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Nanoparticles of Copper Nitroprusside: A New route for obtaining electroactive nanocomposites

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Abstract – Nanoparticles of copper nitroprusside (CuNN) have been synthesized and characterized by X-Ray Pattern (XRD), Scanning Electron Microscopy (SEM), Electronic (Uv-Vis) and Vibrational (FTIR) spectroscopies and Cyclic Voltammetric (VC) techniques. The electronic spectra of CUNN shown a broad intervalence charge transfer band at 685 nm. In XRD patterns of the CuNN. was verified that the peaks are broadened, indicating a decrease in the particle size when formamide is used. The cyclic voltammogram of the modified electrode containing CuNN, exhibits three redox couples with formal potential ($E^{0\prime}$) : 0.289, 0.508, 0.726 V for $E^{0\prime}_1$, $E^{0\prime}_2$, $E^{0\prime}_3$ respectively.

Nanoscale metal particles are attracting considerable attention for their intriguing properties and potential applications. From a synthetic point of view, the main challenge is to seek new procedures that allow the preparation of nanoparticles in a controlled manner, obtaining a narrow size distribution, because the properties of nanoparticles are highly size dependent [1]. Metal nitroprusside and Prussiam Blue analogues have been studied extensively nowadays due to their electrocatalytical properties. However nano-sized metal nitroprusside is not common than nano sized Prussiam Blue and correlates. Here, we report a new approach for the growth of nanoparticles of copper nitroprusside (CuNN) using an organic solvent, formamide. The nanoparticles was characterized by X-Ray Pattern (XRD), Scanning electron microscopy (SEM), electronic (Uv-Vis) and vibrational (FTIR) spectroscopies and Cyclic Voltammetric techniques (VC).Copper nitroprusside nanoparticles (CuNN) was synthesized following a typical synthesis: 0.7 g of $Na_2[Fe(CN)_5NO]$ were dissolved in 30 ml of formamide–water mixture (solution). Solution B was prepared by dissolving 0.7 g of $CuCl_2\ 2H_2O$ in 20 ml of formamide –water mixture in a separate flask. The volume ratio of formamide and water mixture used was (6:4). The solution B was the added to the solution A at room temperature with vigorous stirring. After the addition, the reaction mixture turned blue and a precipitate was formed (sparkling). The solid phase was separate and the dried product was stored and sheltered from light. The resulting composite was described as CuNN. The diffuse reflectance UV-Vis spectra for CuNN qualitatively shown a broad intervalence charge transfer band at 685 nm. The electrochemical behaviour of CuNN was verified by means of a graphite paste electrode using cyclic voltammetry in a potential range from -0.5 to 1.2 V (*vs* Ag/AgCl*)*.

The cyclic voltammogram of the modified electrode containing CuNN, exhibits three redox couples with formal potential ($E^{0\prime}$) (where $E^{0\prime} = (E_{Pa} + E_{Pc})/2$) were 0.289 ($E^{0\prime}_1$), 0.508 ($E^{0\prime}_2$), 0.726 ($E^{0\prime}_3$) V (*vs* Ag/AgCl (KCl =1.0M; v =20 mV s^{-1}). The redox couple($E^{0\prime}_1$), and ($E^{0\prime}_3$), were assigned to the $Cu^{(I)}/Cu^{(II)}$ and $Fe^{(II)}(CN)_5NO$ / $Fe^{(III)}(CN)_5NO$ respectively. The redox couple with ($E^{0\prime}_3$), was tentatively attributed to the possible oxidation of formamide moiety to formic acid. From the Scanning electronic microscopy and energy dispersive X-ray analysis ((EDX) of the synthesized sample has been observed particles with high degree organization .It was observed the presence of Na, Cu and Fe and a general formula can be the proposed to be $Na_XCu_Y[Fe(CN)_6]$ for CuNN where x = 0.5-0.9 and Y= 0.7-1.0). Figure 2 Shows XRD patterns of the CuNN. Its was verified that the peaks are broadened, indicating a decrease in the particle size when formamide is used (6:4).

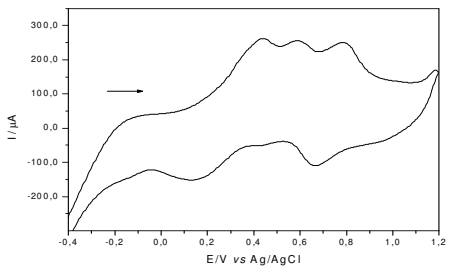

Figure 1: Cyclic voltammogram of CuNN (pH 7.0; v= 20 mVs^{-1} KCl 1.0 mol L^{-1})

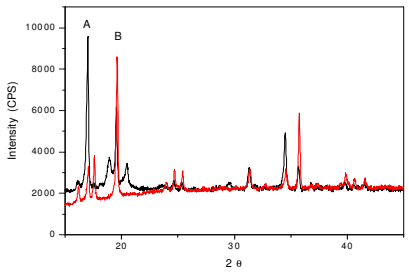

Figure 2: DRX : A) CuNN (formamide : water mixture (4:6)) ;B) Copper nitroprusside (formamide : water mixture (0:10))

References

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