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Effect of additional electron acceptor in hybrid P3HT:PCBM:ZnO spin-coated films for photovoltaic application

Muller T
Ramashia TA
Motaung DE
Cummings F
Malgas G
Oliphant C
Arendse C

ABSTRACT:

Concerted efforts need to be undertaken to overcome limited efficiencies and instability issues in order to ensure a niche for organic photovoltaics (OPVs) in the PV market. Recent improvements on tandem structures aside, in order to achieve further improvements it is sensible to construct test-case scenarios on bulk heterojunction cells. One aspect, involving the low mobility of charge carriers, caused by the short exciton diffusion length in the active layer, has been targeted. In this regard, attempts to incorporate inorganic semiconductors into organic blends in hybrid organic solar cells, in various configurations, have so far been promising. In this work, ZnO nanoparticles were mixed into the poly (3-hexylthiophene) (P3HT):[6,6]-phenyl-C61-butyric acid methyl ester (PCBM) blend, and used as additional acceptors of electrons in the active layer. Metal–oxide interface layers between the active layer and ITO and the top contact layer, respectively, were introduced in the solar cell to compensate for environmental degradation. Thermo-gravimetric analyses of the active layers revealed improved thermal stability of P3HT upon incorporating ZnO in the polymer matrix. The photovoltaic properties demonstrated that the addition of ZnO nanoparticles in the P3HT:PCBM bulk-heterojunction solar cell causes an increase in the power conversion efficiency, while excessive loading of ZnO decreases the efficiency.