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Simultaneously Enhancing the Performance and Stability of Organic Solar Cells by Interfacial Engineering

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Bulk heterojunctions (BHJ) organic solar cells (OSCs) have been recognized to become competitive with silicon-based devices for its light-weight, semitransparent and inexpensive features, and most importantly, a large-area fabrication can be simply prepared by flexible roll-to-roll (R2R) process.[1, 2] A record power conversion efficiency (PCE) of 15.7% for single junction and 17.3% of tandem OSCs has been achieved in this field. The progress can be ascribed to new designed donor and acceptor materials, advanced fabrication processes, interfacial engineering and new device architectures.[3-5]

In this work, we reported an interfacial engineering strategy to simultaneously enhance the performance and stability of OSCs. We fabricated bulk heterojunction OSCs based on the PTB7-Th:ITIC binary system by using an inverted device structure with bilayer structured electron transport layers (ETL) for the first time. An additional ZnO sol-gel layer was spin-coated on the top of the former ETL of ZnO nanoparticles to form a bilayer structure. Compared to devices with single ETL of ZnO nanoparticles, the average PCE of devices with bilayer structured ETL increased from 6.36% to 6.92% with higher open-circuit voltage (V_{oc}), short circuit current (J_{sc}) and fill factor (FF). The performance enhancement was found ascribed to the suppressed surface recombination, reduced leakage current, higher electron mobility and better current extraction process in bilayer structured device. Moreover, the device with bilayer structured ETL was also found owned better stability than the device with a single ETL in the burn-in degradation test.

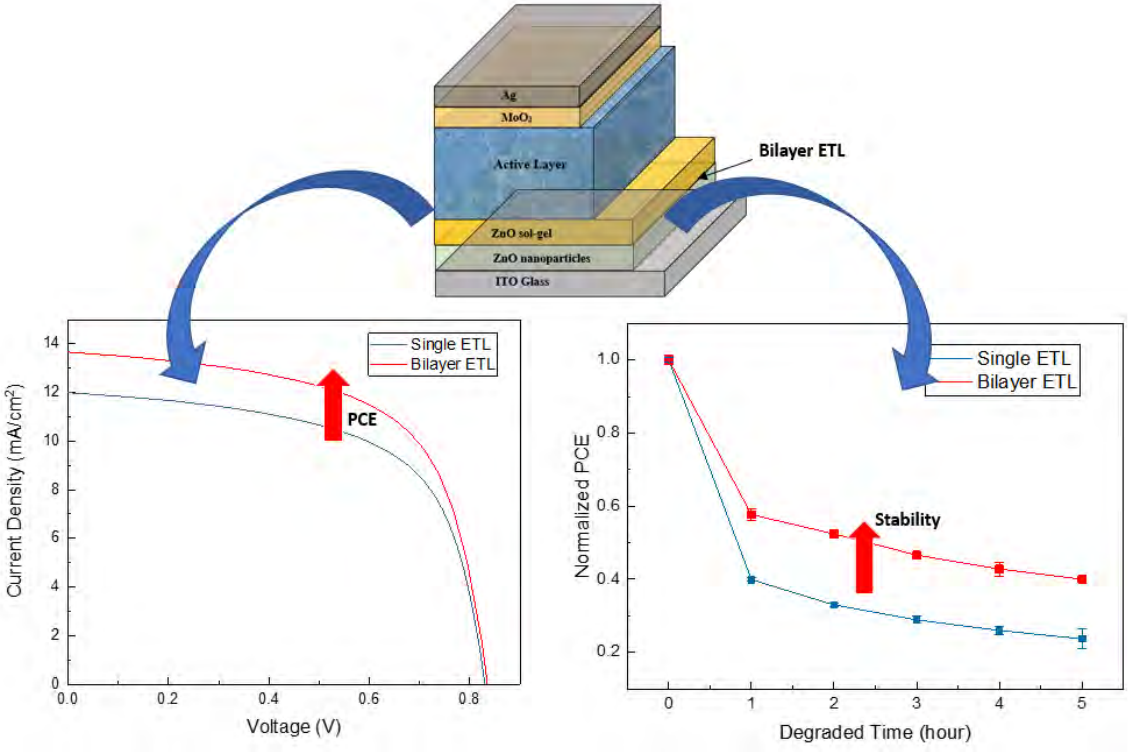

Figure1. Graphic abstract of performance and stability enhancement in bilayer ETL structured devices.

References

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