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Synthesis and Characterization of Polyaniline / Multiwalled Carbon Nanotubes Composites Deposited onto ITO Substrates

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Abstract – Composites of Polyaniline (PANI) and Functionalized Multiwalled Carbon Nanotubes (MWNT) were obtained by in-situ chemical polymerization of aniline in acidic solutions. Four types of composites were obtained changing the synthesis parameters such as monomer-oxidant molar ratioand the oxidant addition procedure. FTIR analyses showed that the corresponding bands of both materials (PANI and MWNT) indicate the formation of the composites. The composites films were deposited by casting onto ITO substrates. The films were characterized by Cyclic Voltammetry and Impedance Electrochemical Analyses. The results showed significant changes in the electrochemical behavior of PANI despite the low proportion of MWNT (2% in mass).

The MWNTs were functionalized in a mixture of sulfuric acid and nitric acid (3:1) by magnetic stirring for 30 minutes and heating (70°C) [1]. The functionalized MWNTs were then neutralized by washing with distilled water and dried by centrifugation. To the composites syntheses, it was prepared a 0.4 M HCl-aniline solution and two different solutions of ammonium persulfate(APS) /HCl (0.1 e 0.4 M). These solutions were used to prepare composites with monomer:oxidant ratios of 1:1 and 4:1 respectively. The syntheses were performed at 24°C for two hours. The oxidant solutions (APS/HCl) were added to the aniline/HCl using two distinct procedures: drop wise addition and quickly addition. Prior to the addition of the APS solution the functionalized MWNTs were mixed to aniline/HCl solution in 2% m/m. After the synthesis, the composites were washed (HCl 1.0M), dried and stored.

The FTIR analyses (Figure 1) showed bands characteristics of both materials. The composite spectra and PANI showed peaks at around 1490 e 1590 cm^{-1} with indicates the presence of benzenoid and quinoid vibrations [2].

The composites were dispersed in 1,0 M HCl solutions. The films were deposited over ITO substrates by four successive additions of 20 µL of the composite solutions and then characterized by Cyclic Voltammetry and Electrochemical Impedance Analysis. The electrochemical behavior of the films showed that the functionalized MWNTs deacreases the intensities of the voltammetric peaks of PANI. Moreover, the shapes of voltammograms showed lower definitions in comparison with the PANI one. This was attributed to the presence of MWNTs that facilitates the electronic transport and increases the electronic conductivity of the films. Additionally, the voltammograms of the composite electrodes are very similar to previously reported modified electrodes used to determine some pesticides [3].

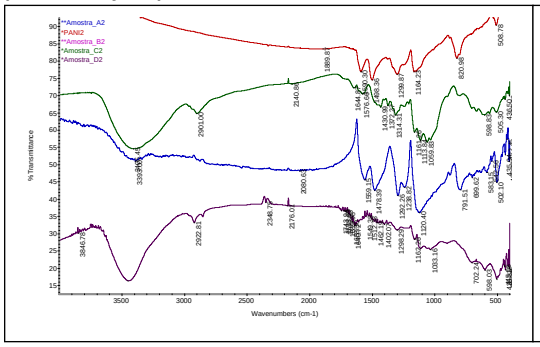

Figure 1. FTIR spectra's of the PANI and composites samples: A2 (1:1 and quick addition); B2 (1:1 and drop wise); C2 (4:1 and quick addition); D2 (1:1 and drop wise).

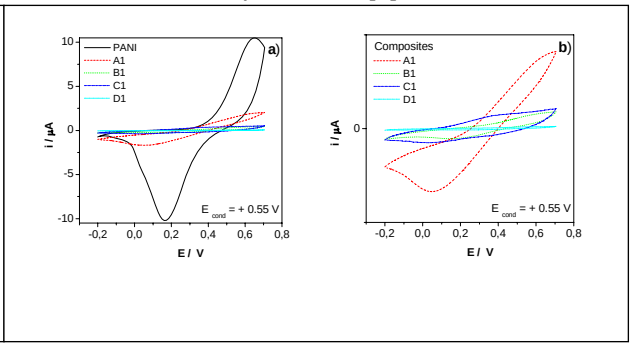

Figure 2: Voltammetric Analyses of **a**) PANI and Composites; **b)** Composites. Support electrolyte of H_2SO_4 0,5 mol L^{-1}. Reference Electrode (ECS). *v* = 100 mV s^{-1}

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