低分子系有機薄膜太陽電池界面における励起子失活抑制と高効率化

Efficient small molecule-based bulk heterojunction photovoltaic cells with reduced exciton quenching in fullerene

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Most of highly efficient small molecule-based bulk heterojunction (BHJ) photovoltaic cells contain a large concentration of fullerene in their blend active layers. However, the excitons generated in fullerene can be seriously quenched at the surface of the commonly used MoO_3 buffer layer, becoming a key limitation to the photovoltaic performance of these cells. In this study, we have investigated various anode buffer layers in the thermally evaporated tetraphenyldibenzoperiflanthene (DBP) [1, 2] and C_{70}-based BHJ cells with high C_{70} concentration. It has been found that obviously enhanced power conversion efficiency (PCE) of up to 6.26% can be obtained in DBP and C_{70}-based BHJ cells via simply replacing the MoO_3 buffer by poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS), which is also one of the commonly used anode buffer materials in polymer-based BHJ cells. It is confirmed by photoluminescence spectra that the exciton quenching at the anode interface was suppressed by inserting PEDOT:PSS buffer layer. Moreover, after adding a C_{70} interlayer for better electron extraction and the further suppression of exciton quenching, the DBP and C_{70}-based M-i-n photovoltaic cells have shown remarkable PCE up to 7.04% under illumination with 100 mW/cm^2, AM 1.5G simulated solar light (Fig. 1) [3]. These results show that there is much room for the improvement of photovoltaic performance in small molecule-based BHJ OPV cells by reducing exciton quenching in fullerene.

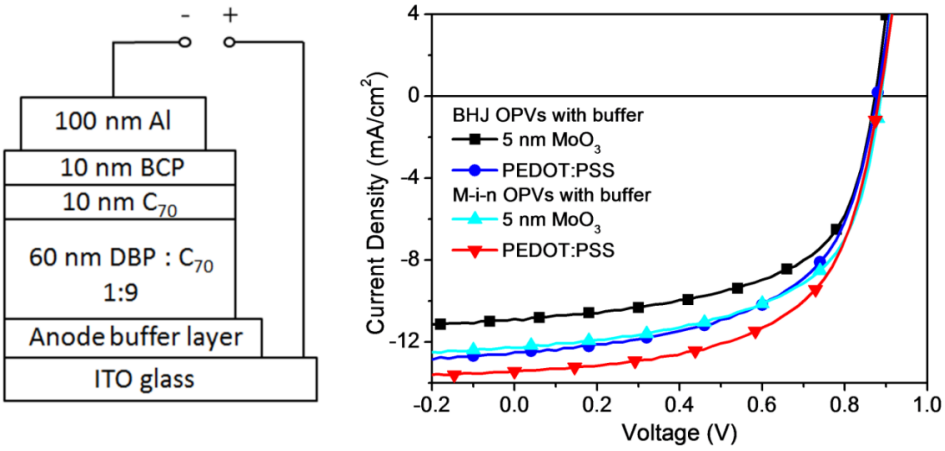

Fig. 1 J–V curves of DBP and C_{70}-based BHJ and M-i-n cells employing PEDOT: PSS buffer or MoO_3 buffer. The device structure of M-i-n cells is also given.

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