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Efficiency Enhancement in P3HT:PCBM Blends using Squarylium III Dye

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Nano-size thin films comprising poly (3-hexylthiophene) (P3HT) and a fullerene derivative [6, 6] Phenyl-C₆₁-butyric acid methyl ester (PCBM) incorporating squarylium dyes III (sq3) are reported. The materials prepared were evaluated for their optical, electrical and photo-conversion efficiency. Materials comprising a blend ratio 1:0.6:1 of P3HT:SQ3:PCBM were deposited by spin-coating or screen printing to produce thin films measuring 100 nm and subsequently annealed at 140°C for 10 min. The films were characterized by UV-Vis-NIR spectroscopy for their optical properties, atomic force microscopy for surface morphology and film thickness, and electrical properties. Optical measurements for blends incorporating different amounts of dye showed increased photo-absorbance with increasing dye concentration. The combined contribution of squarylium III dye and thermal annealing resulted in increased power conversion efficiency (η) of pristine P3HT:PCBM solar cells from 2.8 % to 3.9 %. The dye in the active layer improved photo-absorption by enhanced light harvesting while thermal treatment improved the nanoscale morphology leading to better metal-film interface contact and broadening of the absorption wavelength range.

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