Área: ELE

Development of electrochemical sensors with metallic nanoparticles synthesized in deep eutectic solvents

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Keywords: Electrochemical Sensor, Metallic Nanoparticles, Deep Eutectic Solvent.

Highlights

Synthesis of metallic nanoparticles in deep eutectic solvent (ethaline) and their role as electrochemical sensor modifiers.

Abstract

Deep Eutectic Solvents (DES) are analogous to ionic liquids and have become relevant in recent decades as alternatives to toxic and volatile conventional solvents[1]. DES have been widely investigated for various applications due to their advantageous physical and chemical properties. Due to their characteristics, DES are considered a good option for the synthesis of nanometric materials without the need for extreme temperature and pressure conditions (60-80 °C at 1 atm)[2], which provides a gentler route for the formation of reduced size and uniform morphology metal nanoparticles (MNPs). In this study, the ethaline, DES formed by choline chloride (ChCl) and ethylene glycol (EG) in a molar ratio of 1:2, was employed as the medium for the synthesis of MNPs from cerium chloride using hydrazine sulfate as the reducing agent. The cerium nanoparticles (CeNPs) were analyzed using two characterization techniques: energy-dispersive X-ray spectroscopy (Fig 1 (a)) and transmission electron microscopy (Fig 1 (b)). The analysis also showed that the CeNPs were arranged in clusters, had an average size of 4 nm, and were predominantly composed of oxides. The CeNPs were incorporated into a suspension containing carbonaceous materials (multi-walled carbon nanotubes (MWCNTs) or carbon black (CB)) and a polymeric film-forming agent (Nafion™)[3]. The sensors were modified by drop-casting the suspension onto a glassy carbon electrode (GCE). Cyclic voltammetry analysis with hydroquinone (H_2Q) revealed that CB promotes higher anodic and cathodic peak currents (17% and 36%, respectively, compared to MWCNTs), as illustrated in Fig. 1(c). Based on these analyses, it can be concluded that the proposed method was effective in synthesizing the CeNPs, which showed promising results.

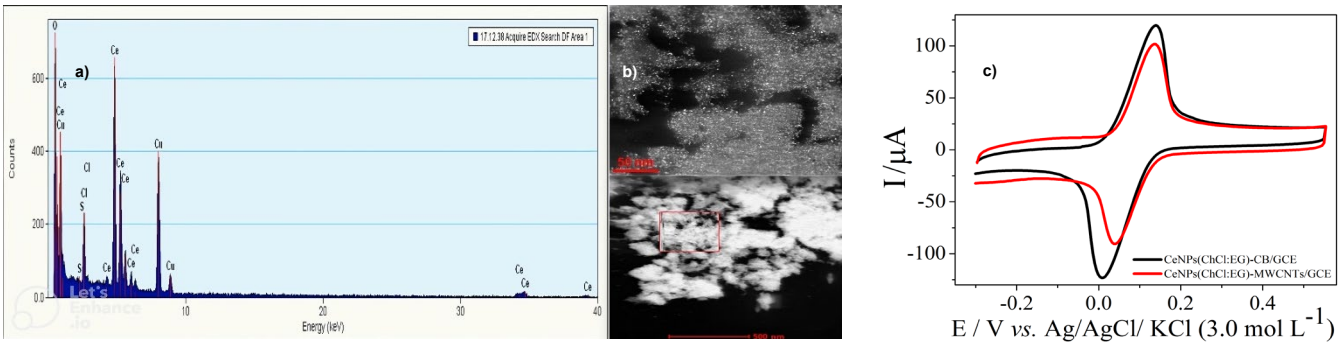

Figure 1 - **(a)** Cyclic voltammogram for 1.0 mmol L^{-1} H_2Q at (—) CeNPs-CB/GCE and (—) CeNPs-MWNTs/GCE sensors. **(b)** EDX spectrum of CeNPs-CB film and (c) TEM image of CeNPs

[1]Abbott. *et al. Chem. Commun.* **19**; [2]Lee, J. S. *Nanotechnology Reviews* **6**; [3]Wong, A., *et al.* Microchemical Journal **147**, 2019.

Acknowledgments

The authors thank grant #140406/2021-2 from CNPq, #2022/15513-2 and #2020/01050-5 from FAPESP, and CAPES – Finance code 001 for the financial support during this research.