

Electroactives nanocomposites containing calcium titanate immobilized with cashew gum and polyaniline: synthesis and electrochemical characterization

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Abstract – In this paper we show the feasibility of fabricating nanostructured layered films containing crystalline CaTiO₃ assembled in conjunction with polyaniline and cashew gums. Ultrathin layers of the inorganic and organic materials had been assembled on ITO substrates using the layer-by-layer technique. The films displayed well defined electroactivity, suggesting their use as nanostructures modified electrodes for sensing.

Recently, calcium titanate (CaTiO₃ or CT) have received special attention from industrial and scientific areas, mainly due to the use in electronic devices. This ceramic belongs to the important group of compounds with perovskite-type structure exhibiting an orthorhombic structure with space group *Pbnm* below 1380 K [1]. CaTiO₃ powders has been synthesized by the complex polymerization method, which provides samples with high composition accuracy and homogeneity.

Exudate gums are natural biopolymers that find application as emulsifying, stabilizing and thickening agents in cosmetic and food industries, where they are used mostly in their crude, native state. The polyelectrolyte character of cashew gum (*Anacardium occidentale L.*), a Brazilian native gum, can be employed to produce electroactive nanocomposites [2].

In this study, LbL films containing crystalline CaTiO₃ were produced with polyaniline (PANI), as cationic solution, and cashew gum (CG) or poly(vinylsulfonic acid) (PVS), as anionic solutions. Two methods were employed for film preparation: a) CT was dispersed in anionic solution (PVS or CG) or b) CT was dispersed in cationic solution (PANI). The films were deposited onto glass covered with indium tin oxide (ITO) substrates and four distinct architectures were proposed: PANI/PVS(CT), PANI/CG(CT), PANI(CT)/PVS and PANI(CT)/CG and the influence of the CT in the nanocomposites were investigated through electrochemical experiments by cyclic voltammetry in acid media, H₂SO₄ 0.05 mol/L. For comparison, films containing only PANI/PVS and PANI/CG were also investigated.

The first redox process for PANI/PVS (0.30V) was shifted to lower potential (0.15V) for PANI/PVS(CT) and another process appear in 0.20V, which may be indicative of the interaction between PVS and CT. The current values increase to PANI/PVS(CT) film comparing with PANI(CT)/PVS, Figure 1. Surprisingly, an opposite effect was observed for the PANI(CT)/CG film (Figure 2). In this case, the redox processes are better defined and the current values are greater when CT was dispersed in PANI alternating with CG. The latter indicates that CG does not have de same interaction observed between CT an PVS in the LbL structure.

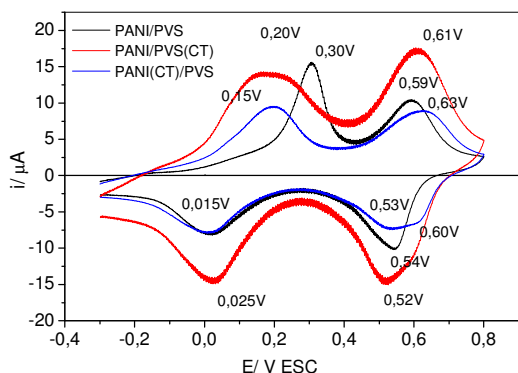


Figure 1: Electrochemical response for 3-bilayers films of PANI/PVS, PANI/PVS(CT) and PANI(CT)/PVS, in H₂SO₄ 0.05 M, 50 mV/s.

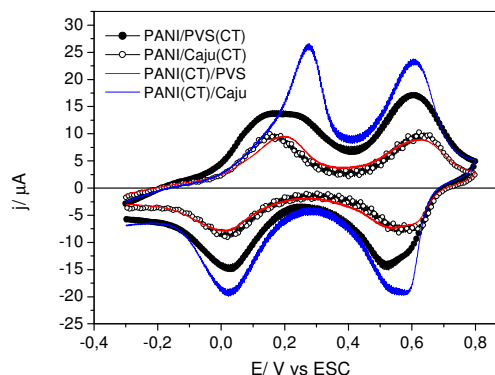


Figure 2: Electrochemical response for 3-bilayers films of PANI(CT)/CG, PANI(CT)/PVS comparing with PANI/CG(CT) and PANI/PVS(CT) films respectively, H₂SO₄ 0.05 M, 50 mV/s.

References

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