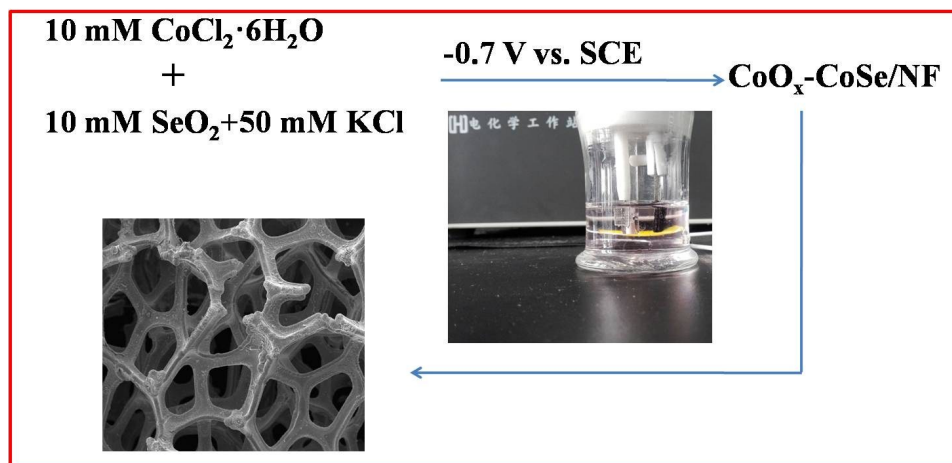


Electronic Supplementary Information(ESI†)

Electrodeposited cobalt-selenide-based film as an efficient bifunctional electrocatalyst for full water splitting

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Scheme S1 The synthesis process of the $\text{CoO}_x\text{-CoSe}$ film on NF.



Fig. S1 Optical photographs of the NF substrate (left) and the $\text{CoO}_x\text{-CoSe/NF}$ film on NF (right).

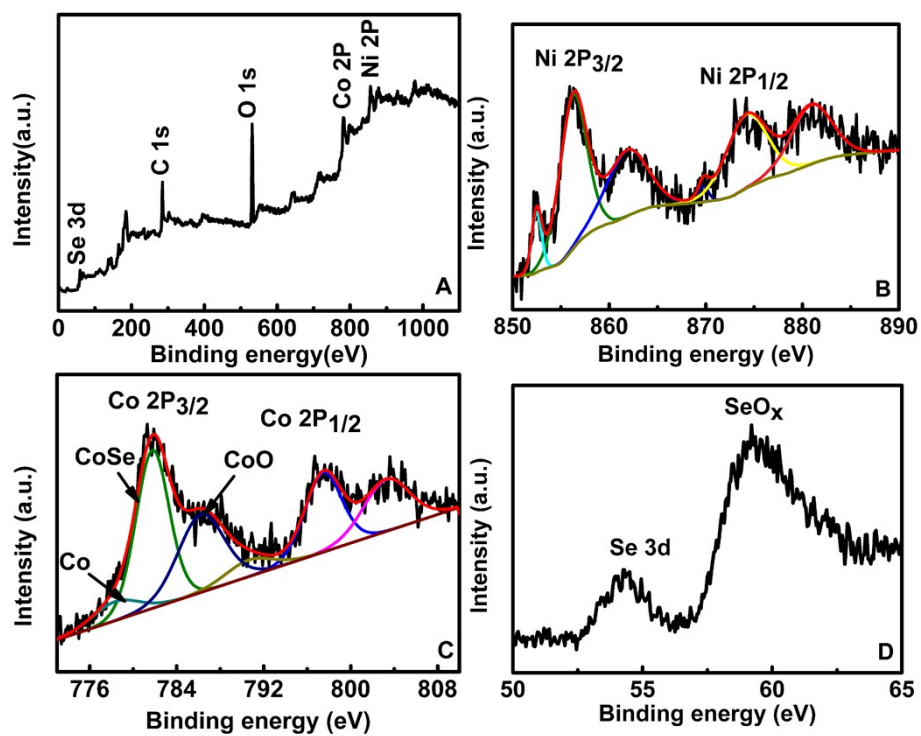


Fig. S2 (A) XPS survey spectrum for the CoO_x-CoSe film on NF. (B, C and D) High resolution XPS spectra of Ni 2P, Co 2p and Se 3d, respectively.

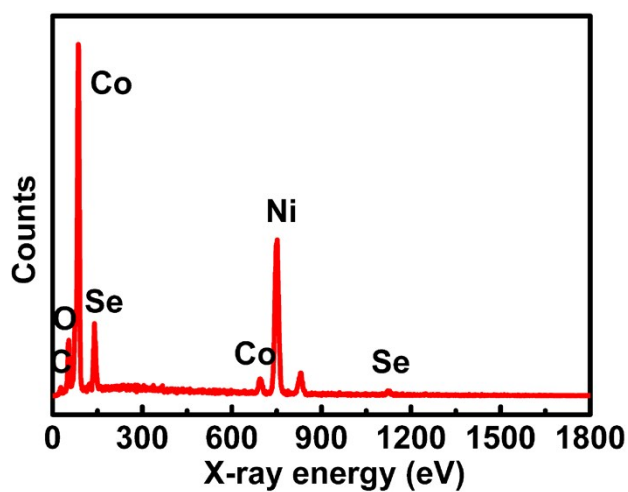


Fig. S3 EDS spectrum of the CoO_x-CoSe film on NF.

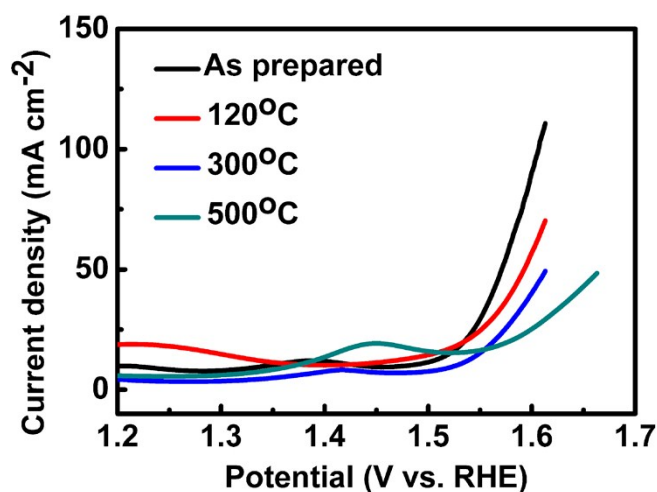


Fig. S4 OER polarization curves of the $\text{CoO}_x\text{-CoSe}$ film electrode obtained at different annealing temperature.

Table S1 Comparison of the electrocatalytic OER activity of the $\text{CoO}_x\text{-CoSe/NF}$ with other non-noble OER catalysts recently reported in alkaline solutions.

Catalyst	Current density j (mA cm^{-2})	η (mV vs. RHE) at corresponding j	Tafel slope (mV dec^{-1})	Electrolyte	Reference
$\text{CeO}_2/\text{CoSe}_2$	10	288	44	0.1 M KOH	<i>Small</i> , 2015, 11 , 182.
CoSe_2 sheets	73	470	64	0.1 M KOH	<i>Angew. Chem. Int. Ed.</i> , 2015, 54 , 12004.
NG- CoSe_2	10	366	40	0.1 M KOH	<i>ACS Nano.</i> , 2014, 8 , 3970
CoSe_2 ultrathin nanosheets	10	320	44	0.1 M KOH	<i>J. Am. Chem. Soc.</i> , 2014, 136 , 15670.
$\text{Mn}_3\text{O}_4/\text{CoSe}_2$	10	450	49	0.1 M KOH	<i>J. Am. Chem. Soc.</i> , 2012, 134 , 2930.
$\text{Ni}_3\text{S}_2/\text{Ni}$	10	187	159.3	0.1 M KOH	<i>Energy Environ. Sci.</i> , 2013, 6 , 2921.
NiCo LDH	20	393	40	1.0 M KOH	<i>Nano Lett.</i> , 2015, 15 , 1421.
$\text{CoO}_x\text{-CoSe}$ film on NF	100 500	300 380	68	1.0 M KOH	This work

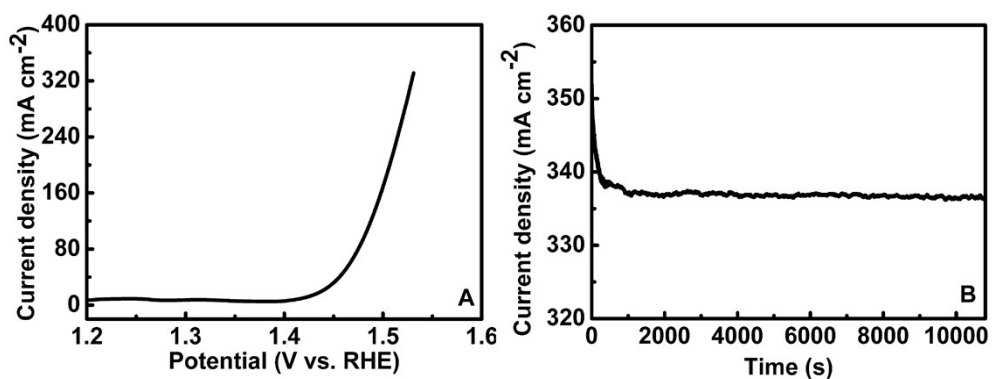


Fig. S5 (A) OER polarization curve for the $\text{CoO}_x\text{-CoSe}$ film in 10 M KOH with a scan rate of 5 mV s^{-1} . (B) Time-dependent current density curve for the $\text{CoO}_x\text{-CoSe}$ film under a fixed potential in 10 M KOH.

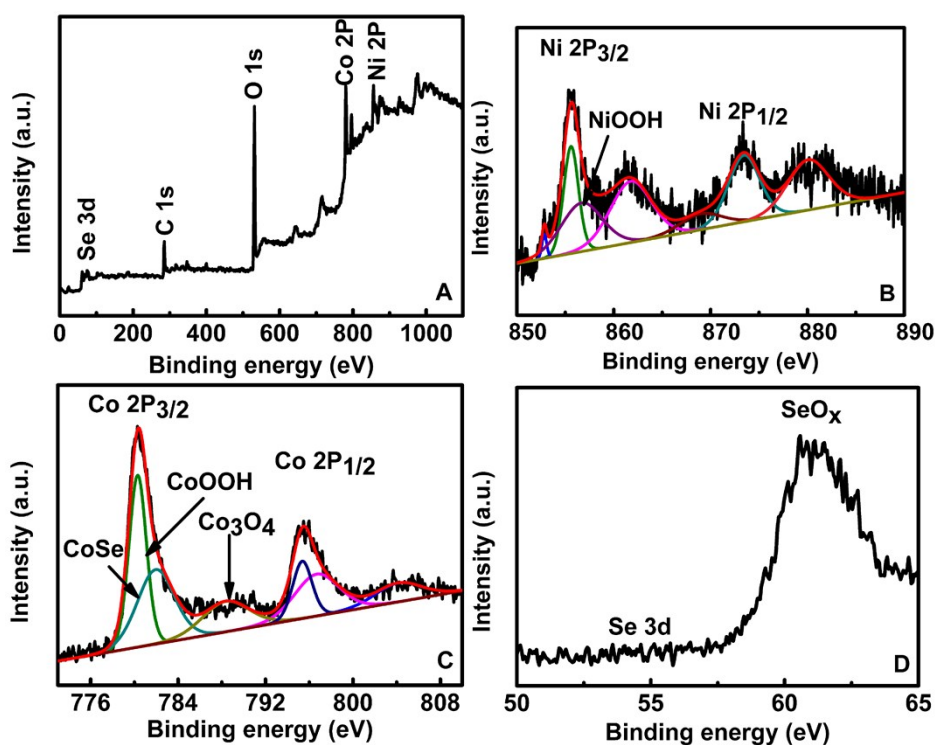


Fig. S6 (A) XPS survey spectrum for the $\text{CoO}_x\text{-CoSe}$ film on NF after OER electrolysis. (B, C and D) High resolution XPS spectra of Ni 2P, Co 2p and Se 3d after OER electrolysis, respectively.

Table S2 Comparison of the electrocatalytic HER performance of the CoO_x-CoSe/NF with other non-noble OER catalysts recently reported in alkaline solutions.

Catalyst	Current density j (mA cm ⁻²)	η (mV vs. RHE) at corresponding j	Tafel slope (mV dec ⁻¹)	Electrolyte	Reference
NiCo ₂ S ₄ NA/CC	50	263	141	1.0 M KOH	<i>Nanoscale</i> , 2015, 7 , 15122.
Ni ₃ S ₂ /NF	10	223	-	alkaline media (pH=14)	<i>J. Am. Chem. Soc.</i> , 2015, 137 , 14023.
Ni-P/Cu foam	10	98	55	1.0 M KOH	<i>J. Power Sources</i> , 2015, 299 , 342.
Ni ₅ P ₄	10	150	53	1.0 M KOH	<i>Angew. Chem. Int. Ed.</i> , 2015, 54 , 12361.
NiS/NF	20	158	83	1.0 M KOH	<i>Chem. Commun.</i> , 2016, 52 , 1486.
CoSe ₂ NW/CC	10	130	32	0.5 M H ₂ SO ₄	<i>ACS Appl. Mater. Interfaces</i> , 2015, 7 , 3877.
CoSe/Ti	10	135	62	0.5 M H ₂ SO ₄	<i>J. Mater. Chem. A</i> , 2014, 2 , 13835.
CoO _x -CoSe film on NF	10	90	94	1.0 M KOH	This work

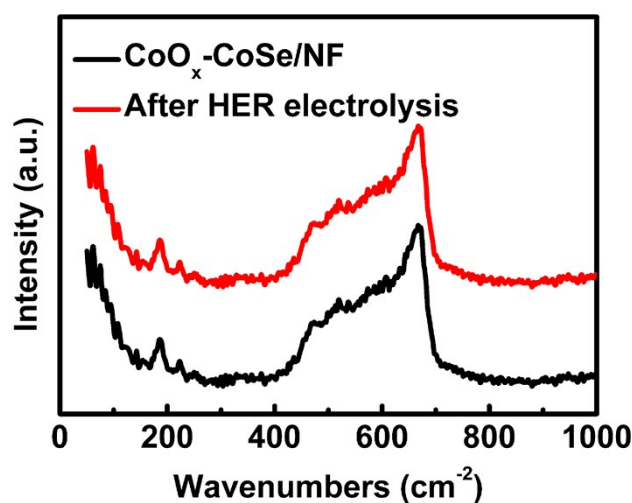


Fig. S7 Raman patterns of the CoO_x-CoSe film before and after HER test.