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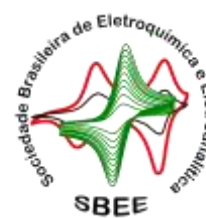
Investigation of the synergistic effect of $\text{Fe}_{1.9}\text{V}_{0.1}\text{O}_3$ nanoparticles as modifiers of Printex L6 Carbon to oxygen reduction reaction for H_2O_2 Electrogeneration

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Hydrogen peroxide (H_2O_2) is an oxidizing compound that has many applications, particularly in the treatment of industrial effluents [1]. Electrochemical technology has been developed to produce H_2O_2 *in situ* through the oxygen reduction reaction (ORR) via 2 electrons pathway, using carbonaceous materials such as Printex L6 carbon (PL6C) [2]. In order to improve the high selectivity and efficiency of PL6C for H_2O_2 electrogeneration, this work studies the synthesis, structural and electrochemical characterization of $\text{Fe}_{1.9}\text{V}_{0.1}\text{O}_3$ nanoparticles (NPs) and used as modifier of PL6C in order to increase the efficiency of ORR via 2 electrons. The NPs were obtained using the Fe^{2+} , Fe^{3+} and V^{5+} salts by co-precipitation method. These materials were characterized by X-ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM-FEG) and transmission electron microscopy (TEM) to determine their crystal structures and morphological analysis. The X-ray photoelectron spectroscopy (XPS), electrochemically active area (EQSA) and the zero charge point (pH_{ZPC}), as well as the contact angle were also determined to understanding the interaction between the NPs and the PL6C. In addition, PL6C modified with $\text{Fe}_{1.9}\text{V}_{0.1}\text{O}_3$ NPs was analyzed by Cyclic Voltammetry (CV) and Linear Voltammetry (LV), with a rotating ring-disk electrode system (RRDE). These analyses were carried out at pH 3.0 and 9.0 to study the electrocatalytic activity, determine the average selectivity for H_2O_2 formation via ORR and the number of average electrons involved in the process. The results of the structural analysis indicate the presence of two oxide phases: maghemite (Fe_2O_3) and hematite ($\gamma\text{-Fe}_2\text{O}_3$), with an average size of 8.0 nm (± 0.5) and spherical morphology, similar to PL6C. The surface interactions indicate a greater interaction of the modified carbon with the electrolyte and the charges present in the medium, based on the decrease in contact angle (from 113° to 99°) and increase of specific capacitance (from $75.6 \mu\text{F}\cdot\text{cm}^{-2}$ to $109.2 \mu\text{F}\cdot\text{cm}^{-2}$) of the 98% PL6C@2% $\text{Fe}_{1.9}\text{V}_{0.1}\text{O}_3$ catalytic coatings. In addition, this composition showed an increase in selectivity for H_2O_2 production by ORR when compared to PL6C, at both pH (6.2 and 16.2%, respectively).

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References:

- [1] Trench, A. et al., Chemosphere, v. 352, 141456 (2024).
- [2] Cordeiro-Junior P. J. M. et al., J. of Catalysis, v. 392, 56-65 (2020).