

Optical Approach for Efficient Light Trapping in Inverted Polymer Solar Cells

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Solution processed polymer Bulk heterojunction (BHJ) solar cells are considered to be one of the most promising technologies for low cost, flexible, and roll to roll processed solar cell applications. The power conversion efficiency of single junction polymer solar cells is already reached to 10% [1]. For commercialization of such promising technology further improvements are still required, especially in terms of power conversion efficiency (PCE) and lifetime. For this purpose additional processing such as doping of additives in the active layer [2], efficient and air stable buffer layers [3] or thermal annealing techniques [4] were reported.

In this paper, we report an optical method for light trapping in inverted BHJ solar cells. Herein, we incorporated a surface modifying layer in inverted polymer solar cells to improve their electrical performance. A 12% enhancement in PCE is realized for polymer solar cells with photoactive layer of low bandgap polymer poly[4,8-bis(5-2-ethylhexyl)thiophen-2-yl]benzo[1,2-b;4,5-b']dithiophene-2,6-diyl-alt-(4-(2-ethylhexyl)-3-fluorothieno[3,4-b]thiophene)-2-carboxylate-2,6-diyl](PTB7-Th) and [6,6]-phenyl C₇₁ butyric acid methyl ester (PC₇₀BM). The fabricated inverted polymer solar cell exhibits a maximum PCE as high as 8.60% under simulated 100 mW/cm² AM 1.5G illumination. The excellent performance of single junction inverted polymer solar cells is attributed to reduction in reflection at the interface. Other reported light trapping approach generally produce charge losses with increasing device resistance resulting in low Fill Factor. Our light trapping approach shows significant improvement in current density of inverted polymer solar cell devices without sacrificing the dark electrical characteristics. This optical approach can be applicable to the performances improvement of future polymer BHJ solar cells.

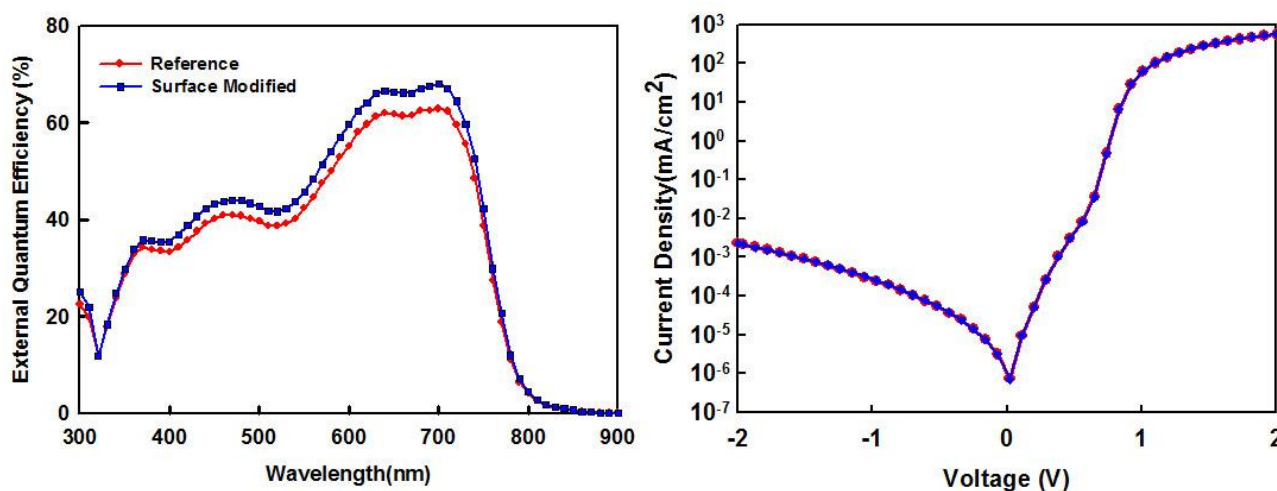


Fig. 1. External quantum efficiency and dark current characteristics of polymer solar cells with and without surface modified layer

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