Electronic Supplementary Material (ESI) for New Journal of Chemistry.


# Supporting Information

## Oxygen defect based Cobalt-doped-$NiMoO_4$ Hierarchical hollow nanosheet-based-nanosphere for oxygen evolution reaction

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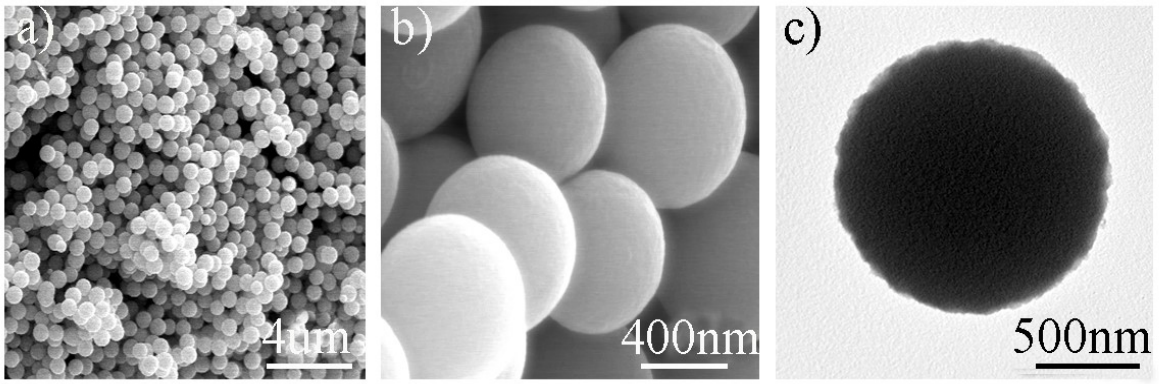


**Figure S1** a,b)SEM image of MoEG c) TEM image of MoEG.

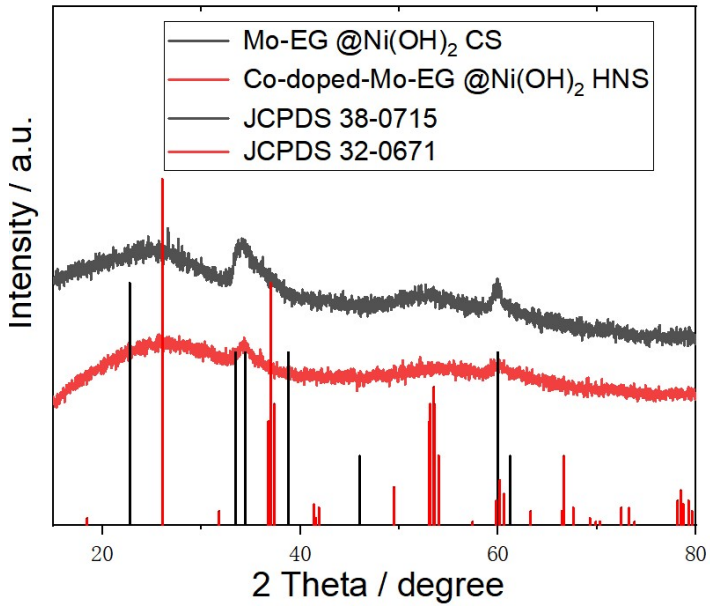


**Figure S2** XRD patterns of Mo-EG @$Ni(OH)_2$ CS and Co-doped-Mo-EG @$Ni(OH)_2$ HNS

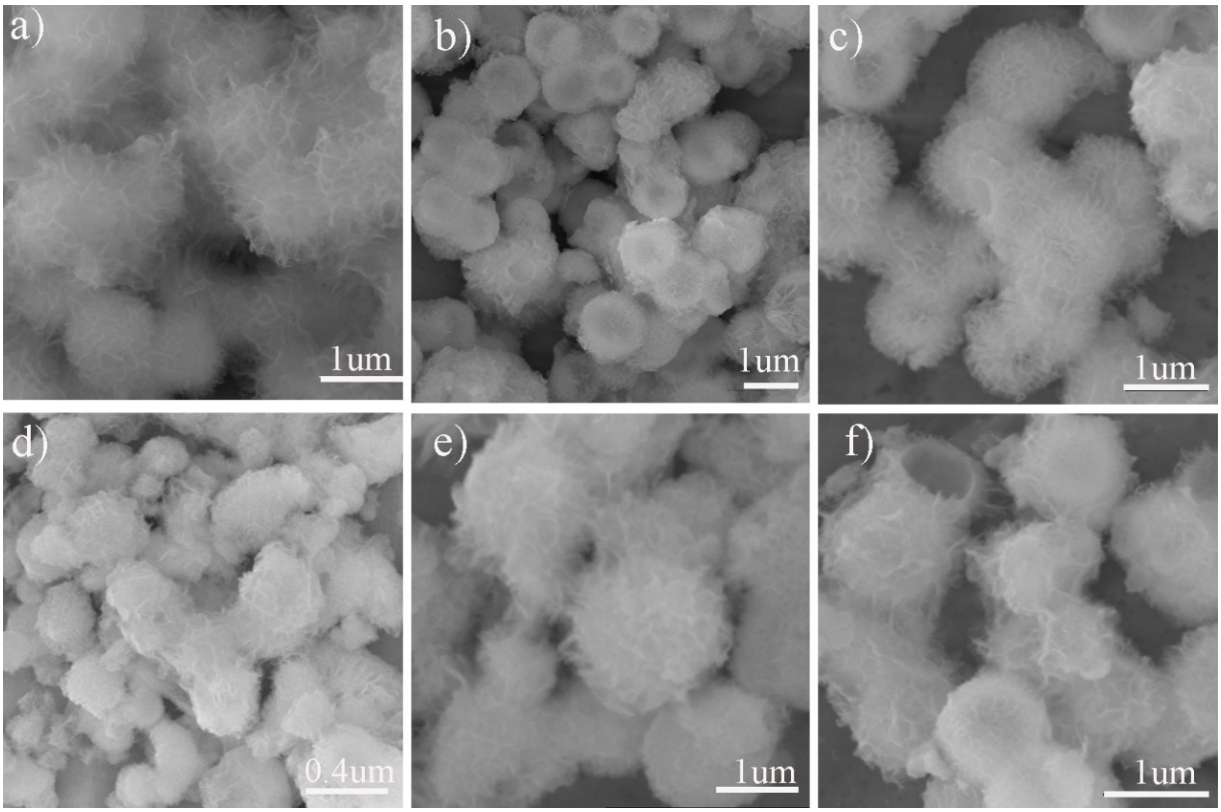


**Figure S3** SEM images of the powder samples prepared at a) NiMo-EG b) Co1-$NiMo_4$-HNS, c)$Co_{1.5}$-NiMo4-HNS, d) $Co_2$-$NiMo_4$-HNS, e) $Co_4$-$NiMo_4$-HNS, and f)$Co_6$-$NiMo_4$-HNS.

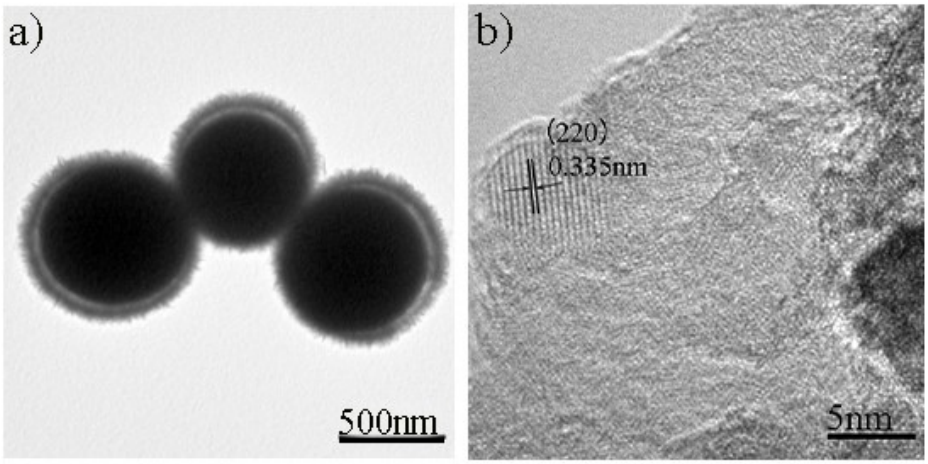


**Figure S4** TEM images of $NiMoO_4$-CS catalysts. a) Low-magnification TEM image, and b) HRTEM image. shows the interplanar distances at marked regions.

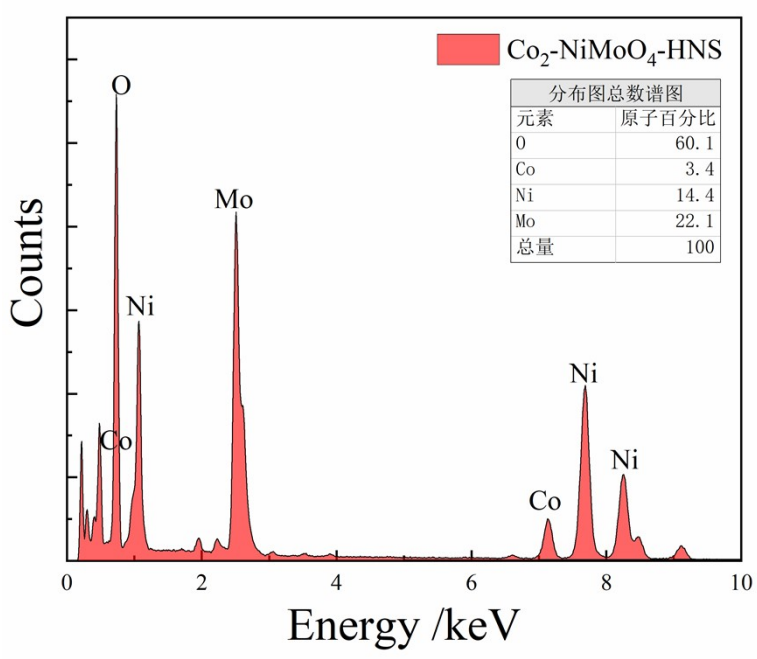


**Figure S5** The EDX pattern of the $Co_2$-$NiMoO_4$-HNS.

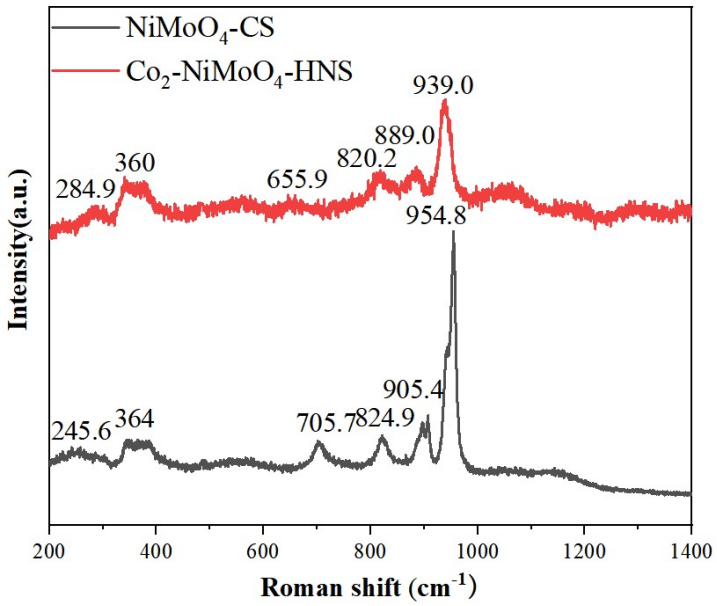


**Figure S6** Raman spectra of NiMoO4 (black) and $Co_2$-$NiMoO_4$-HNS (red).

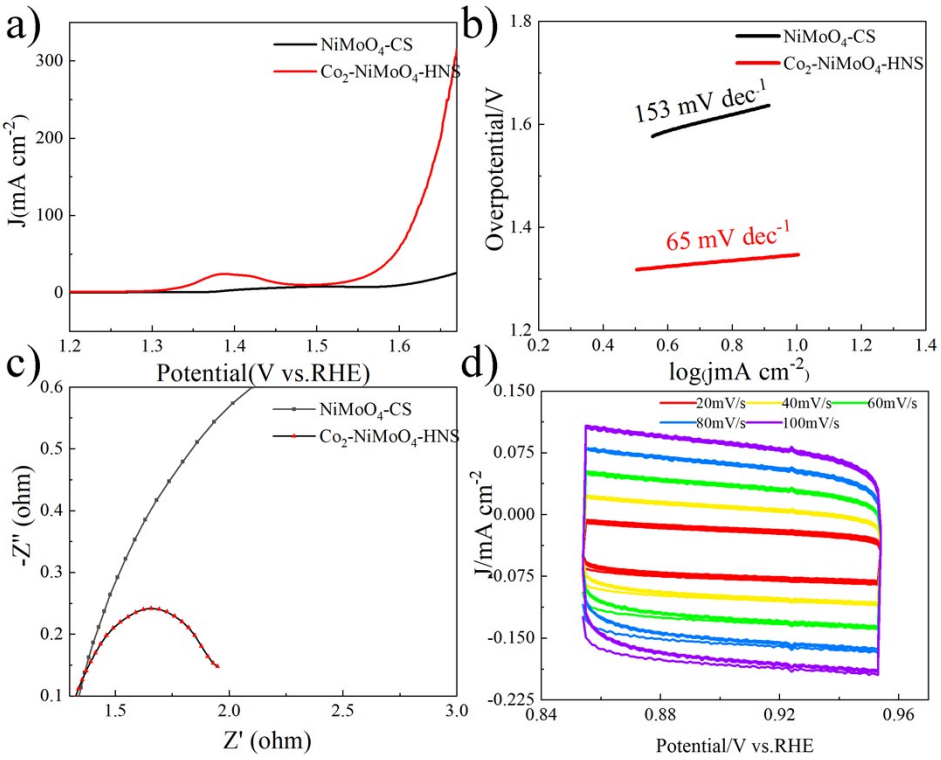


**Figure S7** a) The OER polarization curves of $Co_2$-$NiMoO_4$-HNS and $NiMoO_4$-CS in 1.0 M KOH. b) The corresponding Tafel plots of $Co_2$-$NiMoO_4$-HNS and $NiMoO_4$-CS c) Nyquist plot representations of the electrochemical impedance spectra of $Co_2$-$NiMoO_4$-HNS and $NiMoO_4$-CS. d)The CV curves of $Co_2$-$NiMoO_4$-HNS.

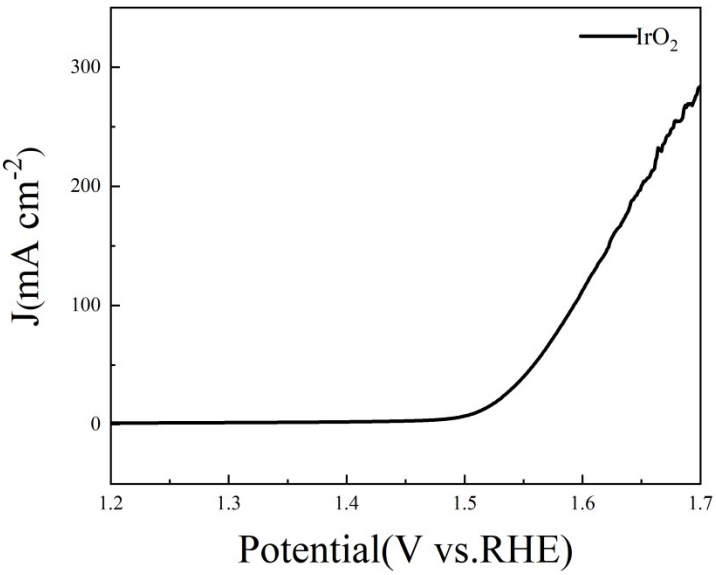


**Figure S8** The OER polarization curves of $IrO_2$.

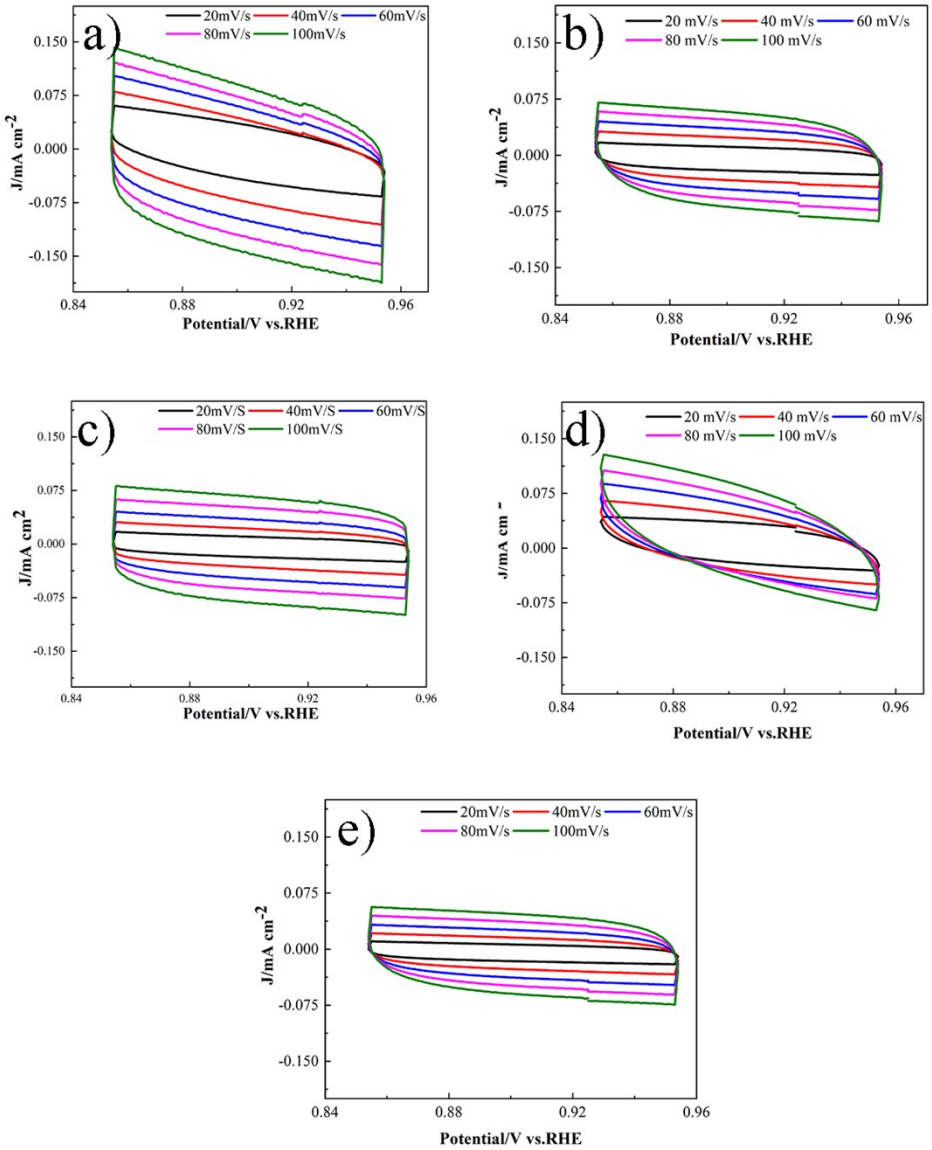


**Figure S9** The CV curves of a) $Co_1$-$NiMoO_4$-HNS, b)$Co_{1.5}$-$NiMoO_4$-HNS, c) $Co_2$-$NiMoO_4$-HNS, d) $Co_4$-$NiMoO_4$-HNS, (e)$Co_6$-$NiMoO_4$-HNS.

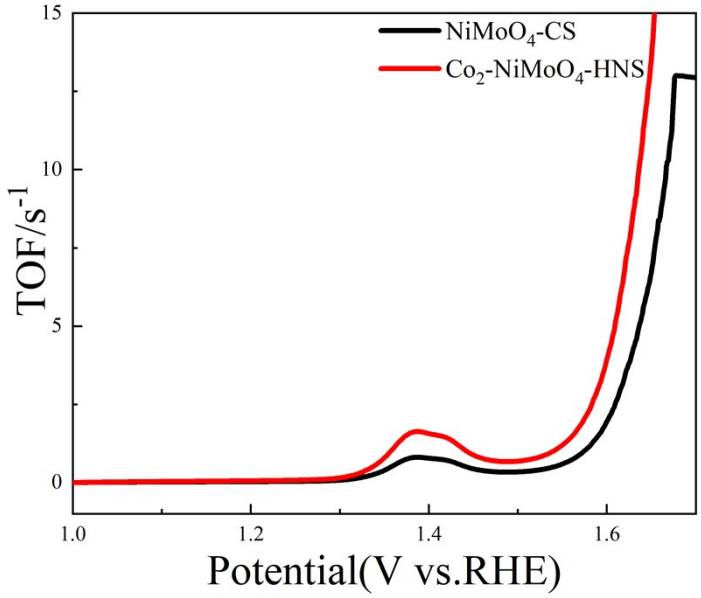


**Figure S10** TOF of $Co_2$-$NiMoO_4$-HNS and $NiMoO_4$-CS.

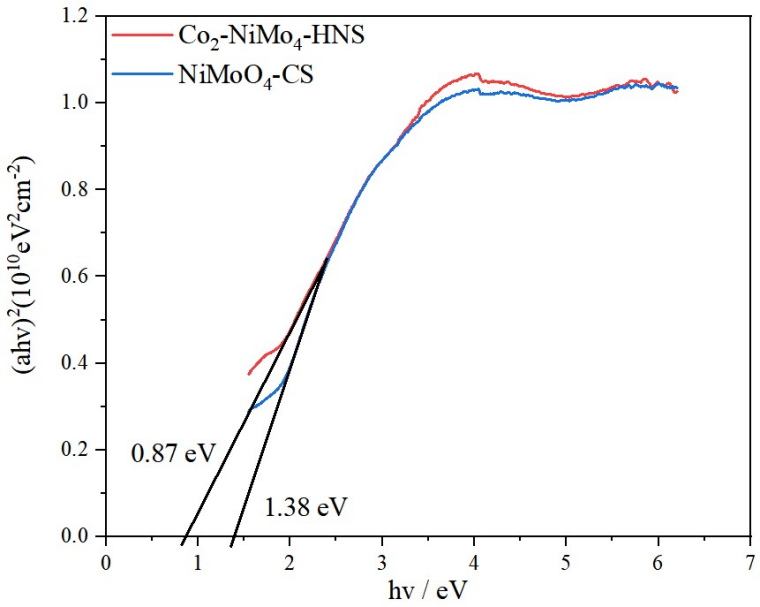


**Figure S11** The kubelka-munk plot for band gap energy of $Co_2$-$NiMoO_4$-HNS and $NiMoO_4$-CS

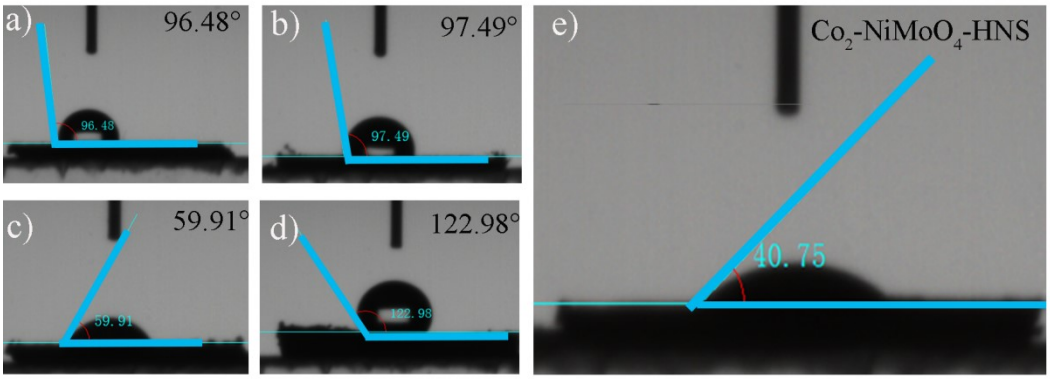


**Figure S12** Water contact angle images of a) $Co_1$-$NiMoO_4$-HNS, b) $Co_2$-$NiMoO_4$-HNS, c) $Co_4$-$NiMoO_4$-HNS, d)$Co_6$-$NiMoO_4$-HNS, e)$Co_{1.5}$-$NiMoO_4$-HNS.

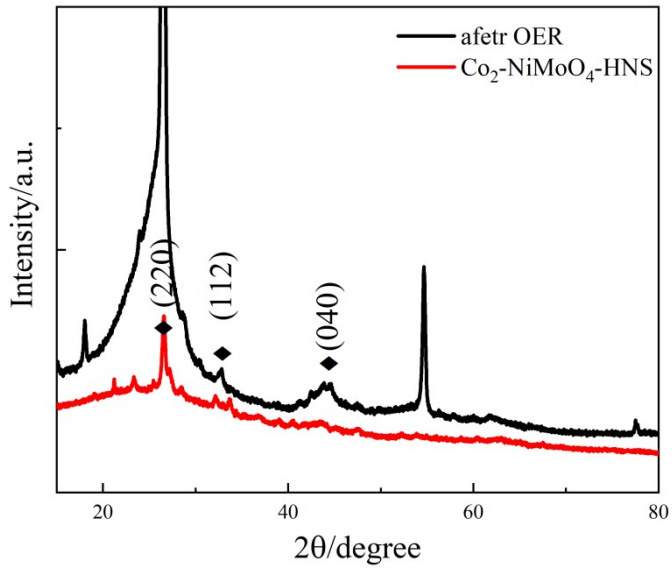


**Figure S13** XRD patterns of $Co_2$-$NiMoO_4$ and after OER.

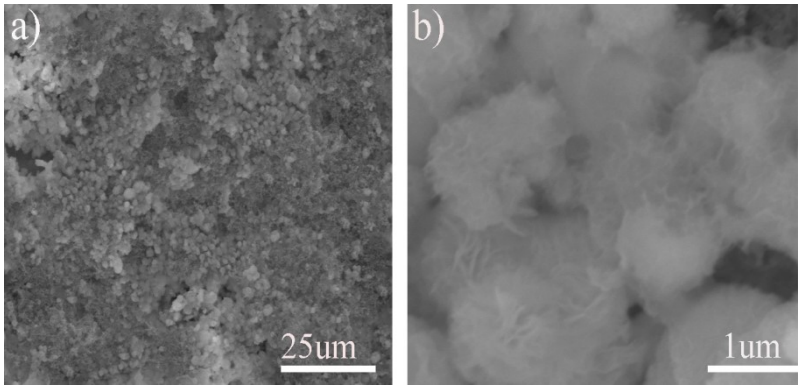


**Figure S14** SEM of $Co_2$-$NiMoO_4$-HNS after OER.

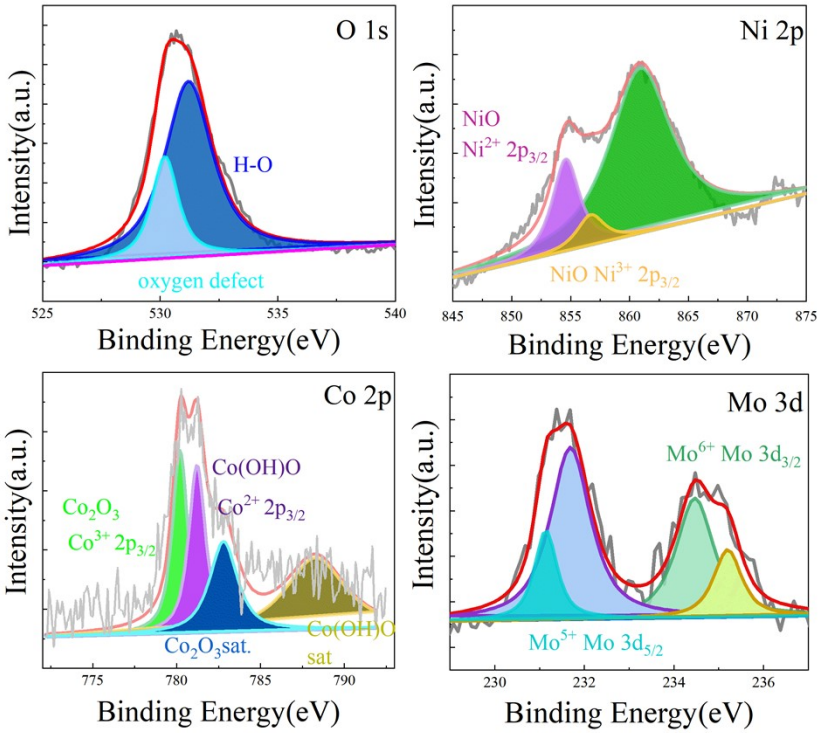


**Figure S15** a) high-resolution O 1s XPS spectra for $Co_2$-$NiMoO_4$-HNS after OER b) high-resolution Ni 2p XPS spectra for $Co_2$-$NiMoO_4$-HNS c) Co 2p d) Mo 3d.

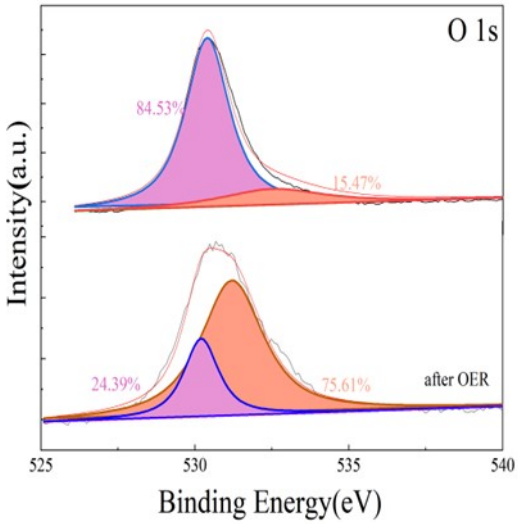


**Figure S16** High-resolution XPS spectra of O 1s

**Table S1**. Comparison of OER activity data among different catalysts.

| Catalysts | Overpotential at 10 mA $cm^{-2}$ (mV vs RHE) | Electrolyte concentration (pH) | Ref. |
|---|---|---|---|
| **$Co_2$-$NiMoO_4$-HNS** | 270 | 14 | This work |
| **$Ni_{0.69}Co_{0.31}$-P** | 276 | 13 | 1 |
| **CoOx-(a)** | 390 | 14 | 2 |
| **NiO** | 420 | 14 | 2 |
| **NiCoOx** | 380 | 14 | 2 |
| **NiMoN-550** | 312 | 14 | 3 |
| **$Ni_3FeN$** | 280 | 14 | 4 |
| **Co/N-C-800** | 274 | 14 | 5 |
| **Ni10-CoPi** | 320 | 14 | 5 |
| **$Co_2Fe$-MOF** | 280 | 14 | 5 |
| **Mn-NiMoO4** | 330 | 14 | 6 |
| **$Co_3O4$@$NiMoO_4$** | >300 | 14 | 7 |
| **NiO@$MoO_3$/VC** | 280 | 14 | 8 |
| **NiMoP@CoCH/CC-2** | >270 | 14 | 9 |
| **NiMn LDHs** | 350 | 14 | 10 |
| **Co-NiMoN NRs** | 294 | 14 | 11 |
| **$Mo_2C$@NC/Co@NG-900** | 420 | 14 | 12 |
| **Co@$Co_3O_4$/NC-1** | 410 | 14 | 13 |

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