Streszczenie pracy doktorskiej

Characterisation of donor-acceptor systems as materials for organic optoelectronics

mgr inż. Aleksandra Nyga

Organic optoelectronics is currently one of the fastest-growing fields of science. Thanks to the development of analytical techniques from the borderline of photophysics and photochemistry it is possible to perform research on increasingly efficient photoactive systems that are being used in organic luminescent diodes, flexible photovoltaic panels or organic transistors and sensors. In the last years, high attention has been paid to donor-acceptor systems applicable in such devices. These systems can be either single-molecule structures consisting of acceptor unit (A, accepting electrons) and donor unit (D, donating electrons) linked by a chemical bond or alternatively obtained by combining donor and acceptor molecules within a mixture or blend. The proper design of chemical structure and ratio of D-to-A units of such systems is important, which allows for optimisation of their physicochemical properties. Such a strategy can bring many possibilities to the research on organic light-emitting diodes (OLEDs) or organic photovoltaics (OPVs) with the aim to enhance the efficiency of processes standing behind their work. Moreover, a serious difficulty is a contribution of non-radiative processes that occur during the relaxation of excited systems. One of such processes, which can cause inefficient energy losses in optoelectronic devices, is the photogeneration of singlet oxygen. In this case excited photoactive molecule transfers its energy to an oxygen molecule resulting in a formation of singlet oxygen, $^1O_2$, which as a very strong oxidant is used both in a number of industry sectors as well as acute medicine or the wider healthcare sector, but is adverse in both OPVs and OLEDs.

Therefore, the main objective of this work is to investigate various acceptor-donor systems in regard to their multifunctionality and applicability in either organic optoelectronic devices or as a source of singlet oxygen. This research presents a new and unique approach to studying such D-A photoactive systems, taking into account not only their electrochemical and photophysical characteristics but also the photochemical ones. Understanding the competitive interactions between the radiative and non-radiative transitions occurring in photoactive molecules used as, i.e. photosensitizers or emitters, will result in a more conscious optimisation of a particular process and, thus, will allow releasing the hidden potential in the D-A photoactive materials.