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CIC biomaGUNE
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

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Carbohydrate-Decorated Antenna Dyes for Photo-Assisted Water Oxidation

Tuesday, 10th December
12.00 p.m.

CIC biomaGUNE - Seminar Room

Artificial photosynthesis - akin to its natural counterpart - harvests sunlight to convert water and carbon dioxide into energy-rich products. Solar fuels could be a viable solution to one of the most pressing challenges faced by society: the need for sustainable, low-carbon energy supplies. The Plankt-ON project aims to develop plankton-like protocells that can oxidize water while reducing CO_2 to formic acid. Water oxidation is a four protons four-electron process that is extremely challenging to promote artificially due to its slow kinetics and high overpotential. Water photo-oxidation devices rely on three fundamental components: light-harvesting chromophores, a water oxidation catalyst, and a semiconductor.

This project builds upon the Quantasome (QS) architecture, a supramolecular assembly developed by Prato, Bonchio, et al. in 2019. The QS consists of a ruthenium-containing catalyst (Ru4POM) surrounded by five light-harvesting chromophores held together by coulombic interactions. Once wired to a proper semiconductor, the QS assembly efficaciously promotes water oxidation by absorbing visible light, as demonstrated by the remarkable photocurrents generated by the photoanode.

A good water affinity of the supramolecular architecture is paramount to ensure optimal performances, so we decided to add hydrophilic pendants, such as carbohydrates, to the light-harvesting antenna. Using a click reaction between the bis-cationic perylene bisimide (PBI) and carefully designed azido sugars we synthesized a small library of compounds with excellent water solubility. The synthesized products - containing D-glucose, L-glucose, or both - underwent deep characterization through UV, fluorimeter, and CD measurements. The supramolecular interaction between the positively charged PBI and the Ru4POM yielded a new generation of chiral Quantasomes with enhanced water solubility and better photocatalytic performances compared to the previous generation.

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