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The Current-Voltage Trade-Off in Organic Photovoltaics and How to Get Around It

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The exciton is a critical part of each of the processes leading to photocurrents in Organic PhotoVoltaics (OPVs), and being able to control the location, lifetime and energy of the exciton is essential to achieving high efficiency. I will discuss our most recent work with both organic dyes, such as squaraines and dipyrrins for OPVs. This involves a careful materials design study that leads to both low energy absorption (into the nearIR) and the efficient use of multiple absorbers to efficiently harvest photons through the entire visible spectrum. In particular, we have used careful control of exciton and carrier energies to design and implement sensitizers that give fullerene films efficient light collection throughout most of the visible spectrum. I will also discuss a new approach to designing materials for OPVs that involves symmetry breaking charge transfer. These materials are symmetric molecules that spontaneously form an intramolecular charge transfer complex, with nearly complete one electron transfer form one part of the molecule to another. This intramolecular CT state readily forms a charge separated state at the D/A interface of the OPV. We have explored these materials as both donors and acceptors in OPVs and found that they give good performance and high V_{oc}.

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