Performance and stability improvement of inverted perovskite solar cells by interface modification of charge transport layers using an Azulene-pyridine molecule.

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Abstract:

In this work, a two-fold interface engineering approach is proposed by implementing an Azulene-Pyridine molecule (AzPy) deposited over the hole and electron charge transport layers (HTL and ETL). Extensive characterization and analyses revealed that the surface engineering of HTL with AzPy improves the perovskite formation, thus increasing light absorption and reducing non-radiative recombination, while protecting the perovskite from the degradation species derived from the HTL. The stability tests of the devices revealed that the PCBM/BCP/Ag interface is the weak interface, in terms of stability, under thermal and light stress and the thermal stress induces a burn-in phenomenon i.e., a rapid decrease in power conversion efficiency (PCE) in few hours. This problem was mitigated, through the second engineering approach, by developing an AzPy layer onto the ETL, thus the performance and stability of the devices under ambient conditions and thermal or light stress were considerably improved. Moreover, a surface treatment of perovskite surface with n-hexylammonium bromide was employed, resulting to devices with PCE over 20%. By combining all the proposed interface engineering approaches, the optimized devices deliver a PCE up to 20.42% and retain 90% of their initial PCE for more than 1200 h under ambient conditions, while the thermal and light stabilities of the devices improved substantially in comparison to the reference.

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