

Supporting Information

Constructing Ru doped Fe/nickel foam with efficient oxygen evolution reaction using a simple one-step electrodeposition technique

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Supporting Figures

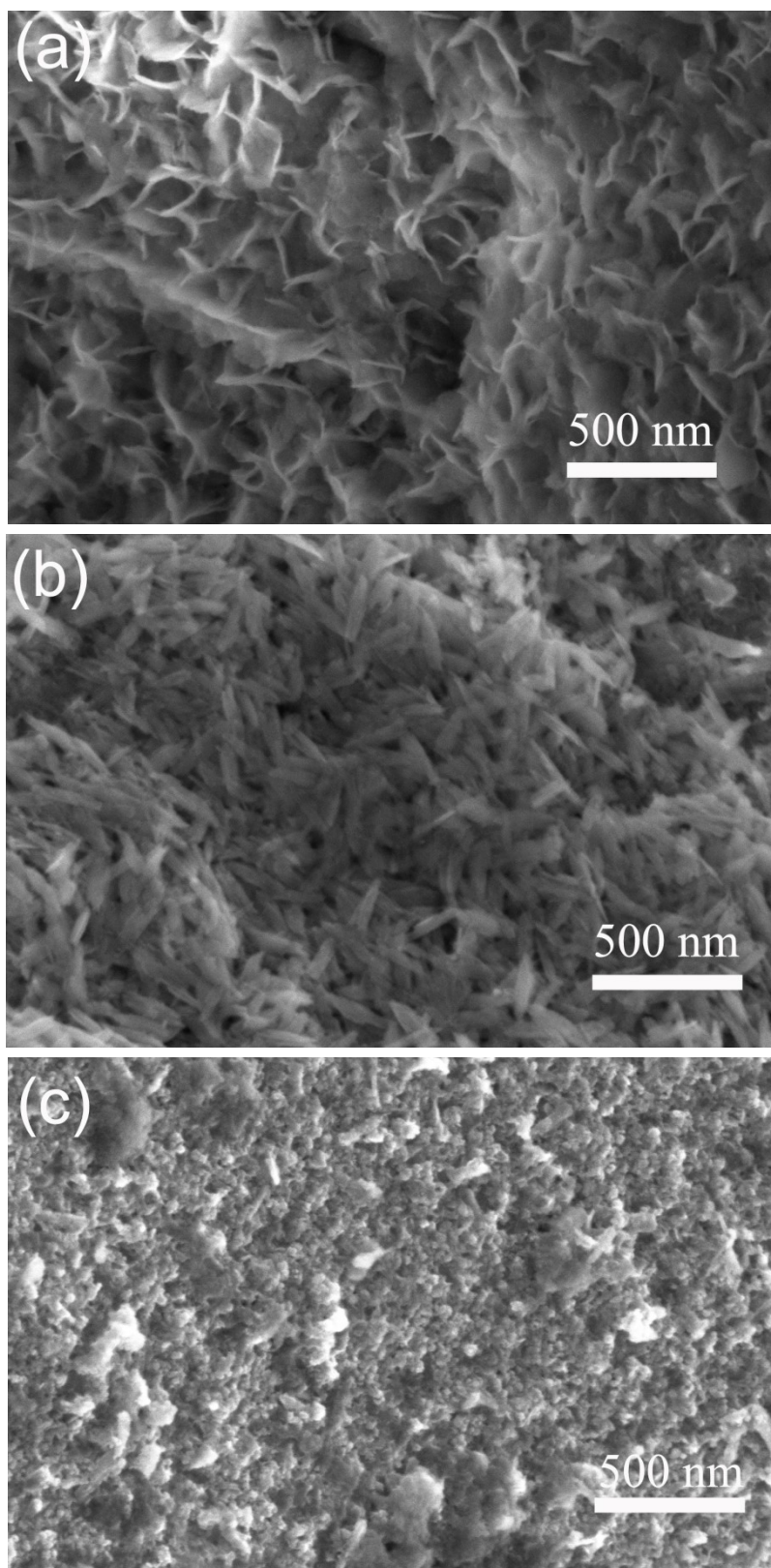


Fig. S1 SEM images of (a) Fe/NF-1.5, (b) Fe/NF-2.5 and (c) Fe/NF-3.5.

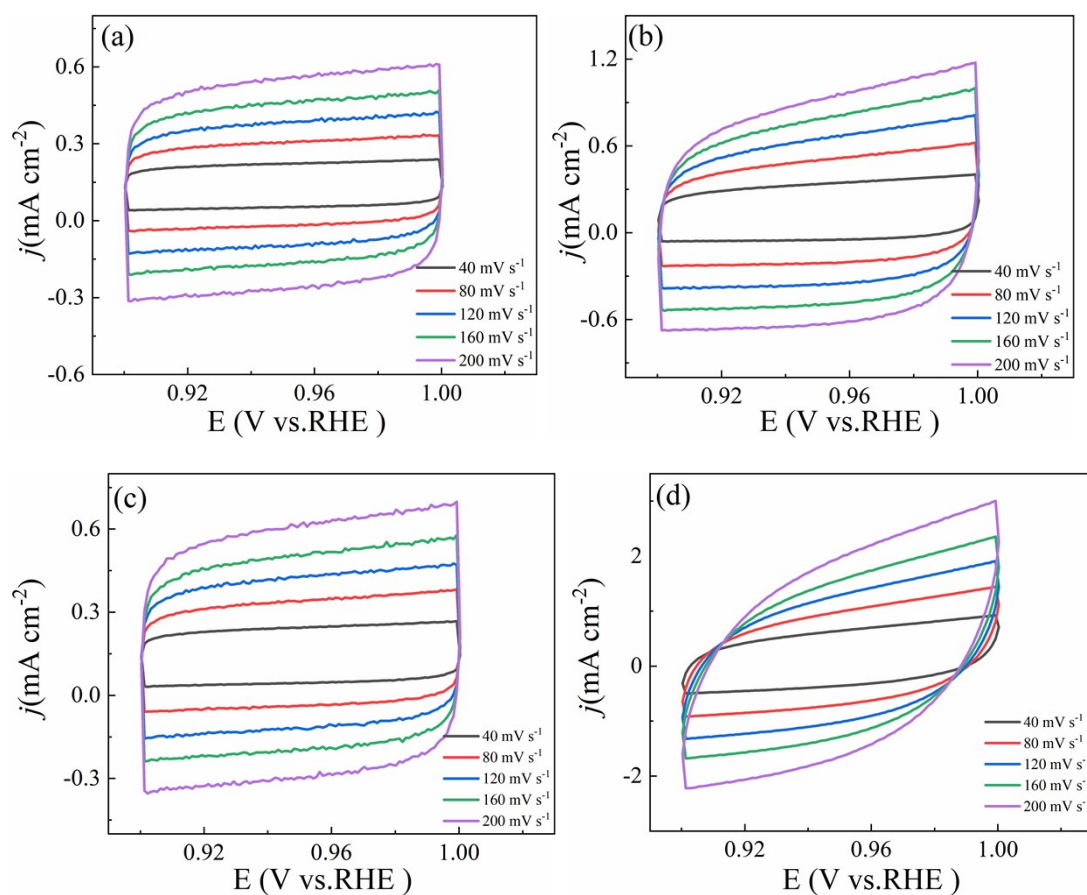


Fig. S2 CV curves of (a) Fe/NF-1.5, (b) Fe/NF-2.5, (c) Fe/NF-3.5 and (d) Ru-0.01-Fe/NF-2.5.

Supporting Tables

Table S1 The proportion of Fe, Ni, Ru, O, and C elements in Ru-0.01-Fe/NF-2.5

Element	Fe	Ni	Ru	O	C
At. %	4.31	3.95	0.28	43.28	48.18

Table S2. Comparison of electrocatalytic OER performance of Ru-0.01-Fe/NF-2.5 with other reported OER electrocatalysts.

Catalysts	Overpotential at 100 mA cm ⁻² (mV)	References
Ru-0.01-Fe/NF-2.5	168	This work
CF-Ru 100 mM	280	Journal of Alloys and Compounds

		1025 (2025) 180409.
FeOOH/Co(OH) ₂	265	Adv. Mater., 36(2024) 2305685.
Pt-NiFe-MOF/NF	261	Inorganic Chemistry, 63 (2024) 5167.
Ce-NiS _x /FeS/NF	280	Applied Surface Science 627(2023) 157287.
CF-FeSO	230	Nat. Commun., 13(2022) 605.
FeNiOOH(Se)/IF	279	Journal of the American Chemical Society 141(2019) 7005.
Ni(OH) ₂ /NF	290	Advanced Materials Interfaces 6(2019) 1900788.
CoFeV LDH/NF	330	ACS Sustainable Chemistry & Engineering 7(2019) 16828.
Fe _{17.5%} -Ni ₃ S ₂ /NF	249	ACS Catal., 8(2018) 5431-5441.
N-Ni ₃ S ₂ /NF	340	Adv. Mater., 29(2017) 1701584.

Table S3 Electrochemically active surface area (ECSA) of the electrocatalysts

Catalysts	Fe/NF-1.5	Fe/NF-2.5	Fe/NF-3.5	Ru-0.01-Fe/NF-2.5
ECSA	50.12	90.12	54.37	194.88

Table S4 Comparison of OWS properties of Ru-0.01-Fe/NF-2.5 with other electrocatalysts reported in recent years.

Electrodes of the electrolytic cell	j (mA cm ⁻²)	Cell voltage η (V)	Reference
Pt/C//Ru-0.01-Fe/NF-2.5	10	1.46	This work
Pt/C//CF-Ru100 mM	10	1.47	[1] Journal of Alloys and Compounds 1025 (2025) 180409
Ir-Co(OH) ₂ -5//Pt/C	10	1.54	[2] Dalton Transactions, 51 (2022) 1527-1532
Ru/NF//Ru/NF	10	1.50	[3] Nanoscale, 16 (2024) 6662-6668.
Pt/C//Co _{0.7} -xFe _{0.3} -yP/Co _x Fe _y OOH	10	1.54	[4]Advanced Functional Materials, 35(2025)2425770.
Ru/D-CTFs-900//Ru-RuO ₂ /D-CTFs-300	10	1.47	[5] Journal of Energy Chemistry, 50 (2020) 135-142.
N-NiCo-LDH//N-NiCo-LDH	10	1.55	[6] Journal of Materials Chemistry A, 9 (2021) 10260-10269.
Pt/C/NF//FNMO/NF	100	1.66	[7] Chem. Commun., 2024, 60, 14224
Co-P-1/NF//Co-P-1/NF	10	1.60	[8] Molecules, 28(2023) 6101
NiFeMo//NiFeMoC _x	10	1.52	[9] Catalysts, 14 (2024) 730.
Mn ₃ O ₄ /MnO/RuO ₂ @C//Mn ₃ O ₄ /MnO/RuO ₂ @C	10	1.55	[10] International Journal of Hydrogen Energy, 158 (2025) 150504.

[1] X.J. Niu, Y.L. Ma, J.Y. Gao, Z.H. Lu, J.S. Li, Interfacial engineering of RuO₂/CoOOH heterojunction for efficient oxygen evolution reaction, Journal of Alloys and Compounds, 1025 (2025) 180409.

- [2] Z. Li, D. Liu, X. Lu, M. Du, Z. Chen, J. Teng, R. Sha, L. Tian, Boosting oxygen evolution of layered double hydroxide through electronic coupling with ultralow noble metal doping, *Dalton Transactions*, 51 (2022) 1527-1532.
- [3] Y. Hou, Z. Qin, X. Han, Y. Liu, W. Zhang, X. Cao, Y. Cao, J.-P. Lang, H. Gu, Thermal evaporation-driven fabrication of Ru/RuO₂ nanoparticles onto nickel foam for efficient overall water splitting, *Nanoscale*, 16 (2024) 6662-6668.
- [4] J. Fan, J. Jiang, Y. Wang, X. Zhang, Y. Liu, X. Yang, T. Pan, D. Xu, N. Shi, Y. Lin, M. Han, H. Pang, Etching Accelerates Reconstruction and Activates Lattice Oxygen of Anion Vacancies-Enriched Cobalt-Iron Phosphide/(O_{xy})Hydroxide Nanohybrid Frameworks for Enhanced Oxygen Evolution, *Advanced Functional Materials*, 35 (2025) 2425770.
- [5] X. Gao, Y. Gao, S. Li, J. Yang, G. Zhuang, S. Deng, Z. Yao, X. Zhong, Z. Wei, J. Wang, Defect CTF derived Ru-based catalysts for high performance overall water splitting reaction, *Journal of Energy Chemistry*, 50 (2020) 135-142.
- [6] Y. Wen, J. Qi, P. Wei, X. Kang, X. Li, Design of Ni₃N/Co₂N heterojunctions for boosting electrocatalytic alkaline overall water splitting, *Journal of Materials Chemistry A*, 9 (2021) 10260-10269.
- [7] J.-Y. Gao, Y.-L. Ma, G.-S. Qian, M.-Y. Si, L.-L. Han, J.-S. Li, Activating FeMoO₄ nanosheet arrays by partial nickel substitution for efficient electrocatalytic seawater oxidation, *Chemical Communications*, 60 (2024) 14224-14227.
- [8] X. He, J. Cai, J. Zhou, Q. Chen, Q. Zhong, J. Liu, Z. Sun, D. Qu, Y. Li, Facile Electrochemical Synthesis of Bifunctional Needle-like Co-P Nanoarray for Efficient Overall Water Splitting, in: *Molecules*, 2023.
- [9] J. Mo, N. Fu, S. Mu, J. Peng, Y. Liu, G. Zhang, Facile Synthesis of Metal/Carbide Hybrid toward Overall Water Splitting, *Catalysts*, 14 (2024) 730.
- [10] J. Zhang, S. Li, J. Cao, L. Hu, Y. Ren, J. Yao, X. Wang, J. Zhu, Synergistic interface engineering in carbon-coated Mn₃O₄/MnO/RuO₂ heterostructure toward high-performance overall water splitting, *International Journal of Hydrogen Energy*, 158 (2025) 150504.

