cbecimat26
26° Congresso Brasileiro de Engenharia e Ciência dos Materiais
22 a 26 de novembro de 2026
Costão do Santinho
Florianópolis-SC

Waste PET-Derived Cu-MOF/g-C_3N_4Composites for Alkaline Hydrogen and OxygenEvolution Reactions

J.A.F.C.R. Rodrigues[1] H. Sleteen[1] T.O. Barros[1] J.V.M.C. Moraes[1] R. Santana[1] R. Suresh Babu[1] Ana L. F. de Barros[1]

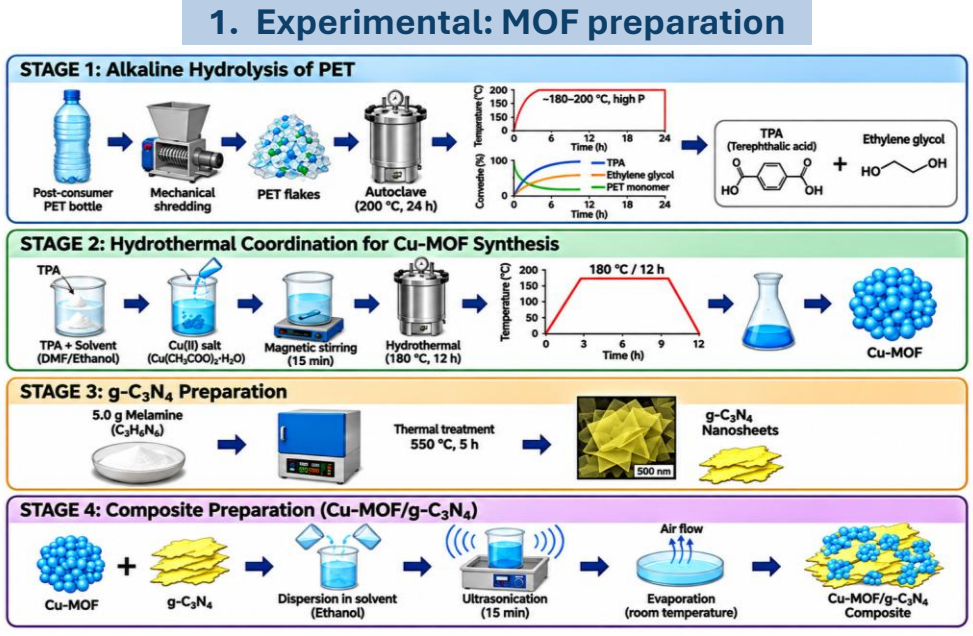
[1] Laboratory of Experimental and Applied Physics (LaFEA),
Universidade Federal de Ciência e Inovação - UFCIRJ- Av. Maracanã, 229, Rio de Janeiro, Brazil

INTRODUCTION

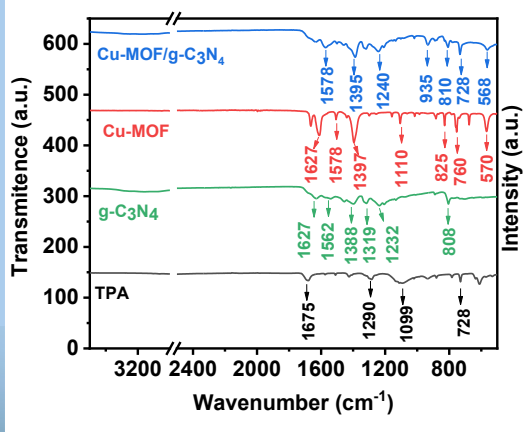
Hydrogen is considered a promising energy carrier for low-carbon energy systems because of its high gravimetric energy density and potential applications in energy storage, transportation, and industrial processes [1,2]. However, hydrogen production remains largely dependent on fossil fuels, particularly natural gas reforming, which generates substantial carbon dioxide emissions. Water electrolysis powered by renewable electricity offers an alternative route for hydrogen production without direct carbon emissions during operation [3,4]. **Objective:** evaluate whether Cu-MOF and Cu-MOF/g-C_3N_4 deposited on graphite improves the hydrogen and oxygen evolution reaction. The modified surface was characterized by FTIR and XRD, and analytical performance was assessed by LSV, Tafel slope, EIS and chronoamperometry.

RESULTS AND DISCUSSION

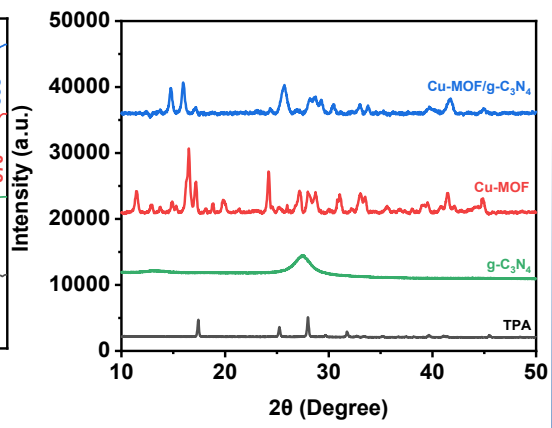
1. Experimental: MOF preparation



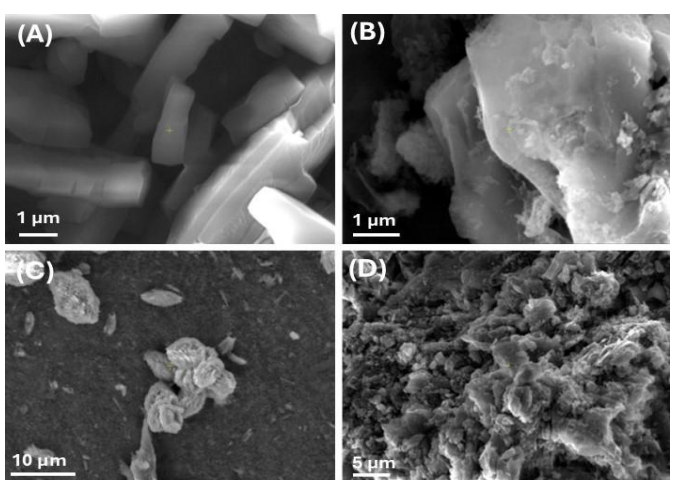
2. FTIR characterization



3. XRD characterization

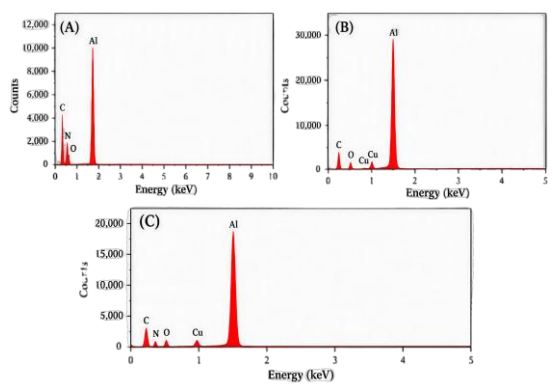


4. SEM and EDS (top) images

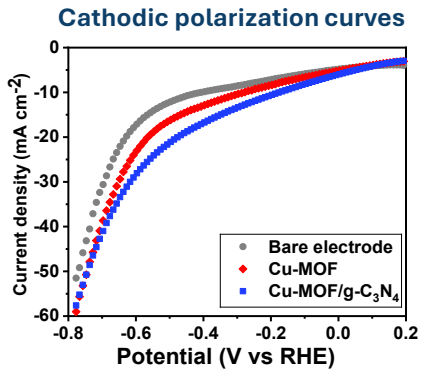


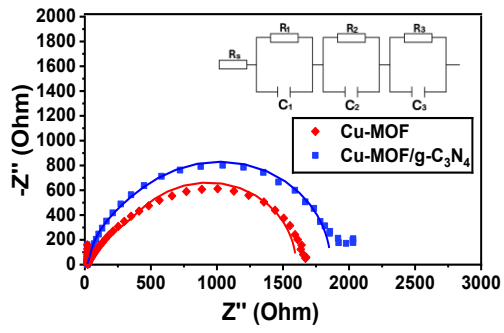
(A) PET-derived TPA (50,000×), (B) g-C3N4 (60,000×), (C) Cu-MOF (8,000×), and (D) Cu-MOF/g-C3N4 (10,000×).

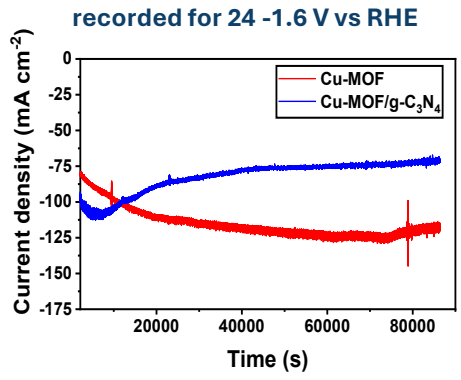
EDS spectra of (A) g-C3N4, (B) Cu-MOF, and (C) Cu-MOF/g-C3N4.



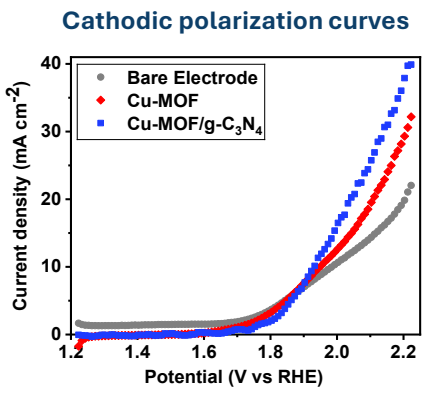
5. HER analysis

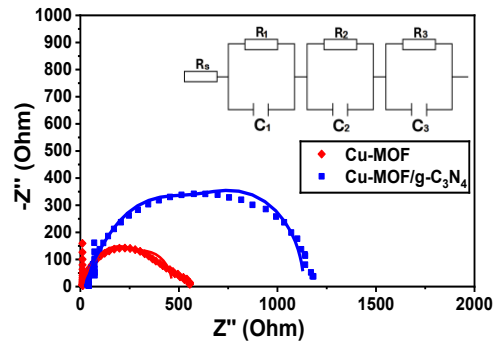


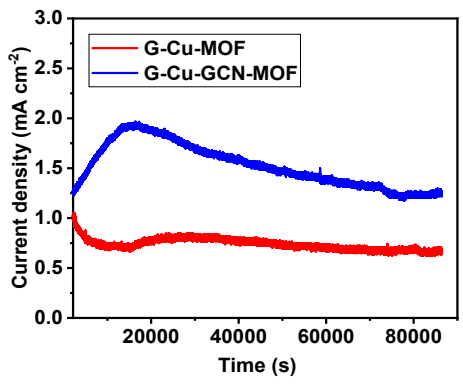




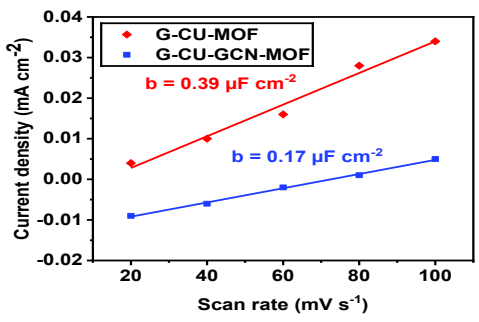
6. OER analysis







7. Eletrochemical Surface Area



ANALYTICAL PERFORMANCE

Electrode	η10 HER (mV)	η10 OER (mV)	Tafel slope HER (mV/dec)	Tafel slope OER (mV/dec)	Impedance HER (Ω)	Impedance OER (Ω)	Cr HER (%)	Cr OER (%)	ECSA (cm^2)	Rf
Cu-MOF	287	720	423.41	247.87	1594.5	501.6	150.30	65.04	0.6892	9.75
Cu-MOF/g-C_3N_4	177	703	575.24	143.00	1864.3	1134.1	81.97	100	0.3092	4.38

CONCLUSIONS

- Feasibility of using PET-derived terephthalic acid as a precursor for Cu-based electrocatalytic materials.
- Combining Cu-MOF with gC3N4 modifies the electrochemical response toward HER and OER.
- Cu-MOF/g-C3N4 presented a better overpotential for 10 mA/cm² in HER and OER, better tafel slope for OER and good current retention for OER. Cu-MOF demonstrated a better Tafel slope for HER, better impedance for both reactions and better current retention for HER.
- The lower roughness fator of Cu-MOF/g-C3N4 indicates that the electrode performance depends on the intrinsic activity while Cu-MOF depends on its deposition structure to get a good eletrochemical result.

REFERENCES AND ACKNOWLEDGMENTS

[1] Tan S, Ouyang W, Ji Y, Hong Q. J. Alloys Compd. 2021, 889, 161528. doi:10.1016/j.jallcom.2021.161528.
[2] Ma W, Zhang Y, Wang B, Wang J, Dai Y, Hu L, Lv X, Dang J. Chem. Eng. J. 2024, 494, 153212. doi:10.1016/2024.153212.
[3] Crabtree GW, Dresselhaus MS. MRS Bull. 2008, 33, 421-428. doi:10.1557/mrs2008.84.
[4] Ju S, Liu Y, Pei M, Shuai Y, Zhai Z, Yan W, Wang YJ, Zhang J. J. Colloid Interface Sci. 2024, 653, 1704-1714. doi:10.1016/j.jcis.2023.10.002.

FAPERJ Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro
CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico
CAPES
Finep INOVAÇÃO E PESQUISA