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Electrical Properties of Polyaniline/indium Tin Oxide Nanocomposites.

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Since the discovery of electroluminescence in polymers, substantial research has been gone into improving the light output, power efficiency, and lifetime of polymer light emitting devices (OLEDs). Typically, OLEDs consists of a transparent hole-injecting anode, an electroluminescent conjugated polymer, and an electron injecting cathode in which their optoelectronic is strongly dependent on the electrical, morphological and optical properties of these materials. The indium-tin oxide - ITO is nowadays their most widely used transparent and electrode, while barium, aluminum and calcium as the metallic one. However, ITO is a non-stoichiometric material which presents a high work function (4.5 - 5.0 eV) and high electrical conductivity, but also acts as an oxygen and metal ion source, resulting in quenching sites for electroluminescence (EL) devices. In order to minimize this effect, an intermediate hole transport layer (HTL) between the ITO and the photoemissive layer is required. Several studies of utilizing doped polymers as HTLs have been reported on literature. Among these polymers, the polyaniline shows attractive characteristics since it presents the possibility to be processed as ultrathin films, and also appropriated work function for OLEDs applications. In this context, the possibility to prepare transparent and ultrathin films based on ITO nanoparticles and doped polyaniline appears here as a great opportunity to develop efficient materials for applications as HTL of OLEDs, in which thorough study is needed to understand the role of ITO on the electrical properties of PANI/ITO medium. In this work we have investigated the alternating conductivity of ultrathin PANI/ITO films obtained from doped PANI and ITO nanoparticles (~ 8 nm). The ac results are typical of a disordered medium in which the logarithm of the real component, $\sigma'(\omega)$, exhibits two frequency regions, one plateau at low frequencies (the dc plateau) followed by a region of increasing conductivity, obeying $\sigma'(\omega) \alpha \omega$^n, where $0 \leq n \leq 1$, for higher values of frequencies. In order to interpret both the real and the imaginary components of $\sigma^*(\omega)$, we developed a model which considers the doped PANI as a semiconductor matrix, sprinkled with conductive ITO nanoparticles. The conduction through the insulating matrix obeys the random free energy barrier model, while ITO nanoparticles a metallic frequency-independent conductivity is considered. From the fittings is possible to obtain the activation energy value of the maximum energy barrier of the doping mechanism and to estimate the concentration of hopping sites. This work was sponsored by FAPEMIG and CNPq.

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