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Development of screen-printed electrodes using the circular economy model for textile dye detection

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Palavras Chave*: Screen-printed electrode, Electrochemical sensor, Reactive black, Emerging pollutants, MOF and Graphene oxide.*

Highlights

- ✓ Electrochemical sensor using a screen-printed electrode modified with graphene oxide, MOF and nafion.
- ✓ A circular energy model, cost-effective and sustainable for the determination of textile dyes such as Reactive Black.

Resumo/Abstract

Environmental contamination by synthetic dyes has driven the development of efficient and sustainable analytical methods. Reactive Black is a dye widely used in the textile industry and due to its high toxicity and chemical stability, this dye represents a great environmental risk1. To mitigate this issue, this work proposes the development of an electrochemical sensor based on a screen printed electrode modified with graphene, Metal-Organic Frameworks (MOF) and Nafion for the sensitive and selective detection of this dye in environmental matrices2. The screen-printed electrodes were fabricated using vinyl adhesive, molded with the Silhouette Studio software, and printed using the Silhouette CAMEO 3. The electrode composition included conductive carbon and silver chloride ink, applied via screen printing and subjected to thermal treatment for drying. The sensor's efficiency was evaluated by square wave voltammetry (SWV) at different concentrations of Reactive Black. Under conditions optimized, the screen-printed electrode exhibited a linear electrochemical response within the concentration range of 9.7 × 10-8 to 1.2 × 10-6 mol L-1, with a detection limit of 5.0 × 10-9 mol L^{-1}. The synergy between graphene and MOF enhanced the sensor's sensitivity, making it a promising tool for detecting the dye in environmental samples. The developed method showed good applicability in environmental samples with percentages close to 100%. Furthermore, the proposed approach aligns with circular economy principles by utilizing low-cost materials and sustainable processes, making it a promising solution for pollutant analysis.

References

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