Highly efficient, photostable and printable organic solar cells using novel non-fullerene acceptors

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Abstract

Although organic photovoltaics (OPVs) based on non-fullerene acceptors (NFAs) exhibit remarkable power conversion efficiencies over 15%, their rapid degradation under illumination conditions is a key bottleneck for their commercialization. To overcome this issue, the origin of the photo-degradation in the NFA-based OPVs should be clarified. In this talk, I will address that the photo-degradation of most NFA-based OPVs results from the ultraviolet (UV) light-mediated photocatalytic reaction between the zinc oxide (ZnO) electron transport layer (ETL) and NFAs, which causes the decomposition of NFAs and thereby deteriorates the device performance. By simply introducing a fullerene/conjugated polyelectrolyte bilayer between the ZnO-ETL and NFA-based bulk-heterojunction (BHJ) layer, we demonstrated photostable NFA-based OPVs, in which the bilayer effectively prevents the photocatalytic reaction at the interface, thereby resulting in prolonged photostability more than 10 times longer than that of the devices without any passivation layer. We also suggest another simple approach using a ternary blend concept to improve the performance of OPVs. By introducing a small amount of fullerene into narrow bandgap NFA-based OPVs, we noticed that the efficiency and the photostability of the devices are simultaneously improved, retaining ~80% of their initial PCEs after 500 h operation under continuous illumination. It appears that the fullerene additive provides an excellent compatibility for efficient electron transfer and also maintains a balanced charge transport in the NFA/fullerene ternary OPVs.

Biography

2019-Present Director of Research Institute for Solar and Sustainable Energies (RISE), GIST, Korea
2015-Present Director of The GIST-ICL International Collaboration R&D Center, GIST, Korea
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