

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

D.Afanasyev (1,2), N.Ibrayev (1), E.Alikhaidarova (1)

(1) *Institute of Molecular Nanophotonics, Buketov Karaganda State University, Karaganda, Kazakhstan*

(2) *Institute of Applied Mathematics, Karaganda, Kazakhstan*

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.