Supplementary information

Two-Phase Synthesis of Fe Doped Cerium Phosphate Ultra-fine Nanocrystals for Efficient Oxygen Evolution

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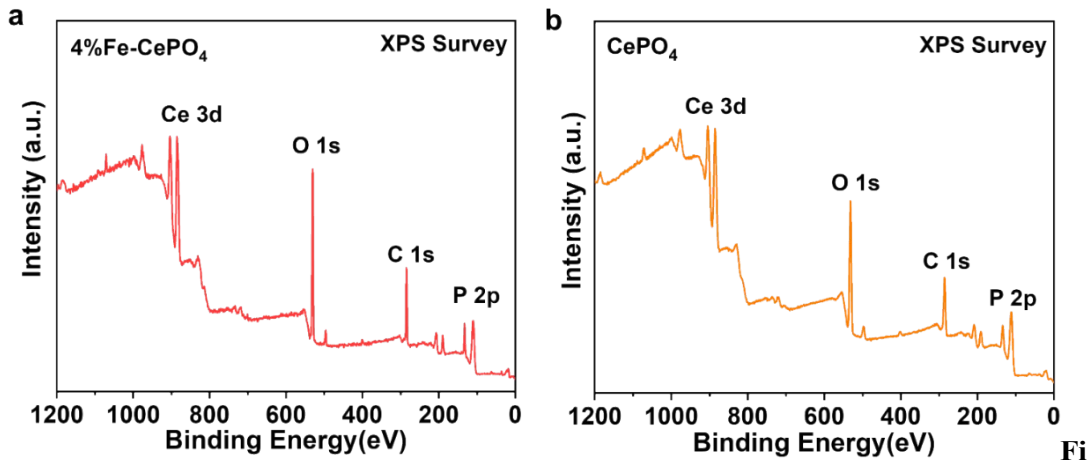

g. S1. (a)The survey spectrum of the Fe-$CePO_4$ and (b) The survey spectrum of the $CePO_4$

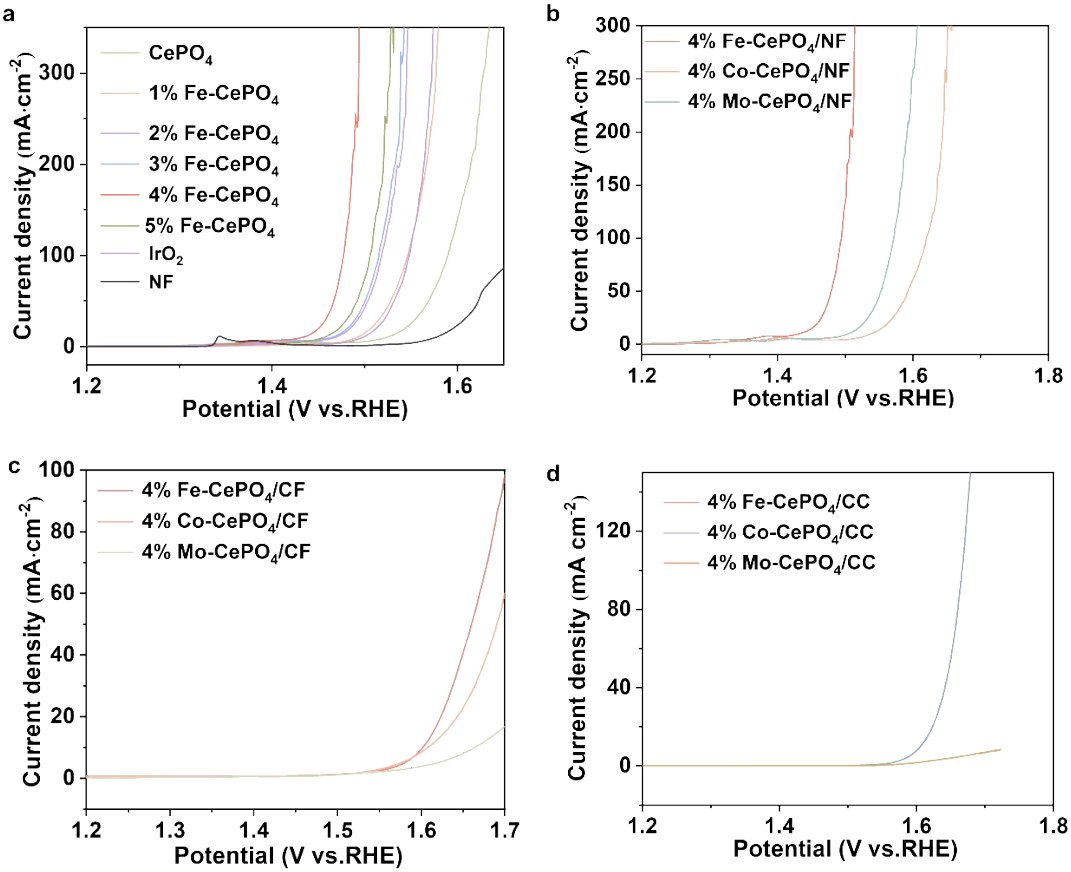

Fig. S2. (a) LSV curves of different Fe doping amounts. $CePO_4$ doped with different doping elements on different catalytic substrates (b) 4%Fe-$CePO_4$、4%Co-$CePO_4$、4%Mo-$CePO_4$ on the foam nickel substrate (c) 4%Fe-$CePO_4$、4%Co-$CePO_4$、4%Mo-$CePO_4$ on the copper foam substrate and (d) 4%Fe-$CePO_4$、 4%Co-$CePO_4$、4%Mo-$CePO_4$ on the carbon fiber cloth substrate.

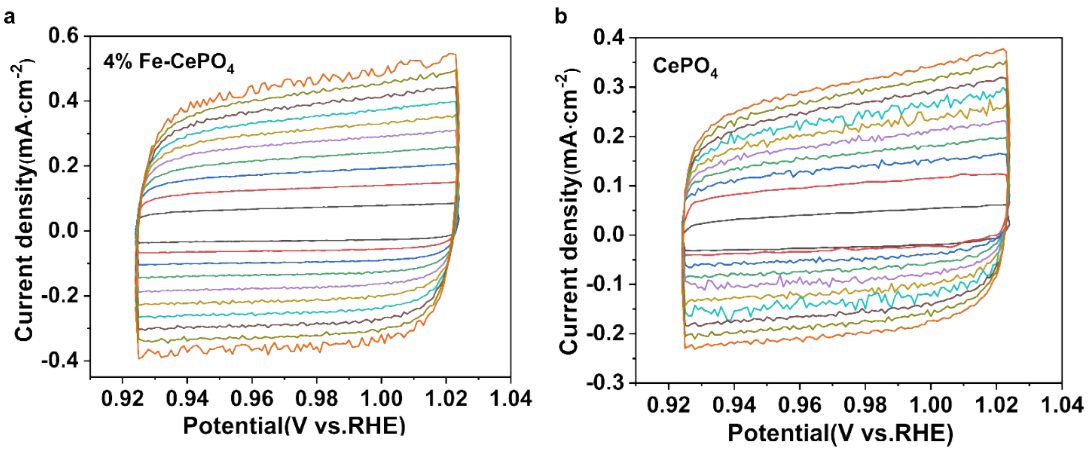

Fig. S3. Cyclic voltammograms of (a) Fe-$CePO_4$, (b) $CePO_4$.

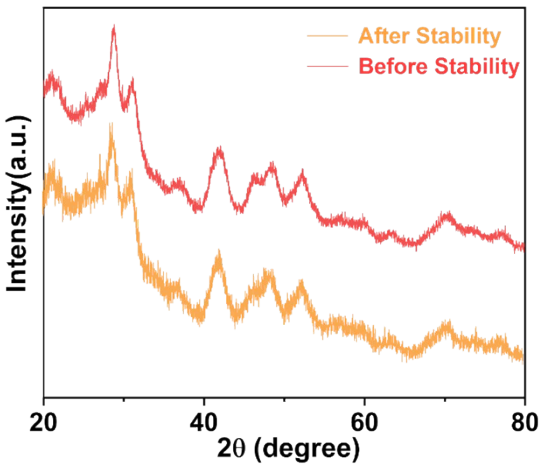

Fig. S4. Comparison chart of XRD before and after stability of Fe-$CePO_4$ sample.

Table S1. ICP-OES characterization of Fe-CePO4 samples

Sample	Element	CC (mg/kg)
Fe-$CePO_4$	Fe	10878.7
	Ce	363023
Theoretical atomic ratio of Fe : Ce =0.08:2		
Experimental atomic ratio of Fe : Ce = 0.07 : 1		

Table S2. Comparison of OER performance for reported electrocatalysts in alkaline electrolytes.

Electrocatalyst	Electrolyte	J ($mA\ cm^{-2}$)	η (mV)	Tafel slope ($mV\ dec^{-1}$)	Ref.
$Fe\text{-}CePO_4$	1M KOH	10	**198**	**52.4**	**This work**
$Ce(OH)_3@NiSe_2$	1M KOH	10	246	37	1, 2
$CeO_2@Co_2N$	1M KOH	10	219	95.8	3
$FeOOH/CeO_2$	1M KOH	10	230	92.3	4
$Co/Ce\text{-}Ni_3S_2$	1M KOH	20	286	71.7	5
$20\%CeO_2@CoS/MoS_2$	1M KOH	10	247	64	6
CoP/CeO_2	1M KOH	10	224	90	7
$Cu@CeO_2@NFC\text{-}0.25$	1M KOH	10	231	33	8
Co_3O_4/CeO_2 NHs	1M KOH	10	270	60	9
NiO/NiFe LDH	1M KOH	10	180	30	10
$NiFe_{0.8}Ce_{0.2}$	1M KOH	10	260	59	11
NiFe-LDH/CeO_2/CeNC	1M KOH	10	235	128.8	12
$CeO_2@$PIZA-1-400	1M KOH	10	370	47.6	13
$Co\text{-}CeO_2/N\text{-}CNR$	0.1M KOH	10	410	90	14
NiCoCe-LDH	1M KOH	10	236	56	15
$Co_3(PO_4)_2@N\text{-}C$	1M KOH	10	290	82	16
FeCoNi-MOF	1M KOH	10	400	72	17
$FeNiCoCrMnS_2$	1M KOH	10	199	10	18

Reference

1. T. Zhang, X. Wu, Y. Fan, C. Shan, B. Wang, H. Xu and Y. Tang, *ChemNanoMat*, 2020, **6**, 1119-1126.
2. S. F. Zai, X. Y. Gao, C. C. Yang and Q. Jiang, *Advanced Energy Materials*, 2021, **11**.
3. J. Zhang, W. He, H. B. Aiyappa, T. Quast, S. Dieckhöfer, D. Öhl, J. R. C. Junqueira, Y. T. Chen, J. Masa and W. Schuhmann, *Advanced Materials Interfaces*, 2021, **8**.
4. J. X. Feng, S. H. Ye, H. Xu, Y. X. Tong and G. R. Li, *Adv Mater*, 2016, **28**, 4698-4703.
5. X. Wu, T. Zhang, J. Wei, P. Feng, X. Yan and Y. Tang, *Nano Research*, 2020, **13**, 2130-2135.
6. W.-H. Huang, X.-M. Li, X.-F. Yang, H.-Y. Zhang, P.-B. Liu, Y.-M. Ma and X. Lu, *Chemical Engineering Journal*, 2021, **420**.
7. R. Zhang, X. Ren, S. Hao, R. Ge, Z. Liu, A. M. Asiri, L. Chen, Q. Zhang and X. Sun, *Journal of Materials Chemistry A*, 2018, **6**, 1985-1990.
8. J. Xia, H. Zhao, B. Huang, L. Xu, M. Luo, J. Wang, F. Luo, Y. Du and C. H. Yan, *Advanced Functional Materials*, 2020, **30**.
9. Y. Liu, C. Ma, Q. Zhang, W. Wang, P. Pan, L. Gu, D. Xu, J. Bao and Z. Dai, *Adv Mater*, 2019, **31**, e1900062.
10. Z. W. Gao, J. Y. Liu, X. M. Chen, X. L. Zheng, J. Mao, H. Liu, T. Ma, L. Li, W. C. Wang and X. W. Du, *Adv Mater*, 2019, **31**, e1804769.
11. H. S. Jadhav, A. Roy, B. Z. Desalegan and J. G. Seo, *Sustainable Energy & Fuels*, 2020, **4**, 312-323.
12. Q. Dong, C. Shuai, Z. Mo, N. Liu, G. Liu, J. Wang, H. Pei, Q. Jia, W. Liu and X. Guo, *Journal of Solid State Chemistry*, 2021, **296**.
13. D.-J. Li, Z.-G. Gu, W. Zhang, Y. Kang and J. Zhang, *Journal of Materials Chemistry A*, 2017, **5**, 20126-20130.
14. A. Sivanantham, P. Ganesan and S. Shanmugam, *Applied Catalysis B: Environmental*, 2018, **237**, 1148-1159.
15. M. Dinari, H. Allami and M. M. Momeni, *Journal of Electroanalytical Chemistry*, 2020, **877**.

16. P. Feng, X. Cheng, J. Li and X. Luo, *Catalysis Letters*, 2017, **148**, 214-219.

17. S. Saha and A. K. Ganguli, *ChemistrySelect*, 2017, **2**, 1630-1636.

18. T. X. Nguyen, Y. H. Su, C. C. Lin and J. M. Ting, *Advanced Functional Materials*, 2021, DOI: 10.1002/adfm.202106229.