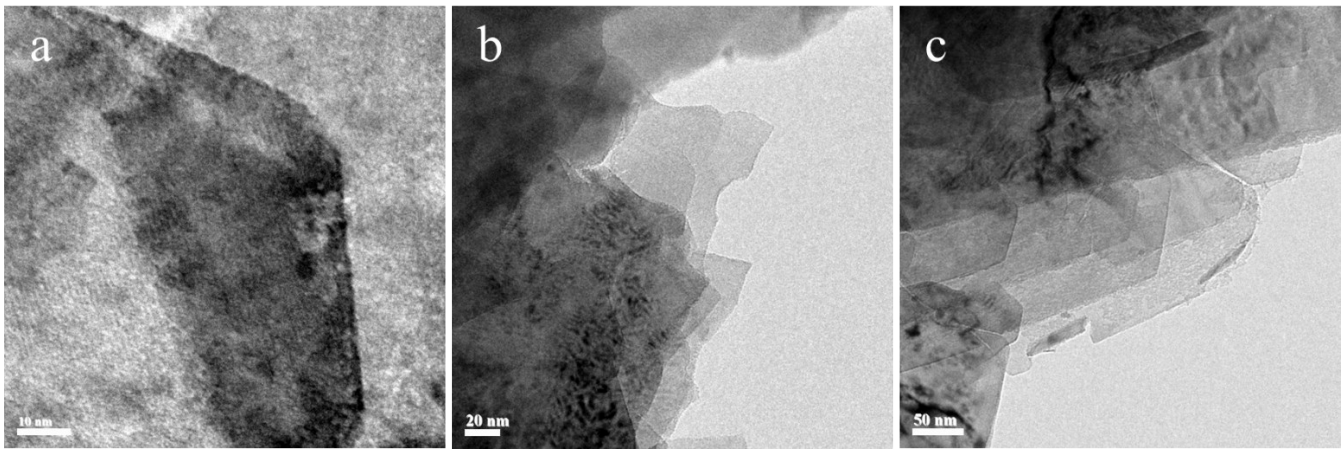

Figure S20. TEM images with different magnifications of $Co(OH)_2/Ni(OH)_2$ NSs@NF after OER at 20 mA cm^{-2} for 24 h.

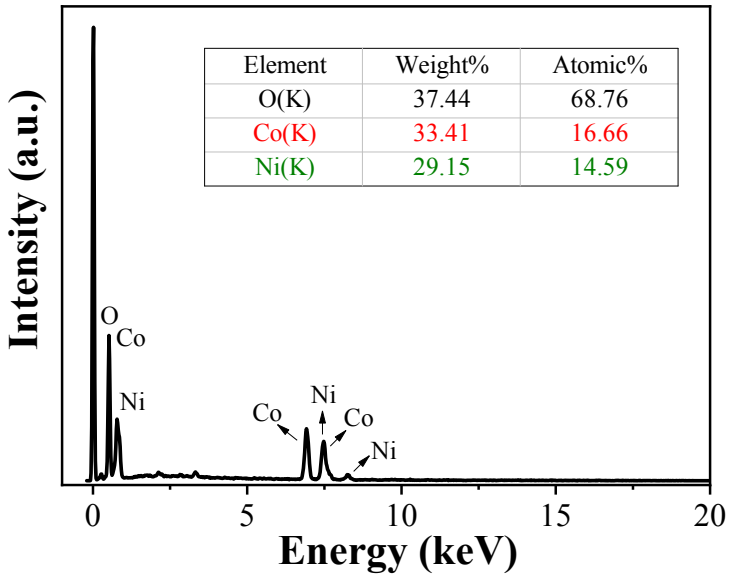

Figure S21. EDS spectrum of $Co(OH)_2/Ni(OH)_2$ NSs after OER at 20 mA cm^{-2} for 24 h.

Table S1. Comparisons of representative cobalt-based and nickel-based OER electrocatalysts in alkaline electrolyte (1.0 M KOH solution).

Catalysts	η@*J* (mV@mA cm^{-2})	Tafel slope (mV dec^{-1})	Reference
$Co(OH)_2/Ni(OH)_2$ NSs	270@20	78	This work
NiCo LDHs	367@10	40	*Nano Lett.* **2015**, 15, 1421
NiCoP/C nanoboxes	330@10	96	*Angew. Chem. Int. Ed.* **2017**, 129, 3955
$NiCo@NiCoO_2$/C PMRAs	366@20	84	*Adv. Mater.* **2018**, 30, 1705442.
Mo-$NiCo_2O_4/Co_{5.47}N$/NF	310@50	55	*Small*. **2020**, 16, 1906775
$NiCo_2O_4/CoMoO_4$/NF	390@50	102	*J. Mater. Chem. A.* **2018**, 6, 16950.
$Co_3O_4/NiCo_2O_4$	340@10	88	*J. Am. Chem. Soc.* **2015**, 137, 5590
NiO/Co_3O_4 microcubes	290@10	73	*Chem. Commun*. **2019**, 55, 6515
$NiCo_2O_4$/CNTs	503@10	67	*J. Mater. Chem. A*. **2018**, 6, 7420
Co_4Ni_1-P	390@50	64	*Adv. Funct. Mater.* **2017**, 27, 1703455.
CoNi-S/NS-rGO-550	290@10	80	*ACS Appl. Mater. Interfaces.* **2020**, 12, 40186

η: Overpotential (mV);
J: Current density (mA cm^{-2});
PMRAs: Porous microrod arrays;
NF: Nickel foam;
CNTs: Carbon nanotubes;
rGO: Reduced graphene oxide.