

TRIPLET-CHARGE ANNIHILATION IN A SMALL MOLECULE DONOR: ACCEPTOR BLEND AS A MAJOR LOSS MECHANISM IN ORGANIC PHOTOVOLTAICS

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Organic photovoltaics (OPV) are close to reaching a landmark 20% device efficiency.^[1] One of the proposed reasons that OPVs have yet to attain this milestone is their propensity toward triplet formation.

In this talk,^[2] the small molecule donor, DRCN5T, is studied using a variety of spectroscopy techniques, and blended with both fullerene and non-fullerene acceptors. Specifically, picosecond and microsecond transient absorption and Raman spectroscopies are focused on. Despite DRCN5T's ability to achieve OPV efficiencies of over 10%,^[3] it generates an unusually high population of triplets. These triplets are primarily formed in amorphous regions via back recombination from a charge transfer state. As such, triplets have a dual role in DRCN5T device efficiency suppression: they both hinder free charge carrier formation and annihilate those free charges that do form.

Using microsecond transient absorption spectroscopy under oxygen conditions, this triplet-charge annihilation (TCA) is directly observed as a general phenomenon in a variety of DRCN5T: fullerene and non-fullerene blends. Since TCA is usually inferred rather than directly observed, it is demonstrated that this technique is a reliable method to establish the presence of TCA.

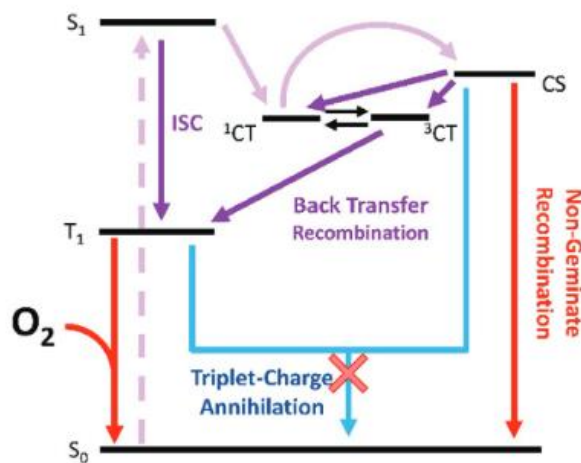


Figure 1. Summary of the processes occurring in DRCN5T blend systems under inert atmosphere (blue arrows) and under oxygen (red arrows and red cross). Purple arrows illustrate the processes that take place both under oxygen and inert atmospheres.

References

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