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Utilization of Poly(butylene adipate-co-terephthalate) (PBAT) and carbon materials at the macro and nano scale for the fabrication of electrochemical devices

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In this work it was manufactured and characterized a conductive composite from the polymer PBAT with graphite and Carbon Nitrite Dots (CNDs), in order to study the behavior of electrodes when manufactured with materials in macro and nanostructured scale. This polymeric base (PBAT) was chosen for being a biodegradable and biocompatible copolyester that combines in its linear chain aliphatic and aromatic parts. Its commercial name is Ecoflex, produced by the company BASF (BASF, 2018). Although PBAT has characteristics that make it a great polymeric material, it is insulating and therefore unsuitable for an electrochemical sensor if employed alone. An alternative is then to use substrates containing the PBAT and a conductive material. Graphite, for example, is already widely used in analytical and bioanalytical applications. Graphite is the most abundant allotropic form of pure carbon, sp2 hybridized with high electrochemical reactivity, mechanical rigidity, and high thermal stability. Compared to other carbon materials, it has the advantage of being commercially available at low cost. This hybridization allows carbon to establish three covalent bonds and one of a more delocalized character. From this delocalization of electrons arises the electrical conductivity of graphite. The carbon nitrite quantum dots (CNDs), are materials synthesized in a simple way, without using pollutant solvents, so the work proposes to use CNDs with PBAT. The advantage of using CNDs is the presence of fluorescence and conductivity of these materials that can be an interesting property associated with PBAT. From the proposed study, we will be able to understand the behavior of flexible substrates with two types of carbon materials in the application in electrochemical sensors. To test the functionality of these composites as a conductive substrate, we employed electrochemical techniques of Cyclic Voltammetry (CV) and Electrochemical Impedance Spectroscopy (EIS). The electrode behavior for a solution of K3[Fe(CN)6] in KCl (0.1 mol L-1) from the VC technique, the current density (J) values were 4.56 x 10-4 and 3.95 x 10-4 (mA/cm²), for the CD-based and graphite-based electrodes, respectively. The Nyquist plot comparing the flexible electrode produced by conductive materials at the macro and nano scale and the Rcts values were equal to 115.28 and 188.49 (K? cm²) for the CD-based and Graphite-based electrodes, respectively. From the results obtained it is seen that the electrochemical response for both electrodes are noticeable, however the mass use of CNDs is relatively less for the production of the sensor and its synthesis can be easily performed in laboratories. In addition, CNDs exhibit flexible and low toxicity properties and can be applied in the development of wearable sensors.