Abstract

Organic electronic devices such as organic field effect transistors (OFETs), light-emitting diodes (OLEDs), resistive memory elements or organic solar cells have attracted an increasing attention in recent years due to the vision of a low-cost and large-scale production of printable electronics. Many papers published during the last decade focused on the intrinsic properties of organic conductors, semiconductors and dielectric materials. Since most of the devices consist of multilayer structures the mutual influence of the processes that take place in the particular layers are important for the functionality of the whole device.

This work is aimed to contribute to the characterization and understanding of the mutual interactions of individual layers in the multilayer structures of organic devices. The main achievements of this work can be listed as:

(i) Optimization of the thermal stability and dielectric properties of cyanoethylated polyvinylalcohol (CEPVA) high-k dielectric by the crosslinking reaction with the low molecular weight materials or mixing with a high T<sub>g</sub> polymer.

(ii) Finding possible phenomena in the CEPVA polymer dielectric that influence the charge carrier transport in the OFET active channel made of bis(triisopropylsilyllythynyl) pentacene organic semiconductor, using a combination of methods as FTIR, solid-state NMR and broad-band dielectric spectroscopy.

(iii) Showing the role of both plasmonic and non-plasmonic secondary effects of gold nanoparticles (NPs) arrays on the optical and electrical properties of poly (3-hexylthiophene) (P3HT) by analyzes of thermal dependences of electrical conductivity and optical absorption in UV-vis region.

(iv) Design of the blends consisting of conjugated diketopyrrolopyrrole (DPP) based polymers, as a hole transporting polymer matrix, molecularly doped with the low molecular mass electron acceptors based on perylene derivatives that show hysteresis in their current-voltage characteristics, Those blends were applied as active layers in resistive non-volatile memory elements (memristors).

(v) Improvement of the memory behavior by designing a multilayer structure in which the trapped charge is stabilized by a mutual interaction between charged Au nanoparticles and permanent dipoles of the high-k CEPVA polymer.

Keywords: high-k polymer dielectric, crosslinking, OFET, organic semiconductors, charge transport, plasmonic nanoparticles, memristor,