Supporting Information

For

Core-shell FTO@Co_3O_4 Nanoparticles as Active and Stable Anode Catalysts for Acidic Oxygen Evolution Reaction and Proton Exchange Membrane Water Electrolysis

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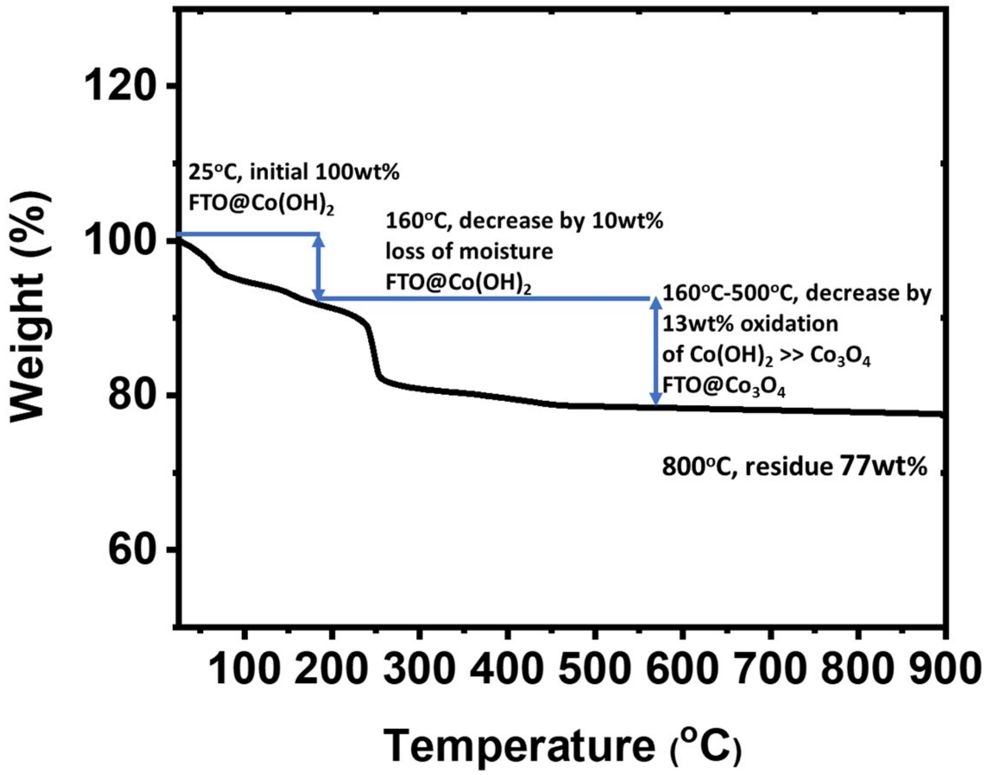

Figure S1. Thermogravimetric curve of FTO@$Co(OH)_2$ in air. Heating rate: 5 ^{o}C min^{-1}.

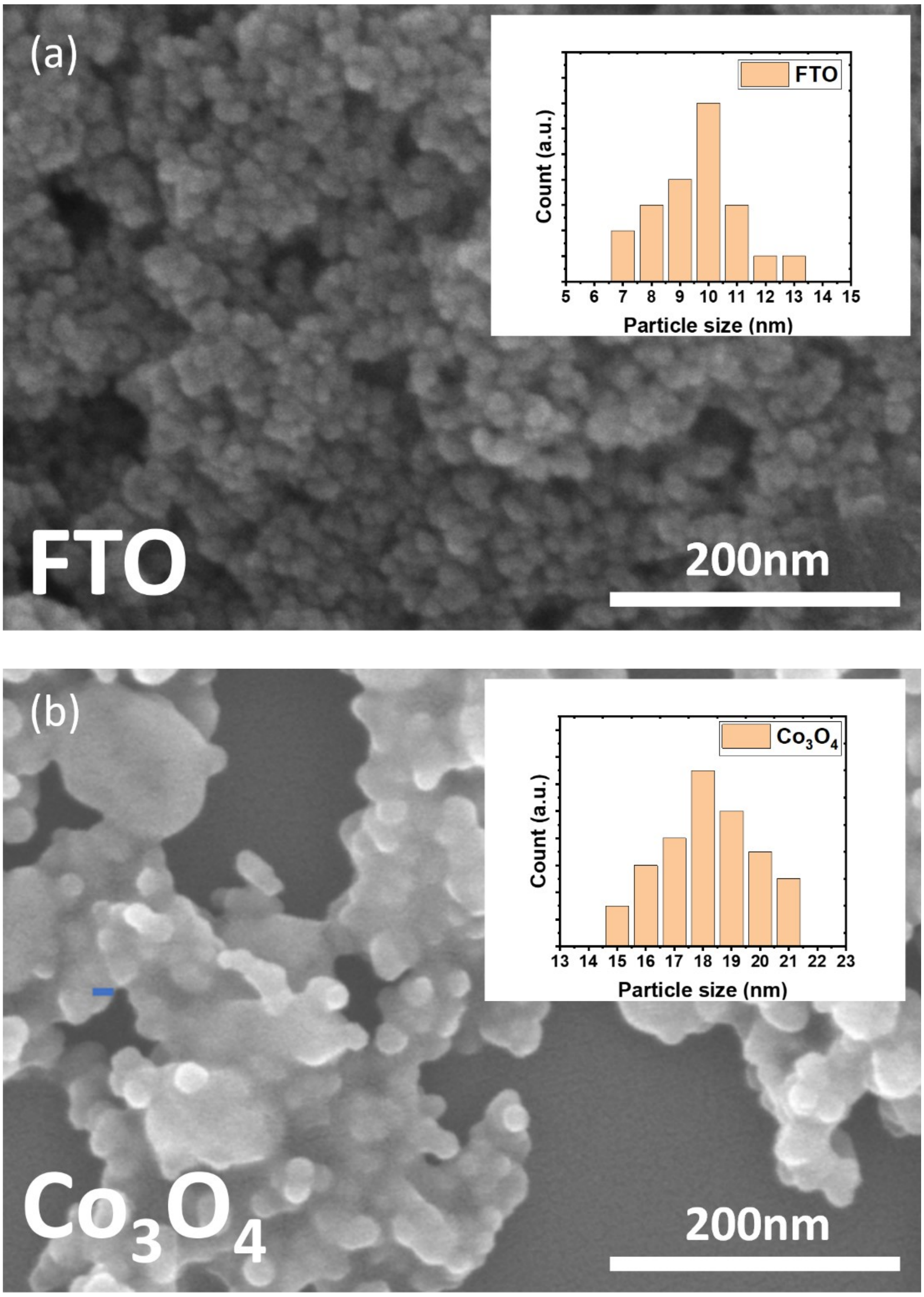

Figure S2. SEM images of (a) FTO and (b) Co_3O_4 nanoparticles. Insets show size distributions of nanoparticles.

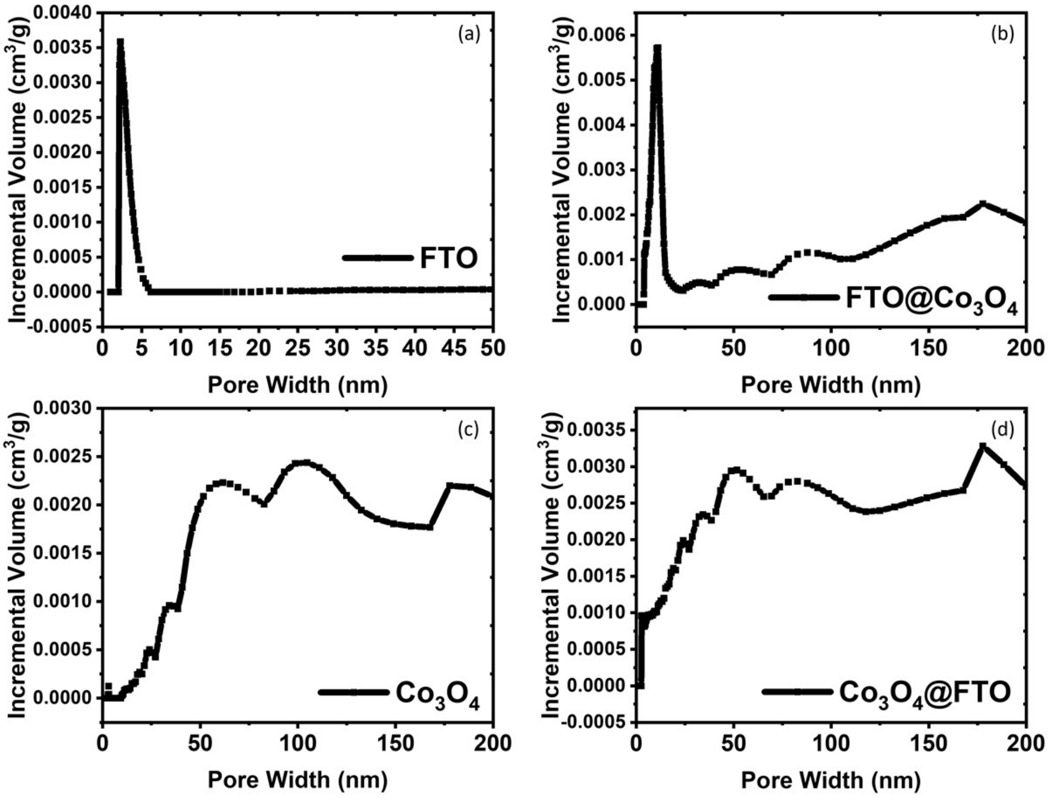

Figure S3. Pore size distribution of (a)FTO (b)FTO@Co_3O_4 (c) Co_3O_4 (d) Co_3O_4@FTO nanoparticles.

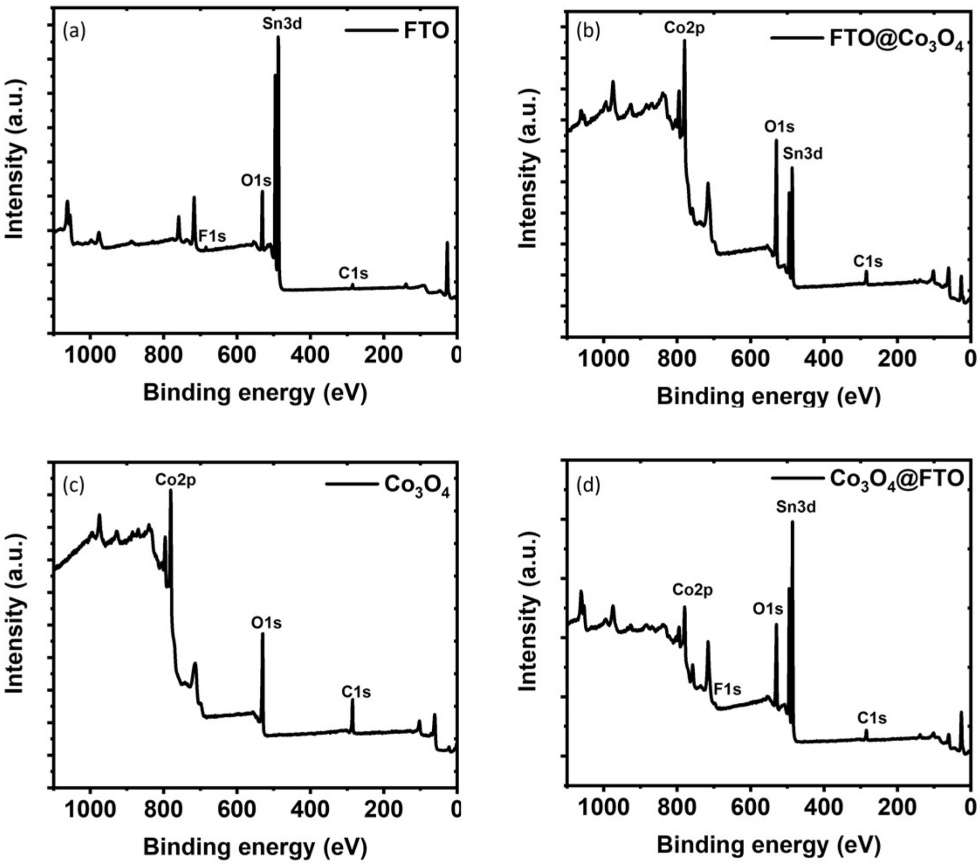

Figure S4. XPS survey spectra of (a) FTO, (b) FTO@Co_3O_4, (c) Co_3O_4 , and (d)Co_3O_4@FTO.

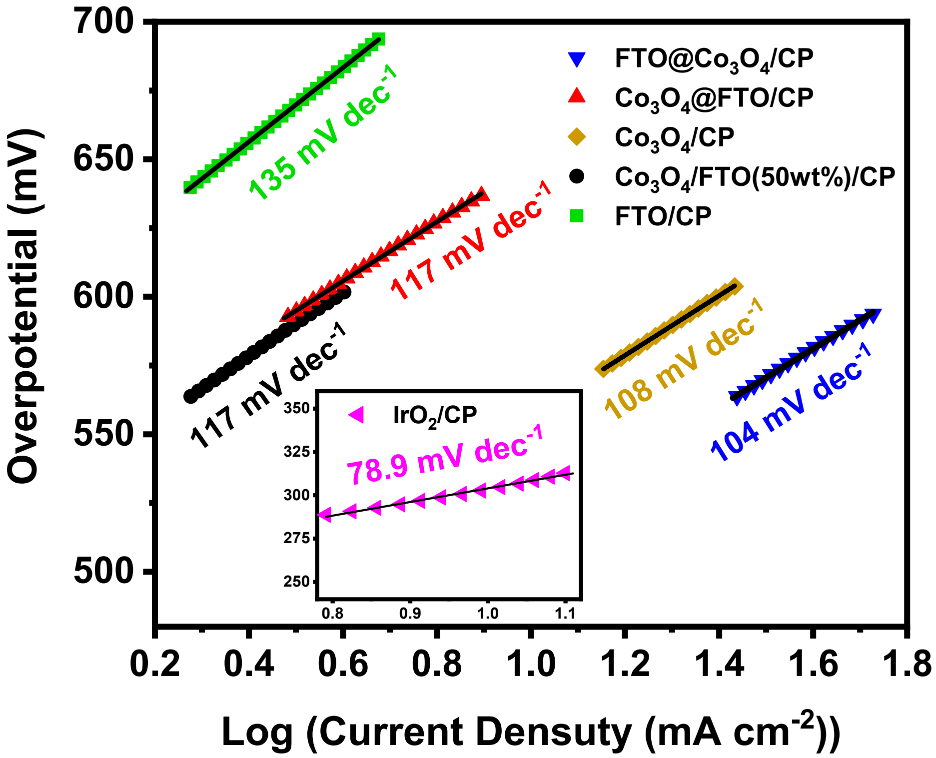

Figure S5. Tafel plots of FTO/CP, FTO@Co_3O_4/CP, Co_3O_4/CP, Co_3O_4@FTO/CP, and Co_3O_4/FTO(50wt%)/CP.

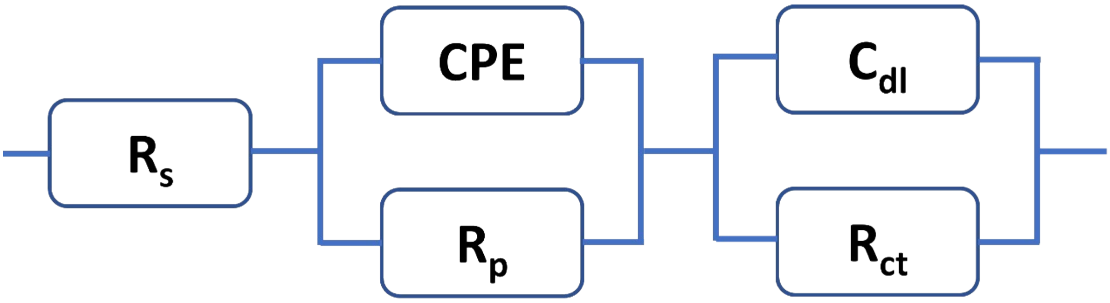

Figure S6. Equivalent circuit model: R_s for solution resistance, CPE for constant phase element accounting for electrode porosity, R_p for electrode porosity resistance, C_{dl} for double layer capacitance, and R_{ct} for charge transfer resistance.

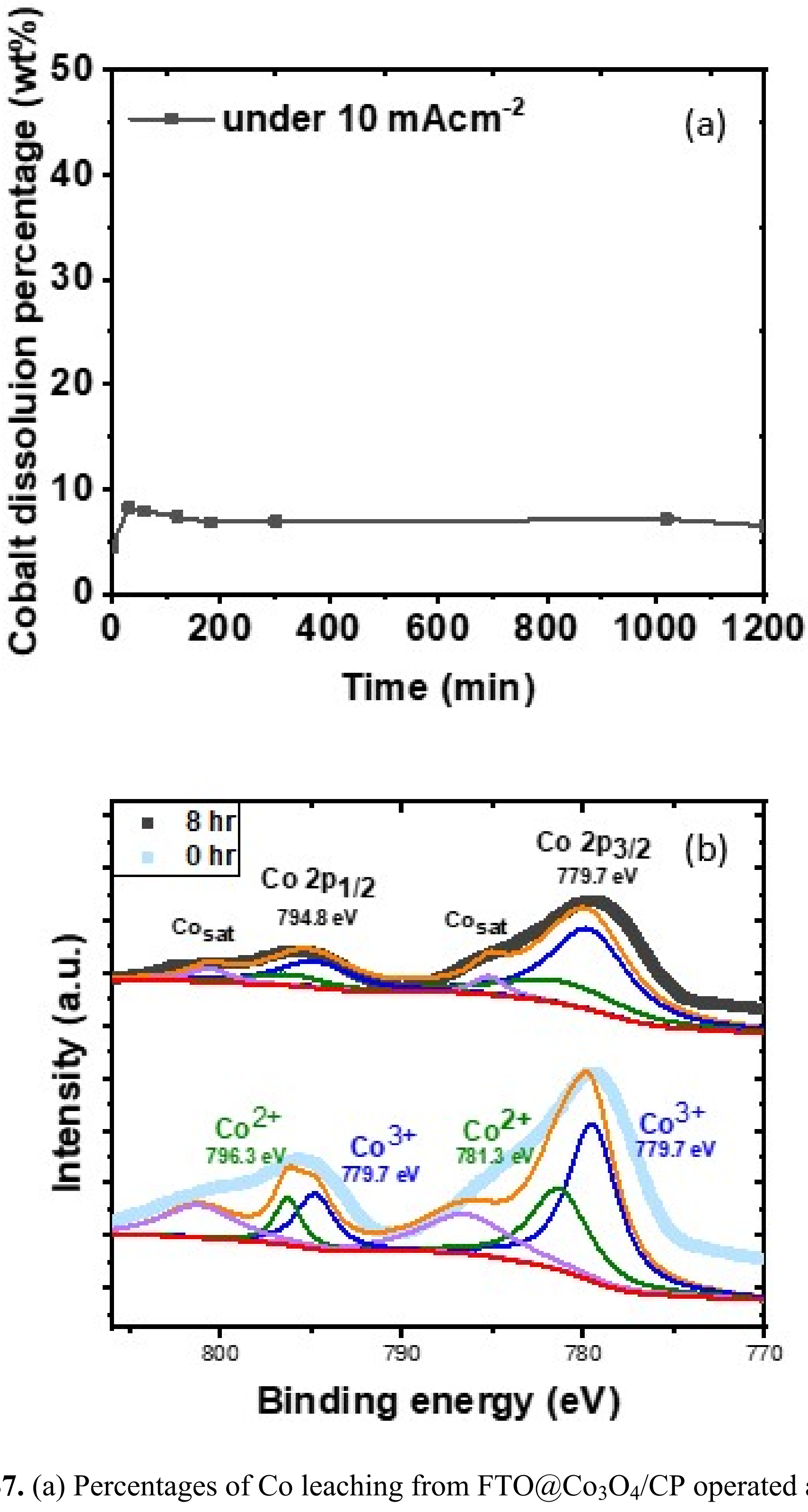

Figure S7. (a) Percentages of Co leaching from FTO@Co_3O_4/CP operated at 10 mA cm^{-2} during course of 20 hours. (b) HRXPS spectra of Co 2p of FTO@Co_3O_4/CP after operations at 10 mA cm^{-2} for 0 and 8 hours.

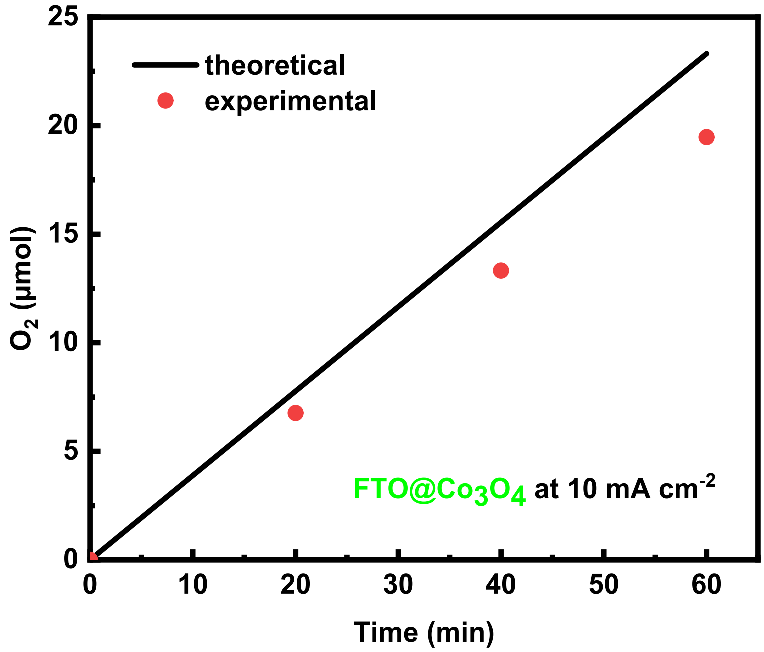

Figure S8. Theoretical and experimental O_2 generation for determination of Faradaic efficiency of FTO@Co_3O_4/CP operated at 10 mA cm^{-2} for 60 min. Experimental test conditions: 0.25 cm^2 for electrode surface area and 298 K for temperature.

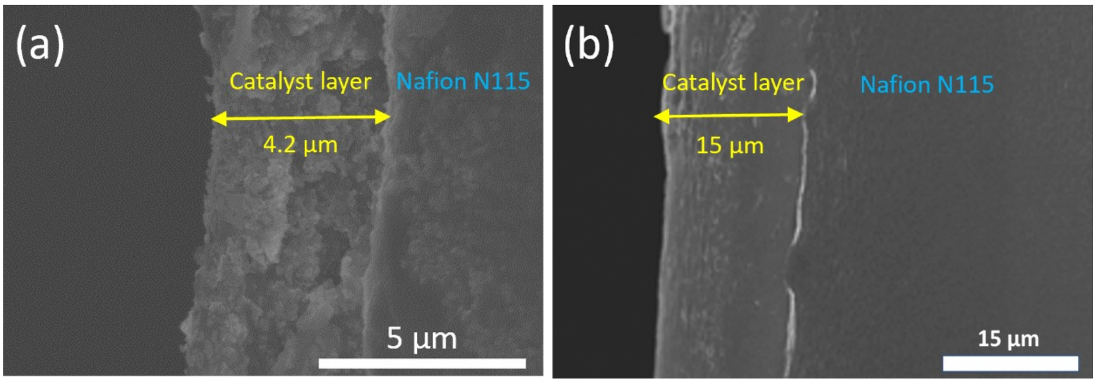

Figure S9. SEM images of (a) anode (FTO@Co_3O_4) and (b) cathode (Pt/C).

Table S1. PEMWE performances of non-noble metal based anode catalysts.

Membrane (temperature)	Cathode catalyst (loading in mg cm^{-2})	Anode catalyst (loading in mg cm^{-2})	Current density @2 V (in A cm^{-2})	Reference
N115 (25°C)	Pt/C (0.2)	FTO@Co_3O_4 (3.0)	0.205	This work
N115 (80 °C)	Pt/C (0.5)	CoHFe/ATO (2.0)	0.05-0.1	[S1]
N117 (25°C)	Pt/C (0.5)	Co/29BC (N/A)	0.12	[S2]
N117 (25°C)	Pt/C (0.1)	γ-MnO_2 (3.5)	0.13	[S3]

Reference:

[S1] B. Rodríguez-García, Á. Reyes-Carmona, I. Jiménez-Morales, M. Blasco-Ahicart, S. Cavaliere, M. Dupont, D. Jones, J. Rozière, J.R. Galán-Mascarós, F. Jaouen, Cobalt hexacyanoferrate supported on Sb-doped SnO_2 as a non-noble catalyst for oxygen evolution in acidic medium, Sustainable Energy & Fuels 2(3) (2018) 589-597. https://doi.org/10.1039/C7SE00512A.

[S2] Q. Lai, V. Vediyappan, K.-F. Aguey-Zinsou, H. Matsumoto, One-Step Synthesis of Carbon-Protected Co_3O_4 Nanoparticles toward Long-Term Water Oxidation in Acidic Media, Advanced Energy and Sustainability Research 2(11) (2021) 2100086. https://doi.org/https://doi.org/10.1002/aesr.202100086.

[S3] A. Li, H. Ooka, N. Bonnet, T. Hayashi, Y. Sun, Q. Jiang, C. Li, H. Han, R. Nakamura, Stable Potential Windows for Long-Term Electrocatalysis by Manganese Oxides Under Acidic Conditions, Angew Chem Int Ed Engl 58(15) (2019) 5054-5058. https://doi.org/10.1002/anie.201813361.