Abstract

The progress in the domain of organic semiconductors resulted in the growth of their commercial application in different optoelectronic devices. However, the intensive research to obtain the electroactive compounds of the most useful properties and simultaneously enabling cheap industrial production of optoelectronic devices is still being carried out. The aim of this doctoral dissertation was the synthesis and study of physico-chemical properties of new organic compounds with imine bonds for optoelectronic applications. This work presents the results of the studies of the following groups of compounds: (poly)azines, azomethines, dihydrazides, polyhydrazides and (poly)azomethine-diimide. The solubility, thermal, optical (UV-Vis absorption and photoluminescence) and electrochemical properties of the obtained compounds were investigated. The selected compounds were also used in active layers in organic light emitting diodes and bulk-heterojunction solar cells. Thermal stability was examined by thermogravimetric analysis while phase transitions temperatures and corresponding enthalpy values were determined by differential scanning calorimetry. Optical properties were studied both in solution in chloroform and *N*-methyl-2-pyrrolidone and in solid state as blends with PMMA and fluorescence lifetimes and fluorescence quantum yields were determined for the chosen compounds. The redox properties were examined by cyclic voltammetry and the energies of HOMO and LUMO orbitals and energy band gaps were estimated from the oxidation and reduction potentials.

The most promising photoluminescence properties were found in compounds containing triphenylamine and phtalic diimide. These compounds exhibited HOMO orbital energies suitable for their use in active layers in "host-guest" organic light emitting diodes with PVK:PBD as a matrix.

The energy band gaps values for most of the obtained compounds were below 3 eV. The most promising compounds as *p*-type semiconductors were: unsymmetrical azine synthesized from benzophenone hydrazone containing triphenylamine, azomethines with pyridine, hydroxyphenyl and 3,4-ethylenedioxythiophene, dihydrazides with dimethylaminophenyl or heptadecafluoroundecyloxyphenyl and azomethinediimide with triphenylamine. (Poly)azomethinediimides exhibited mostly *n*-type semiconducting or ambipolar properties. Electron-accepting properties were found in: phtalic (poli)azomethinediimides containing tetramethylphenyl with heptadecafluoroundecyloxyphenyl, octadecyloxyphenyl, thiophene, 3,4-ethylenedioxythiophene and triphenylamine as substituents and phtalic azomethinediimide containing naphtalene substituted with furan. Ambipolar properties were found in: phtalic azomethinediimides containing tetramethylphenyl with pyridine, bithiophene and furan as substituents and phtalic azomethinediimides containing naphtalene with thiophene or bithiophene as substituents. The compounds exhibiting the most promising properties were used in active layers in organic light emitting diodes with the following architectures: ITO/PEDOT:PSS/**compound**+FIrpic/TPBi/LiF/Al or ITO/PEDOT:PSS/**compound**:PVK:PBD/Al and in organic photovoltaic cells with the ITO/PEDOT:PSS/P3HT:**compound**/Al architecture.