SUPPLEMENTARY INFORMATION

Improved Electrocatalytic Oxidation of Artificial Seawater with an Applied Magnetic Field in a Forward Osmosis System

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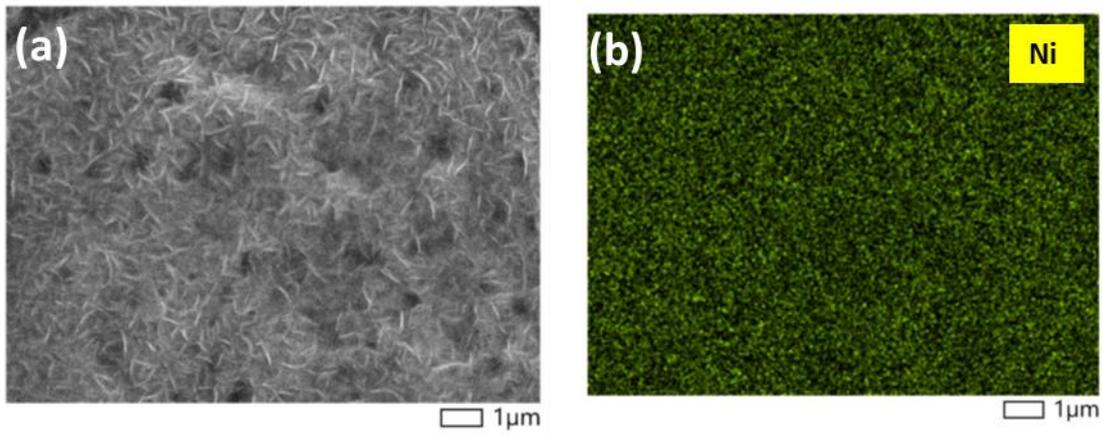
E-mail: mats.johnsson@su.se

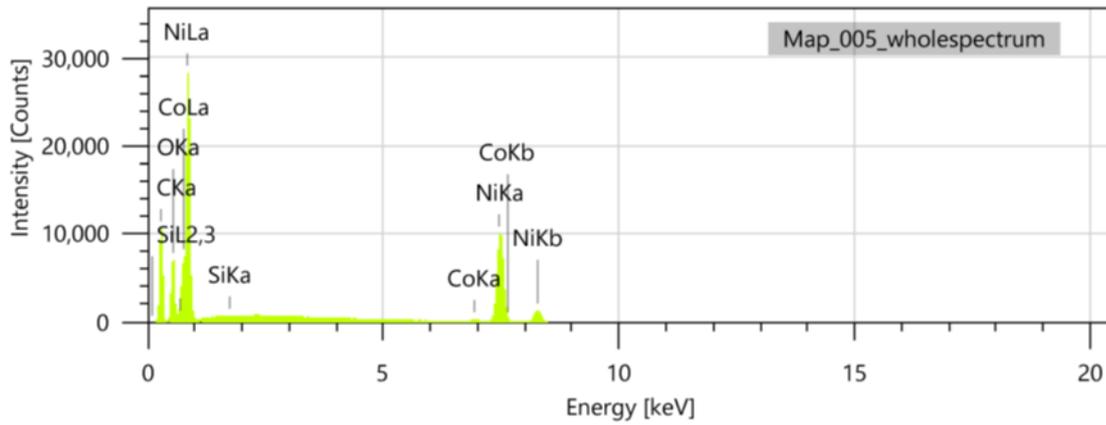Figure S1. (a) SEM image and (b) EDS mapping of Ni-NiO.

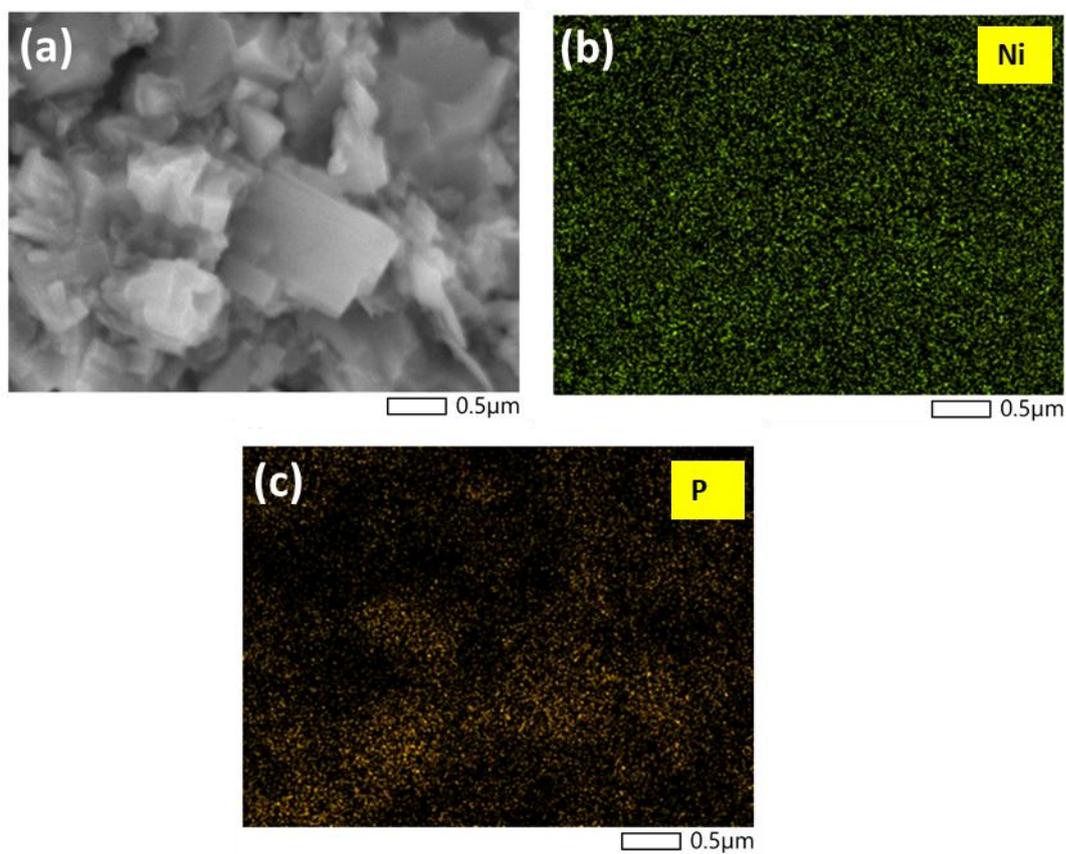Figure S2. EDS spectra of Ni-NiO. (The trace of Co comes from the holder)

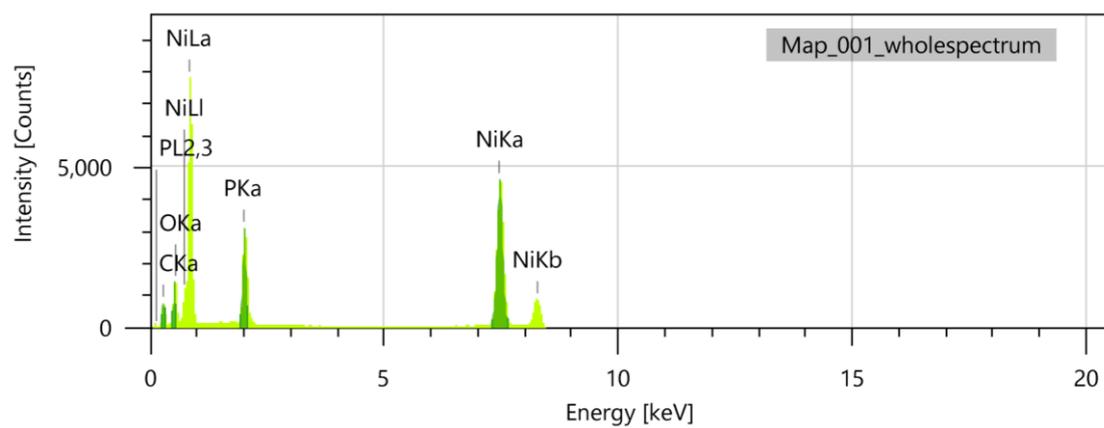Figure S3. (a) SEM image and (b-c) EDS mapping of Ni-NiPO.
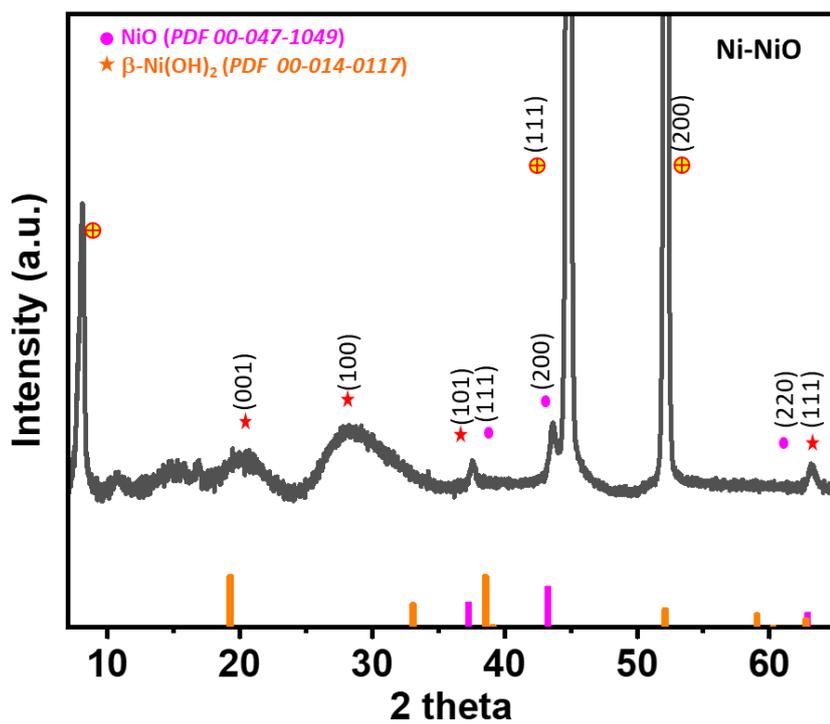

Figure S4. EDS spectra of Ni-NiPO.
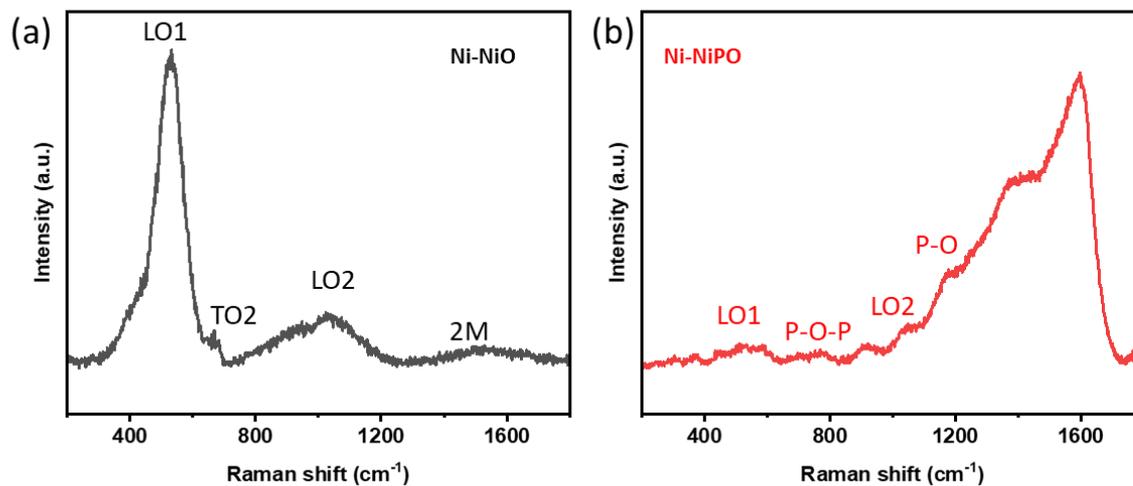
Figure S5. XRD of Ni-NiO.

Figure S6. Raman spectra of (a) Ni-NiO and (b) Ni-NiPO.
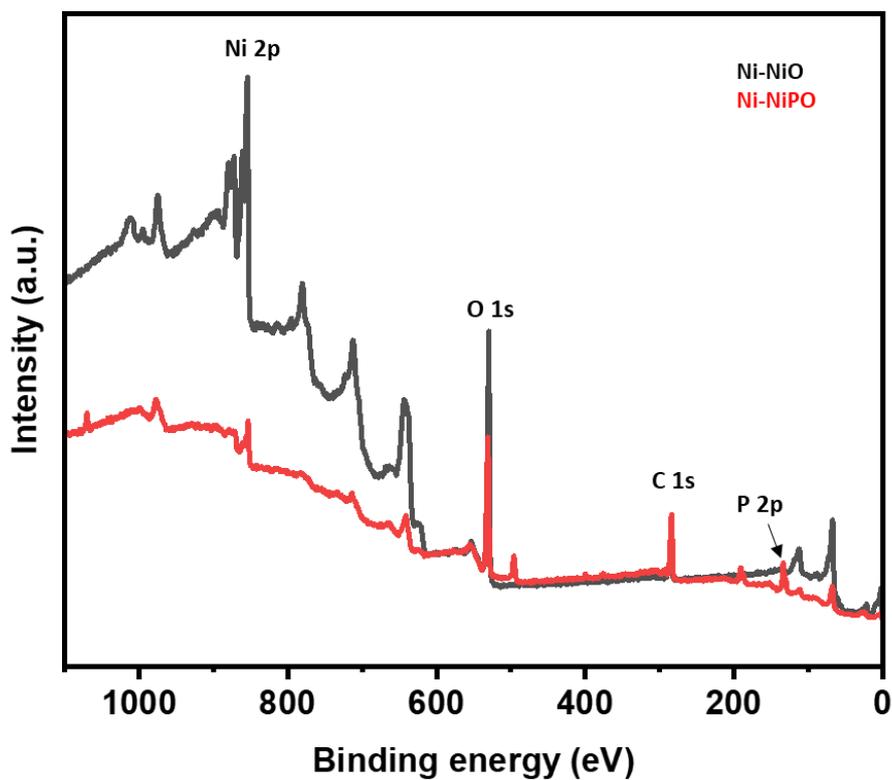
Figure S7. X-ray photoelectron survey spectrum of Ni-NiO and Ni-NiPO.

Table S1. Overpotential of Ni-NiPO catalyst in 1 M phosphate buffer at pH 6, 7 and 8, varying time without magnetic field (B = 0 mT) with FOWS setup.

Time	Overpotential at pH 6 (V)	Overpotential at pH 7 (V)	Overpotential at pH 8 (V)
0 h	0.93	0.54	0.49
1 h	1.05	0.58	0.48
2 h	1.10	0.59	0.48

Table S2. R_{ct} and C_{dl} of Ni-NiPO catalyst in 1M phosphate buffer at pH 6, 7 and 8.

Electrolyte	R_{ct} (ohm)	C_{dl} (mF)
pH 6	35.9	0.8
pH 7	26.0	0.9
pH 8	12.3	1.0

Figure S8. Tafel slope of Ni-NiPO in in 1 M phosphate buffer (pH 6, 7 and 8).

Figure S9. Linear sweep voltammetry of Ni-NiPO in 1 M phosphate-buffer with (a) pH 6, and (b) pH 7 with FOWS setup and an applied magnetic field (B = 100 mT).
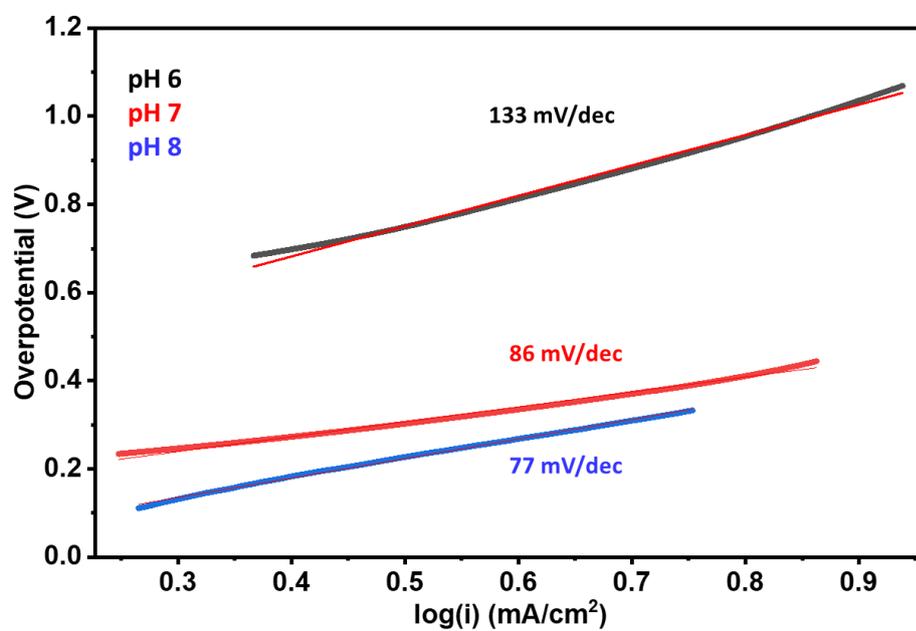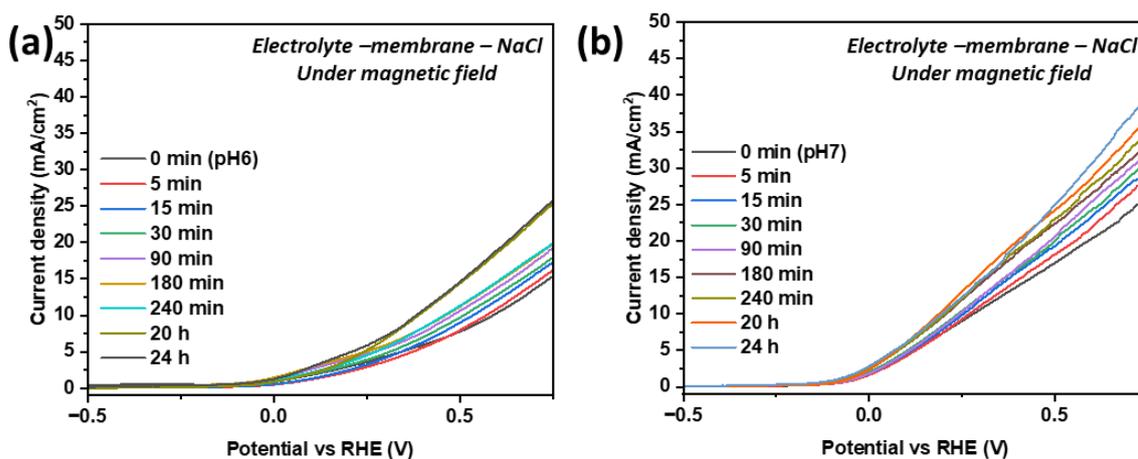
Table S3. Overpotential of Ni-NiPO catalyst in 1 M phosphate buffer at pH 6, 7 and 8, varying time under magnetic field (B= 100 mT) with FOWS setup.

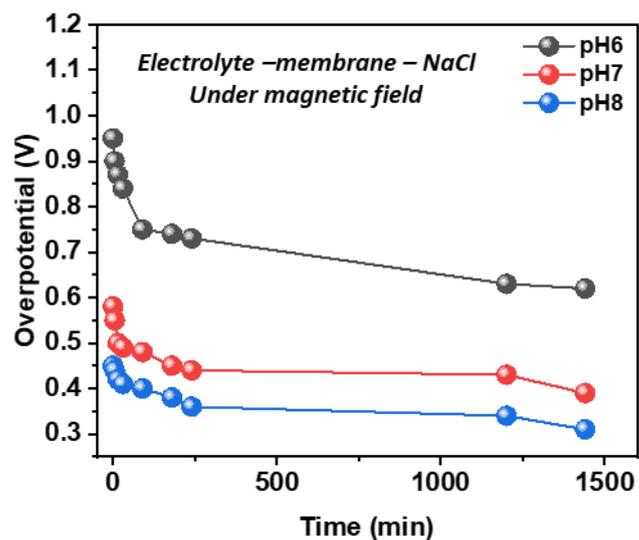| Time	Overpotential at pH 6 (V)	Overpotential at pH 7 (V)	Overpotential at pH 8 (V)
0 min	0.95	0.58	0.45
5 min	0.90	0.55	0.44
15 min	0.87	0.50	0.42
30 min	0.84	0.49	0.41
90 min	0.75	0.48	0.40
180 min	0.74	0.45	0.38
240 min	0.73	0.44	0.36
20 h	0.63	0.43	0.34
24 h	0.62	0.39	0.31

Figure S10. Overpotential of the Ni-NiPO catalyst in 1 M phosphate buffer (pH 6, 7 and 8) with different time interval with FOWS setup under magnetic field.
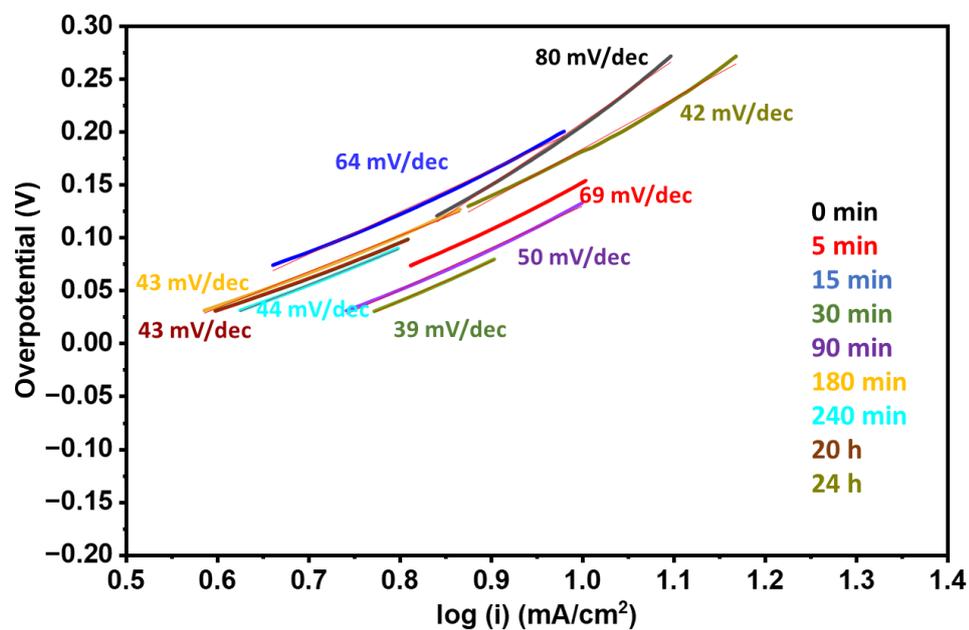

Figure S11. Tafel slope of Ni-NiPO in 1 M phosphate buffer (pH 8) under magnetic field with FOWS setup.
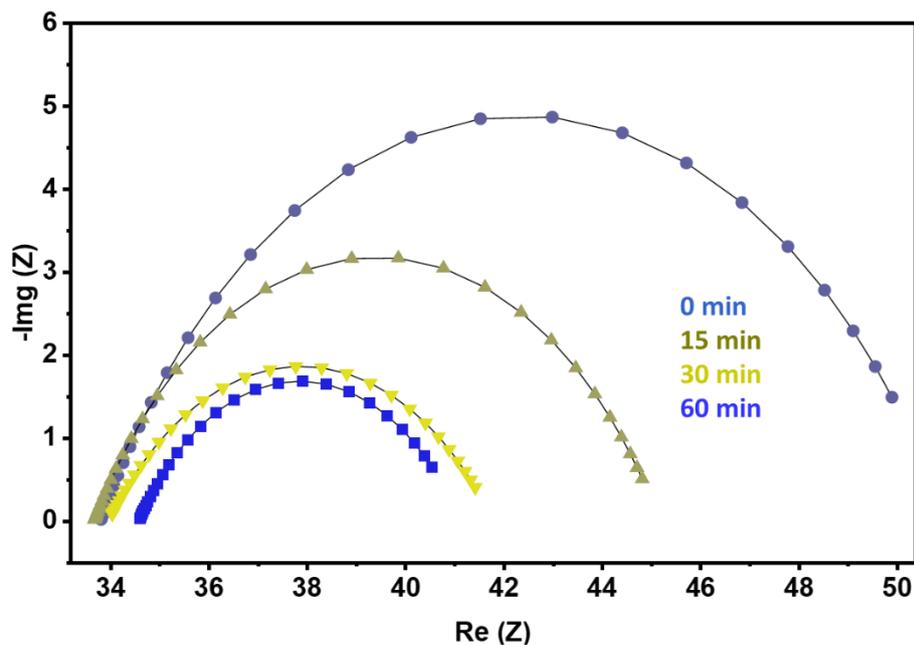
Figure S12. Impedance spectroscopy: Nyquist plot of Ni-NiPO with FOWS setup under magnetic field (B=100 mT) with time in 1 M phosphate buffer (pH 8).

Table S4. R_{ct} and C_{dl} of Ni-NiPO catalyst in 1M phosphate buffer at pH 8 in FOWS setup with time.

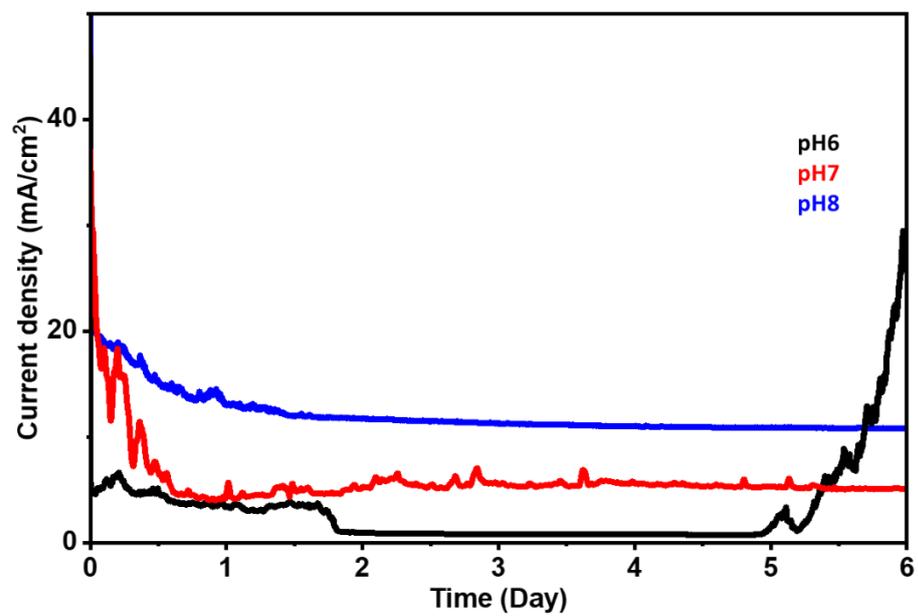| Time (min)	R_{ct} (ohm)	C_{dl} (mF)
0	14.9	1.0
15	11.0	1.3
30	8.5	1.4
60	7.7	1.4

Figure S13. Chronoamperometry for OER with Ni-NiPO catalyst in 1 M phosphate buffer at pH 6, 7 and 8, under magnetic field (B = 100 mT) with FOWS setup for 6 days.
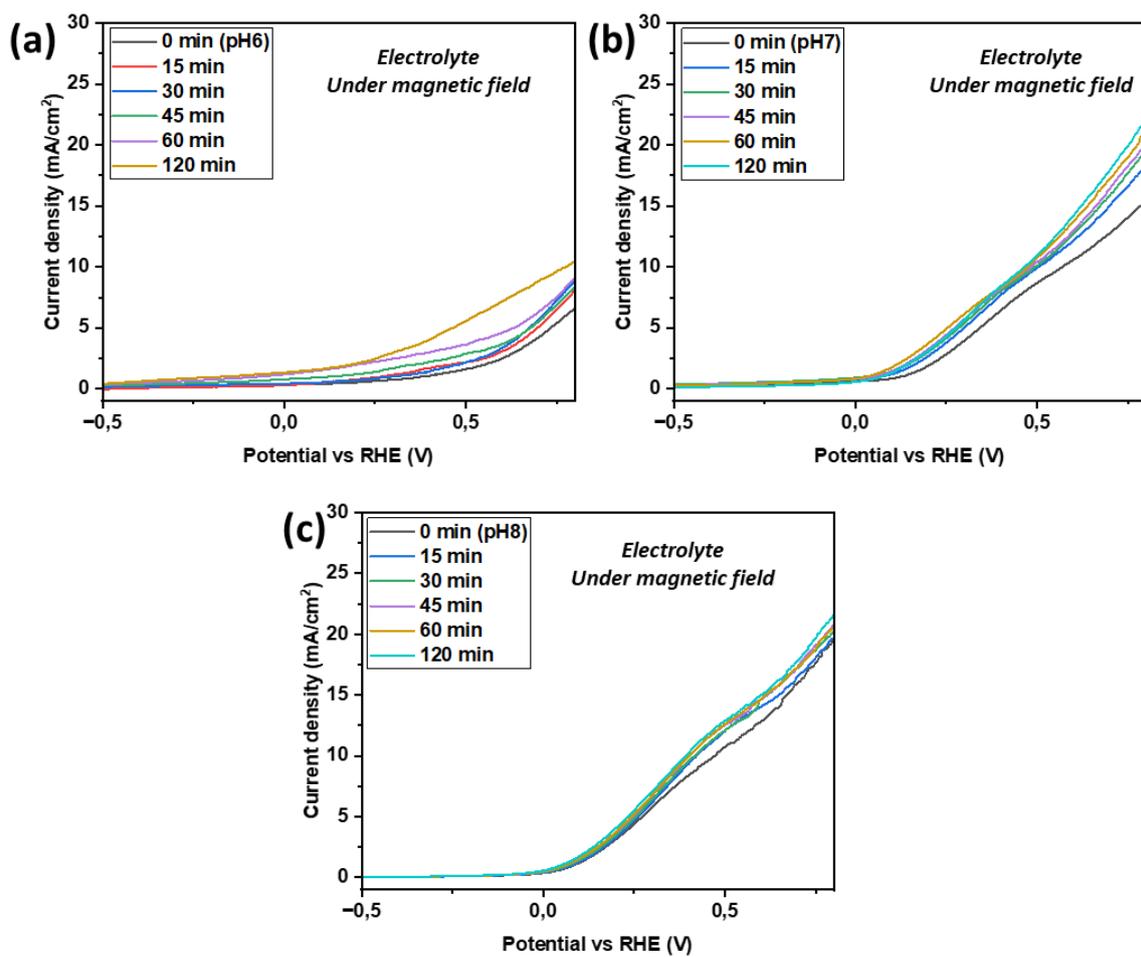
Figure S14. Linear sweep voltammetry for OER with Ni-NiPO catalyst in 1 M phosphate buffer at (a) pH 6, (b) pH 7 and (c) pH 8, varying time under magnetic field (B= 100 mT) without FOWS setup.

Table S5. Overpotential of Ni-NiPO catalyst in 1 M phosphate buffer at pH 6, pH 7 and pH 8, varying time under magnetic field (B = 100 mT) without FOWS setup.

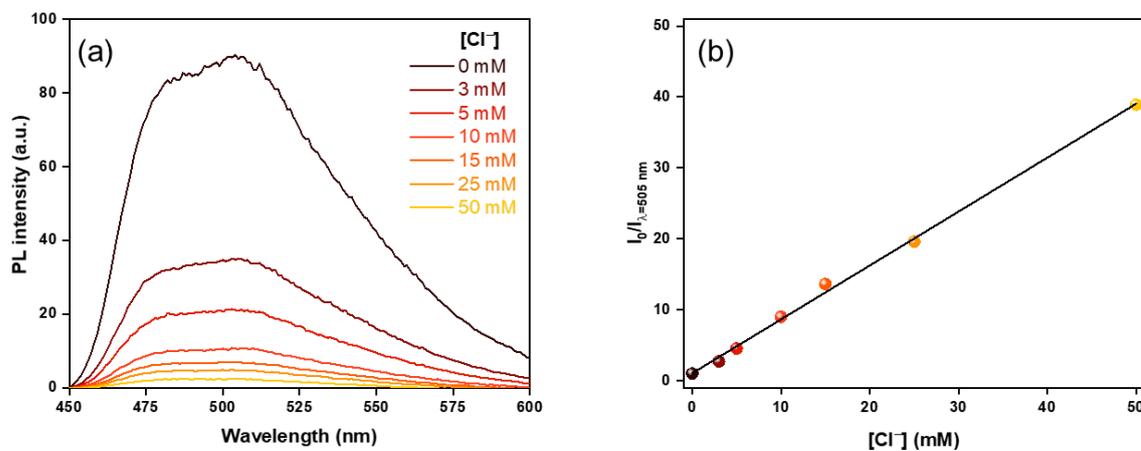| Time	Overpotential at pH 6 (V)	Overpotential at pH 7 (V)	Overpotential at pH 8 (V)
0 min	0.92	0.56	0.49
15 min	0.86	0.53	0.44
30 min	0.84	0.50	0.42
45 min	0.83	0.49	0.41
60 min	0.82	0.48	0.40
120 min	0.78	0.47	0.39

Figure S15. (a) Emission spectra and (b) standard fitted curve for lucigenin assay at different concentration of [Cl⁻]: 0 mM, 1 mM, 2 mM, 5 mM, 10 mM, 15 mM, 20 mM, 30 mM and 50 mM. The emission at 505 nm was used for the standard curve and measurement of all the samples.
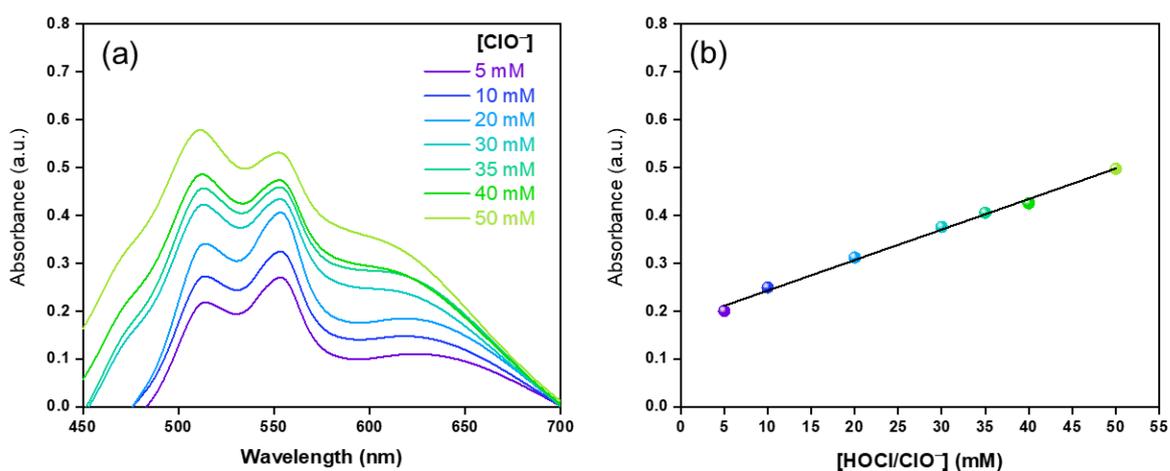
Figure S16. (a) Absorption spectra and (b) standard fitted curve DPD assay at different concentrations of HClO/ClO⁻: 5 mM, 10 mM, 20 mM, 30 mM, 35 mM, 40 mM and 50 mM. The absorption at 535 nm was used for the standard curve and measurement of all the samples.
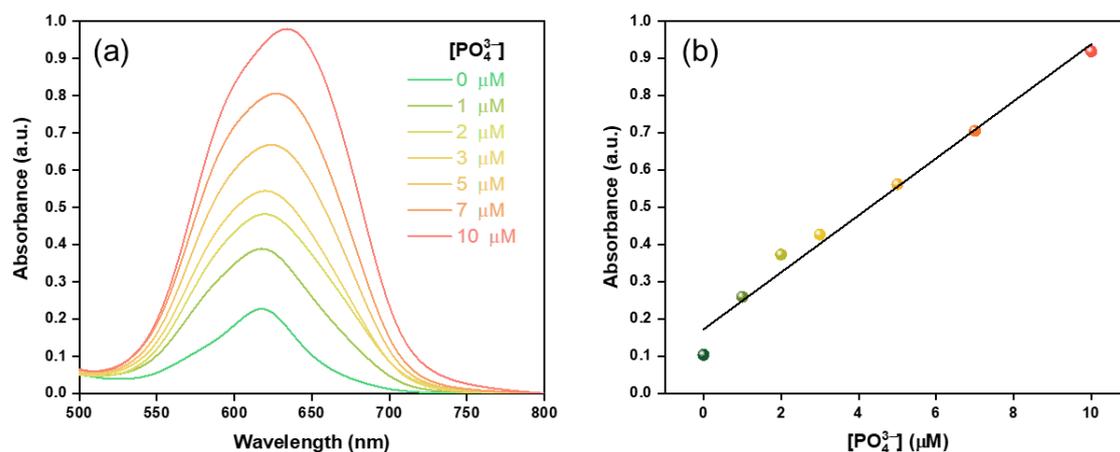

Figure S17. (a) Absorption spectra and (b) standard fitted curve for malachite green phosphate assay at different concentration of [PO_4^{3-}]: 0 μM, 1 μM, 2 μM, 3 μM, 5 μM, 7 μM, and 10 μM. As suggested by the commercial test kit, absorption at 650 nm was used for the standard curve and measurement of all the samples.
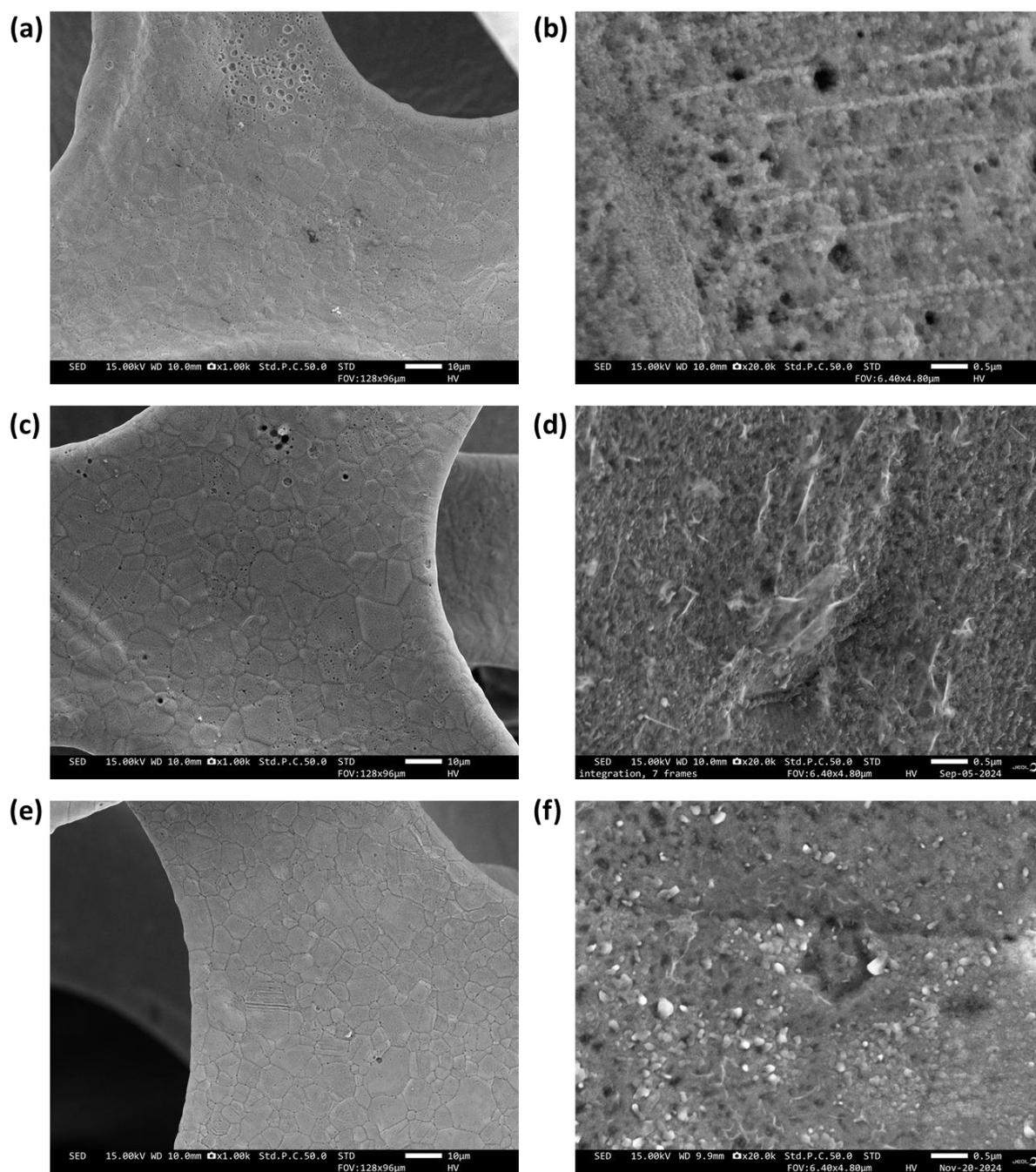
Figure S18. SEM of Ni-NiPO catalyst after electrocatalysis for OER in 1 M phosphate buffer at (a, b) pH 6, (c, d) pH 7 and (e, f) pH 8 under magnetic field (B= 100 mT) with FOWS setup.
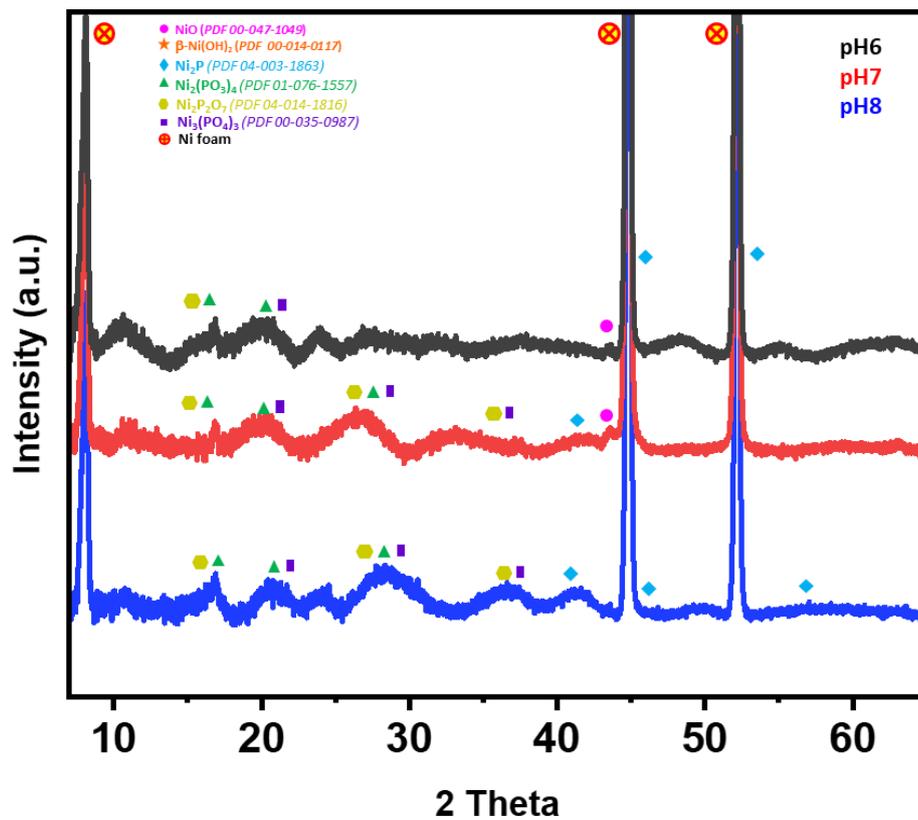
Figure S19. X-ray diffraction pattern of Ni-NiPO catalyst after electrocatalytic for OER in 1 M phosphate buffer at pH 6, pH 7 and pH 8, under magnetic field (B = 100 mT) with FOWS setup (same labeling as Figure 2a and S5).
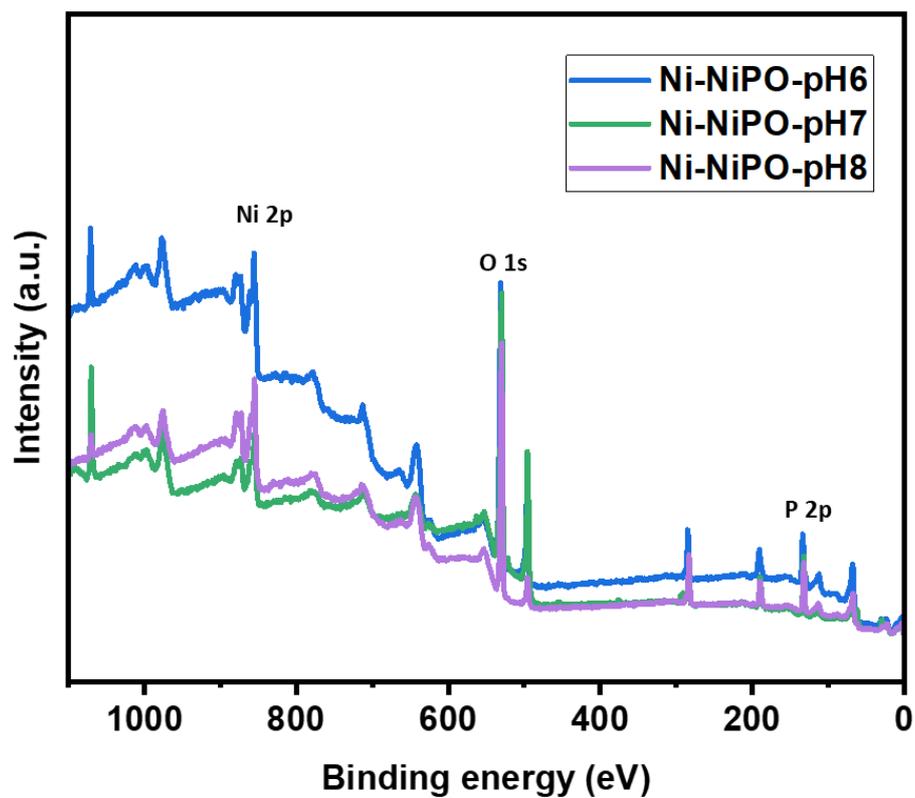
Figure S20. XPS survey spectra of Ni-NiPO catalyst after electrocatalytisis for OER in 1 M phosphate buffer at pH 6, pH 7 and pH 8, under magnetic field (B= 100 mT) with FOWS setup.

Figure S21. High-resolution XPS spectra of (a) Ni 2p, (b) O 1s and (c) P 2p of Ni-NiPO catalyst after electrocatalytic for OER in 1 M phosphate buffer at pH 6 under magnetic field (B = 100 mT) with FOWS setup.

Figure S22. High-resolution XPS spectra of (a) Ni 2p, (b) O 1s and (c) P 2p of Ni-NiPO catalyst after electrocatalytic for OER in 1 M phosphate buffer at pH 7 under magnetic field (B = 100 mT) with FOWS setup.
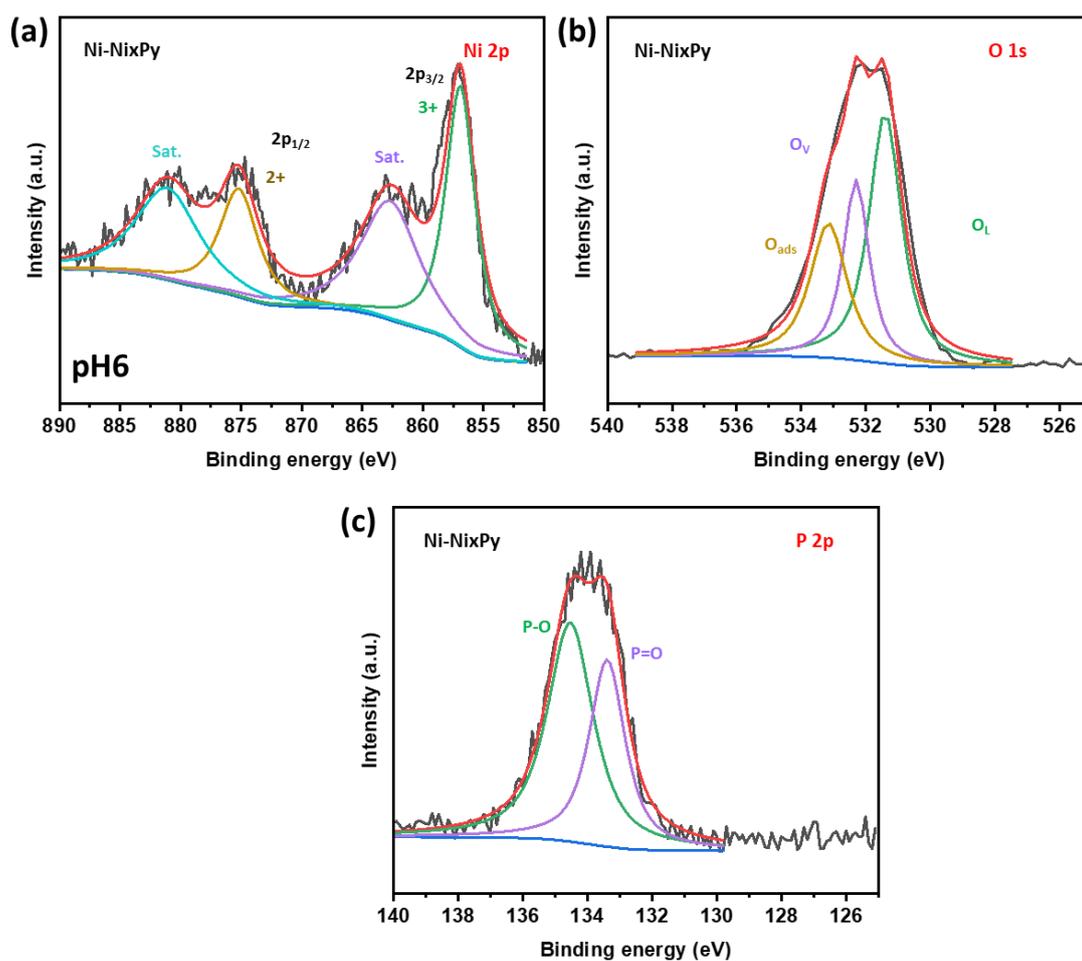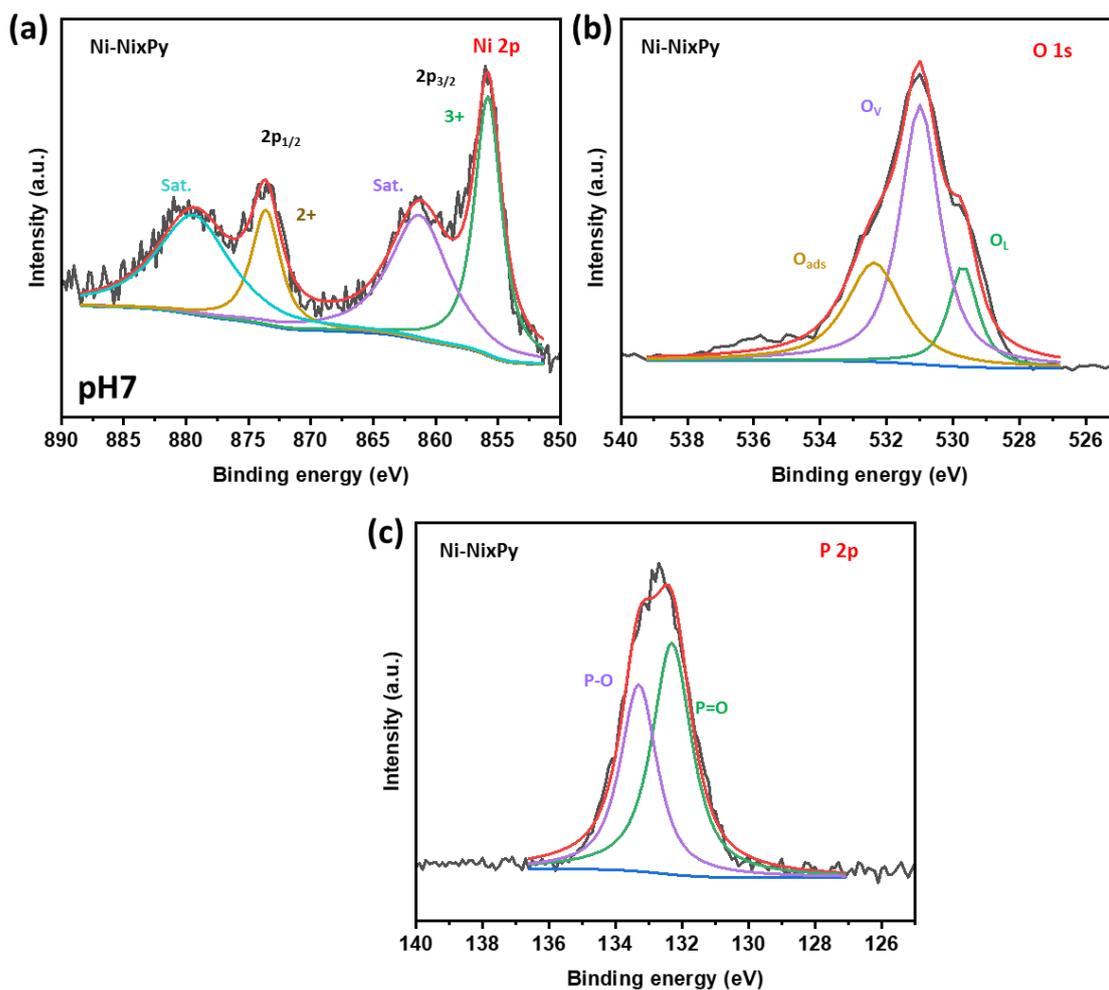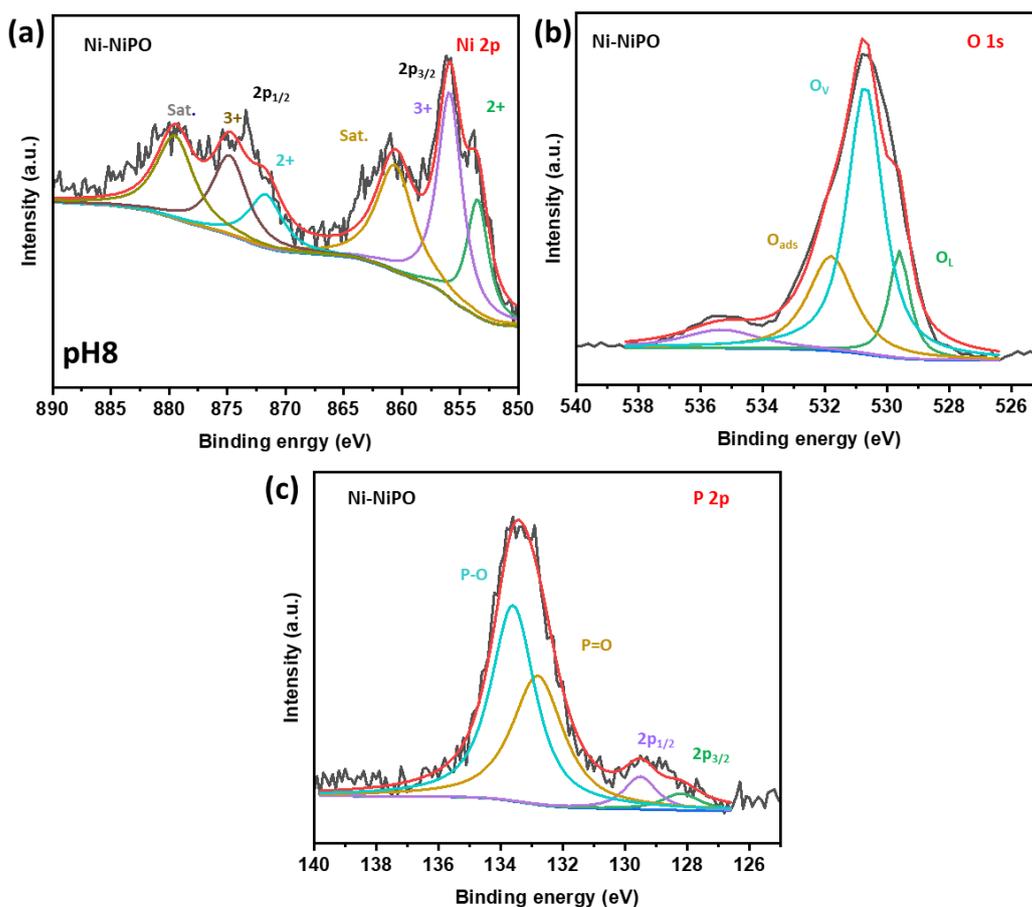
Figure S23. High-resolution XPS spectra of (a) Ni 2p, (b) O 1s and (c) P 2p of Ni-NiPO catalyst after electrocatalytic for OER in 1 M phosphate buffer at pH 8 under magnetic field (B = 100 mT) with FOWS setup.

Table S6. Comparison table of various Ni-based electrocatalysts for OER.

No.	Catalyst	Electrolyte	pH	Overpotential (mV)	References
1	Ni-NiPO	1 M phosphate buffer	8	310	This work (with FOWS setup and an applied magnetic field of 100 mT)
2	Ni-NiPO	1 M phosphate buffer	7	390	This work (with FOWS setup and an applied magnetic field of 100 mT)

3	Ni-NiPO	1 M phosphate buffer	6	620	This work (with FOWS setup and an applied magnetic field of 100 mT)
4	Ni−Mo MS/Cu	1 M KOH	-	335	Gao, M. Y.; Yang, C.; Zhang, Q. B.; Zeng, J. R.; Li, X. T.; Hua, Y. X.; Xu, C. Y.; Dong, P. J. Mater. Chem. A 2017, 5 (12), 5797−5805.
5	CoNiFe-LDH	1 M KOH	-	257	Wu, J.; Yang, T.; Fu, R.; Zhou, M.; Xia, L.; Wang, Z.; Zhao, Y. Adv. Funct. Mater. 2023, 33 (37), 2300808.
6	a-P:NiFe	0.5 M phosphate buffer	7	600	Shih-Ching Huang, Hsiang-Chun Yu, Chun-Kuo Peng, Yan-Gu Lin, Chia-Yu Lin Small 2025, 21, 2408957.
7	Ni_2CoS_4/WO_3	1 M KOH	-	290	Michaela Plevová, Jaromír Hnát, Karel Bouzek Journal of Power Sources 507 (2021) 230072.
8	Ni–W–B alloy	1 M NaOH	14	334	Li, S.; Ling, Y.; Chen, J.; Yuan, X.; Huang, Q.; Zhang, Z. Int. J. Hydrogen Energy 2024, 68, 614–622.
9	Ni_2CuS_n	1 M KOH	14	300	Lakharwal, P.; Ahmed, H.; chaudhary, V.; Patel, P. C.; Kandpal, H. C.; Gujjar, D. J. Mater. Sci. 2024, 59 (13), 5470– 5479.
10	Ni-RuO_2	0.1 M $HClO_4$	0.5	214	Wu, ZY., Chen, FY., Li, B. et al. Nat. Mater. 2023, 22, 100–108.