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Analysis of Charge Carrier Transport in Organic Photovoltaic Thin Films and Nanoparticle Assemblies XU HAN, DIMITRIOS MAROUDAS, Univ of Mass - Amherst — We present a systematic analysis of charge carrier transport in organic photovoltaic (OPV) devices based on phenomenological charge carrier transport models. These transient drift-diffusion-reaction models describe electron and hole transport and their trapping, detrapping, and recombination self-consistently with Poisson's equation for the electric field in the active layer. We predict transient currents in devices with active layers composed of P3HT, PCBM, and PBTDV polymers, as well as donor-acceptor blends. The propensity of the material to generate charge, zero-field carrier mobilities, as well as trapping, detrapping, and recombination rate coefficients are determined by fitting the modeling predictions to experimental data of photocurrent evolution. We have investigated effects of material structure and morphology by comparing the fitting outcomes for active layers consisting of both thin films and nanoparticle assemblies. We have also analyzed the effect on charge carrier transport of nanoparticle surface characteristics, as well as of thermal annealing of both thin-film and nanoparticle-assembly active layers. The model predictions provide valuable input toward synthesis of new nanoparticle assemblies that lead to improved OPV device performance.

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