Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Deciphering the role of Fe impurities in the electrolyte boosting the OER activity of $LaNiO_3$

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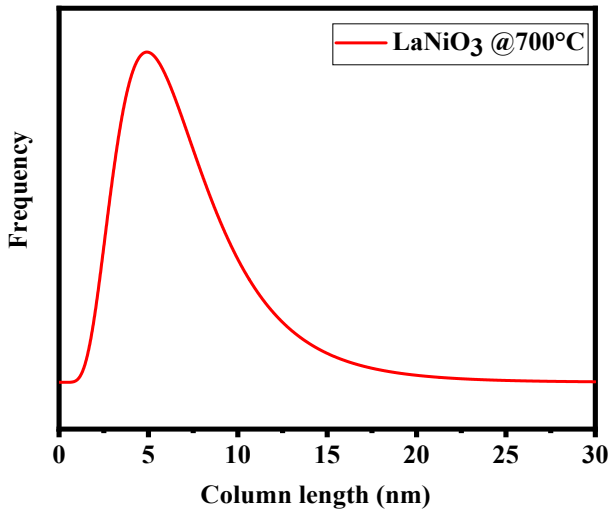

Figure S1. Column length distribution of $LaNiO_3$ obtained at 700 °C.

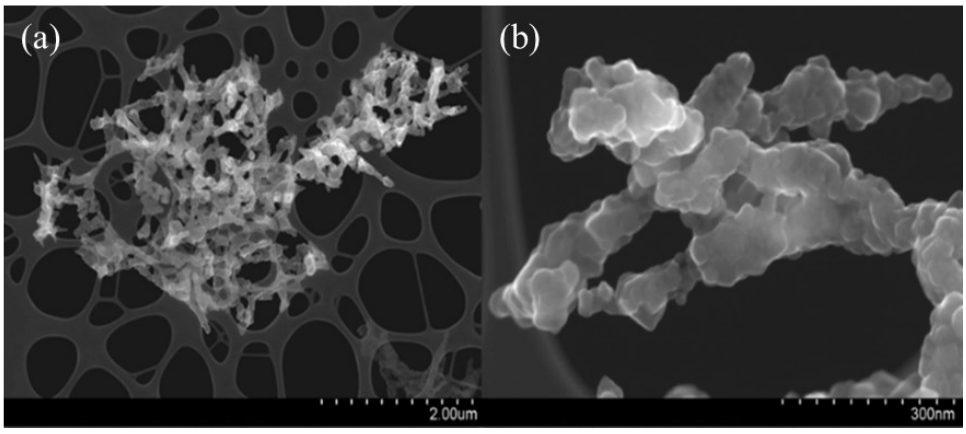

Figure S2. Scanning electron microscopy images of $LaNiO_3$ shown in different magnifications (a) and (b).

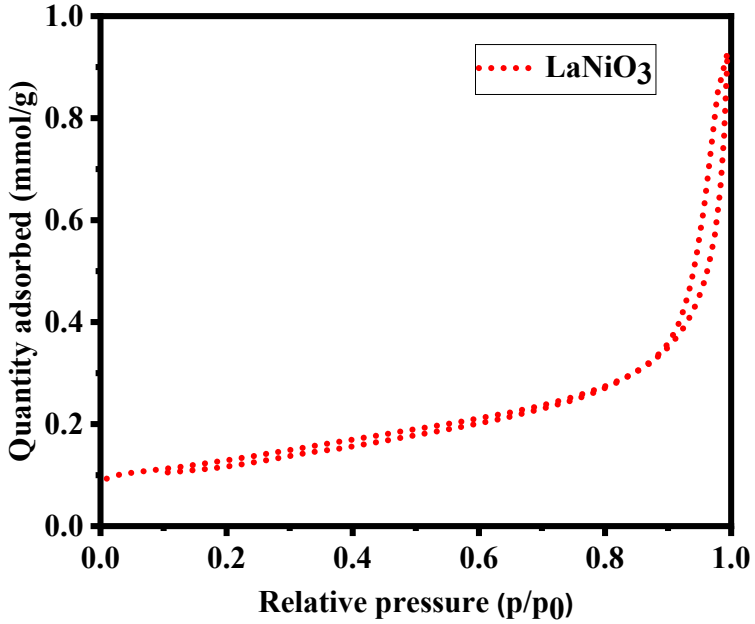

Figure S3. Nitrogen physisorption isotherms of $LaNiO_3$.

Electrolyte	Fe /ppm
1 M commercial KOH solution	0.43
Purified KOH solution	0.005
Purified KOH solution + 1 ppm Fe	1.34
Purified KOH solution + 3 ppm Fe	3.22
Purified KOH solution + 7.5 ppm Fe	7.60
Purified KOH solution + 10 ppm Fe	10.65

Table S1. ICP-OES data of 1 M KOH under controlled addition of Fe impurities.

Samples	$R_{electrolyte}$ /Ω	R_{ct} /Ω
Purified KOH solution	1.5	10.8
Purified KOH solution + 1 ppm Fe	1.5	4.5
Purified KOH solution + 3 ppm Fe	1.4	1.4
Purified KOH solution + 7.5 ppm Fe	1.4	0.6
Purified KOH solution + 10 ppm Fe	1.8	1.1

Table S2. Nyquist plot fits using the Randles circuit.

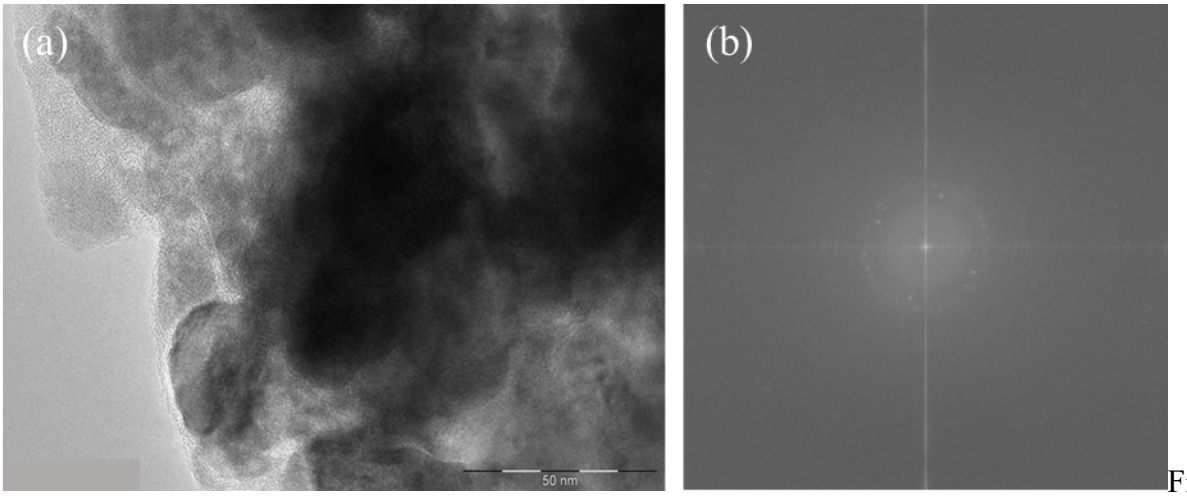

Figure S4. (a) TEM image and (b) its corresponding Fast Fourier Transform (FFT) of $LaNiO_3$ obtained after the stability test. The presence of reflections in the FFT indicates that the crystallinity is preserved during the stability test.

Raman shift /cm^{-1}	Vibrational modes
~156	Internal vibration of La
~209	Rotational vibration corresponding to structural distortion
~400, ~451	Vibration modes of the oxygen octahedra
~474, ~555	Bending and stretching modes of Ni-O in NiOOH[1]
~825	O-O stretch of adsorbed *O-OH species on the Au surface[2]

Table S3. Different Raman modes of $LaNiO_3$. [3, 4]

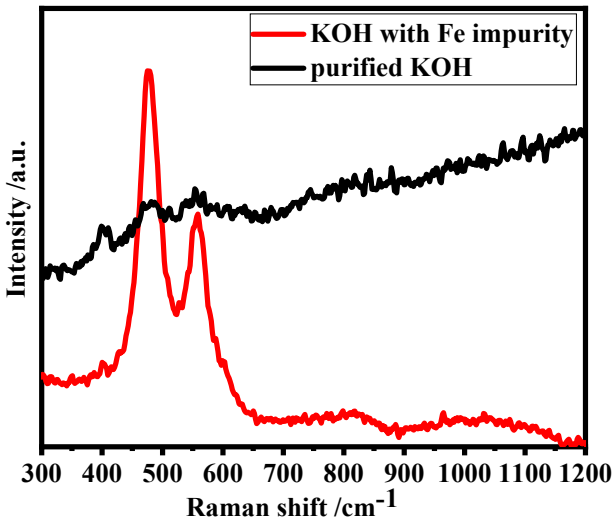

Figure S5. Comparison of Raman spectra of $LaNiO_3$ with the one obtained at a potential of 1.5 V in 1 M KOH with additional Fe impurities.

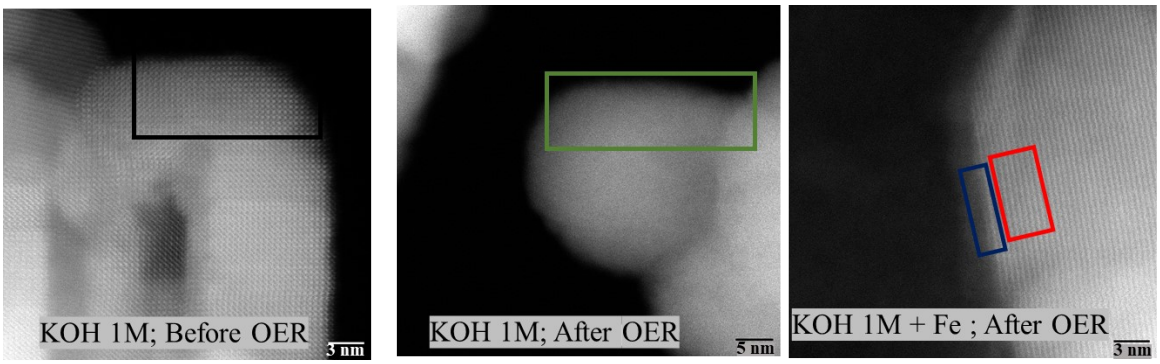

Figure S6. STEM images of $LaNiO_3$ under different conditions. The EELS spectra are collected from the respective marked regions; before OER (black colour), after OER in 1M KOH (green colour), nanoparticles after OER in 1M KOH with Fe impurities, the amorphous layer formed after OER in 1M KOH with Fe impurities.

Sample	La (ppm)	Ni (ppm)	Fe (ppm)
Electrolyte before OER	-	-	7.6
Electrolyte after OER	0.4	-	5.8

Table S4. ICP-OES data of the electrolyte before and after OER.

REFERENCES

1. L. Trotochaud, S. L. Young, J. K. Ranney and S. W. Boettcher, *J Am Chem Soc*, 2014, **136**, 6744-6753.
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3. N. Chaban, M. Weber, S. Pignard and J. Kreisel, *Applied Physics Letters*, 2010, **97**.
4. A. Schober, J. Fowlie, M. Guennou, M. C. Weber, H. Zhao, J. Íñiguez, M. Gibert, J.-M. Triscone and J. Kreisel, *APL Materials*, 2020, **8**.