Harvesting solar energy via artificial photosynthesis

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Photosynthesis, the process of converting light energy into chemical energy, involves two major steps, absorption and transportation of light energy of appropriate wavelength by the antenna light harvesting molecules to the reaction center, and photoinduced electron transfer (PET) to generate charge separated entities by using the electronic excitation energy. Mimicking these functions using relatively simple synthetic molecules is of paramount importance since they can be directly used to build devices to convert light energy into electricity, like in photovoltaic devices and organic solar cells.

In the present study, we report electronic energy transfer (EET) in newly synthesized, covalently linked boron dipyrrin (BODIPY) and zinc porphyrin dyads in which the number of boron dipyrrin units is increased from 1 to 4. Both steady-state and time-resolved emission as well as transient absorption studies revealed occurrence of efficient singlet-singlet energy transfer from BDP to zinc porphyrin with the time scale of 28-48 ps. A decrease in time constants for energy transfer with increasing the number of BDP units is observed revealing better antenna effect of dyads bearing higher number of boron dipyrrin entities. Further, supramolecular triads to mimic the 'antenna-reaction center' functionality of photosynthetic reaction center have been successfully developed by coordinating fulleropyrrolidine appended with an imidazole ligand to the zinc porphyrin. The presentation will focus on the synthesis, characterization, and donor-acceptor assembly formation, and photochemical studies revealing occurrence of electronic energy transfer and electron transfer. Finally, organic photocells to harvest light energy into electricity will also be presented.