

## Abstract (ENG)

Photosensitizers are compounds with exceptionally high application potential. For this reason, new and more efficient materials capable of storing energy and subsequently transferring it to further desired processes are continuously being sought. Since most efficient photocatalytic systems are based on inorganic materials, which are currently being gradually replaced by organic counterparts, one of the main aims of this work is to investigate new organic photosensitizers in terms of their potential applications. A particularly interesting aspect is the possibility of using such compounds to convert absorbed solar energy into chemical energy.

In order to convert absorbed solar energy efficiently, photosensitizers must absorb a broad range of visible light, exhibit long excited-state lifetimes, show high fluorescence quantum yields, and effectively transfer excitation energy to a catalyst. In addition, a potential photosensitizer should be highly stable. Moreover, since most of these processes take place in aqueous solutions, good solubility in this medium is also desirable.

This work focuses on improving potential photosensitizers in terms of visible-light absorption and selecting structures capable of storing photoexcitation energy in triplet states. For this purpose, donor–acceptor systems, such as perylene diimides and/or phenazine derivatives connected with carbazole and/or DMAC donor units, were investigated. In these systems, absorption strongly depends on the angle between the donor and acceptor fragments.

Photophysical studies of phenazine derivatives made it possible to determine how the structure of the chromophore, the presence of a heavy atom, and molecular organization affect ISC processes, delayed emission, and the ability to store excitation energy. These conclusions were then applied to studies of perylenediimide derivatives, which show high potential for photocatalytic hydrogen production from water. Within this work, both a heterogeneous photosensitizer (with  $\text{TiO}_2(\text{Pt})$ ) system and a molecular system formed in situ under irradiation were analyzed, with particular attention paid to the relationship between photophysical properties, charge transfer, and photocatalytic activity.