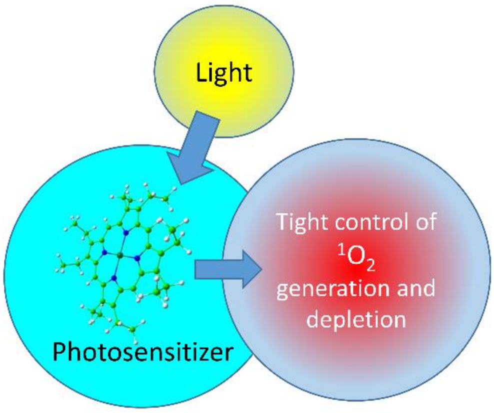

In collaboration with
Light and Matter

Singlet oxygen is an extremely chemically active molecule that is formed from molecular oxygen under light irradiation in the presence of specific organic compounds named photosensitizers. The lifetime of singlet oxygen is very short, only a fraction of a second, but due to its extreme reactivity induces chemical reactions in close environment. In the human body, reactions with singlet oxygen cause the formation of other chemically active compounds – radicals, which are extremely dangerous to our health. The human body tries to eliminate the effects of reactive species formation by producing compounds called antioxidants. These compounds reduce the effects of single oxygen in a more or less effective ways. The imbalance between excessive formation of reactive singlet oxygen species and limited antioxidant species can lead to various diseases and pathologies, including cancer, neurodegenerative or Parkinson's disease.

On the other hand, there are many useful applications of singlet oxygen like photodynamic therapy of cancer, where singlet oxygen may be selectively generated in a cancer tissue and leads to its destruction. Significant from the environment protection point of view, industrial application of singlet oxygen is the acceleration of photodecomposition of polymers under sunlight irradiation, e.g. plastic wastes from the food industry.

The aim of the project is the development of the methodology for a precise generation and, if necessary, control depletion of singlet oxygen by selected photosensitizers as a function of temperature and environment. The project is divided into three objectives. The first one is the characterization of ways of singlet oxygen depletion depending on the environments: starting from simple organic solutions to more complex (simulating biological environment) water/micelle systems. The second stage is the development, based on the knowledge gained in the previous stage, of the mechanism of enhanced singlet oxygen generation by selected molecules (chromophores) in organic solutions and water/micelle systems depending on temperature. In the last part of the project, the synthesis and characterization of molecular complexes composed of two chromophores connected by a bridge (bichromophores) are planned. Depending on the application, bichromophores can be used to generate singlet oxygen or to capture oxygen from solutions.

Successful implementation of the project will be the development of methodology for tight control of oxygen generation and depletion in different environments and allows proposing new effective photosensitizers for various applications. First of all, in photodynamic therapy of cancer and photodynamic inactivation of bacteria as well as in the production of new photocatalysts for polymers decomposition where the efficient generation of singlet oxygen is a crucial process. Secondly, in light upconversion processes, where two low-energy photons produce one high-energy photon, with perspectives of usage in solar cells. Finally, in dosimetry and medical and biological imaging techniques based on singlet oxygen phosphorescence.