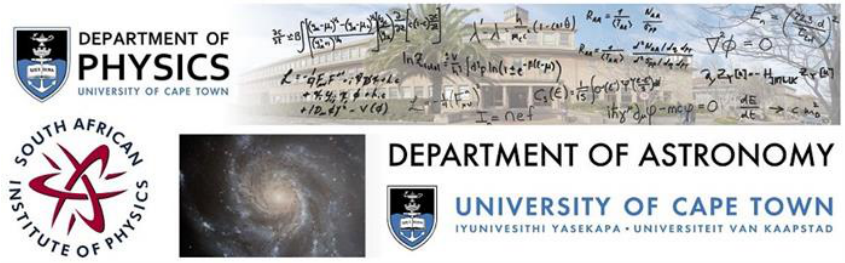

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Effect of annealing of P3HT:PCBM blend in the performance of organic solar cell devices

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Abstract content
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The performance of bulk heterojunction organic solar cells based on Poly (3-hexylthiophene) (P3HT) and 1-(3-methoxycarbonyl)-propyl-1-phenyl-(6,6)C61 (PCBM) can be enhanced by annealing of the blend. In this work, the effect of pre-heat treatment of the donor material (P3HT) before P3HT:PCBM blend formation on the power conversion efficiency is investigated. Atomic force microscopy, UV-vis spectroscopy, Raman spectroscopy and Photoluminescence (PL) studies on the P3HT and P3HT:PCBM blend films are carried out to establish the optical properties and the kinetics of thermal annealing on the blend. AFM measurements have shown homogenous films with increased surface roughness upon annealing. This indicates an improved interpenetrated network which increases the optical absorption as corroborated by UV-Vis spectroscopy. Raman spectroscopy has shown that pre-heating of P3HT before blend formation increases its structural order, thereby limiting the diffusion of PCBM due to the formation of P3HT and PCBM domains in the blend matrix. Annealing of the pristine blend favoured the diffusion of the PCBM into the P3HT matrix forming a percolated network that enhanced the short circuit current density Jsc and carrier mobility by up to 6.5% and 4 fold respectively. Conversely devices made with a blend of pre- heated P3HT exhibit a higher degree of de-mixing which reduces the mobility by 84%. The enhanced photo conversion efficiency of 3.5% is attributed to increased P3HT crystallinity and acceptor – donor interfacial area as evident by the increased Raman peak intensity and the reduction of their full width at half maxima (fwhm). The J-V measurements were carried out under Air Mass 1.5, 100mW/cm2 illumination.

References.
[1] Renewable and Sustainable Energy Reviews 11 (2007) 1388–1413.
[2] S.R. Forrest, The limits to organic photovoltaic cell efficiency, MRS bulletin, 30 (2005) 28-32.

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