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Surface treatment of PTAA hole transport layer for inverted perovskite solar cells

Poly[bis(4-phenyl)(2,4,6-trimethylphenyl)amine] (PTAA) was chosen as a hole transport layer for inverted perovskite layer. It is the first layer deposited on the FTO substrate and thus directly affect the structure and performance of the inverted or p-i-n perovskite solar cells. It was found that untreated PTAA layer yielded large distribution of photovoltaic parameters and low reproducibility. In this work, the PTAA was dissolved in chlorobenzene (CB) and spin-coated on the FTO substrates and baked at 105 deg;C for 10 mins as pristine samples. The surface treatment of PTAA was performed by washing the pristine samples with 200 µl dimenthylformamide (DMF) on a spin coater and followed by dynamic spin of 50 µl and 75 µl of CB or Toluene (TO). It was observed that the surface treatment affected the wettability of PTAA surface by the reduction of contact angle from 46deg; of pristine sample to 25deg; –35deg; of treated samples that could lead to a better interface and formation of a MAPbI₃ perovskite layer. On the contrary, the optical transmittance, surface morphology and roughness of the treated samples were insignificantly affected. It was demonstrated that the surface treatment of PTAA using DMF and 50 µl of TO could significantly reduce the fluctuation of photovoltaic parameters and also improve the repeatability of the fabrication process. The maximum power conversion efficiency (PCE) of 15.4% was obtained for the optimal condition.

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