Supramolecular Photosystems based on Perylene Bisimide Dyes

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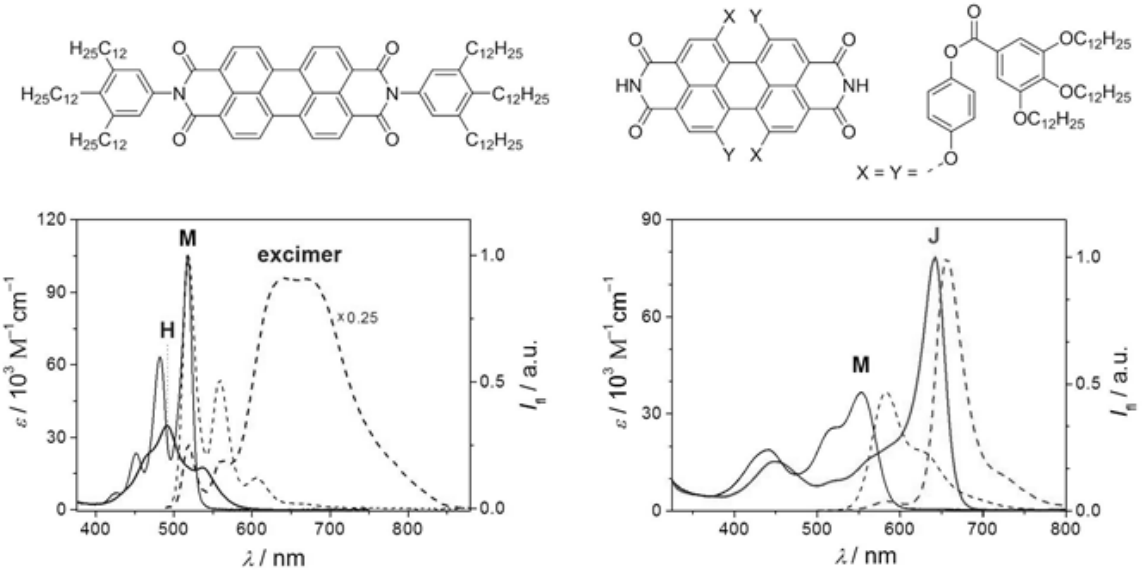
The unique combination of properties (strong absorbance, high fluorescence quantum yield, photostability) makes perylene bisimides a favored class of dyes for fundamental photophysical studies and various applications. Motivated by the prospects arising from the supramolecular organization of these dyes we have intensively investigated the organization of perylene bisimide dyes into desirable nanoscale architectures.

In this lecture, I will highlight recent achievements in the preparation of defined perylene bisimide dye ensembles by covalent and non-covalent syntheses and discuss the processes that originate in these supramolecular photosystems upon photoexcitaton. . In particular, the spectral characteristics and relaxation processes of photoexcited H- and J-aggregates will be discussed as well as the consequences for long range exciton transport. Furthermore I will illustrate our recent achievements in the synthesis of p/n heterojunction model systems composed of oligophenyleneethynylene backbones and appended perylene bisimide dyes.



Coupled Nanotubular J-Aggregates and Quantum Dots for Efficient Resonance Excitation Energy Transfer

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Resonant coupling between distinct excitons in organic supramolecular assemblies and inorganic semiconductors is supposed to offer a new approach to design novel opto-electronic devices. Here, we report on colloidal nanohybrids, which consist of supramolecular tubular J-aggregates decorated with semiconducting quantum dots (QDs) via an electrostatic self-assembly process. The role of the QD in the energy transfer process can be switched from donor to acceptor by tuning its size and thereby the band gap while keeping the chemistry unaltered. The tubular structure of the J-aggregates remains unaltered and the particles are located within a close distance to the aggregate surface of less than 4 nm. The close proximity of J aggregates and QDs results in strong excitation energy transfer coupling, which is close to 100% for the case of energy transfer from the QD donor to the J-aggregate acceptor and approx. 20% for the reverse case. This system demonstrates a model for an organic-inorganic light harvesting complex using methods of self-assembly in aqueous solution and highlights a possible route towards hierarchical synthesis of structurally well-defined supramolecular objects for advanced functionality.