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Passive exciton gating via directed energy transfer in organic photovoltaic cells S. MATTHEW MENKE, TYLER K. MULLENBACH, RUSSELL J. HOLMES, University of Minnesota — We present a Kinetic Monte Carlo method to model exciton diffusion across non-reflective, non-quenching, exciton permeable interfaces where standard analytical and numerical solutions to the exciton diffusion equation are not available. The combination of energy transfer rates and separately measured natural lifetimes allows for the modeling of exciton diffusion across a wide range of inhomogeneous landscapes. This model is successfully applied to quantitatively account for the photocurrent enhancements present in dilute donor organic photovoltaic (OPV) devices incorporating the archetypical electron donor boron subphthalocyanine chloride (SubPc), the wide energy gap host material p-bis(triphenylsilyl)benzene (UGH2), and fullerene C60. Furthermore, this modeling is extended to provide an optimization route for advanced, cascade OPVs where excitons are transferred between layers before reaching the acceptor material. Analysis of exciton motion in these architectures also reveals how inhomogeneous energy transfer landscapes can lead to directed exciton motion, thus deviating from the typical diffusive or sub-diffusive behavior. The implications for directed exciton motion are then discussed in terms of passive exciton gating towards the ultimate goal of finely controlling the migration of energy in these devices as well as the broader field of organic optoelectronic devices.

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