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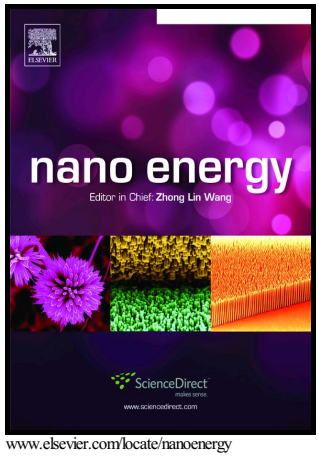

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High-efficiency and air stable fullerene-free ternary organic solar cells

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Abstract

Fullerene-free acceptors and ternary strategy have aroused extensive attention due to their great potential for improving efficiency and stability of organic solar cells (OSCs). Here, we demonstrate high-efficiency and air stable OSCs by combining the benefits of fullerene-free acceptors and ternary strategy. A polymer acceptor N2200 as the third component is incorporated with PBDB-T:ITIC to fabricate fullerene-free ternary OSCs, which achieve an outstanding power conversion efficiency (PCE) of 11.41% and excellent stability in air conditions. Compared with the binary cells, the performance improvement of ternary OSCs is mainly attributed to the enhanced photon harvesting and optimized morphology of active layers. Replacing ITIC by a similar acceptor ITIC-Th or IT-M in the ternary OSCs, the optimized PCE of 11.40% or 12.10% can be achieved for PBDB-T:ITIC-Th:N2200-based or PBDB-T:IT-M:N2200-based cells, respectively.

KEYWORDS: fullerene-free; ternary strategy; organic solar cell; power conversion efficiency; stability

Efficiency and stability of organic solar cells (OSCs) are two decisive factors for its future practical applications [1-5]. The first prerequisite for achieving efficient OSCs is to harvest as much photon as possible by the active layer. Typically, the active layer of bulk-heterojunction OSCs generally contains one electron donor and one electron acceptor, named as binary OSCs. The mostly used fullerene derivatives with large band gap may limit the photon harvesting for PCE further improvement of binary OSCs. Tandem OSCs with stacking two or more sub-cells have been confirmed as an efficient method to enhance