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Nb:Ce:La ternary catalyst: synthesis, characterization and potential application for the environment

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The study aimed to create a ternary catalyst using Nb, Ce, and La, intending to modify graphene and utilize it on an EDG cathode for enhancing the electrogeneration of hydrogen peroxide in solution [1-2]. The catalyst synthesis involved diluting 700 mg of Nb_2O_5, $CeCl_3$, and La_2O_3 in 20 mL of distilled water, in a Teflon capsule, followed by the slow addition of 10 g of NaOH diluted in 5 mL of distilled water, stir for 30 minutes. After this period, the capsule was closed and placed in a hydrothermal reactor maintained at 100°C for 24h. After the hydrothermal stage, the catalyst went through the process of 3 washes (water, 50% isopropyl alcohol, water), followed by centrifugation (5000 rpm) and was subsequently dried at 80°C for 10h and calcined at 500°C for 3h. The catalyst was characterized by Raman spectroscopy, showing a characteristic displacement of Nb_2O_5 of 230 cm^{-1}, CeO_2 of 500 cm^{-1}, and a displacement of around 850 cm^{-1} characteristic of La_2O_3. In XRD, a peak was noted at 20° corresponding to Ce, at 32° corresponding to Nb, and at 55° corresponding to La. In the SEM, one could observe the formation of nanorods, evident in the EDX analysis revealing their composition of cerium and lanthanum, with niobium present alongside these filamentous structures.Graphene demonstrated a hydrogen peroxide electrogeneration rate of 67%. This catalyst was used to modify graphene using the impregnation method, in quantities of: 1%, 3% and 5% by mass. in solution, following the 2-electron mechanism. Graphene modified with 1%, 3% and 5% of the catalyst showed about 99% of electrogeneration of peroxide in solution, respectively. The modification was aimed at increasing the electrogeneration of H_2O_2 in the solution during the oxygen reduction reaction (ORR).

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References:

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