76th Annual Meeting

of the International Society of Electrochemistry

7 - 12 September 2025

Mainz, Germany

PROGRAM

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Designing La_2CuO_4/Printex L6 Composites: A Characterization-Guided Strategy for Enhanced CO_2 Electroreduction

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The conversion of carbon dioxide (CO_2) into fuels and value-added compounds is a promising strategy to mitigate climate change and reduce the environmental impact of emissions [1]. Among various approaches, CO_2 electroreduction (CO_2RR) stands out for its clean and efficient transformation [2]. In this study, nanostructured electrocatalysts based on perovskite oxide La_2CuO_4, combined with Printex L6 carbon black, were developed for the first time for application in the CO_2RR. The sol-gel synthesis involved gel formation at 80°C and 180°C, followed by calcination at 800°C in an oxidizing atmosphere. The structural, morphological, and electrochemical characterizations of the materials were performed using Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Raman Spectroscopy, Brunauer-Emmett-Teller (BET) analysis, X-Ray Diffraction (XRD), X-Ray Photoelectron Spectroscopy (XPS), Electrochemical Impedance Spectroscopy (EIS) and capacitance analysis. The electrocatalytic performance of the materials was evaluated using a rotating disk-ring electrode (RRDE). La_2CuO_4 exhibited a lamellar morphology, while, in the La_2CuO_4/Printex L6 composite, particles were observed anchored onto La_2CuO_4 plates (Fig. 1.a). The XRD diffractograms showed characteristic peaks of the orthorhombic phase of La_2CuO_4 (Fig. 1.b). Hydrodynamic voltammetry in CO_2-saturated $KHCO_3$ (0.1 mol L^{-1}, pH 6.8) at 1600 rpm revealed an earlier onset potential (E_{onset}) for the La_2CuO_4/Printex L6 (1:1 w/w) electrocatalyst at -0.78 V vs. RHE, compared to Printex L6 (-1.05 V vs. RHE) and La_2CuO_4 (-1.02 V vs. RHE). The RRDE system detected CO generation at -0.8 V vs. RHE and formic acid at -0.85 V vs. RHE, with signals identified on the ring at 0.85 V vs. RHE and 1.26 V vs RHE, respectively (Fig. 1.c). The use of RRDE minimized the delay between product formation and detection compared to conventional techniques such as Gas Chromatography (GC) and Liquid Chromatography (LC). This approach enables faster screening of promising catalysts, accelerating the discovery of efficient materials for CO2RR.

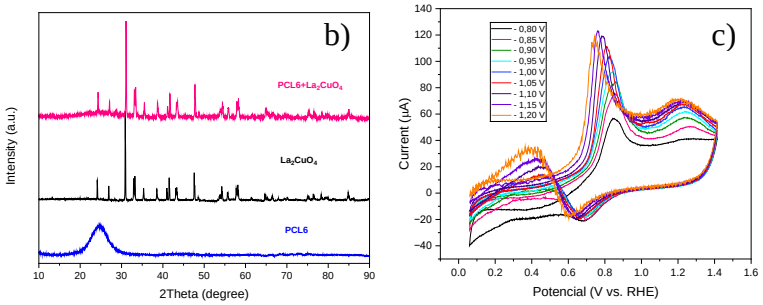

Figure 1. (a) SEM image of La_2CuO_4/Printex L6; **(b)** XRD patterns and (c) CV of the ring electrode between 0.0 V and 1.8 V vs. RHE at 1600 rpm and a sweeping rate of 100 mVs^{-1} at different disk electrode potentials.

Acknowledgements:
The authors acknowledge the São Paulo Research Foundation (FAPESP) for financial support (grant numbers #2024/10973-0, #2024/10952-3, #2022/12895-1, #2018/22022-0 and #2019/06650-3) and CNPq.

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