

Correlated decay mechanisms in weakly bound acene molecules attached to neon clusters

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Charge/excitation transfer along with the corresponding decay/loss mechanism are fundamental aspects in light harvesting, organic photovoltaics, and optoelectronic devices. In our studies, we probe aggregates of organic molecules isolated on neon clusters in order to understand collective processes of electronically excited systems.

Collective processes in weakly interacting systems offer a unique means to study energy and charge transfer processes. In particular, singlet fission is a unique decay mechanism where a molecule excited to its singlet state can partially transfer its energy to a neighboring ground state molecule, and thereby create two molecules excited to a triplet state. As such, singlet fission can increase the efficiency of organic electronics and photovoltaics by creating multiple charge carriers from one single photon [1,2,3].

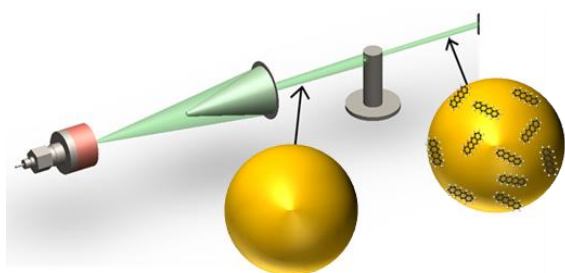


Figure 1. Neon cluster doping schematic.

Here, we show the experimental observation of fluorescence lifetime reduction of tetracene, pentacene and anthracene by directly tuning the number of molecules placed on the surface of neon clusters. Such complexes are ideally suited to probe the role of e.g. the number and the intermolecular distance of interacting molecules. We attribute these effects to singlet fission. Furthermore, we observe in the same systems, Dicke superradiance [4], which describes the effect of an ensemble of excited molecules collectively emitting radiation as a coupled quantum lifetimes and an enhancement in

the radiative intensity system. This leads to a reduced effective lifetime and an enhancement in the radiative intensity. Also depending on the substance and the aggregate, the experimental results indicate that triplet-triplet annihilation is another process that can influence the system.

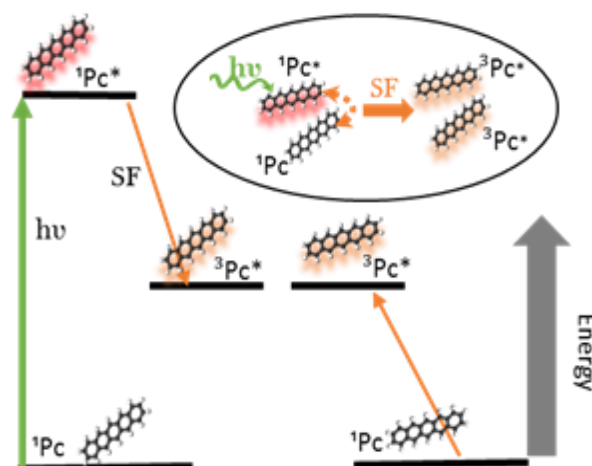


Figure 2. Depiction of singlet fission.

References

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