Newer insights on light and Reactive Oxygen Species applications: a DQ/QOPNA contribution

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Advantages and drawbacks on the use of Light related with the formation of Reactive Oxygen Species (ROS) are well known. Light is unquestionably responsible for life, but long exposures to it could be threatening and several diseases can come up. So oxygen reactive species can have that dual behavior. In fact, in recent years, the Organic Chemistry group of DQ/QOPNA has carried out research pointing to the advantage of using Light and ROS.

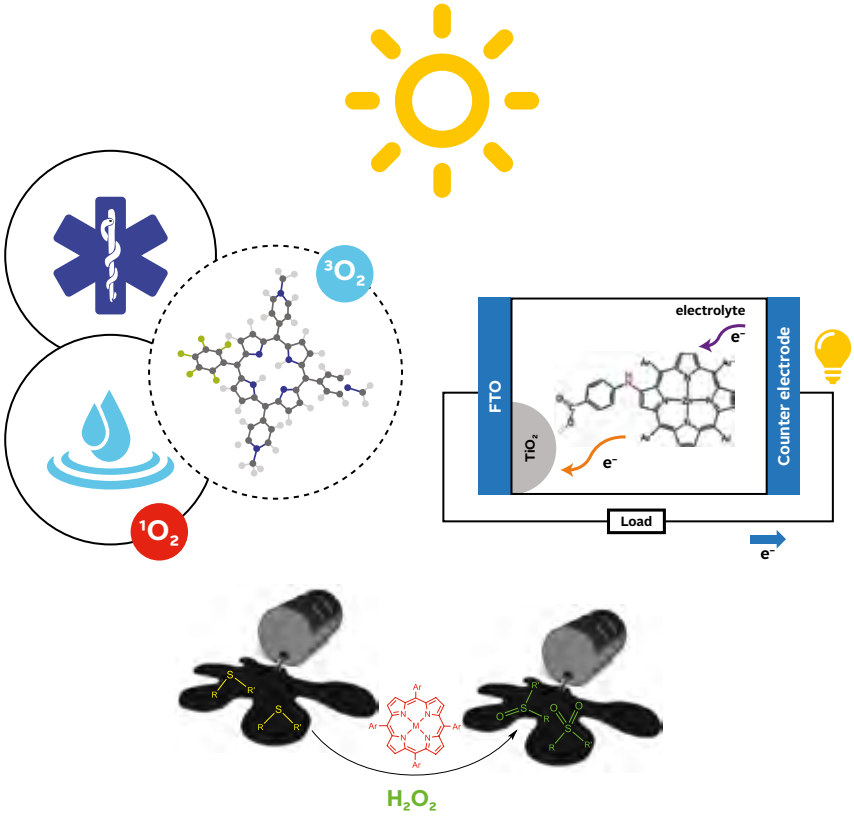

FIGURE 1
Illustration of a Dye-Sensitizer Solar Cells (DSSC), photoinactivation of microorganisms (PDI) present in hospital effluents and oxidative desulfurization (ODS) by porphyrin derivatives.

One promising research area is the development of robust organic dyes to prepare Dye-Sensitized Solar Cells (DSSCs) for harvesting and conversion of sunlight into electricity. The operation of these photovoltaic devices (Fig. 1) is based on the electron transfer from a photoexcited dye to the conduction band of a nanocrystalline semiconductor followed by a redox reaction for dye regeneration. Very recently we demonstrated that ß-(p-carboxyaminophenyl) porphyrins were efficiently incorporated as dyes in DSSC devices, in which a power conversion efficiency of about 30% of the more conventional Ru(II)-sensitizer N719 was achieved.

Another research line developed in our group combines Light and ROS to inactivate microorganisms, namely multidrug-resistant ones. Last developments with this approach highlighted that cationic porphyrins developed by us under visible light irradiations are able to destroy a large range of clinical multi-resistant bacteria either in filtrated hospital wastewaters. It is also demonstrated a synergistic effect when the inactivation of antibiotic resistant bacteria is performed in the presence of antibiotics opening good perspectives to develop efficient effluent treatments.

Our expertise leads us also to take advantage of the oxidizing properties of H^2O^2 in the presence of efficient biomimetic P450 catalytic systems to potentially decontaminate petroleum derivatives by an oxidative desulfurization (ODS) approach. Sulfur compounds are usually associated with the formation of acid rains and of the poisoning of catalysts and corrosion of combustion engines and the recent very restrictive regulations limiting the sulfur content on petroleum products highlight the interest on this environmentally sustainable methodology.