Polyaniline polymer-modified ZnO electron transport material for High-performance planar perovskite solar cells

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ABSTRACT

In this study, an efficient strategy is used to prepare perovskite photoactive layer with superb optoelectronic merits by utilizing polyaniline polymer as an efficient additive to improve perovskite quality. As a result, we prove that the small content of polyaniline (PANI) provides not only suppresses the perovskite defects and lead iodide but also produces a passivation impact. By regarding using macromolecular phases with long chain polymers, the generation of a PANI-perovskite cross-linking is possible. The cross-linking acts to bridge the perovskite crystals, mitigating carrier trapping by grain boundaries and achieving remarkable air stability against humid, which has not been obtainable with tiny molecules defect passivating materials. Also, PANI promoted the development of Lewis base adduct with the perovskite precursor, which, maximized the activation energy for nucleation and growth of the perovskite phase. Therefore, the perovskite layer with optimized PANI additive showed higher crystallinity in (110) crystal plane. After PANI addition, the perovskite grains found to be enlarged from 350 nm to 620 nm. Also, the PSCs with PANI showed suppressed luminescence effect, which indicates lower recombination rates. The SCLC measurements revealed that the PANI additive improving the interfacial contact between the ZnO and perovskite due to reduction the trapped density from 1.78 × 1016 cm-3 to 2.46 × 1015. Consequently, the champion cell yields an efficiency of 17.39% for 4% polyaniline doped electron transport material with negligible hysteresis. This reduces PSC instability generating a device that retained 93% of its original performance after 600 h maintaining in air conditions without any encapsulation