Air-processed ternary active layers for neutral color transparent polymer solar cells

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Polymer solar cell (PSC) active layers based on three active materials can harvest a large amount of sunlight resulting in high short-circuit current densities (Jsc) and power conversion efficiencies (PCEs) over 14%.[1] If the three components have complementary absorption properties, active layers uniformly absorbing visible light are formed which can be employed for semi-transparent photovoltaic windows fabrication.[2] We combined an air-stable electron donor (PCDTBT) with reference fullerene ($PC_{71}BM$) and non-fullerene (ITIC) acceptors in inverted architecture PSCs and compared the photovoltaic performances and operational stability of binary (PCDTBT:$PC_{71}BM$) and ternary (PCDTBT:$PC_{71}BM$:ITIC) devices.

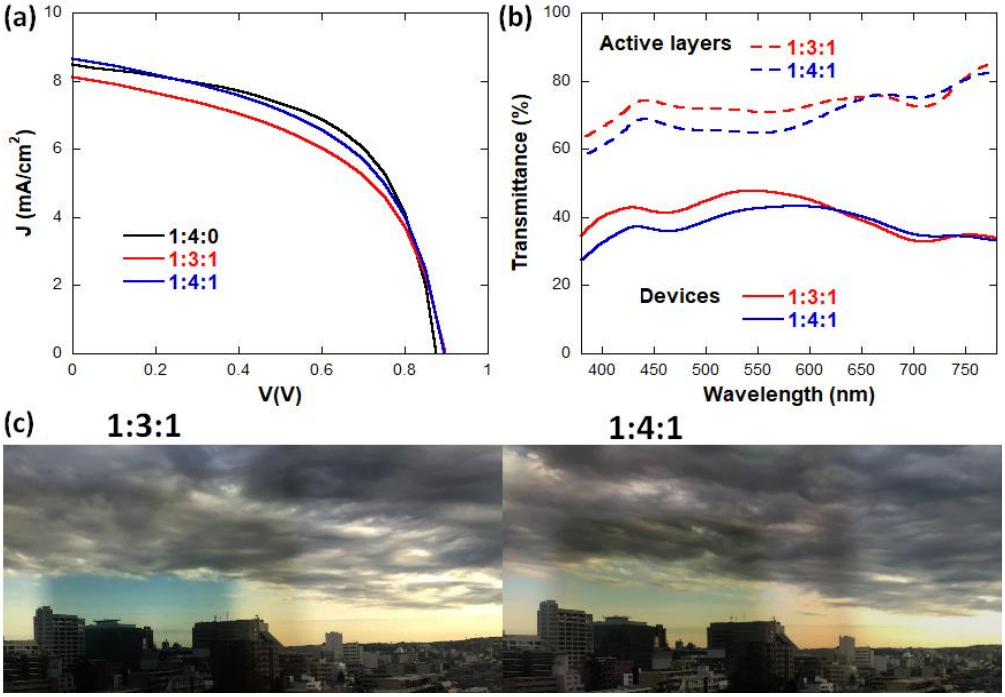

Fig. 1: (a) J-V curves, (b) transmission spectra and (c) photographs of semi-transparent PSCs.

We observed that PSCs with a PCDTBT:$PC_{71}BM$:ITIC composition of 1:4:1 yield similar PCEs to binary (1:4:0) ones in both opaque and semi-transparent devices. The slightly higher Jsc in 1:4:1 PSCs compensates for the small decrease observed in fill factor (FF) upon addition of ITIC to the binary blend. Although uniformly absorbing active layers are produced with a 1:3:1 ratio, lower photovoltaic performances were measured (**Fig. 1**). When combined with semi-transparent MoO_3 (10 nm)/Ag (15 nm)/MoO_3 (30 nm) top anodes, the 1:4:1 active layers produce neutral color semi-transparent PSCs with an average PCE over 4% and better operational stability than binary and opaque devices.

[1] Z. Xiao *et al*. *Science Bulletin 62*, 1562-1564 (**2017**).

[2] M. Makha *et al. Science and Technology of Advanced Materials 18*, 68-75 (**2017**).