

Operating Temperature of Non-Fullerene Acceptor Based Bulk Heterojunction Organic Solar Cells

This study focuses on the operating temperature of organic solar cells. The researchers studied things like how much heat is generated when the solar cells absorb light, and how much of the solar energy is converted into electricity, in three different cells (OSC1, OSC2 and OSC3). The researchers found that OSC3 worked slightly better than the OSC1 and OSC2 because it was better at absorbing light and generating electricity, even though they all worked at about the same operating temperature. The study looked at how the solar cells work and can help scientists design better solar cells in the future.

Abstract

The research and development in the field of bulk heterojunction organic solar cells (BHJ OSCs) have been thriving over the last few decades due to their promise of low cost, light weight and flexibility compared to the inorganic solar cells (ISCs). A comprehensive study of the operating temperature (T_{cr}) of three non-fullerene acceptor based (NF) BHJ OSCs, two conventional (OSC1 and OSC2) and one inverted (OSC3) structure, is presented in detail. A quantitative analysis of the thermal power generated by photon absorption in transport layers and electrodes, thermalisation of photoexcited charge carriers, tail state recombination and resistive heating in a BHJ OSC are carried out in this study. The dependence of operating temperature T_{cr} on the voltage is simulated and found that OSC1 and OSC2 have nearly equal T_{cr} at about 320 K, a little higher than OSC3 at 319 K for most of its operating voltage range. It is also found that the thermal power generated due to thermalization (P_T) and absorption in other than the active layer (P_{Abs}^{ot}) in OSC3 are smaller than those in both OSC1 and OSC2 and the thermal power generated due to the resistive heating (P_R) is larger in OSC3 than in OSC1 and OSC2 leading to the net power absorbed in the active layer of OSC3 higher than that in OSC1 and OSC2. Thus, OSC3 may be regarded to be better in its photovoltaic performance although the operating temperature of all three cells remain in the range of 320 K to 321 K. [1] This study may help future researchers develop highly efficient and stable NF BHJ OSCs.