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Exciton-induced degradation of photocurrent in small-molecule organic solar cells XIAORAN TONG, Materials Science and Engineering, University of Michigan, Ann Arbor, NANA WANG[1], Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MICHAEL SLOOTSKY, Physics, University of Michigan, Ann Arbor, STEPHEN FORREST, MSE, EECS and Physics, University of Michigan, Ann Arbor — The reliability of organic photovoltaic cells (OPVs) has become a focus of research. In this work, the intrinsic degradation mechanism of archetypal subphthalocyanine/fullerene OPVs in the absence of water and oxygen is studied. We focus on the initial burn-in period (<10h) during which there is no significant change in fill factor or open-circuit voltage, suggesting stable interfacial and bulk morphology. In planar OPVs employing C_{60} as the acceptor, the efficiency drop is primarily due to a reduction of photocurrent contributed by C_{60}, as observed in the spectrally-resolved external quantum efficiency (EQE). The current loss occurs after the cell is illuminated in the C_{60} absorption range, regardless of intensity and proportional to the total number of C_{60}-absorbed photons. The degradation over time is modeled as due to an increasing density of exciton-induced quenching sites that hinder exciton diffusion to the donor-acceptor interface. Experimentally, we find this mechanism can be effectively mitigated by employing a mixed donor-acceptor active layer where excitons are rapidly dissociated and the steady-state exciton density is reduced. The trap formation rate and exciton dynamics will be discussed in detail. Degradation of different OPV systems will be compared.

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