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The Dual Role of Disorder on the Dissociation of Interfacial Charge Transfer Excitons LIANG SHI, University of California, Merced, CHEE-KONG LEE, ADAM WILLARD, Massachusetts Inst of Tech-MIT — In organic-based photovoltaics (OPV), dissociation of neutral photo-excitations (i.e., Frenkel excitons) into free charge carriers requires the excitons to overcome binding energy that can significantly exceed thermal energies. The inability of bound charges to overcome this large binding energy has been implicated as a primary source of efficiency loss in OPVs. Despite the potential impact on the performance of organic solar cells much remains to be understood about the microscopic mechanism of exciton dissociation in OPV materials. Here we explore the role of static molecular disorder in mediating this charge dissociation process. Using a simple lattice model of exciton dynamics we demonstrate that random spatial variations in the energetic landscape can mitigate the effects of the exciton binding energy by lowering the free energy barrier. By considering the competition between this thermodynamic effect and the disorder-induced slowing of dissociation kinetics we demonstrate that exciton dissociation yields are expected to depend non-monotonically on the degree of static disorder. We conclude that a certain amount of molecular-scale disorder is desirable in order to optimize the performance of organic photovoltaic materials.

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