catalysts

Supplementary Materials

Coupling $LaNiO_3$ Nanorods with FeOOH Nanosheets for Oxygen Evolution Reaction

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The synthesis of 0.25Fe/LNO: 0.125 mmol K_2FeO_4 was dissolved in 50 ml 6 M NaOH solution by sonication for 10 min. Then, the solution was stirred for 24 hours, and the FeOOH samples were obtained after being washed several times with DI water. Then, all the FeOOH obtained was mixed with 0.375 mmol LNO and ground for 30 minutes to obtain 0.25 Fe/LNO.

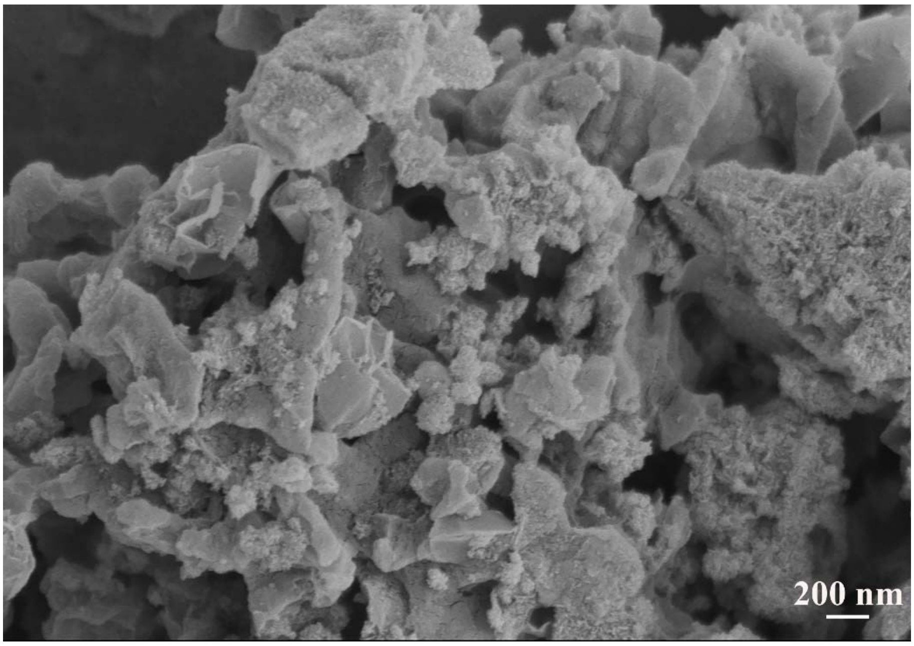

Figure S1. SEM image of FeOOH nanosheets.

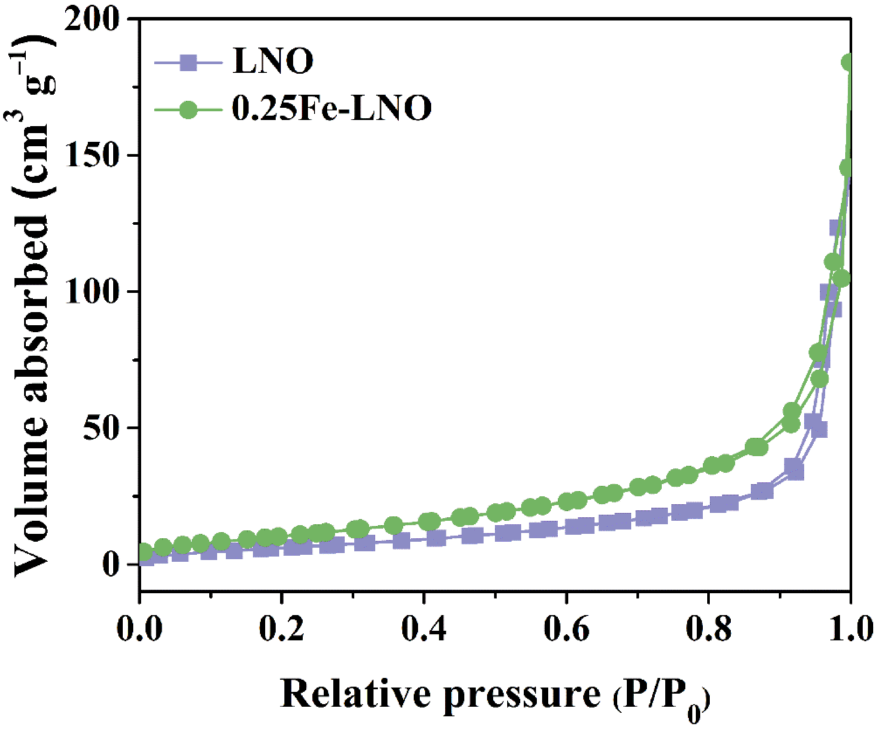

Figure S2. N_2 adsorption–desorption isotherms of LNO and 0.25Fe-LNO.

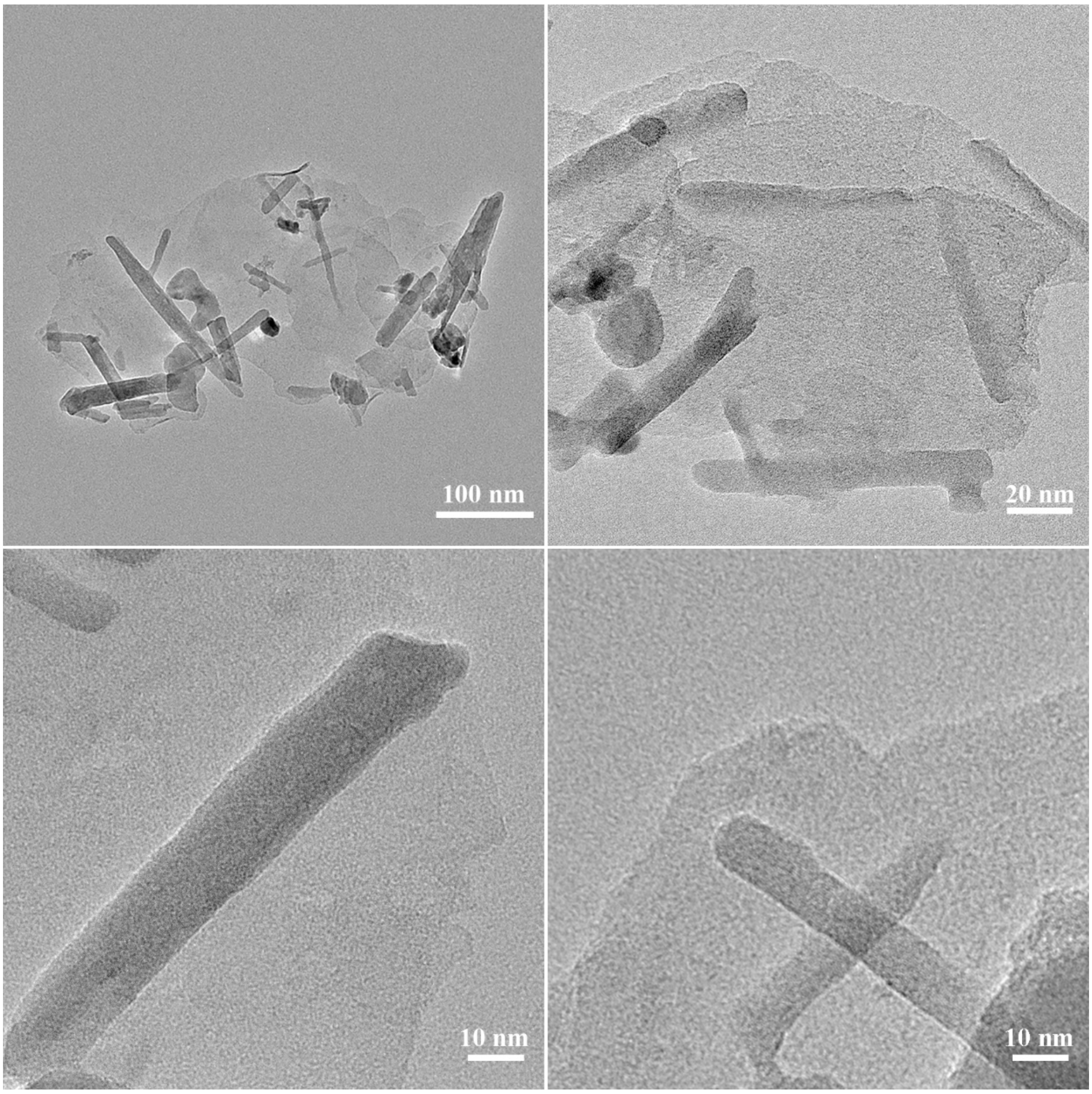

Figure S3. TEM image of 0.25Fe-LNO

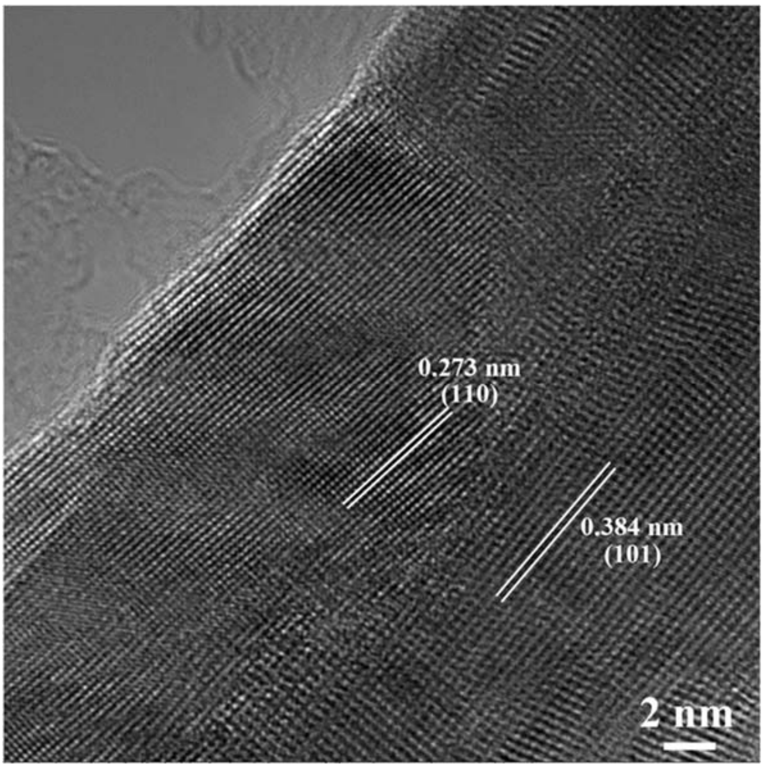

Figure S4. HRTEM image of LNO

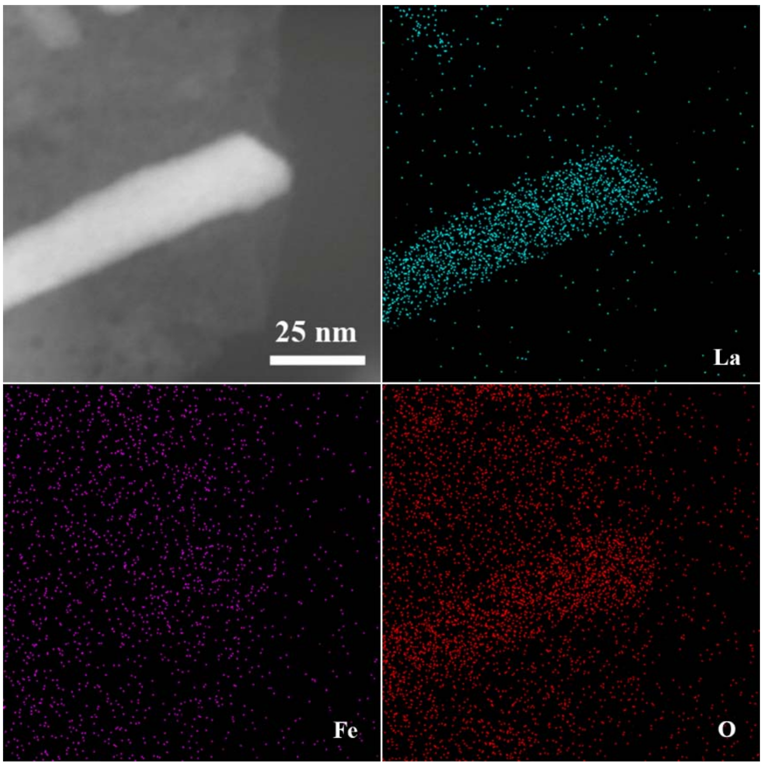

Figure S5. HAADF-TEM image of 0.25Fe-LNO and the corresponding elemental mapping images

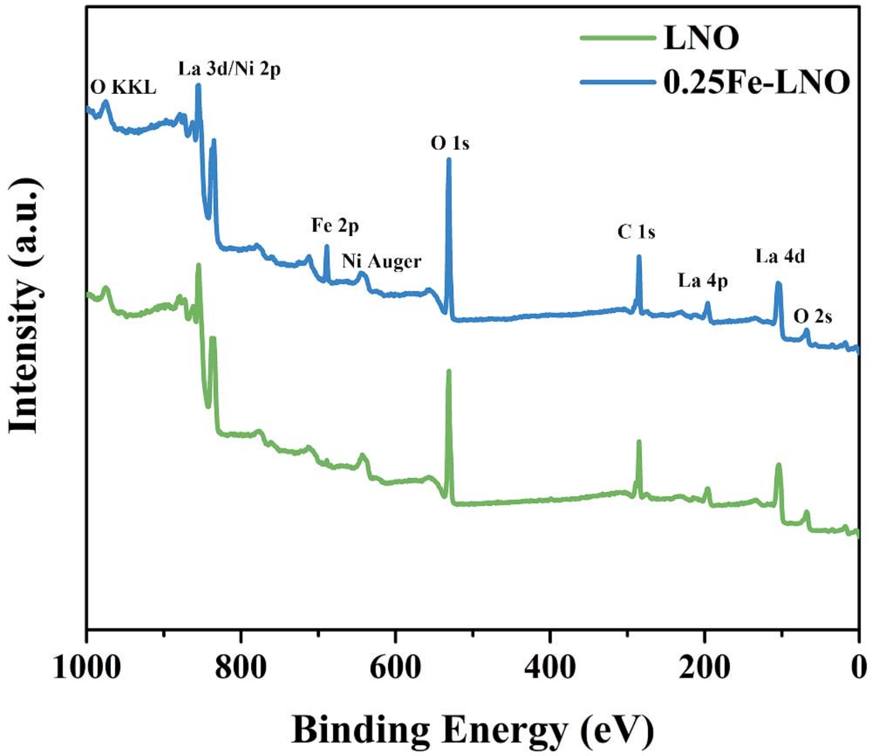

Figure S6. XPS survey spectra of LNO and 0.25Fe-LNO

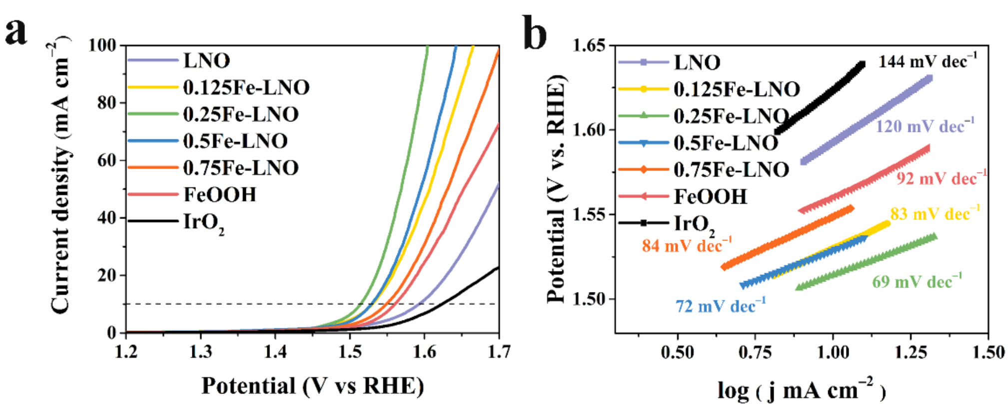

Figure S7. (**a**) LSV of LNO, FeOOH, Fe-LNO and IrO_2 samples. (**b**) The corresponding Tafel plots.

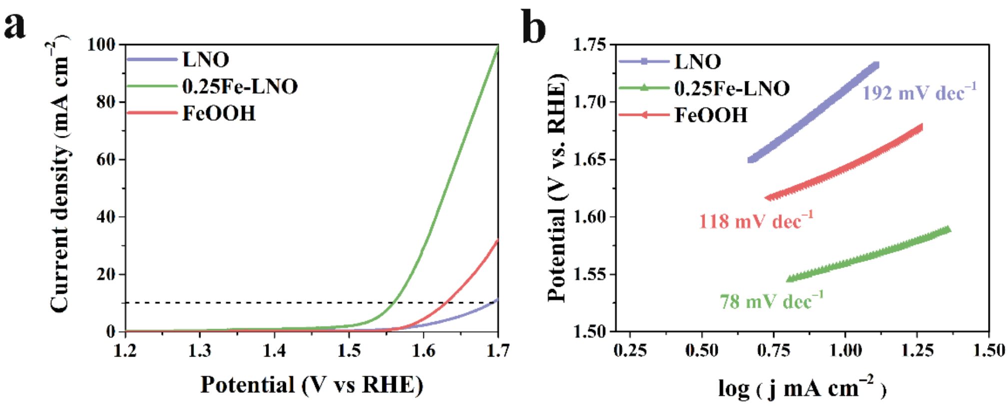

Figure S8. (**a**) LSV of LNO, FeOOH and 0.25Fe-LNO samples without Ketjenblack carbon. (**b**) The corresponding Tafel plots.

With Ketjenblack carbon, the overpotentials of 0.25Fe-LNO, LNO and FeOOH are 284 mV, 363 mV and 330 mV, respectively, while without Ketjenblack carbon, the overpotentials become 329 mV, 482 mV and 413 mV, respectively. The addition of Ketjen Black can improve the performance of these catalysts to varying degrees, and the positive effect on LNO (119 mV) and FeOOH (83 mV) is greater than that of 0.25Fe-LNO (45 mV). The resistivities of LNO (0.32 Ω·cm) and 0.25Fe-LNO (0.17 Ω·cm) were also tested by a four-probe resistance tester, which further demonstrated the enhanced conductivity of 0.25Fe-LNO.

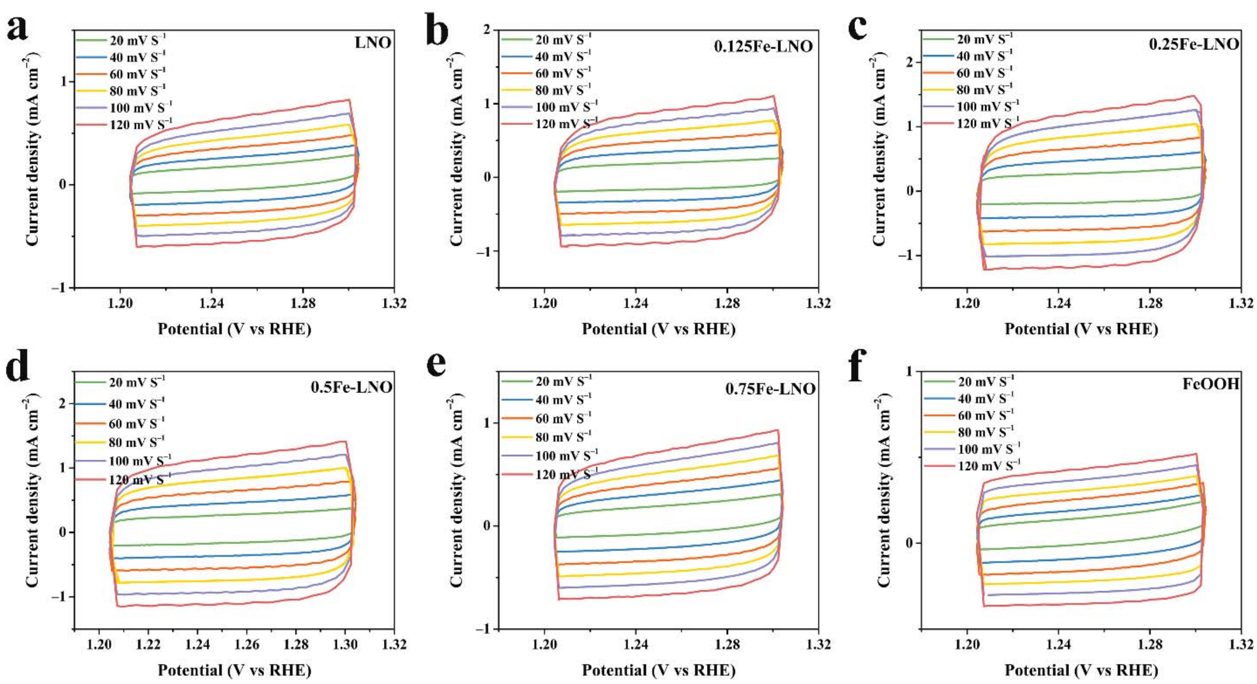

Figure S9. CV curves measured from 20 mV S^{-1} to 120 mV S^{-1} of (**a**) LNO, (**b**) 0.125Fe-LNO, (**c**) 0.25Fe-LNO, (**d**) 0.5Fe-LNO, (**e**) 0.75Fe-LNO and (**f**) FeOOH.

According to the excellent work of the Risch group, the selection of a CV measuring window, the scan rates and the data are reasonable in this paper. The percentage of non-linearity (%nL) was used to assess the suitability of a linear model, and the %nL of every sample obtained was less than 2.5%, proving the reliability of the data.[1]

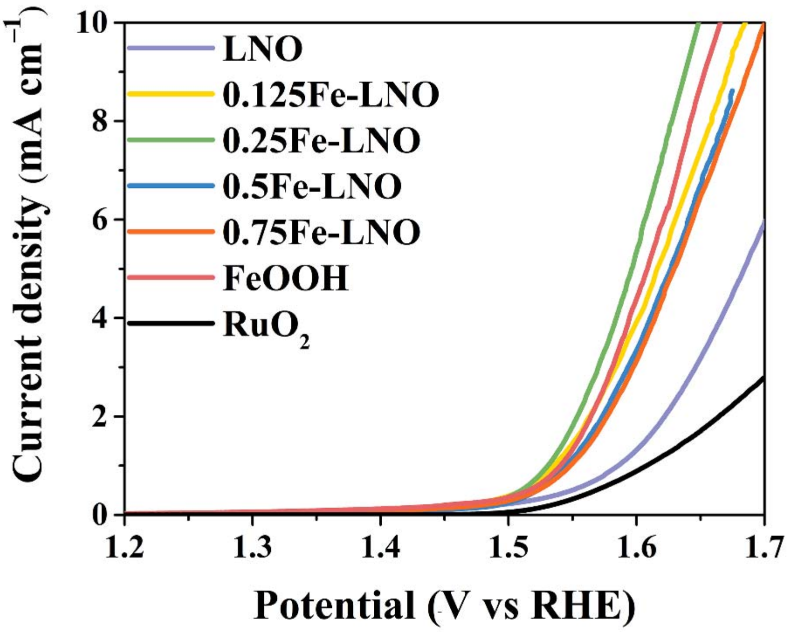

Figure S10. ECSA-normalized LSV of LNO, xFe-LNO, FeOOH and RuO_2

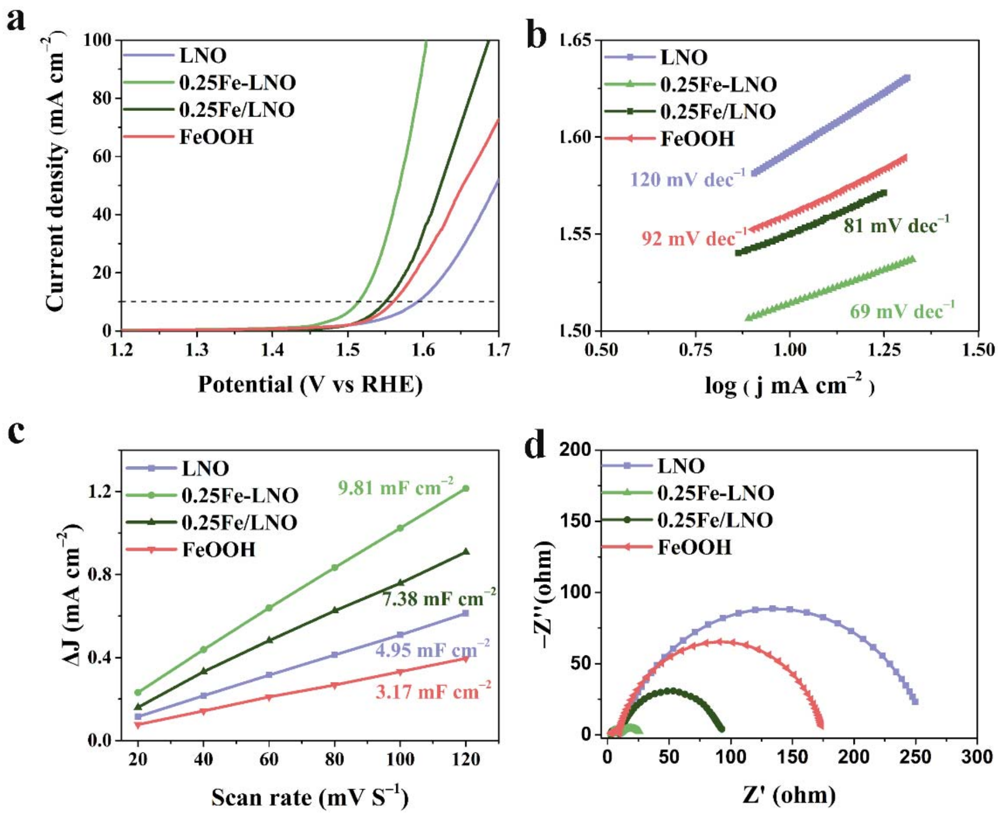

Figure S11. (**a**) LSV of LNO, FeOOH, 0.25Fe-LNO and 0.25Fe/LNO samples. (**b**) The corresponding Tafel plots. (**c**) Linear fits of half capacitive currents versus scan rates for the extraction of the double-layer capacitances. (**d**) Nyquist plots.

0.25Fe/LNO displays increased OER activity compared to LNO and FeOOH, with the overpotential of 320 mV at 10 mA cm^{-2} and the Tafel slope of 81 mV dec^{-2}.

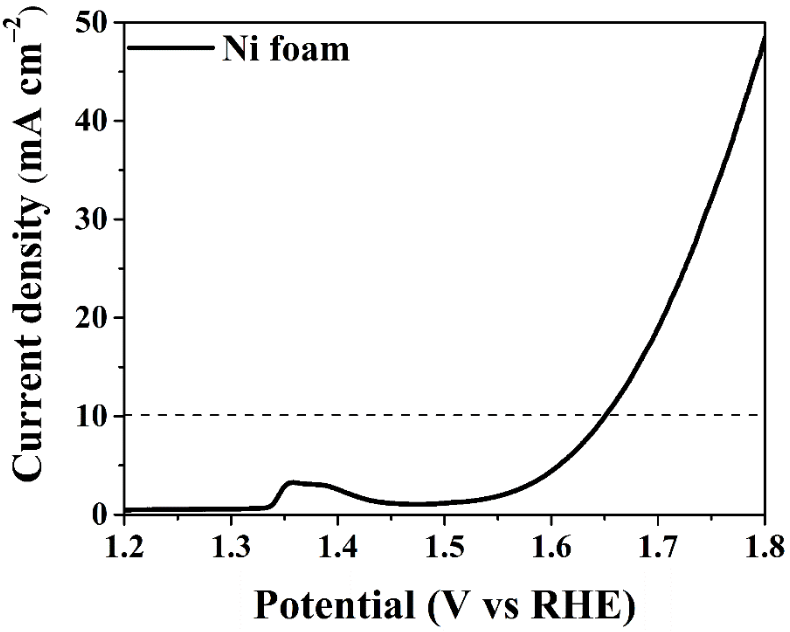

Figure S12. The LSV of Ni foam.

Table S1. The fitting parameters of Nyquist plots

Sample	LNO	0.125Fe-LNO	0.25Fe-LNO	0.5Fe-LNO	0.75Fe-LNO	FeOOH
R_s (Ω)	2.8	2.9	3.0	2.8	2.8	2.7
R_i (Ω)	7.0	7.5	6.2	7.0	9.6	6.2
R_{ct} (Ω)	250.6	75.8	19.1	27.3	93.2	166.4

Table S2. TOF @ 1.60 V vs. RHE (S^{-1}) of LNO, xFe-LNO and FeOOH samples

Sample	LNO	0.125Fe-LNO	0.25Fe-LNO	0.5Fe-LNO	0.75Fe-LNO	FeOOH
TOF @ 1.60 V vs. RHE (S–1)	0.031	0.114	0.243	0.122	0.055	0.022

The number of active sites is not clear; the value assumes the mole amount of all Ni and Fe atoms in each catalyst [2]. The atomic ratios of samples are calculated from the results of the energy-dispersive X-ray spectroscopy (EDS).

Table S3. Atomic ratios of xFe-LNO from the SEM-EDS results

Atomic percent (%)	0.125Fe-LNO	0.25Fe-LNO	0.5Fe-LNO	0.75Fe-LNO
La L	19.33	21.05	16.91	14.02
Ni K	21.70	22.32	18.92	15.51
Fe K	1.07	2.22	5.22	12.28
O K	57.90	54.52	58.95	58.20

The low atomic percentage of Fe is caused by the incomplete hydrolysis of K_2FeO_4 within 24 h

References

1. Morales, D.M.; Risch, M. Seven steps to reliable cyclic voltammetry measurements for the determination of double layer capacitance. *J. Phys. -Energy* **2021**, *3*, 034013. https://doi.org/10.1088/2515-7655/abee33.
2. Chen, Q.; Gong, N.; Zhu, T.; Yang, C.; Peng, W.; Li, Y.; Zhang, F.; Fan, X. Surface Phase Engineering Modulated Iron-Nickel Nitrides/Alloy Nanospheres with Tailored d-Band Center for Efficient Oxygen Evolution Reaction. *Small* **2022**, *18*, e2105696. https://doi.org/10.1002/smll.202105696.