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Development and Electrochemical Characterization of Polyaniline–Graphene-Derivative Hybrid Screen-Printed Electrodes for Biofuel Cells

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This work presents the development and electrochemical characterization of screen-printed electrodes (SPE) modified with polyaniline (PAni) and its hybrid with reduced graphene oxide (rGO) to enhance electron transfer in biofuel cell (BFC) applications. PAni was synthesized via in-situ chemical polymerization, while rGO was obtained using a modified Hummers method. The synthesized materials were incorporated into graphite-based conductive inks to produce batch-modified SPEs. The structural and morphological properties of the materials were characterized using Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, X-ray diffraction (XRD), and scanning electron microscopy (SEM). The electrochemical properties of the modified electrodes were investigated through cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), differential pulse voltammetry (DPV), and polarization curves. The results indicate that the incorporation of PAni and PAni-rGO into the electrode matrix significantly enhances charge transfer kinetics, improving the electrochemical performance of Saccharomyces cerevisiae biofilms. The presence of PAni promotes proton-coupled electron transfer (PCET), while the PAni-rGO hybrid further increases conductivity and electrode stability. Additionally, the extracellular polymeric substances (EPS) produced by S. cerevisiae contribute to the improved bioelectric performance by providing structural support to the biofilm and facilitating extracellular electron transfer (EET) [2]. Compared to unmodified SPEs, PAni and PAni-rGO modified electrodes exhibited higher current densities and lower charge transfer resistance, demonstrating their potential for optimizing bioelectrochemical applications, particularly in BFCs.

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References
[1] ARAÚJO, G. M; CARDOSO, M. A.; CODOGNOTO, L.; BRETT, C. M. A.; SIMÕES, F. R. Screen-Printed Electrodes based on conductive inks of polyaniline/graphene hybrids and their application to progesterone detection. ECS Advances, v. 2, n. 1, p. 016504, 2023.

[2] XIAO, Y.; ZHANG, E.; ZHANG, J.; DAI, Y.; YANG, Z.; CHRISTENSEN, H. E. M.;

ULSTRUP, J.; ZHAO, F. Extracellular polymeric substances are transient media for microbial extracellular electron transfer. Science Advances, v. 3, n. 7, 2017.