Non-fullerene acceptors: A universal answer towards addressing the “burn-in” stability challenge of solution processed organic solar cells

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Fullerene-based organic photovoltaics (OPV) tend to exhibit a rapid initial phase of performance loss under 1 sun illumination in nitrogen, dropping by 25–50 % over tens of hours, before entering a slower phase of degradation. This initial rapid phase of degradation is widely referred to as “burn-in” and has had a number of origins suggested, including: photoinduced fullerene dimerization and spinodal demixing. Non-fullerene acceptors (NFA) are a new class of electron accepting materials with reportedly high efficiencies (over 13 %) and promising stability. One such NFA, Eh-IDTBR, was shown to form burn-in free devices when utilized with PCE11. There was a stark contrast in stability when compared with fullerene-based PCE11:PC71BM devices, attributed to the trap-assisted recombination through increased photoinduced trap states in the fullerene-based devices. In this study, we systematically tested the two highest performing families of NFA:IDTBR (>12%) and ITIC (>13%) with a range of polymers. In every case, NFAs outperform fullerene acceptors, exhibiting devices with both higher efficiency and reduced burn-in. We utilized advanced characterization; including transient photovoltage measurements, to provide some insight on the origins of the burn-in effect. We demonstrate a universal superiority of NFAs device stability over fullerenes, indicating that the answer for high performance stable OPV which may lie with NFA development.

Recent Publications

Biography
Zhe Li has completed his PhD in 2012 from the University of Cambridge and Post-doctoral studies from the Imperial College London in 2014. Later on he joined Swansea University as a Research Fellow (2014–2016) and Senior Research Fellow (2016-2017). He is now a Lecturer of Energy Materials at the School of Engineering, Cardiff University. He has published more than 30 papers in reputed journals and holder of one industrial patent.

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