Relationship between exciton and charge dynamics in organic blends through nano-morphology

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Exciton diffusion plays a vital role in determining the power conversion efficiency in organic semiconductor based solar cells through controlling the efficiency of exciton splitting [1]. However, measurements of diffusion length in organic semiconductors requires specialized equipment and expertise [2, 3]. Measurements of exciton splitting efficiencies rely upon quenching experiments prone to erratic errors and large uncertainties. In this presentation I will introduce a quasi-steady state technique to measure exciton diffusion lengths in organic semiconductors, named pulsed-PLQY [4]. Further, I will show how this technique can be utilized in bulk heterojunctions to measure the efficiency of exciton splitting and, also the difficult-to-measure-domain-size. Finally, I will discuss the relationships between nanoscale exciton dynamics and the enhanced charge carrier dynamics seen in state-or-the-art non-fullerene organic solar cells.

The long diffusion lengths measured in non-fullerene acceptor based organic solar cells [3, 4] support large domain sizes while maintaining high exciton splitting efficiencies. These increased domain sizes can lead to large reductions in bimolecular recombination [5, 6], further impacting the efficiency of devices. Lastly, I will discuss the relationship between the enhanced charge carrier dynamics seen in state-of-the art non-fullerene organic solar cells [7] and improved exciton dynamics, enabled by the nano-morphology of the bulk heterojunction.

References:

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