ELECTRONIC PROPERTIES OF POLYMER-FULLERENE SOLAR CELLS

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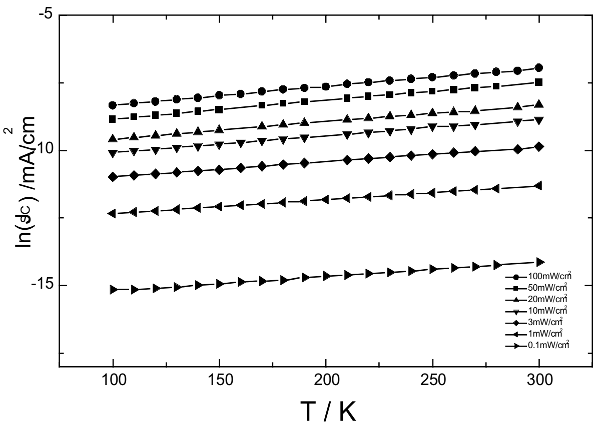
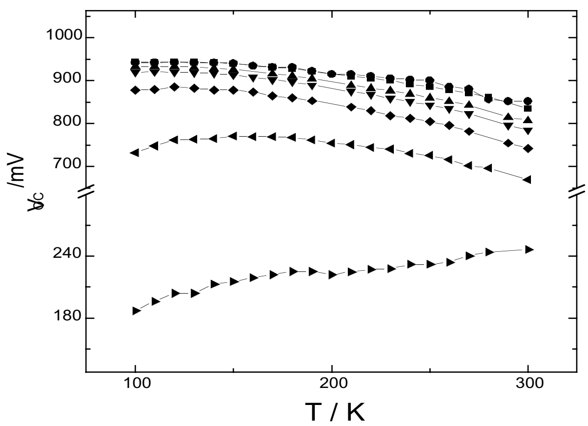
The utilisation of conjugated polymers in the solar cell's active layer is based on the phenomenon of photoinduced electron transfer. Most of the activities in the field are devoted to the wide-gap polymers, mainly poly-(phenylene-vinylene), with the semiconducting gap of about 2.4eV, and fullerene C_{60}, or it's derivatives, as an acceptor molecule. Fundamental understanding of the processes of charge generation, recombination and transport in this class of materials is decisive for their applicability in photovoltaics. To study electronic transport properties of solar cells based on composites of conjugated polymer MDMO-PPV - poly (2-methoxy-5-(3-,7-dimethyloctyloxy)-1,4-phenylene vinylene and fullerene derivative PCBM — [6,6]-phenyl-C_{61}-butyric acid methyl ester, the temperature and illumination intensity dependent I-V analysis has been performed. The behaviour of the cell parameters is found to be more complex as compared to that known for inorganic pn-solar cell. The temperature and illumination intensity dependences of J_{SC} and V_{OC} of a ITO/MDMO-





PPV:PCBM/Al device are shown in the Figures above. The V_{OC}(figure right) increases from 850mV to 940mV when cooling down the device from 300K to 100K. At lowest illumination intensity of 0.1mW/cm^2, the V_{OC} breaks down and the influence of the parallel resistance is dominant. Surprisingly, the J_{SC} (figure left) increases exponentially with the temperature, whereas a nearly temperature independent behaviour as in the conventional semiconductor-based solar cells is expected. This increase will be discussed in terms of temperature dependent series resistance. Further studies by admittance spectroscopy revealed non-trap frequency dependent contributions to the device capacitance which originate from the freeze-out of free charged carriers in the bulk of the absorber material.