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Title: Device Characterization of conjugated polymer/methanofullerene bulk heterojunction solar cells.

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Abstract: We recently reported a power conversion efficiency of about 2.5% (electrical power out/incident light power) for bulk heterojunction solar cells from poly(2-methoxy-5-(3',7'-dimethyl-octyloxy))-p-phenylene vinylene, (MDMO-PPV), as an electron donor, and (6,6)-phenyl-C_{61}-butyric-acid methyl ester (PCBM; a soluble C_{60} derivative) as electron acceptor. These efficiencies are the highest for this class of devices. The understanding of the device properties of bulk heterojunction solar cells formed between conjugated polymers and fullerenes is a key ingredient for further device optimization. Current-voltage (I-V) measurements were performed on a series of MDMO-PPV:PCBM solar cells in the temperature range between 15 K and 300 K. For the electrodes, an indium tin oxide (ITO) layer with a 100 nm poly(3,4-ethylene-dioxy-thiophene) (PEDOT) layer is used as anode while the cathode layer consists of a combination of lithium-fluoride and aluminum (LiF/Al) or gold respectively. The dependence of the I-V characteristics of these devices on the temperature in the range between 15 K and 300 K is carefully analyzed (Figure 1 & Figure 2). Typical sets of I-V curves measured in the dark and under illumination are shown in Figs. 1 and 2, respectively. In the back direction (negative bias voltage), the current is limited by a leakage current. In forward direction (positive bias voltages) the behavior appears to be dominated by a delicate interplay between carrier injection and transport efficiency. The parameters limiting the performance of the solar cells will be identified. Based on these results, strategies for further optimizing the solar cell performance will be outlined.

References

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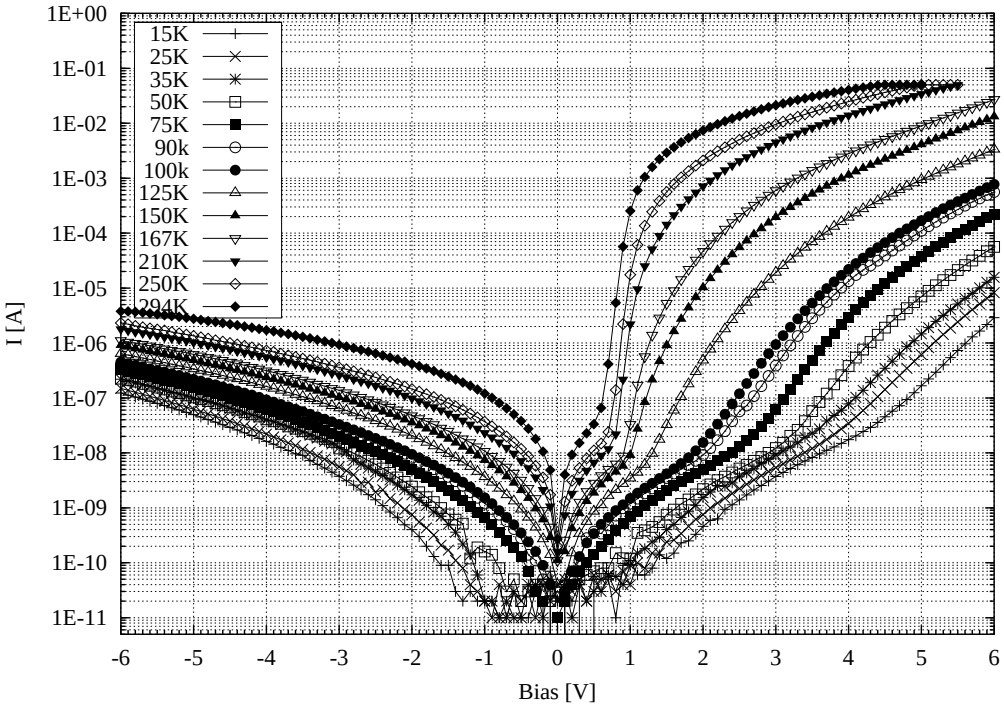

Figure 1: Temperature dependent dark I/V behavior of ITO/PEDOT/MDMO-PPV:PCBM/LiF/Al solar cell.

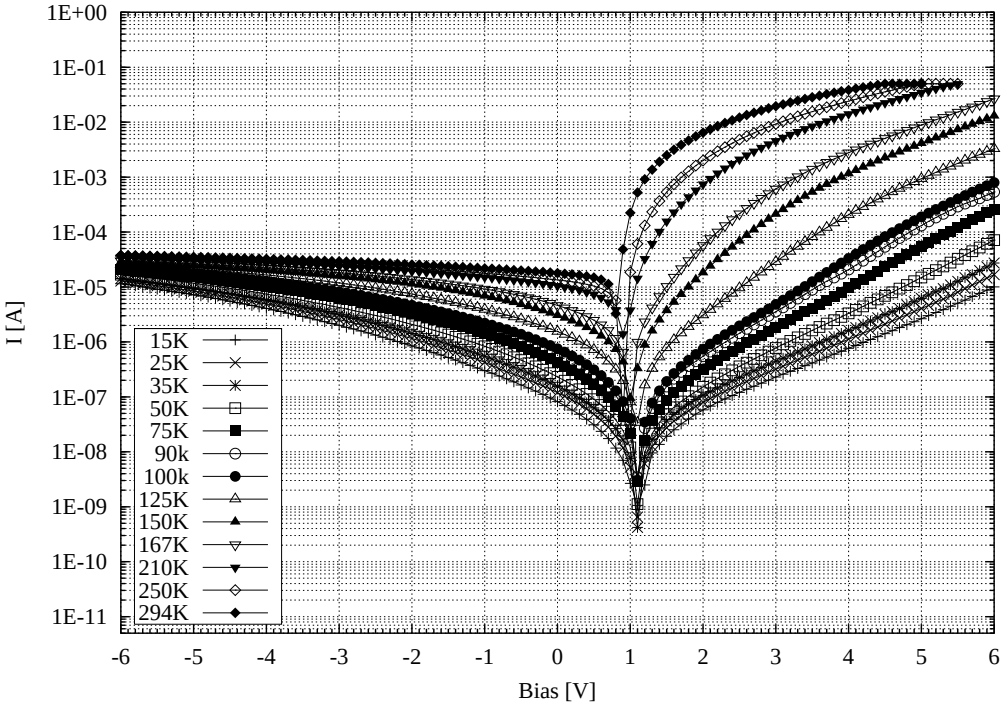

Figure 2: Temperature dependent illuminated I/V behavior of ITO/PEDOT /MDMO-PPV:PCBM/LiF/Al solar cell.