# Photophysical Properties of Perylene Dye Aggregates

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The unique combination of properties (strong absorbance, high fluorescence quantum yield, photostability, n-type semiconduction) 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 by non-covalent forces into desirable nanoscale architectures. In this lecture, we will highlight some of our recent achievements in the preparation of defined perylene bisimide dye assemblies and their functional properties that originate from π–π-stacking.

The first part of the talk will deal with cyclophanes containing two perylene bisimide dyes in rather rigid arrangements (see Figure 1). Here we will show that the interaction of two perylene bisimide dyes opens up new relaxation pathways, e.g. symmetry-breaking charge separation (SB-CS) leading to the population of significant amounts of triplet states that are otherwise not easily accessible for this class of dyes. Complexation of electron poor guest molecules, e.g. anthraquinone, will restore the otherwise common intense fluorescence of the perylene bisimides whilst complexation by electron rich guests, e.g. carbazole, leads to ultrafast charge separation and recombination (see Figure).

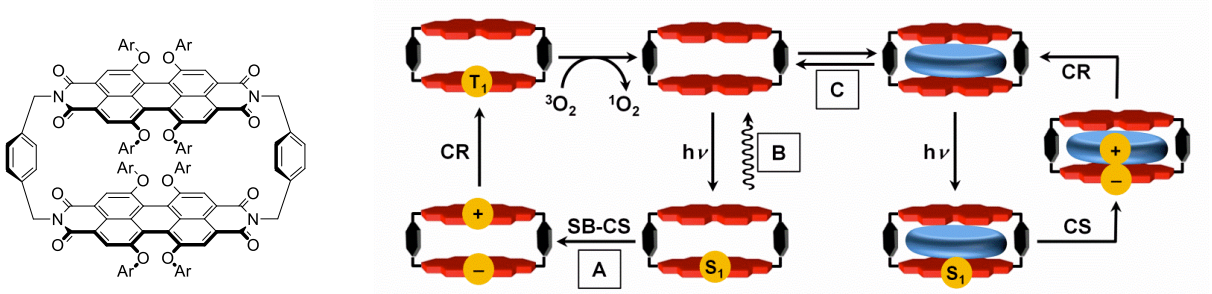


Figure. Cyclophane bearing two perylene bisimides and photophysical decay processes observed in the absence (A,B) or presence (C) of guest molecules (blue).

The second part of the talk will deal with larger self-assembled one-dimensional nanostructures. Whilst the parent perylene bisimides self-assemble into H-type aggregates whose exciton transport properties are limited by the formation of excimer traps, hydrogen-bond directed self-assembly via the imide groups enables the formation of highly fluorescent J-aggregates. Investigations by single molecule spectroscopy revealed up to 100 nm exciton diffusion lengths.