

Ternary Metal-Organic Framework of FeCoZn-ZIF as an Efficient Electrocatalyst for the Oxygen Evolution Reaction

Yan E^a, Heng Li^a, Hu Fan^a, Mingkun Du^a, Ke Sun^a, Yuxuan Li^a, Shuo Dong^a, Yijie Liu^a, Yi Liu^a, Xuelin Dong^{a}, Xianxu Chu^{a*}.*

^aHenan Key Laboratory of Biomarker Detection and Diagnosis for Neurodegenerative Diseases, College of Chemistry and Chemical Engineering, Shangqiu Normal University, Shangqiu 476000, PR China.

**Corresponding authors, emails: dongaynu@163.com. xxchu13633@163.com.*

Figure S1–S4

Table S1

Reference

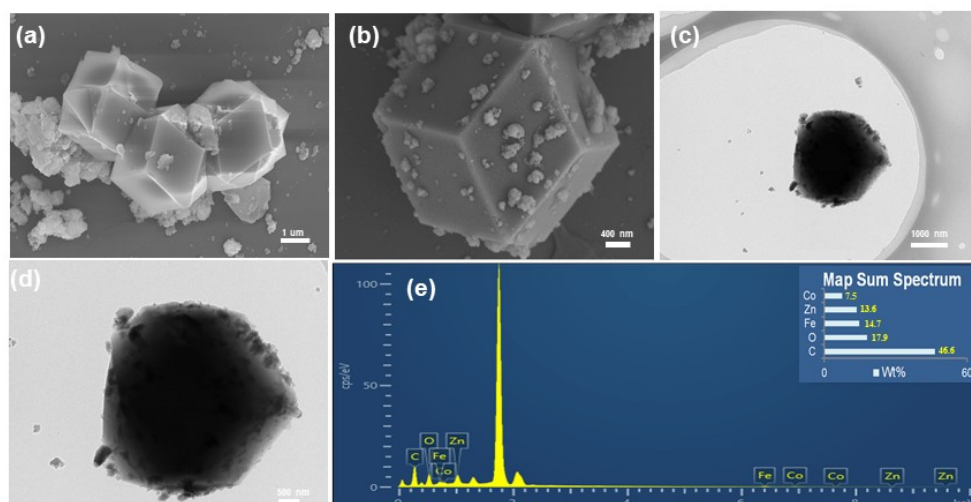


Figure S1. (a, b) SEM images of Fe₁Co₁Zn₂-ZIF, (c, d) TEM images, (e) EDX spectrum.

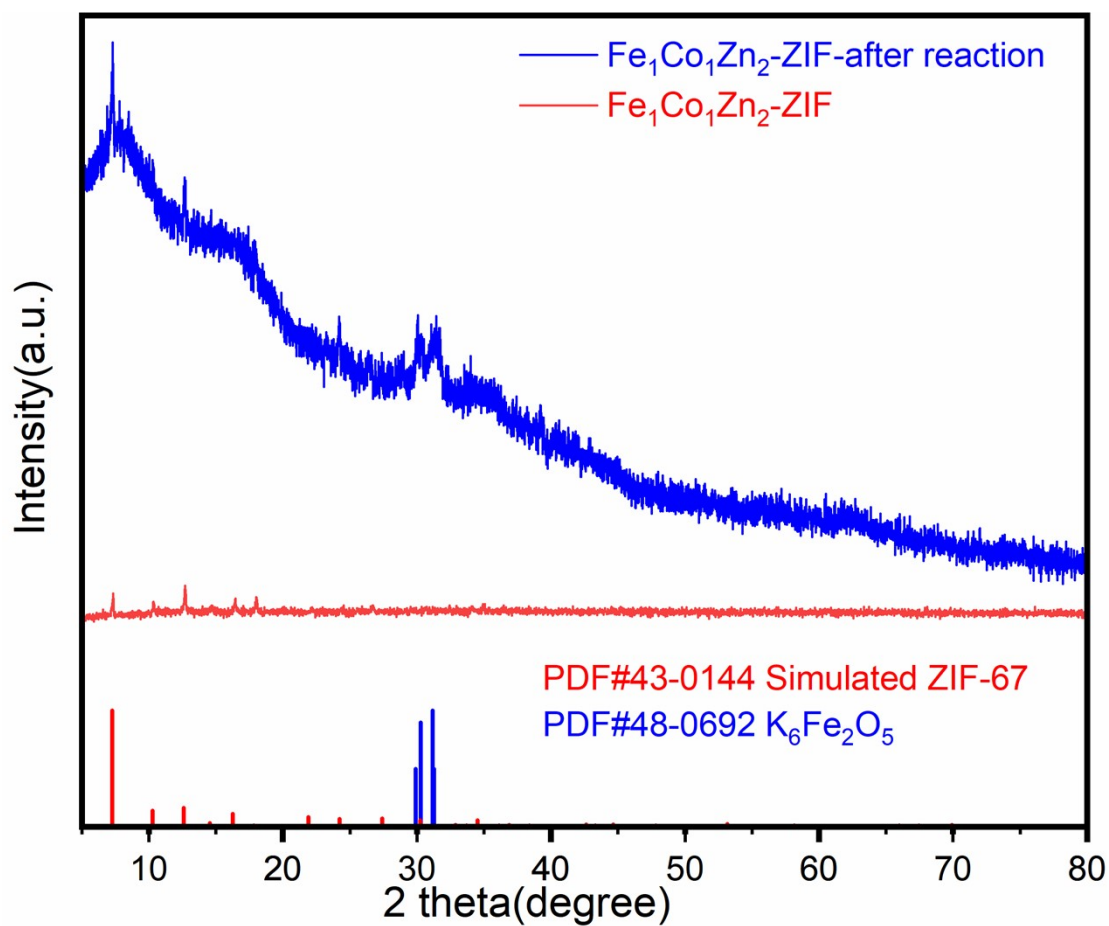


Figure S2. XRD pattern of Fe₁Co₁Zn₂-ZIF before and after stability test (Cu K α).

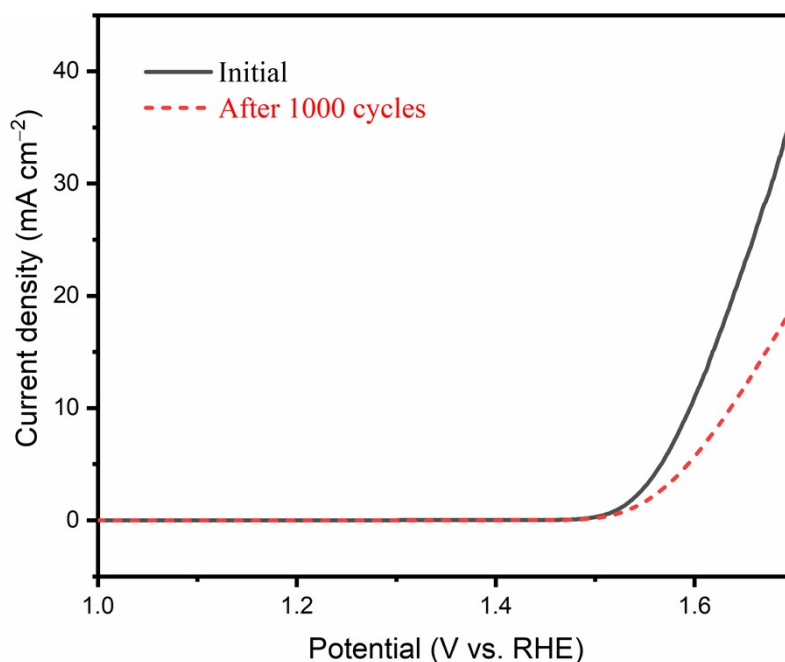


Figure S3. LSV Polarization curve of $\text{Fe}_1\text{Co}_1\text{Zn}_2\text{-ZIF}$ before and after 1000 cycles.

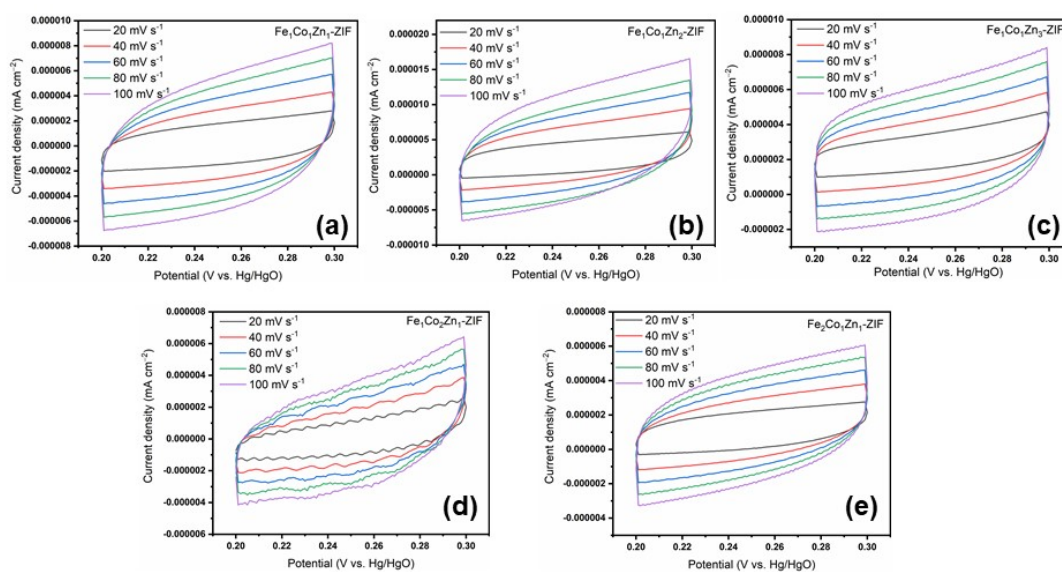


Figure S4. Cyclic voltammograms of different samples at various scan rates: (a) CV curves of $\text{Fe}_1\text{Co}_1\text{Zn}_1\text{-ZIF}$; (b) CV curves of $\text{Fe}_1\text{Co}_1\text{Zn}_2\text{-ZIF}$; (c) CV curves of $\text{Fe}_1\text{Co}_1\text{Zn}_3\text{-ZIF}$; (d) CV curves of $\text{Fe}_1\text{Co}_2\text{Zn}_1\text{-ZIF}$; (e) CV curves of $\text{Fe}_2\text{Co}_1\text{Zn}_1\text{-ZIF}$.

Table S1 Comparison of the OER activities of some ZIF electrocatalysts.

| Catalysts | J (mA cm ⁻²) | Overpotential (mV) | Tafel slope (mV dec ⁻¹) | Stability (h) | Reference |
|--|-----------------------------|-----------------------|--|------------------|-----------|
| ZIF-67 | 10 | 450 | 144 | / | [1] |
| Zn-ZIF-800 | 10 | 595 | / | / | [2] |
| CoZn-ZIF | 10 | 569 | 124.6 | / | [3] |
| Fe-ZIF/NFs | 10 | 612 | 185 | / | [4] |
| FeCo-ZIF/NFs | 10 | 286 | 77 | 12 | [4] |
| NiCo-ZIF | 10 | 445 | 210 | / | [5] |
| NiCoZn-ZIF | 10 | 370 | 126.7 | / | [1] |
| NiCoZn-ZIF/HTTP | 10 | 193 | 97.4 | 6 | [1] |
| ZIF-67-CNT | 10 | 390 | 95.7 | / | [6] |
| ZIF-Co _{0.85} Se | 10 | 360 | 62 | 2.77 | [6] |
| Co-ZIF-550-N ₂ | 10 | 405 | 281 | / | [7] |
| ZIF-8@ZIF-67@POM | 10 | 490 | 88 | 10 | [8] |
| Commerical RuO ₂ | 10 | 366 | 125 | / | [5] |
| Fe ₁ Co ₁ Zn ₂ -ZIF | 10 | 366 | 78.7 | 28 | This work |

Reference

- [1] Li X, Li J, Kurbanjan D, Yu T, Du H. Synergistic effect of trimetallic doping and π - π conjugation in NiZnCo-ZIF@HHTP for efficient oxygen evolution reaction. *J. Electroanal. Chem.* **2023**, 937, 117410.
- [2] Zhang HJ, Chen B, Feng X, Yu M, Luo J, Xue Y. Nanoparticles of CoFeZn supported on N-doped carbon as bifunctional catalysts for oxygen reduction and oxygen evolution. *ACS Appl. Nano Mater.* **2024**, 7, 23054–23061.
- [3] Wang L, Meng T, Chen C, Fan Y, Zhang Q, Wang H, Zhang Y. Facile synthesis of ZnCo-ZIFs-derived $Zn_xCo_{3-x}O_4$ hollow polyhedron for efficient oxygen evolution reduction. *J. Colloid Interface Sci.* **2018**, 532, 650–656.
- [4] Sankar SS, Keerthana G, Manjula K, Sharad JH, Kundu S. Electrospun Fe-incorporated ZIF-67 nanofibers for effective electrocatalytic water splitting. *Inorg. Chem.* **2021**, 60, 4034–4046.
- [5] Wang C, Gao P, Yao X, Sun X, Du H. NiCo-ZIF-based ternary MOF composite materials for high-efficiency and stable oxygen evolution reactions. *CrystEngComm.* **2025**, 27, 5595–5602.
- [6] Wen H, Zhang S, Yu T, Yi Z, Guo R. ZIF-67-based catalysts for oxygen evolution reaction. *Nanoscale.* **2021**, 13, 12058–12087.
- [7] Sankar SS, Ede SR, Anantharaj S, Karthick K, Sangeetha K, Kundu S. Electrospun cobalt-ZIF micro-fibers for efficient water oxidation under unique pH conditions. *Catal Sci Technol* **2019**, 9, 1847–1856.
- [8] Usman K A S, Maina J W, Seyedin S, Conato M T, Payawan L M, Dumée L F, Razal J M. Downsizing metal–organic frameworks by bottom-up and top-down methods *NPG Asia Mater.* **2020**, 12, 58.