

The phenomenon of charge transfer (CT) is based on the electronic charge shift between the molecular entities occurring under the influence of light. Its great significance for the scientists is strongly related to the role it plays in various redox processes in living systems, such as cellular respiration and photosynthesis. The conversion of solar energy into electricity, occurring in photovoltaic cells, is the perfect example of CT's use with the reduction of the energy losses being one of the crucial issues. Since the phenomenon of charge transfer is essential for our life, the understanding of its mechanisms is of paramount importance.

Dipoles are characterized by a dipole moment referring to the uneven charge distribution within the molecule. The first reports on the influence of electric dipoles on electron-transfer (ET) started to appear 50 years ago. In the 1990s unequivocal demonstration of dipole effects on long-range ET in macrodipole of a polypeptide helix has been shown, and initiated investigation of this subject. Our concept of electrets i.e. systems with ordered electric dipole moments, will allow to advance the field beyond its current limits. The use of electrets will enable to slow down the rate of charge-recombination vs. that of the forward charge-transfer, making it possible to reach exceptionally long lifetimes of charge-separated states.

The electric fields near the molecular dipoles are enormous and therefore should strongly influence ET. Often, experimentally determined dependence of ET and dipoles' orientation does not allow for making general conclusions, keeping these effects not well understood. Within this project, we will conduct innovative study on the influence of molecular dipoles on long-range CT occurring according to various mechanisms. This basic-science research is motivated by the need to improve structure-function understanding that relates molecular structure and CT dynamics.

In the view of the project objectives, our study will be divided into three tasks. First of all, we will perform the synthesis of model conjugates, comprising electron-rich pyrrolopyrroles as donors, anthranilamides oligomers as bridges, and diketopyrrolopyrroles as acceptors and photosensitizers. Next, the synthesis of target conjugates bearing longer oligo-anthranilamides using the solid-phase methodology will be developed. All obtained systems will be thoroughly investigated in the last stage, that will allow to determine the impact of their structure on the charge transfer.

The obtained results will allow determining the rate of charge transfer under various conditions and the relationship between the structure of anthranilamides oligomers and two competitive long-range CT mechanisms. It is obvious that further progress in this field can only be achieved *via* studies of longer oligoanthranilamides, containing scaffolds, which allow for full control over optoelectronic properties. Synthetic methods which enable access to such multichromophoric systems do not exist and the key goal of this grant proposal is to develop them.

The long-term impact on the scientific community encompasses the deepened understanding of the relations between the structure of biomolecules containing amide bonds (and their mimetics) and the mechanism of electron transfer. Answering the question under what conditions particular mechanism becomes dominant, will influence development of better materials for solar-driven water splitting to obtain clean fuels essential for sustaining the human civilization on our planet.