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Cyclodextrin Polymers for Scalable Green Photooxygenation of Aromatic Substrates in Water

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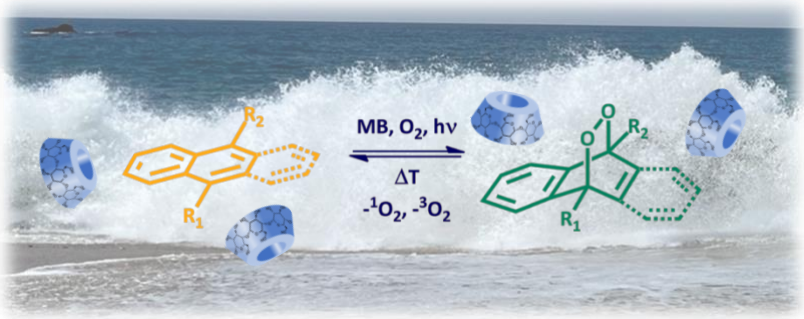
Abstract:

Water-soluble and biocompatible cyclodextrin (CyD) polymers can be easily prepared in alkaline environment upon polycondensation of natural monomeric CyDs with a crosslinking agent.[1] These polymers were explored to implement the photochemical synthesis of aromatic endoperxoides as potential Oxygen releasing agents (ORA).[2] Nowadays there's wide interest in the design of molecular systems as ORA able to supply O_2 in tissues as they can be employed in various therapeutic applications. Some examples are as the relieve of low oxygen levels in tumor tissues inducing resistance to chemotherapy, the improvement of the efficacy of Photodynamic Therapy (PDT) in conditions of hypoxia, the recovery of physiological levels of O_2 after stroke etc. In this frame we selected some new derivatives of Anthracenes and Naphthalenes as ORA candidates on basis of computational calculations. Visible light photocatalyzed conversion of the aromatic substrates in endoperoxides has been achieved in the presence of the photosensitizer methylene blue (MB) in homogeneous aqueous environment exploiting the CyD polymers as inert reaction matrix solubilizing the aromatics in mM range.2 In a first approach, few ml of CyD polymer solution of the aromatics and MB were irradiated with Hg lamp, next flow photochemistry with red emissive leds was exploited to optimize the reaction time and product amount. Some of the endoperoxides obtained indeed act as ORA and release O_2 thermally either in its triplet state to feed the PS or as singlet oxygen ($^1O_2$). Next, co-encapsulation of the ORA and PS in the CyD polymeric carrier has been achieved in dosage-consistent amounts for the implementation of PDT under hypoxia. Our results forecast the use of these CyD polymers as interesting, scalable vessel for the green production of new molecules and the delivery of a combination of therapeutic agents.



[1]M. Agnes, E. Pancani, M. Malanga, E. Fenyvesi, and I. Manet, Macromol. Biosci. 2022, 22, 2200090 DOI: 10.1002/mabi.202200090
[2]M. Agnes, A. Mazza, E. Kalydi, S. Béni, M. Malanga, and I. Manet, Chem. Eur. J. 2023, e202300511 DOI: 10.1002/chem.202300511