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Supporting Information

An Efficient Ternary $CoP_{2x}Se_{2(1-x)}$ Nanowire Array for overall Water Splitting

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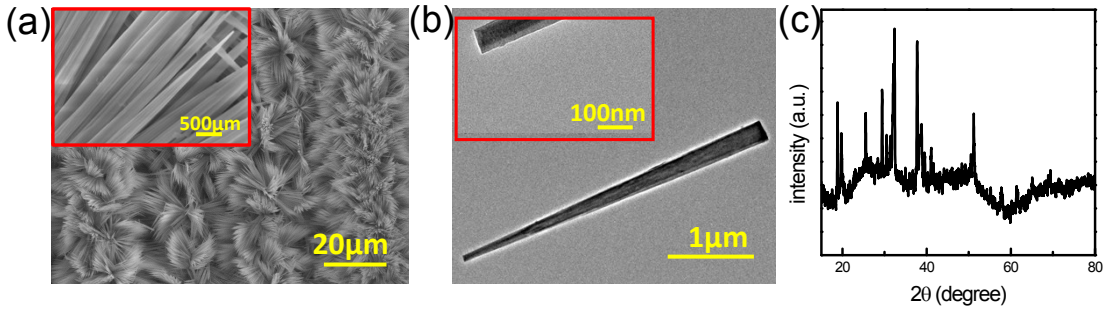

Fig. S1. SEM (a) and TEM (b) images of $Co(OH)_2$, XRD pattern of $Co(OH)_2$ (c).

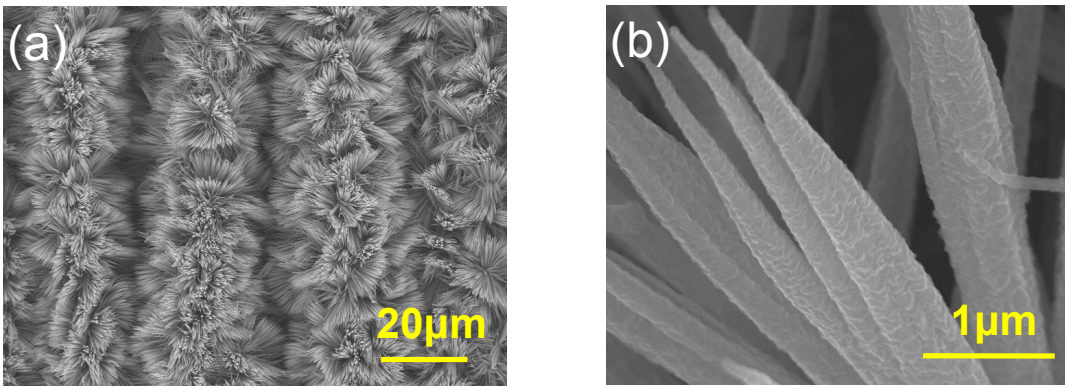

Fig. S2. Low-magnification SEM (a) and high-magnification SEM (b) of $CoP_{2x}Se_{2(1-x)}$ NWs.

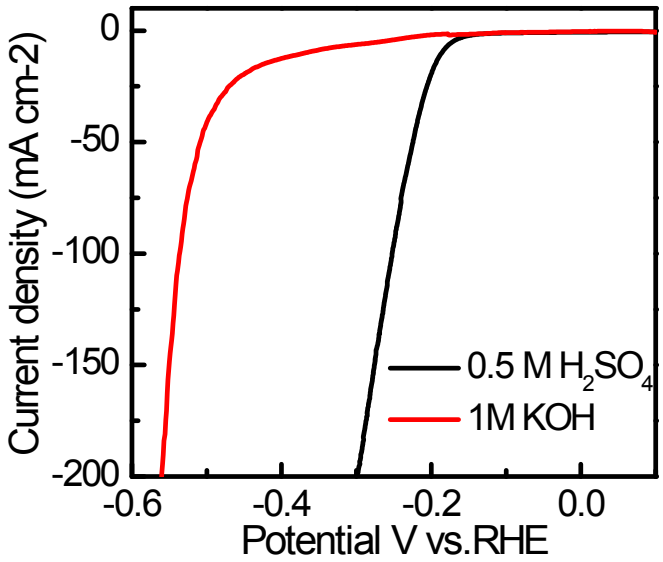

Fig. S3 Polarization curves of $CoSe_2$NWs for HER in both 0.5 M H_2SO_4 and 1.0 M KOH solution.

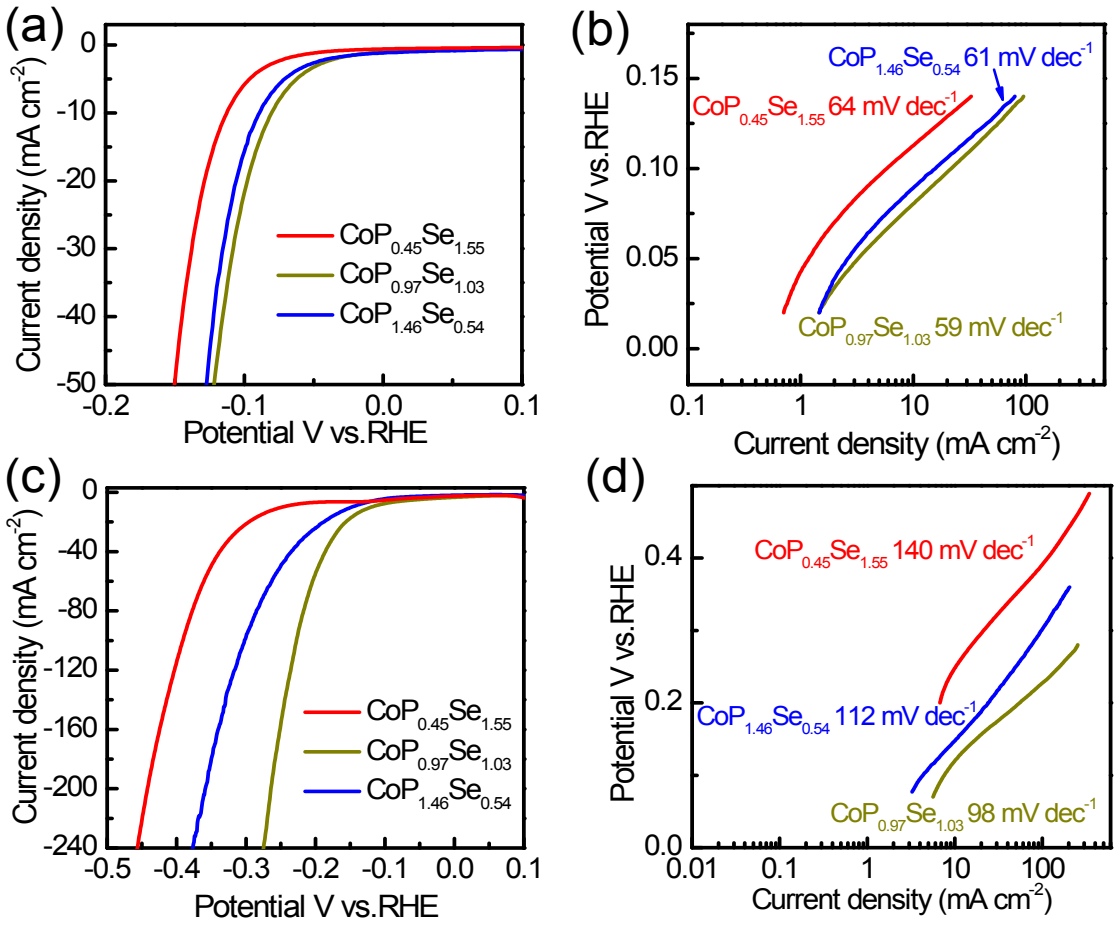

Fig. S4. Polarization curves of $CoP_{0.45}Se_{1.55}$, $CoP_{0.97}Se_{1.03}$ and $CoP_{1.46}Se_{0.54}$ NWs for HER in both 0.5 M H_2SO_4 and 1.0 M KOH solution (a and c). The corresponding Tafel plots for these ternary samples (b and d).

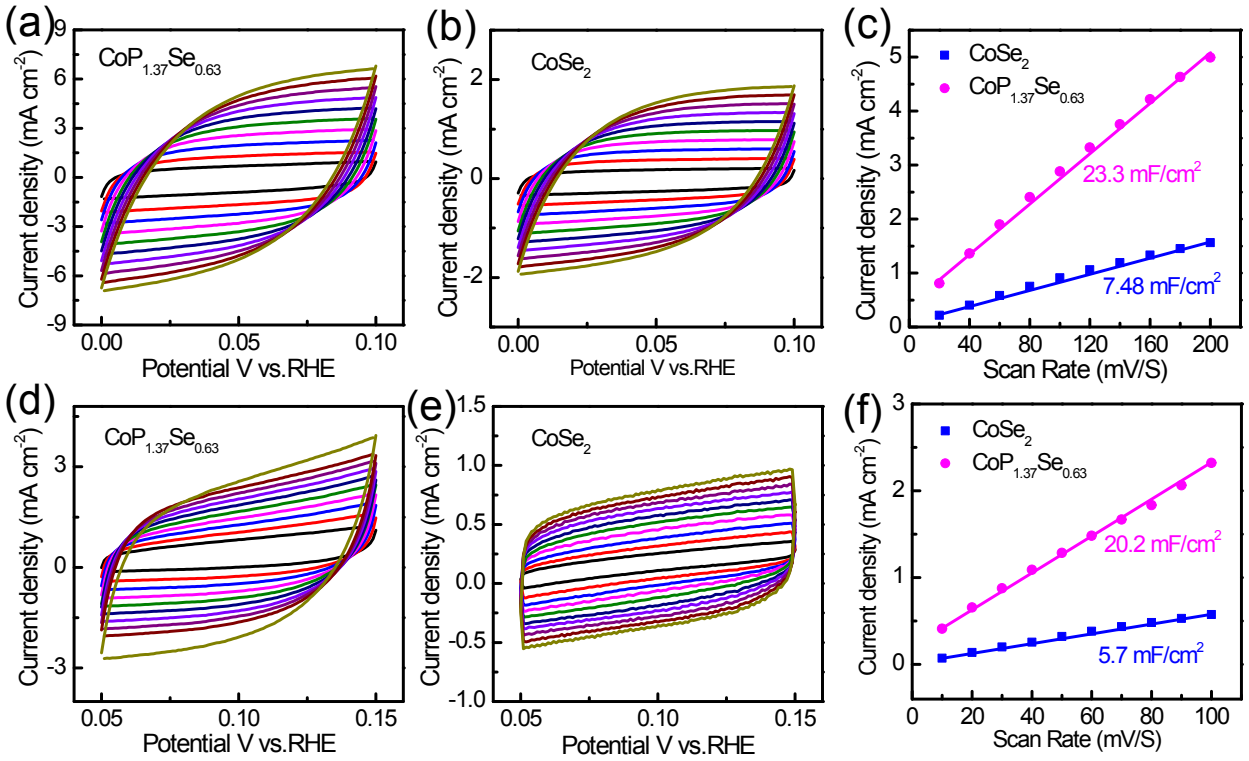

Fig. S5. Cyclic voltammograms (CV) curves of $CoP_{2x}Se_{2(1-x)}$ NWs (a) and $CoSe_2$ NWs (b) at scan rates of 20mv/s-200 mv/s in 0.5 M H_2SO_4 . (c) Linear fitting of C_{dl} plots at 0.05 V *vs.* RHE of the catalysts *vs.* scan rate in 0.5 M H_2SO_4. Cyclic voltammograms (CV) curves of $CoP_{2x}Se_{2(1-x)}$ NWs (d) and $CoSe_2$ NWs(e) at scan rates of 10mv/s-100 mv/s in 1.0 M KOH. (f) Linear fitting of the C_{dl} plots at 0.10 V *vs.* RHE of the catalysts *vs.* scan rate in 1.0 KOH.

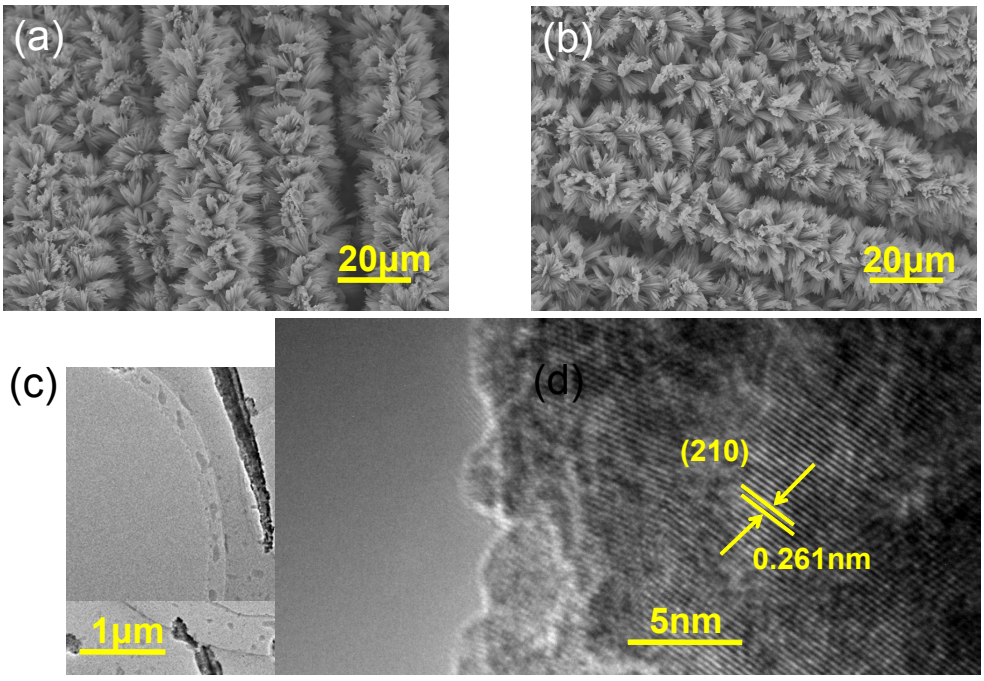

Fig. S6. SEM image of $CoP_{1.37}Se_{0.63}$ NWs after HER test in 0.5 M H_2SO_4. SEM (b), TEM (c) and HRTEM (d) of $CoP_{1.37}Se_{0.63}$ NWs after HER test in1.0 M KOH.

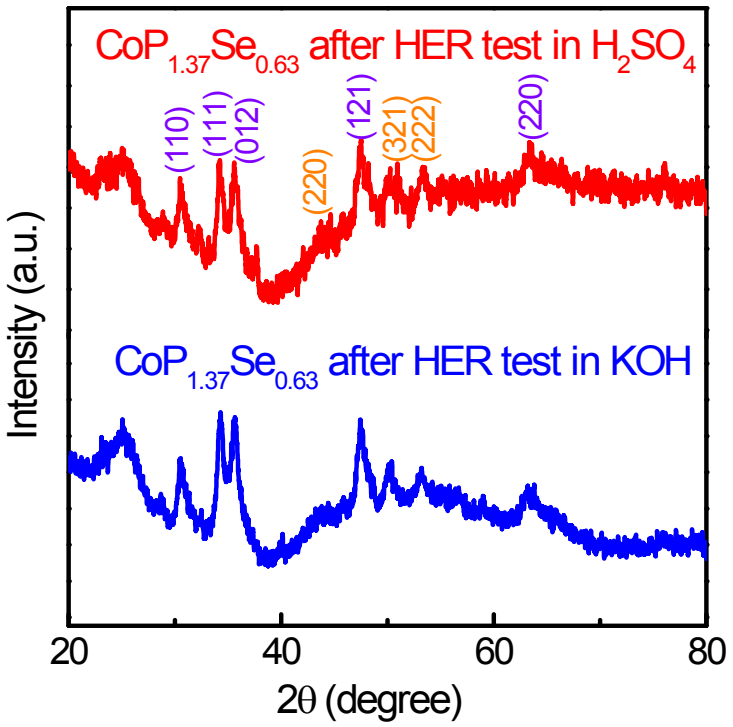

Fig. S7. XRD patterns of $CoP_{1.37}Se_{0.63}$ NWs after HER test in both 0.5 M H_2SO_4 and 1.0 M KOH solution.

Table S1. Comparison of HER performance of $CoP_{1.37}Se_{0.63}$ NWswith other reported catalysts in both acidic and alkalinesolution.[1-10]

Catalyst	Electrolyte	η @ 10 mA cm^{-2} (mV vs. RHE)	Tafel slope (mV dec^{-1})	Reference
$CoSe_2$ nanoparticles	0.5 M H_2SO_4	137	42.1	Ref. 1
$NiP_{1.93}Se_{0.07}$ nanoflakes	0.5 M H_2SO_4	84	41	Ref. 2
porous $NiSe_2$ nanosheets	0.5 M H_2SO_4	135	37.2	Ref. 3
Ni_5P_4 films	0.5 M H_2SO_4	140	40	Ref. 4
$CoS_{2x}Se_{2(1-x)}$ NWs	0.5 M H_2SO_4	129.5	44	Ref. 5
CP@Ni-P	0.5 M H_2SO_4	98	58.8	Ref. 6
MoSSe	0.5 M H_2SO_4	164±2	48±2	Ref. 7
MoP|S	0.5 M H_2SO_4	64	50	Ref. 8
$CoP_{1.37}Se_{0.63}$ NWs	**0.5 M H_2SO_4**	**70**	**54**	**This work**
Ni_5P_4 films	1 M KOH	150	53	Ref. 4
porous $NiSe_2$ nanosheets	1 M KOH	184	76.6	Ref. 3
CP@Ni-P	1 M KOH	117	85.4	Ref. 6
porous CoP nanowires	1 M KOH	209	129	Ref. 9
CP/CTs/Co-S	1 M KOH	190	131	Ref. 10
$CoP_{1.37}Se_{0.63}$ NWs	**1 M KOH**	**98**	**74**	**This work**

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