

Interlayer Treatments to Improve Charge Selectivity in High-efficient and Stable Organic Photovoltaic Devices

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Low-band gap Poly(3-hexylthiophene-2,5-diyl):Phenyl-C61-butyric acid methyl ester (P3HT:PCBM) modified with iso-propanol (IPA) was used as a hydrophilic sensitizer for polymer solar cells (PSCs). It was also found upon treatment, this PEDOT:PSS/IPA oxidizes P3HT, creating a thin p-type interlayer of P3HT⁺/IPA⁻ on top of the BHJ, which blocks electron diffusion through PEDOT:PSS. Using contact angle measurements, elemental analysis, and UV-vis absorption spectroscopy, this P3HT⁺/IPA⁻ layer is shown to be hydrophilic (Contact angel improved from 102° to 56°), with higher oxygen moiety on top of layer (in compare to the bulk) (confirmed by XPS measurements), and improved band gap (reducing from 2.3 eV to 2.0 eV), exhibited higher interfacial contact with PEDOT:PSS followed by higher device efficiency. Current density-voltage measurements show this doped interlayer reduces injected dark current while increasing both open-circuit voltage and fill factor through the creation of a more hole selective BHJ-PEDOT:PSS interface, indicating its bulk media remains intact during the IPA treatment.