OPTICAL AND ELECTRICAL PROPERTIES OF COMPOSITIONAL FILMS BASED ON SEMICONDUCTOR POLYMERS DOPED BY Ag-TiO2 AND Ag-SiO2 NANOSTRUCTURES

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One of the promising materials for polymer electronics is nanocomposite films based on semiconductor polymers with the addition of nanoparticles (NP’s) of metals and nanostructures (NS’s) based on them. NS’s with a plasmonic Ag nanoparticle as a core and a protective shell of TiO2, SiO2 allow changing both the optical and electrical properties of nanocomposite films.

The paper presents the results of a study of the optical and electrical properties of composite films based on semiconductor polymers P3HT and PEDOT: PSS with the addition of Ag NP’s and Ag-TiO2, Ag-SiO2 NS’s.

Polymer mixtures with Ag-TiO2 NS’s and Ag-SiO2 NS’s in chlorobenzene with polymer concentrations of 0.001% and 1% by weight of solvent were investigated. The selected polymer concentrations in solution are two systems with strong and weak intermolecular interactions. Adding Ag-TiO2 nanostructures to a solution with a P3HT polymer leads to an increase in the optical density of the long-wavelength part of the absorption spectrum of the polymer. At the maximum concentration of NS’s in the long-wavelength part of the P3HT absorption spectrum, additional absorption bands appear. With increasing concentrations of polymer and NS’s, the P3HT band gap decreases.

Adding Ag-TiO2 NS’s to the solution only leads to a decrease in the fluorescence intensity of the polymer. At low concentrations of Ag – SiO2 NS’s in the solution, an increase in the fluorescence intensity of the polymer is observed. As the Ag-SiO2 NS’s concentration increases, polymer fluorescence is quenched. A study was also conducted of the effect of NP’s and NS’s on the optical properties of PEDOT: PSS solutions and films.

Measurements of the surface resistance (ρ) of the PEDOT: PSS films showed that the addition of Ag NP’s and Ag-TiO2 NS’s reduces the ρ films. In the case of Ag-SiO2 NS’s, an increase in the electrical resistance of the films is observed. An increase in the dielectric constant of a composite film containing Ag NP’s and Ag-TiO2 NS’s was found. The electrical properties of composite films based on P3HT with the addition of Ag NP’s and Ag-TiO2, Ag-SiO2 nanoparticles are also studied.