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Synthesis and characterization of polythiophene and silver nanocomposites

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Polymers are well known because their insulator properties. However, after the treatment of polyacetylene with Lewis acids or bases [1], a new segment of polymers was created. These polymers have conjugated pi bonds that when oxidized in the presence of a counter ion generates distortions in the polymer chain leading to energetic states between the valence and conduction bands (process called doping). Doped conjugated polymers have been applied in different devices such as electrochromic, electroluminescent, photovoltaic and sensors. One of the well-known conjugated polymer is polythiophene, which has one of the smallest band gap. The combination of polythiophene with metallic nanoparticles, as silver, may improve the performance as support materials in electroanalytical sensors and biosensors due to electrocatalytic properties improved by larger surface areas and electronic transfer. In this work, polythiophene was chemically synthesized in the presence of $AgNO_3$ (precursor of silver nanoparticles), methyl orange (MO, a dopant/soft template) and ferric chloride (an oxidant/dopant). An investigative study was carried out to evaluate the impact of synthesis composition on the optical, electrochemical and morphological properties. Shifted UV-Vis bands evidenced interactions between MO and polythiophene. Working electrodes composed of polythiophene-silver presented an additional redox pair at ca. 0.35 V (anodic) and 0.26 V (cathodic) (vs. Ag/AgCl). Concerning the optical band gap, these samples presented slightly lower values (1.90 eV against 1.87 eV (absence of silver). Although similar, the optical band gap was more affected by changes in the oxidant/monomer ratio than by the presence of silver nanoparticles.

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References

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