# HYDROTHERMAL SYNTHESIS OF SULFONATED ZnO/BIOCHAR CATALYSTS WITH HIGH SELECTIVITY FOR THE ELECTROCHEMICAL REDUCTION OF $CO_2$ TO CO

**Gonçalves Jotamo Marrenjo [a,b], Sheila Cristina Canobre [c], Daniel Pasquini [d], Osmando Ferreira Lopes [e]**

[a] PhD student in the Graduate Program in Biofuels at UFU. E-mail: goncalves.marrenjo@ufu.br
[b] Professor, Department of Chemistry, UNISAVE, Massinga-Mozambique.
[c] Professor, Department of Chemistry, UFU. E-mail: sheila.canobre@ufu.br
[d] Professor, Department of Chemistry, UFU. E-mail: daniel.pasquini@ufu.br
[e] Professor, Department of Chemistry, UFU. E-mail: osmando@ufu.br

## RESUMO

*Excessive emissions of greenhouse gases into the atmosphere are one of the main causes of climate changes. Thus, the development of innovative catalysts based on low-cost materials with high activity, stability, and selectivity for the electrochemical reduction of $CO_2$ is crucial for converting these gases into valuable fuels and raw materials. ZnO is recognized for its excellent activity in the electrochemical reduction of $CO_2$. However, challenges such as low conductivity, limited long-term stability, and the need for improved reaction pathways still hinder its practical deployment. In this work, a ZnO catalyst functionalized with sulfonated biochar was developed, characterized by a large surface area that improves $CO_2$ capture and facilitates its electrochemical reduction to CO. The ZnO/Biochar catalyst was prepared via the hydrothermal method and characterized using various techniques. These analyses confirmed the formation of ZnO modified by sulfonated biochar, demonstrating the success of the functionalization and the incorporation of biochar into the ZnO structure. Additionally, the influence of carbon black concentration on the current density of the material was investigated. The results showed that electrodes prepared with ZnO functionalized with sulfonated biochar, without the addition of carbon black (0%), in a 1 M KOH solution and with a $CO_2$ flow rate of 30 mL $min^{-1}$, exhibited the best performance in the electrochemical conversion of $CO_2$ to CO. Under these conditions, the electrochemical flow cell achieved a current density of -120 mA $cm^{-2}$, partial current density of -50 mA $cm^{-2}$ respectively and a faradaic efficiency of approximately 70% at -0.8 V vs. RHE. These findings demonstrate that the developed catalyst is promising for the electrochemical conversion of $CO_2$ into high-value-added chemical compounds.*

***Keywords:*** *greenhouse gases, carbon black, electrochemical flow cell, faradaic efficiency.*

## ACKNOWLEDGEMENT

*The authors acknowledge FAPEMIG (5.10/2022), CNPq and Biofuel programme*