

Supplementary Data

Electrochemical investigation of the OER activity for nickel phosphite-based compositions and its morphology-dependent fluorescence properties

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Equations

Equation (1) was used to convert the measured electrochemical potentials to the Reversible Hydrogen Electrode (RHE) scale [29], Equation (2) was employed to calculate the OER overpotential (η) [S1], and Equation (3) - the Randles-Sevcik equation - to estimate the electroactive surface area (EASA) and the diffusion coefficient of the electroactive species [30,66].

$$E_{\text{RHE}} = E_{\text{Ag/AgCl(sat. KCl)}} + 0.059 \times \text{pH} + 0.197 \quad (1)$$

$$\eta = E_{\text{RHE}} - 1.23 \quad (2)$$

where: E_{RHE} is the reversible hydrogen electrode potential (V), $E_{\text{Ag/AgCl(sat. KCl)}}$ is the potential vs. the Ag/AgCl (sat. KCl) reference electrode (V), and η is the OER overpotential (V).

$$I_p = (2.69 \times 10^5) \times n^{3/2} \times A \times D^{1/2} \times C \times \nu^{1/2} \quad (3)$$

where: I_p = the peak current (A); n = the number of electrons involved in the redox process at $T = 298 \text{ K}$ ($n = 1$ for the ferrocyanide/ferricyanide redox system); A = the surface area of the working electrode (cm^2); C = the bulk concentration of the electroactive species (mol L^{-1}); ν = the scan rate (V s^{-1}) and D = the diffusion coefficient of the electroactive species ($\text{cm}^2 \text{s}^{-1}$). The reported theoretical value of the diffusion coefficient in the case of the ferrocyanide/ferricyanide redox system is $6.7 \times 10^{-6} \text{ cm}^2 \text{s}^{-1}$ [30,67,68].

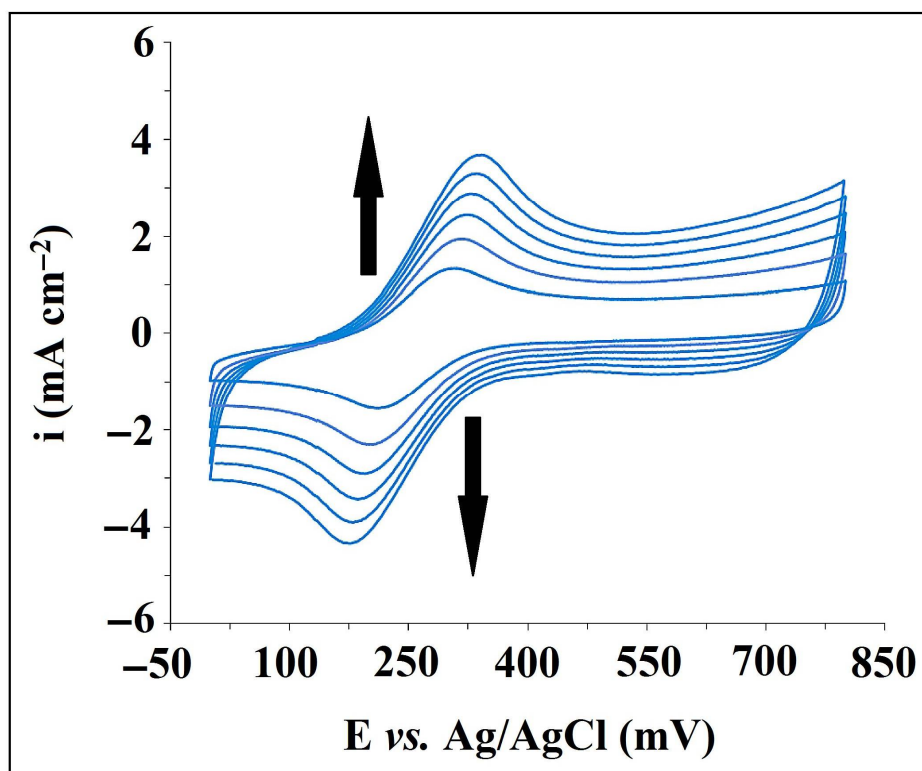


Figure S1. Cyclic voltammograms recorded on the G9 electrode in 1 mol L⁻¹ KNO₃ + 4 mmol L⁻¹ K₃[Fe(CN)₆] electrolyte solution, at various scan rate values ($\nu = 0.05, 0.1, 0.15, 0.2, 0.25$ and 0.3 V s^{-1}).

Table S1. The electrocatalytic properties for the OER of the composition containing Ni₁₁(HPO₃)₈(OH)₆, carbon black and rGO, applied on graphite substrate, and that of other electrocatalysts reported in the scientific literature, in 1 mol L⁻¹ KOH electrolyte solution.

Electrocatalysts	Overpotential (mV)	Current Density (mA cm ⁻²)	Tafel Slope (mV dec ⁻¹)	Ref.
Ni ₁₁ (HPO ₃) ₈ (OH) ₆ + carbon black + rGO	470	10	111	This work
MnO ₂ + carbon black + Nafion solution	530	10	144	[47]
Fe ₃ O ₄ + carbon black	510	10	310	[47]
5-(3-hydroxy-phenyl)-10,15,20-tris-(3-methoxy-phenyl)-porphyrin	730	10	-	[14]
Pt(II) 5-(3-hydroxy-phenyl)-10,15,20-tris-(3-methoxy-phenyl)-porphyrin	640	10	-	[14]
5-(4-pyridyl)-10,15,20-tris(4-phenoxyphenyl)porphyrin	780	10	343	[15]
Fe _{11.7%} -Co ₁₁ (HPO ₃) ₈ (OH) ₆	206	20	47	[69]
Co ₃ (OH) ₂ (HPO ₄) ₂ nanosheets	290	10	82	[70]
NiCoFe phosphate nanosheets	240	10	58	[71]
NiFe-phosphate/phosphide	230	10	57	[72]
Ni ₁₁ (HPO ₃) ₈ (OH) ₆ nanorods	232	10	91	[23]

NiFe-OH-PO ₄ nanobelts	249	20	~42	[73]
Co ₃ O ₄ @CoP	238	10	~51	[74]
Fe(PO ₃) ₂ /Ni ₂ P/Ni foam	177	10	~52	[75]
Ni ₁₂ P ₅ /Ni ₃ (PO ₄) ₂ hollow spheres	318	10	~52	[76]
porous MoO ₂ /Ni foam	250	10	54	[77]
compact MoO ₂ /Ni foam	500	10	88	[77]
FeP-rGO on Au coated glass	260	10	~50	[78]
Ni(OH) ₂ nanosheets on Ni foam	330	10	150	[79]
Ni ₂ P/Ni/Ni foam	200	10	-	[80]
Ni phosphides porous nanoplates	300	10	64	[81]
NiCo-MOF	250	10	61	[82]
NiCoP nanocrystals/rGO	270	10	~66	[83]
NiCoP on Ni foam	280	10	87	[84]
Co ₃ (PO ₄) ₂ nanoparticles decorated with nitrogen-doped carbon layers	317	10	62	[85]
Ni ₃ S ₂ nanosheet arrays on Ni foam	250	10	-	[86]
Ni ₂ P nanowires on FTO	400	10	60	[87]
Ni ₂ P nanoparticles on FTO	500	10	70	[87]
Co ₃ O ₄ /NiCo ₂ O ₄ double-shelled nanocages	340	10	88	[88]
CoP/Cu	345	10	47	[89]
Co/CoO _x /N-doped carbon hybrids	260	10	-	[90]
NiCo layered double hydroxide nanoplates	367	10	40	[91]
Ni ₅ P ₄ films	290	10	40	[92]
NiFeCo-NC2*	390	10	-	[93]
Co-Fe-1,4-benzenedicarboxylate	295	10	34.8	[45]
NiFe _{2.5} on Ni foam*	495	10	-	[94]
FeNi-MOF (metal-organic framework) nanoarrays on Ni foam	213	10	52.4	[46]

* 0.1 mol L⁻¹ KOH electrolyte solution.