On the stability of a variety of organic photovoltaic devices by IPCE and in situ IPCE analyses – the ISOS-3 inter-laboratory collaboration

This work is part of the inter-laboratory collaboration to study the stability of seven distinct sets of state-of-the-art organic photovoltaic (OPV) devices prepared by leading research laboratories. All devices have been shipped to and degraded at Risø-DTU up to 1830 hours in accordance with established ISOS-3 protocols under defined illumination conditions. In this work, we apply the Incident Photon-to-Electron Conversion Efficiency (IPCE) and the in situ IPCE techniques to determine the relation between solar cell performance and solar cell stability. Different ageing conditions were considered: accelerated full sun simulation, low level indoor fluorescent lighting and dark storage. The devices were also monitored under conditions of ambient and inert (N2) atmospheres, which allows for the identification of the solar cell materials more susceptible to degradation by ambient air (oxygen and moisture). The different OPVs configurations permitted the study of the intrinsic stability of the devices depending on: two different ITO-replacement alternatives, two different hole extraction layers (PEDOT-PSS and MoO3), and two different P3HT-based polymers. The response of un-encapsulated devices to ambient atmosphere offered insight into the importance of moisture in solar cell performance. Our results demonstrate that the IPCE and the in situ IPCE techniques are valuable analytical methods to understand device degradation and solar cell lifetime.

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