Electronic Supplementary Material (ESI) for Nanoscale.


# Supplementary Information

## Assembling Ni-Co phosphides/carbon hollow nanocages and nanosheets with carbon nanotubes into a hierarchical necklace-like nanohybrid for electrocatalytic oxygen evolution reaction

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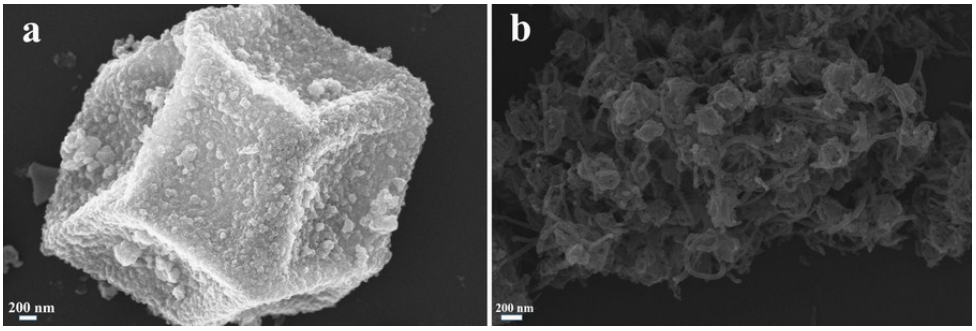


**Fig.S1** SEM images of (a) NiCoP/C and (b) CNTs@CoP/C reference samples.

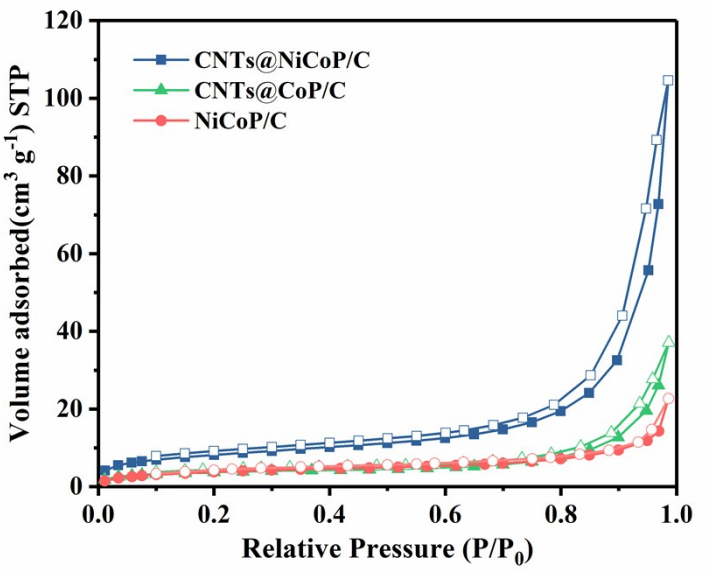


**Fig.S2** Low-temperature $N_2$ adsorption-desorption isotherms of different samples.

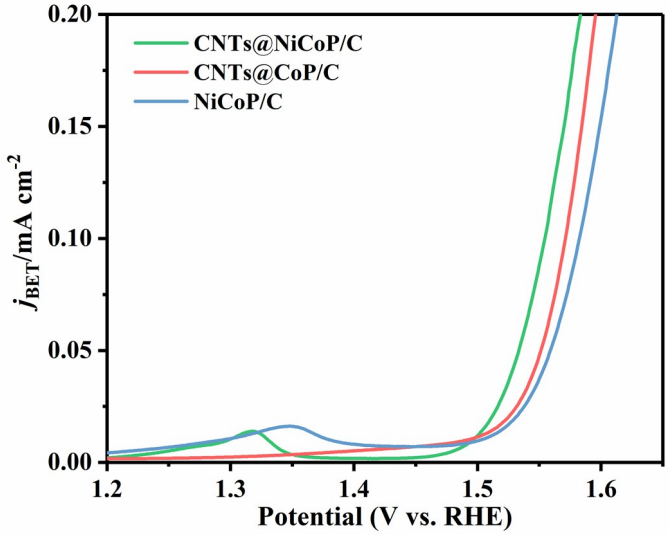


**Fig.S3** LSV curves normalized to the BET surface areas of different samples

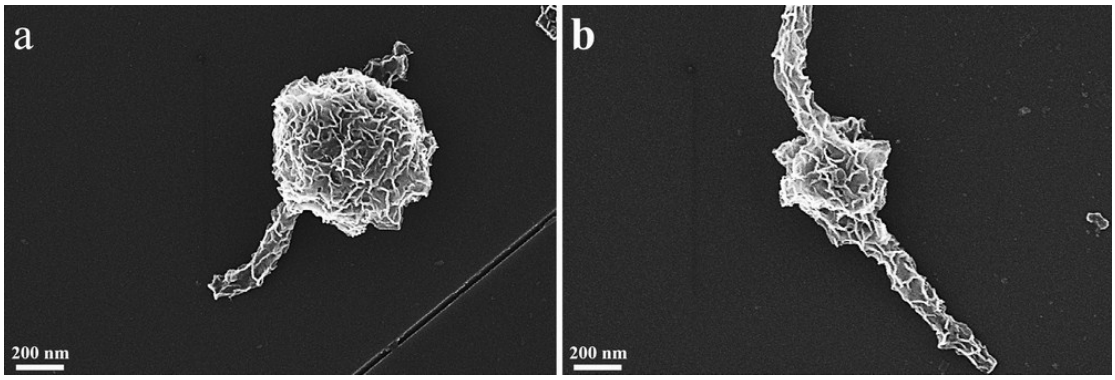


**Fig.S4** SEM images of CNTs@$Ni_1Co_1$-LDH/ZIF-67 (a) and CNTs@$Ni_3Co_1$-LDH/ZIF-67 (b) composite precursors.

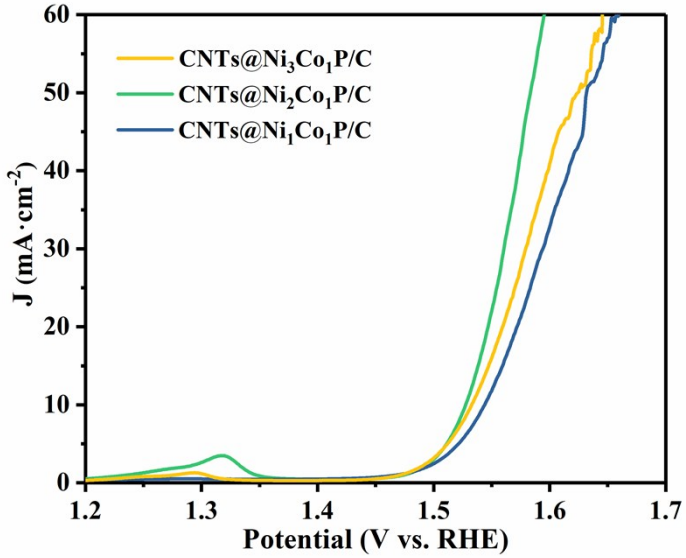


**Fig.S5** LSV curves of different Ni content of samples

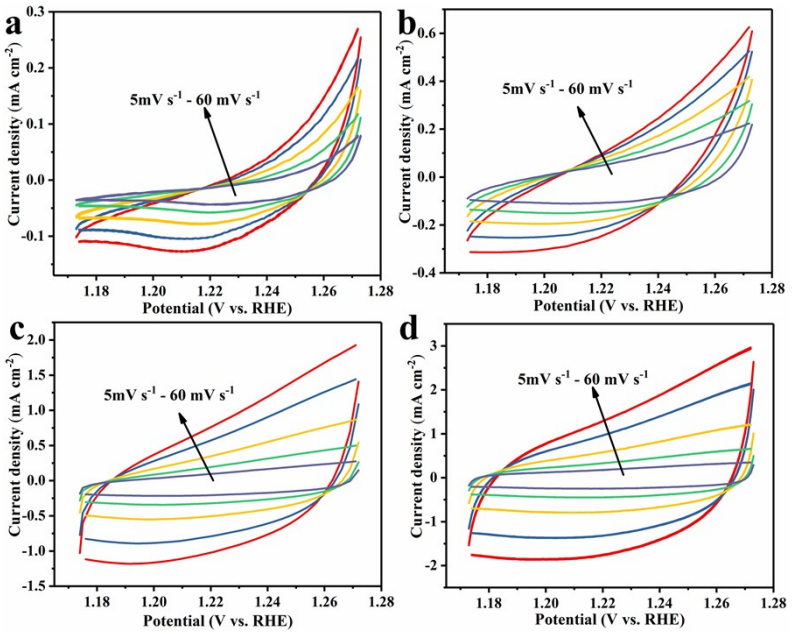


**Fig.S6** Cyclic voltammetry curves of (a) CNTs@NiCo-LDH/ZIF-67, (b) NiCoP/C, (c) CNTs@CoP/C, (d) CNTs@NiCoP/C at different scan rate from 5 to 60 mV $s^{-1}$

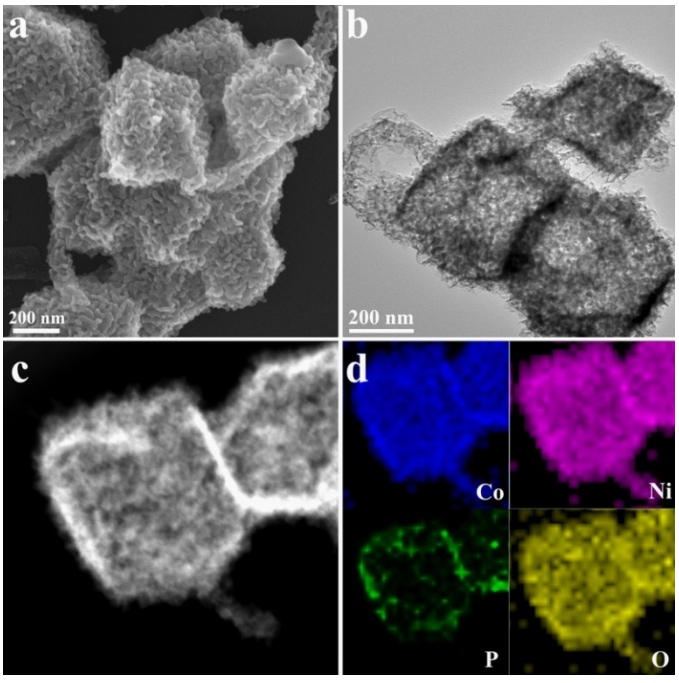


**Fig.S7** SEM (a), TEM (b), STEM (c, d) images of CNTs@NiCoP/C after durability test

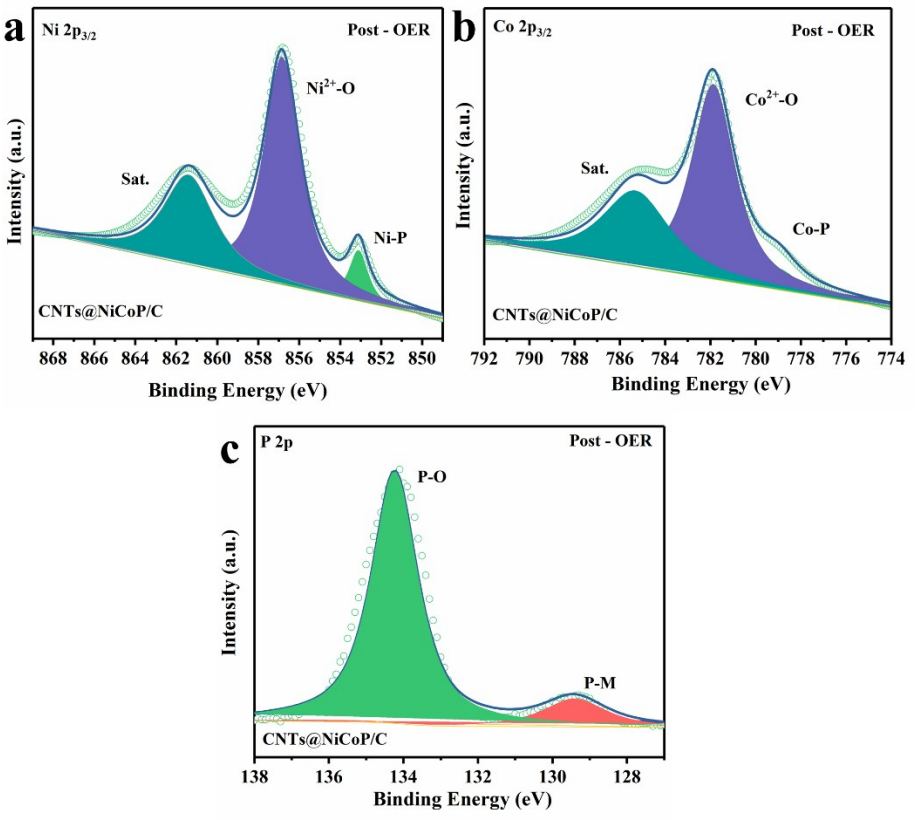


**Fig.S8** XPS of Ni 2p (a), Co 2p (b) and P 2p (c) regions for CNTs@NiCoP/C after OER.

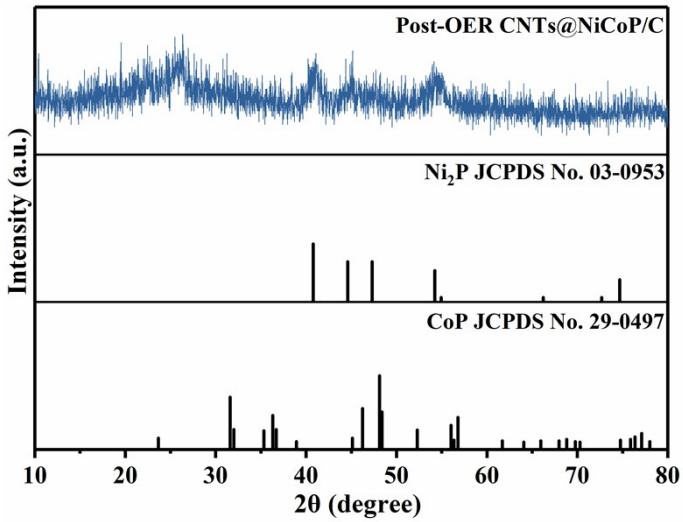


**Fig.S9** XRD patterns of CNTs@NiCoP/C after OER.

**Table S1** Summary for the properties of recent reported OER electrocatalysts.

| Electrocatalysts [a] | Overpotential (mV) at 10 mA $cm^{-2}$ | Tafel ($mV\ dec^{-1}$) | Refs. |
|---|---|---|---|
| NiCoP/C nanoboxes | 330 | 96 | [44] |
| $Ni_{0.6}Co_{1.4}P$ nanocages | 300 | 80 | [45] |
| h-CoNiP/rGO | 280 | 65.2 | [46] |
| $Ni_2P$@NC | 320 | 50 | [47] |
| CoP/rGO | 340 | 66 | [48] |
| Multishelled $Ni_2P$ | 270 | 40.4 | [49] |
| $Co_2P$/NPCNT | 370 | 53 | [50] |
| $Ni_2P$−CoP | 320 | 69 | [51] |
| $Ni_{0.88}Co_{1.22}Se_4$ [b] | 320 | 78 | [52] |
| CoP [c] | 400 | 57 | [53] |
| $Co_2P$@Co/N−C | 320 | 48.8 | [54] |
| CoP NR/C | 320 | 71 | [18] |
| CNTs@NiCoP/C | 297 | 57.35 | This work |

[a] deposited on glassy carbon electrode. [b] hollow microparticles. [c] hollow polyhedron.