Flexible and Semitransparent All-Polymer Solar Cells through Lamination

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A novel technic is used to make semitransparent solar cell, whose functional layers including electrodes, active layer and interlayers are all from polymers, so we call it all-polymer solar cell. The solar cells fabrication is following the lamination process that was developed by our group, Figure 1. [1] We use high conductive PEDOT:PSS as anode, which acts both as electrode as well as hole transport layer, and PEI modified PDEOT:PSS as cathode. All these PEDOT:PSS and PEI were all slot-die coated in air on very thin Polyethylene terephthalate (PET) foils. The active layer is deposited on cathode side and anode side separately and then laminated together. The advantages of lamination procedure are avoiding the wet deposition of top PEDOT:PSS layer that would either make contact to the bottom electrodes layer and/or introduce oxidation or traps of active layer.

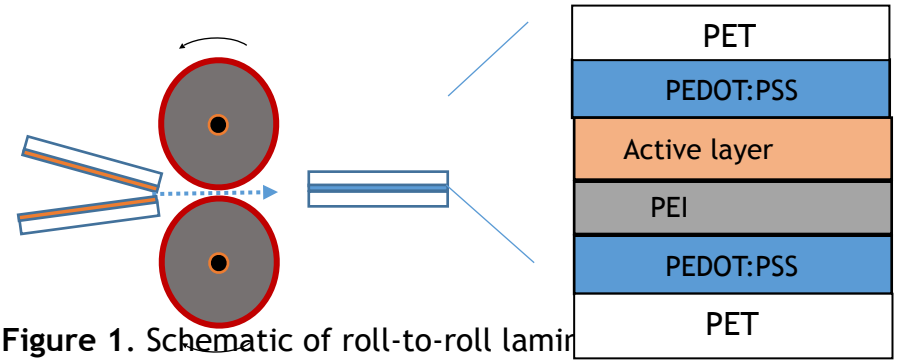

Figure 1. Schematic of roll-to-roll lamin

As the promising alternative choice than the polymer/PCBM, the polymer-polymer has achieved steady progress in recent years, with PCE reproaching 9%. [2] [3] Here we use two different polymer donor , TQ1 and PTB7-Th, combined with polymer acceptor PNDI-T10, [2]to build efficient semitransparent solar cells. And the lamination also gives us freedom to choose different active layer on different electrode side. The active layer could be pure donor, pure acceptor, or a blend of donor and acceptor. we build a serie of solar cells using all possible combination and maximum power conversion efficiency(PCE) of 1.2% and 2.5% was achieved for TQ1 and PTB7-th separately. And we found that with a thin layer of PNDI-T10 on cathode side laminated with a blend layer would improve the efficiency of solar

cells compared to symmetric blend layer on both side. But the mechanism is different for TQ1 and PTB7-th systems.

For TQ1, the devices with PNDI-T10 have higher Jsc but lower FF and thus we attribute the bimolecular recombination as we observe improved field dependence of carrier extraction as well as closer to linear light intensity dependency of Jsc. But for PTB7-th, the improvement is both FF and Jsc, although little difference in light intensity dependence measurement was observed. But the improved morphology determined from electroluminescence could be the reason.

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[2] Z. Li, X. Xu, W. Zhang, X. Meng, W. Ma, A. Yartsev, O. Inganäs, M. R. Andersson, R. A. J. Janssen, E. Wang, Journal of the American Chemical Society 2016, 138, 10935.
[3] Z. Li, X. Xu, W. Zhang, X. Meng, Z. Genene, W. Ma, W. Mammo, A. Yartsev, M. R. Andersson, R. A. J. Janssen, E. Wang, Energy & Environmental Science 2017, 10, 2212.