Determine the Efficiency of Novel Non-fullerene Acceptor Material in Organic Solar Cells

AhmedHussain, Masarah (School: Dar Al-Tarbia Al-Hadetha)

Organic solar cells (OSCs) are attracting significant interest due to their increasing power conversion efficiency (PCE) values. OSCs are advantageous for architectural application since they are flexible, light, semitransparent, easily integrated, and simply fabricated. The highest OSC PCE record confirmed by the National Renewable Energy Laboratory is 15.7%, and for silicon-based solar cells 27.6%. This project aims to contribute to increasing the PCE of OSCs by optimizing the morphology of the bulk heterojunction active layer consisting of a promising non-fullerene acceptor. The morphology is affected by different factors, among which is the studied factor, the annealing temperature on the active layer. In the experimentation, 60 OSCs with the structure glass/ITO/PEDOT:PSS/IT-M:PBDB-T/DPO/Al were fabricated with the spin-coating method. The active layer was coated, then samples were annealed through different temperatures divided into 5 groups: control group, 80ºC, 120ºC, 160ºC, 200ºC. The annealing temperature affects the active layer morphology, causing the variation of short circuit current density and fill factor (FF), thus affecting PCE. 160ºC samples have shown a promising PCE of 10.1% and FF of 69.5%. After proving the IT-M:PBDB-T potential, 60 pixels were fabricated using the doctor-blade method to simulate industrial fabrication, the optimized annealing temperature of which is 160ºC, obtaining 9.1% PCE and 66.1% FF. In conclusion, an annealing temperature of 160 ºC for the IT-M:PBDB-T active layer was ideal to overcome the 10% PCE threshold. 10.1% efficient devices were successfully fabricated using novel non-fullerene acceptor material, paving the way for commercially viable next-generation solar cell technology.