Electronic Supplementary Information (ESI) for:

Novel Synthesis of In-situ CeO_x Nanoparticles Decorated on CoP Nanosheets for Highly Efficient Electrocatalytic Oxygen Evolution

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1. Supporting Figures

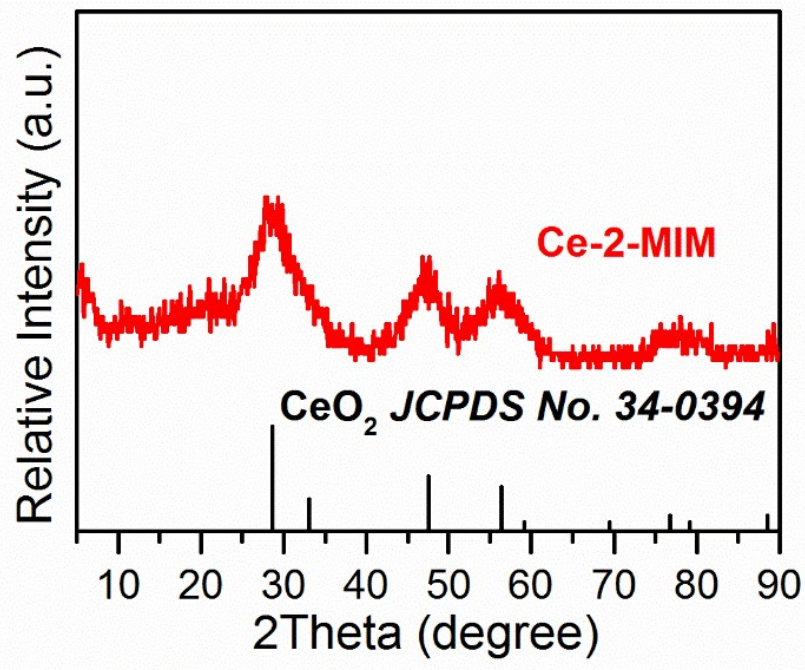

Fig. S1. XRD patterns of Ce-2-MIM

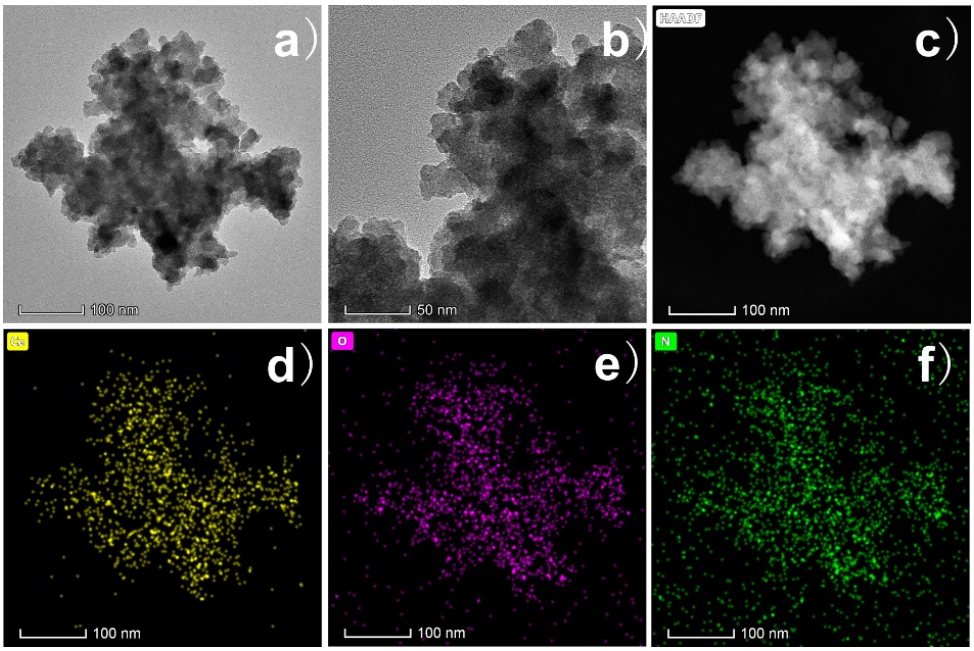

Fig. S2. TEM images of Ce-2-MIM

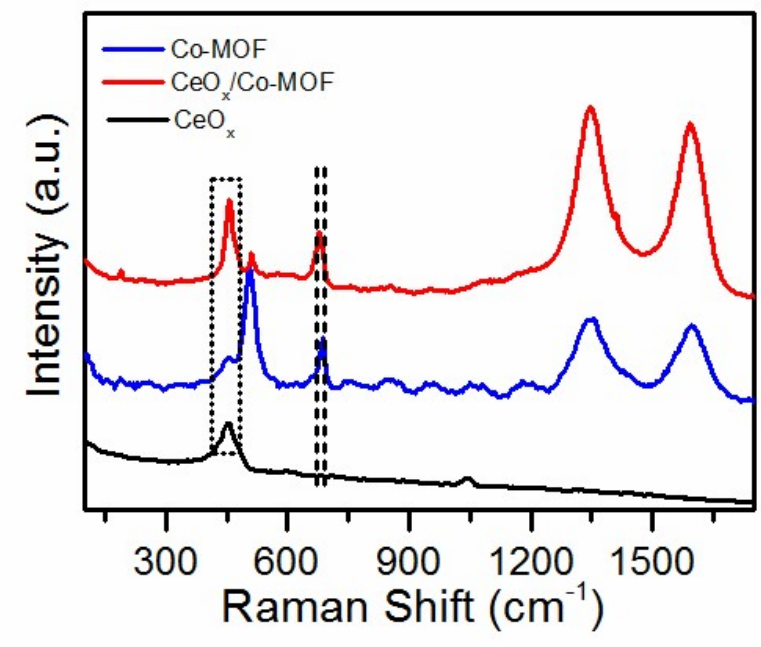

Fig. S3. Raman spectra of CeO_x, Co-2-MIM and CeO_x/Co-2-MIM

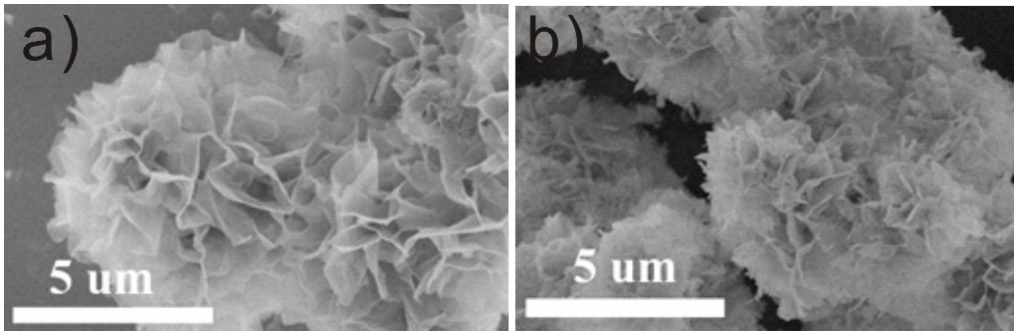

Fig. S4. SEM images of a) Co-2-MIM and b) CeO_x/Co-2-MIM

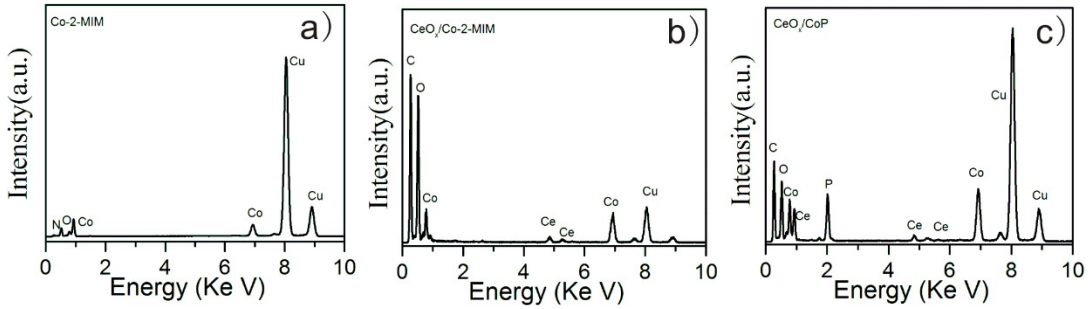

Fig. S5. EDX analysis of as-prepared electrodes

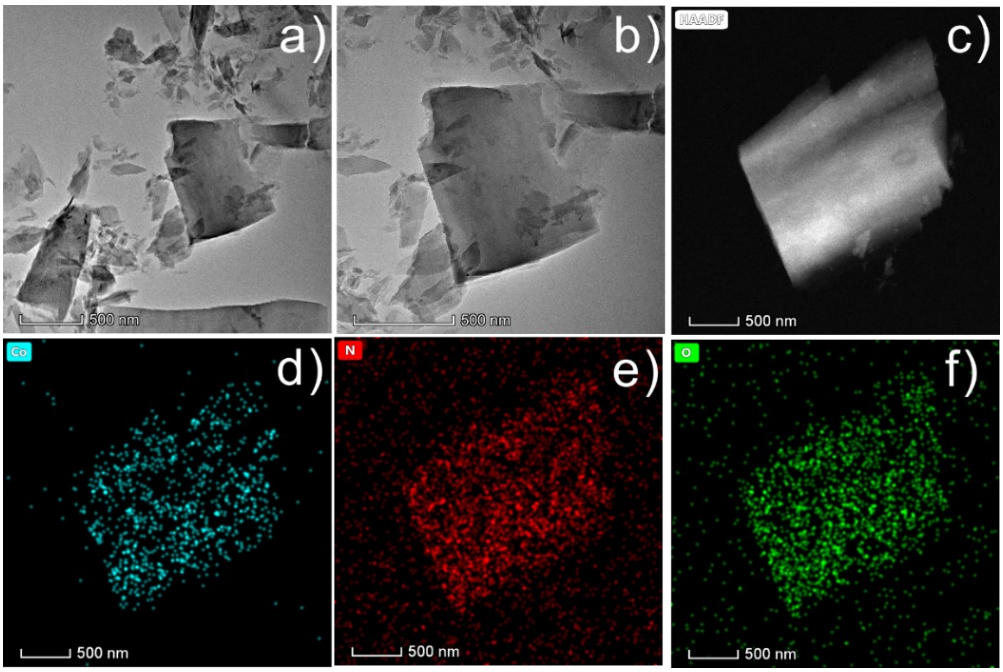

Fig. S6. TEM images of Co-BPDC

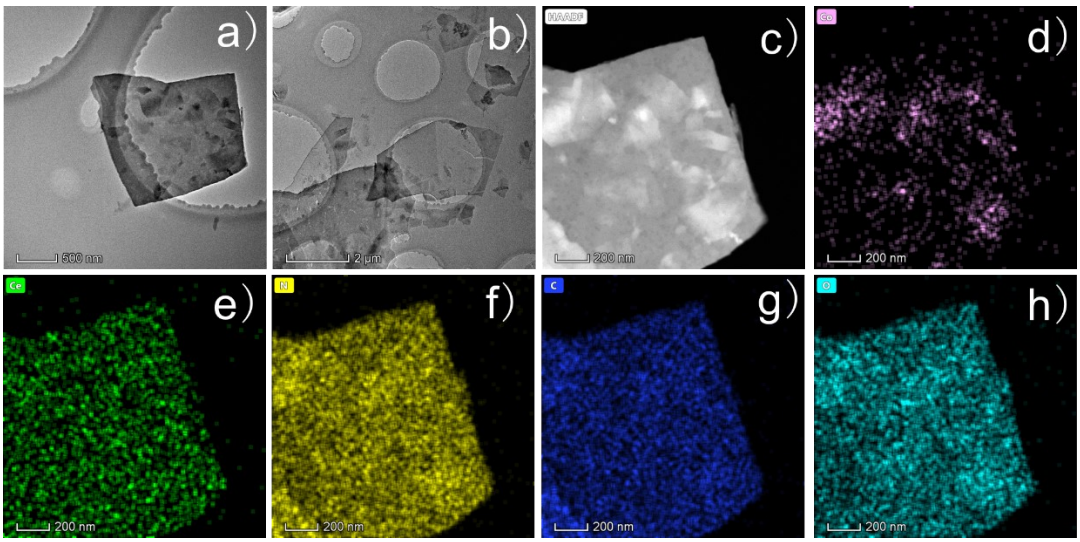

Fig. S7. TEM images of Ce-BPDC+Co-BPDC

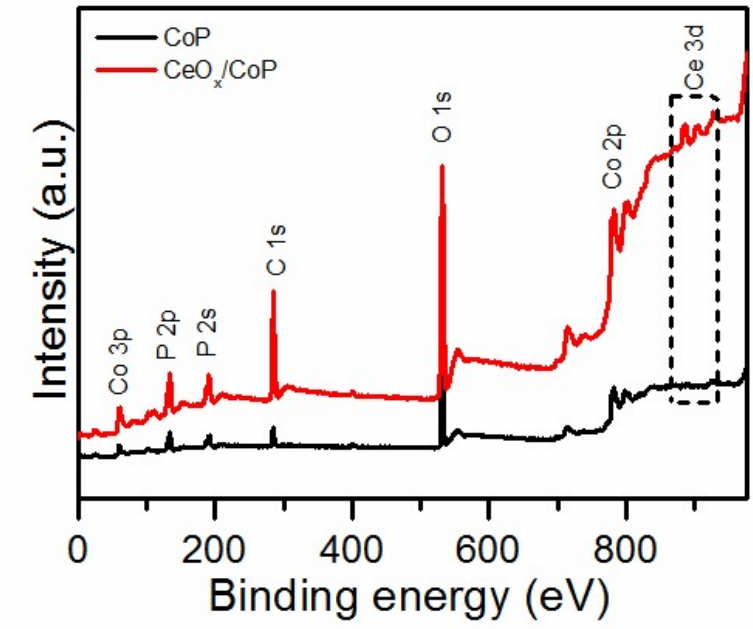

Fig. S8. XPS survey spectrum of CoP and CeO_x/CoP

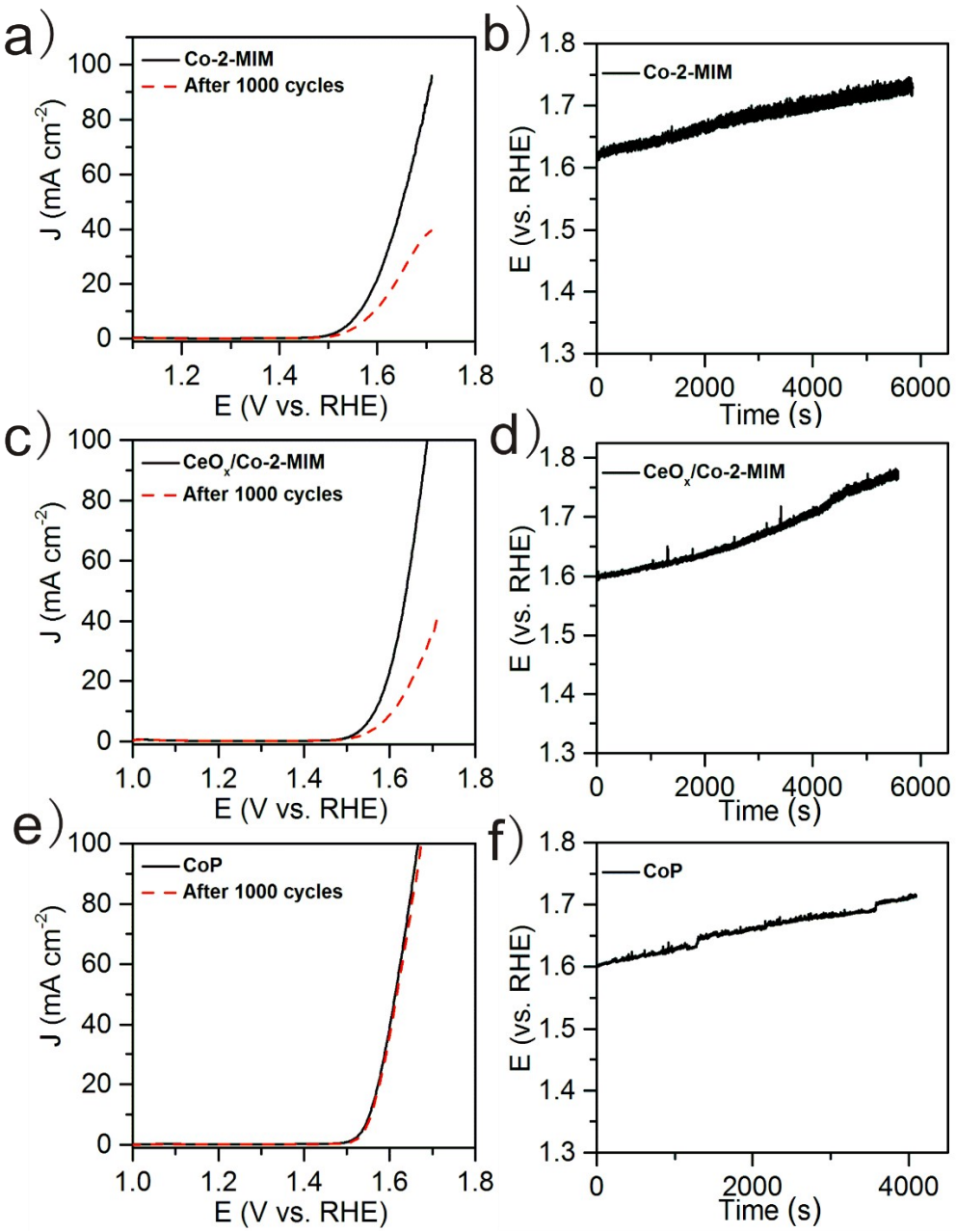

Fig. S9. Polarization curves before and after CV sweeps and chronopotentiometric curve of (a-b) Co-2-MIM; (c-d) CeO_x/Co-2-MIM and (e-f) CoP

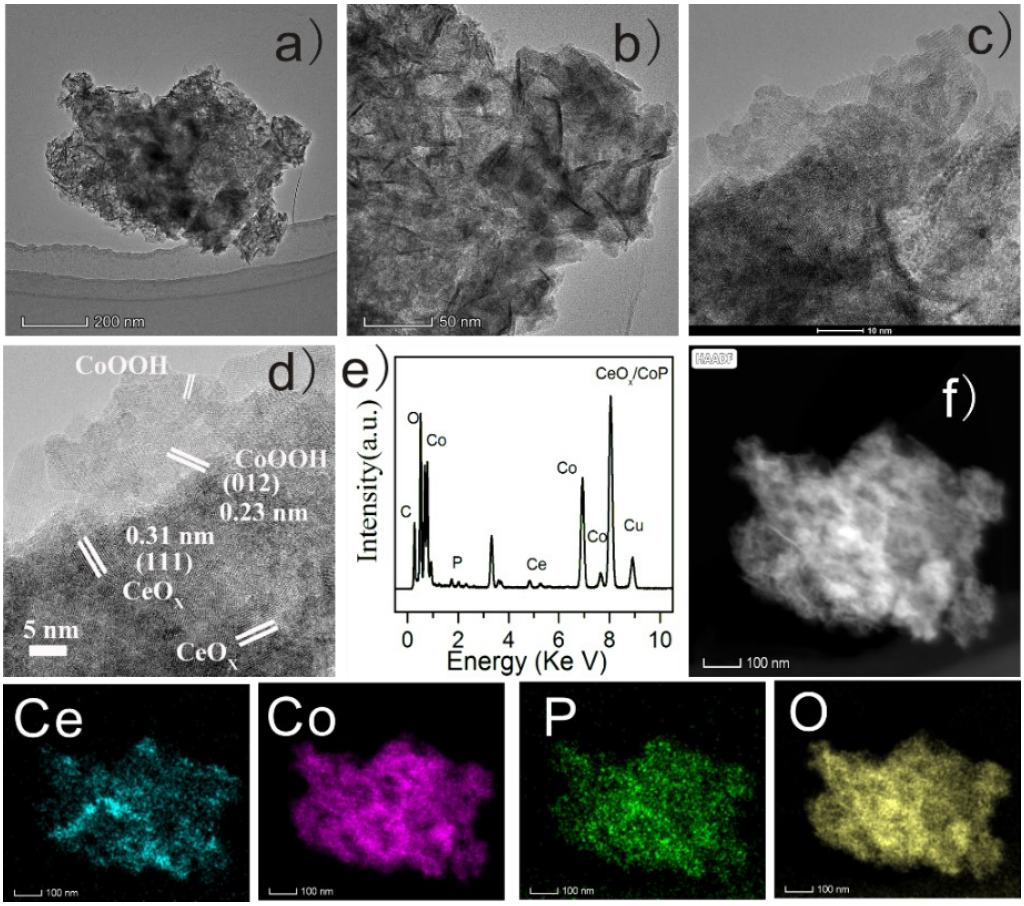

Fig. S10. CeO_x/CoP after the OER reaction of (a-c) TEM images; (d) highmagnification TEM images; (e) EDX analysis; (f) corresponding elemental mapping results.

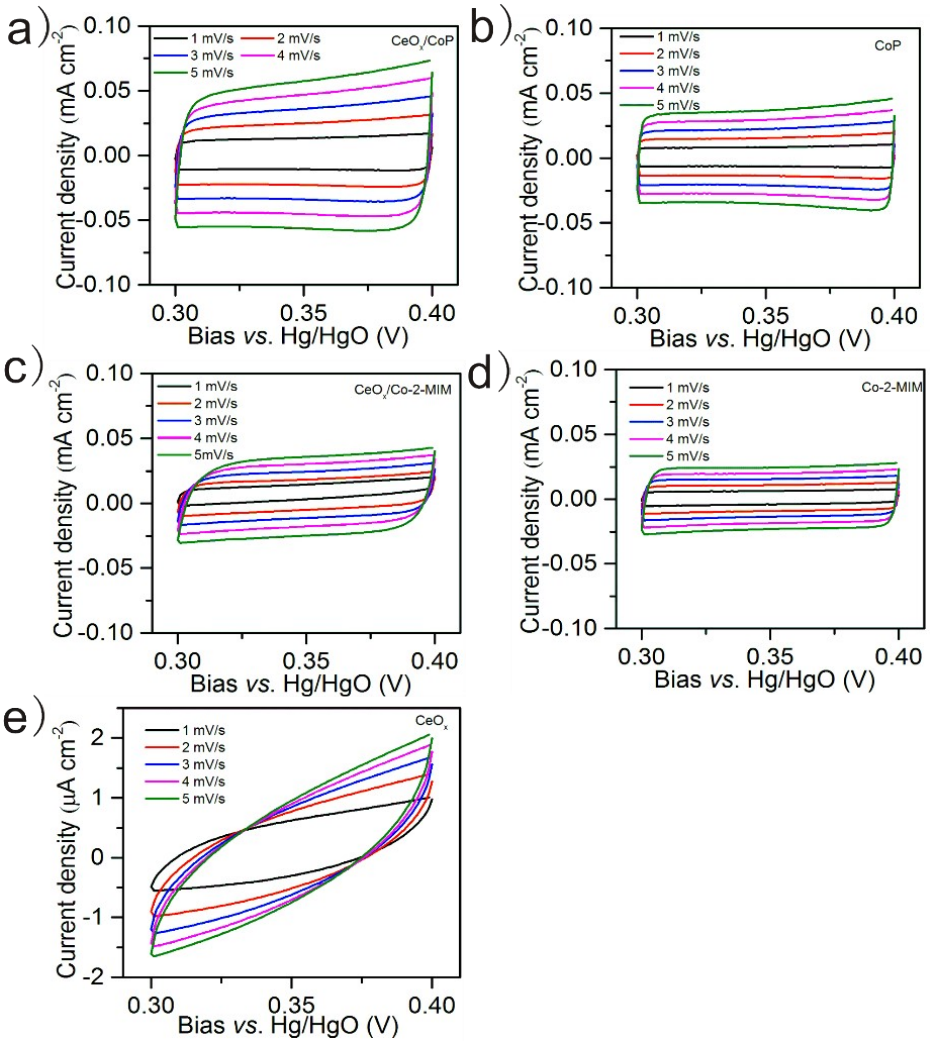

Fig. S11. (a-e) Typical cyclic voltammetry curves of as-prepared electrodes with different scan rates (1, 2, 3, 4, 5 mV s^{-1})

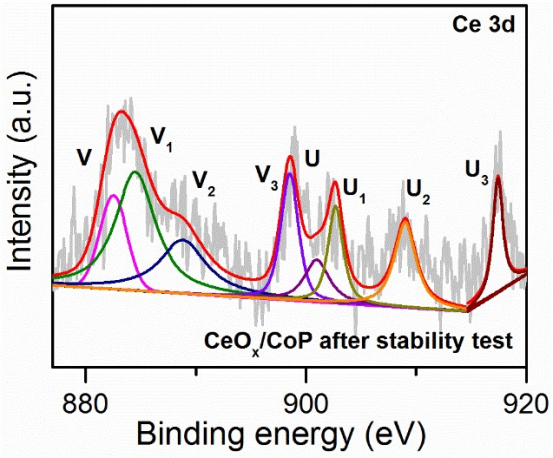

Fig. S12. Ce 3d XPS spectra of CeO_x/CoP after the OER reaction

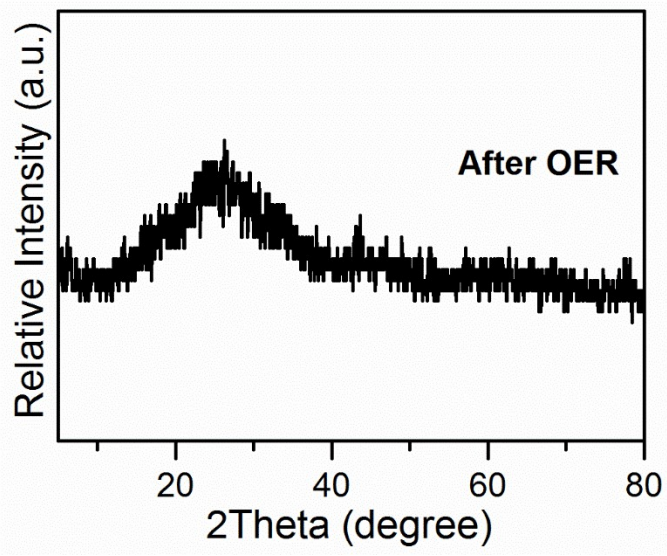

Fig. S13. XRD patterns of CeO_x/CoP after the OER reaction

2. Supporting Tables

Table S1. The weight percentage content of elements in CeO_x/CoP from ICP-AES and Elemental analysis data.

Element	Ce	Co
wt%	10.72	89.28

Table S2. Comparison of catalytic performance with cobalt-based electrocatalysts previously reported.

Catalysts	Support	η@ mA cm^{-2} (mV)	Ref.
CoP	CC	300@10	1
Co-P@NC	GC	370@10	2
P-Co_3O_4	NF	260@20	3
Ni_1Co_3-P@CSs	RDE	330@20	4
MoCoP	CC	305@10	5
Co_3S_4@MoS_2	GC	310@10	6
Cobalt Sulfide	CP	306@10	7
$Co_{0.6}Fe_{0.4}P_{1.125}$	GC	298@10	8
CoP/NCNHP	Ni foam	310@10	9
$NiCo_2S_4$ HSs	GC	400@10	10
CoS_x/Ni_3S_2@ NF	Ni foam	280@20	11
CoP/CNTs	Ni foam	309@10	12
CeO_x/CoP	**GC**	**293@10**	**This work**

3. Supplementary References

1. Y. Cheng, F. Liao, W. Shen, L. Liu, B. Jiang, Y. Li and M. Shao, Carbon cloth supported cobalt phosphide as multifunctional catalysts for efficient overall water splitting and zinc-air batteries, *Nanoscale*, 2017, **9**, 18977-18982.

2. M. Zhai, F. Wang and H. Du, Transition-Metal Phosphide-Carbon Nanosheet

Composites Derived from Two-Dimensional Metal-Organic Frameworks for Highly Efficient Electrocatalytic Water-Splitting, *ACS Appl. Mater. Interfaces*, 2017, **9**, 40171-40179.

3. Z. Wang, H. Liu, R. Ge, X. Ren, J. Ren, D. Yang, L. Zhang and X. Sun, Phosphorus-Doped Co3O4 Nanowire Array: A Highly Efficient Bifunctional Electrocatalyst for Overall Water Splitting, *ACS Catalysis*, 2018, **8**, 2236-2241.

4. V. H. Hoa, D. T. Tran, H. T. Le, N. H. Kim and J. H. Lee, Hierarchically porous nickel–cobalt phosphide nanoneedle arrays loaded micro-carbon spheres as an advanced electrocatalyst for overall water splitting application, *Appl. Catal. B: Environ,* 2019, **253**, 235-245.

5. C. Guan, W. Xiao, H. Wu, X. Liu, W. Zang, H. Zhang, J. Ding, Y. P. Feng, S. J. Pennycook and J. Wang, Hollow Mo-doped CoP nanoarrays for efficient overall water splitting, *Nano Energy*, 2018, **48**, 73-80.

6. Y. Guo, J. Tang, H. Qian, Z. Wang and Y. Yamauchi, One-Pot Synthesis of Zeolitic Imidazolate Framework 67-Derived Hollow Co3S4@MoS2 Heterostructures as Efficient Bifunctional Catalysts, *Chemistry of Materials*, 2017, **29**, 5566-5573.

7. J. Wang, H.-x. Zhong, Z.-l. Wang, F.-l. Meng and X.-b. Zhang, Integrated Three-Dimensional Carbon Paper/Carbon Tubes/Cobalt-Sulfide Sheets as an Efficient Electrode for Overall Water Splitting, *Acs Nano*, 2016, **10**, 2342-2348.

8. Y. Lian, H. Sun, X. Wang, P. Qi, Q. Mu, Y. Chen, J. Ye, X. Zhao, Z. Deng and Y.

Peng, Carved nanoframes of cobalt-iron bimetal phosphide as a bifunctional electrocatalyst for efficient overall water splitting, *Chem. Sci.*, 2019, **10**, 464-474.

9. Y. Pan, K. Sun, S. Liu, X. Cao, K. Wu, W. C. Cheong, Z. Chen, Y. Wang, Y. Li, Y. Liu, D. Wang, Q. Peng, C. Chen and Y. Li, Core-Shell ZIF-8@ZIF-67-Derived CoP Nanoparticle-Embedded N-Doped Carbon Nanotube Hollow Polyhedron for Efficient Overall Water Splitting, *J. Am. Chem. Soc.*, 2018, **140**, 2610-2618.

10. F. Kong, K. Chen, S. Song and D. Xue, Metal organic framework derived CoFe@N-doped carbon/reduced graphene sheets for enhanced oxygen evolution reaction, *Inorg. Chem. Front.*, 2018, **5**, 1962-1966.

11. S. Shit, S. Chhetri, W. Jang, N. C. Murmu, H. Koo, P. Samanta and T. Kuila, Cobalt Sulfide/Nickel Sulfide Heterostructure Directly Grown on Nickel Foam: An Efficient and Durable Electrocatalyst for Overall Water Splitting Application, *ACS Appl. Mater. Interfaces*, 2018, **10**, 27712-27722.

12. X. Zhang, X. Zhang, H. Xu, Z. Wu, H. Wang and Y. Liang, Iron-Doped Cobalt Monophosphide Nanosheet/Carbon Nanotube Hybrids as Active and Stable Electrocatalysts for Water Splitting, *Adv. Funct. Mater.,* 2017, **27**, 1606635.