Fabrication of Inverted Organic Solar Cells on Stainless Steel Substrates

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Increasing demand for manufacturing PV cells has directed scientists around the globe to investigate polymer based organic solar cells (OSCs) owing to their development in efficiency, cost, process, and stability. Moreover, in the recent years, OSCs with inverted structures have gained more attention compared to the conventional configuration of devices.[1] In this study, ITO-free inverted OSC devices were fabricated on polished stainless steel (SS) substrates with top illumination in order to have the device structure of SS/P3HT:PCBM/PEDOT:PSS/Au. The active layer was spin-coated from a bulk heterojunction polymer blend of regioregular Poly(3-hexylthiophene) (P3HT) and Phenyl-C61-butyric acid methyl ester (PCBM) on pre-cleaned SS substrates and subsequent annealing step was followed. On the top of the active layer, doped poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS) was blade coated as the hole transport layer. After the stack was annealed, Gold (Au) was sputter coated to create the top contact.[2] The device performance was optimized varying a number of parameters including annealing temperature, annealing time, composition of the polymer blend and dopant material of PEDOT:PSS dispersion. The best device exhibited a maximum power conversion efficiency of 0.05% with fill factor (FF) of 25%. The maximum device voltage was obtained at the wavelength range of 480-550 nm in the spectral response. The solar cell produced a short circuit current (I_{SC}) of 2.58 mA and open circuit voltage (V_{OC}) of 228 mV with the highest current density (J_{SC}) of 6.2 mA/cm^2.

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