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Optical and Electrical Characterization of Nanocomposites Based on Conjugated Polymer and Nanoparticles or Nanotubes

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Abstract – Nanosized materials as noble metal nanoparticles and carbon nanotubes have been attracted much interest in recent years due to their unique properties and potential application in several areas. In this work we have studied the optical and electrical properties of nanocomposites made of semiconducting polymer and metal nanoparticles or carbon nanotubes. The combination of such materials makes possible the development of new devices in the organic electronic area.

Most physical and chemical properties of metal nanoparticles (NPs) depend on their size and shape. Therefore is important to develop synthetic routes to obtain non-agglomerated, uniform nanoparticles with well-controlled mean size and a narrow size distribution. In this work, the NPs (gold and silver) are produced by the two phase liquid – liquid method using dodecanethiol as ligand [1]. The size distribution, structure and morphology of the nanoparticles are obtained by UV-vis spectra, X-ray diffraction and transmission electron microscopy (TEM). The carbon nanotubes used in this work are multi walled (MWNT) and were produced through the pyrolysis of ferrocene in a poor oxygen-containing atmosphere by the chemical vapor deposition (CVD) technique [2]. The nanotubes present variable diameter and lengths. The semiconducting polymer is the poly 3-hexyl-thiophene (P3HT) acquired from Aldrich and is dissolved in chloroform solvent.

The nanocomposites are made by mixing the polymer solution and the nanoparticles or carbon nanotubes dispersions. The thin films are produced by spin coating. The concentration of the nanostructures in the polymer matrix is variable and is relative to the mass fraction of the polymer. In order to make electrical and optical measurements, the samples are prepared in a sandwich structure where the nanocomposites are located between two electrodes, usually tin doped fluorine (FTO) and aluminum. The electrical properties are analyzed by current density – voltage ($J \times V$) curves and a drastic change is observed when a small amount of metal nanoparticles or carbon nanotubes [3] are add to the polymer matrix. The optical properties are studied through absorption UV-vis spectra of the films with different nanostructures concentrations. The samples are also submitted to the measurement of the photocurrent by collecting the charges generated by the absorption of the nanocomposites.

References

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