Solar energy utilization using porphyrin based artificial photosynthetic systems

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Handling the constant depletion of fossil fuels, along with the world's increasing energy demands, is one of the most vital challenges in modern society. Therefore, the exploitation of environmental friendly energy sources is a crucial challenge of the 21st century. Of all the available renewable energy sources, sunlight is by far the most advantageous candidate. Photosynthesis, for more than 3 billion years, converts the solar energy into chemical energy via photo-initiated multistep electron transfer processes. In order to mimic natural photosynthesis it is essential: i) to understand in detail the mechanism of this process and ii) to develop efficient artificial photosynthetic systems capable of harvesting and converting solar energy into useful fuels.

In the first part of my talk I will describe a biomimetic P_{680}/Tyr_Z/His_{190} model of Photosystem II. We prepared and characterized a fused porphyrinimidazole/phenol derivative as a new model for the P_{680} pigment and the Tyr_Z/His_{190} cofactors. Photophysical studies revealed that the presence of water molecules is crucial in triggering a light induced one-electron two-proton coupled transfer (E2PT) process. In the second part I will present the synthesis of porphyrin-diphenylalanine hybrids. These derivatives are able to self-assemble into various well-ordered nanostructures (nanospheres or nanofibers). Finally, I will describe the application of the chrompophore containing nanostructures in supramolecular DSSCs and towards photocatalytic hydrogen production.