The excitation bond in organic molecules: concepts for catalysis and solar cells

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Organic materials offer a rich palate to be decorated with functional units in order to tune various properties. For example, the ability to generate multiple excitons from a single photon (singlet fission in molecular materials) has the potential to significantly enhance the photocurrent in single-junction solar cells, and thus raise the power conversion efficiency from the theoretical limit of 33% to 44%. However, there is a paucity of materials that undergo efficient singlet fission. Our group is interested in designing building blocks that are capable of generating triplet pairs in modular small molecules and polymers. In this vein, the reverse process of singlet fission – triplet fusion – provides the ability to upconvert low energy unabsorbed infrared photons into visible energy that can be used to improve the light absorption in solar cells. Here, we discuss our efforts into developing triplet fusion materials and the new potential applications. This talk will provide an overview on our approach to the design, synthesis, and evaluation of the materials for singlet fission and triplet fusion.