Abstract

The aim of the doctoral thesis was to obtain low molecular weight compounds with systems of π-conjugated bonds and examine the relationship between their chemical structure and selected physical properties important from the point of view of a potential application in organic optoelectronics. In the frame of work, 57 compounds were obtained and investigated. They can be divided into three groups, namely derivatives of malononitrile, azomethines, and azometineimides. To study thermal properties of the synthesized compounds, that is, thermal stability and temperature of phase transitions and glass transition temperature, thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) were applied, respectively. Absorption and photoluminescence properties (PL) in the UV-Vis range were investigated in solution and solid state in the form of films and blends (with PMMA and/or with PVK and/or with PVK: PBD). Cyclic voltammetry (CV) was used to estimate the ionization and electron affinity potentials and the energy band gap. Compounds with appropriate properties were selected to verify their electroluminescence (EL) capability in light emitting diodes (OLED), where they acted as the emission layer or its component.

In this Ph.D. work, for the first time, the electroluminescence of azomethines (with the structure of thiophene and fluorene and with the N-phenylpyrrolidine substituent) and azomethineimides (containing a derivative of carbazole, benzoindole, phenanthrene) was demonstrated. It was found that increase of malononitrile derivative with triphenylamine and four CN groups and azomethineimides with phenanthrene and biphenyl, content from 2 to 15 wt. % in the PVK: PBD matrix raises the intensity of EL. Moreover, in the case of azomethineimides also change of color of the light emitted by the diode was observed. Some of the azomethines tested exhibited photoluminescence from the S_2 singlet state, which has not been described so far in the literature for this group of compounds.

In summary, taking into account the EL properties of the tested compounds, the attention should be paid on the malononitrile derivatives containing carbazole and triphenylamine structure, azomethines with fluorene and two N-phenylpyrrolidine groups and azomethineimides bearing a carbazole, triphenylamine, phenanthrene and biphenyl derivative, which seems to be the most promising for further application investigations.

The investigations conducted within the framework of the Ph.D. thesis are basic research and contribute to a significant extension of knowledge concerning the selected types of compounds. The carried out research let to evaluate synthesized compounds ability for potential applications. Moreover, the found dependencies may help to design new materials with appropriate properties for applications in organic optoelectronics.