A low-cost mixed fullerene acceptor blend for large-scale roll-to-roll printed solar cells

Nathan A. Cooling¹,*, Evan F. Barnes¹, Furqan Almyahi¹,³, Krishna Feron¹,², Mohammed Al-Mudhaffer¹,³, Alaa Al-Ahmad¹,³, Ben Vaughan¹, Thomas R. Andersen¹, Matthew J. Griffith¹, Andrew S. Hart¹, Acadia G. Lyons¹, Warwick J. Belcher¹, Paul C. Dastoor¹

Supplementary Information

UV-vis analysis of ICxA components

Chromatography showed that ICxA consists of a mixture ICMA, ICBA and ICTA. No higher adducts were observed. A very small amount of C₆₀ was present which contributed less than 0.5% to the total mass of ICxA, so its contribution to the absorption spectrum of ICxA was ignored.

The ICMA:ICBA:ICTA weight ratio of the synthesised product was determined using absorption spectroscopy. The spectrum of the synthesised product is simply the superposition of the individual ICMA, ICBA and ICTA spectra when sufficiently diluted in tetrahydrofuran, i.e.

\[ A_{ICXA}(\lambda) = aA_{ICMA} + bA_{ICBA} + cA_{ICTA} \quad (1) \]

where \( A \) is absorbance, \( a \) the ICMA concentration (mg/ml), \( b \) the ICBA concentration (mg/ml) and \( c \) the ICTA concentration (mg/ml). \( A_{ICMA}, A_{ICBA} \) and \( A_{ICTA} \) are the mass attenuation coefficients of pure ICMA, ICBA and ICTA respectively. These reference spectra are shown in Figure S1. The three components have distinctly different absorption spectrum, in particular the region between 400 and 500 nm (shown in the inset of Figure S1).
Figure S1. Molar extinction coefficients for ICMA, ICBA and ICTA. The inset shows the wavelength region between 400 and 500 nm.

A fit of equation (1) against the measured absorption spectrum of ICxA dissolved in tetrahydrofuran in the wavelength region of 400-500 nm gave the ICMA, ICBA and ICTA concentrations. The fit and measured data of an ICxA solution are shown in Figure S2. The goodness of fit, $R^2$ value, for all cases was better than 0.99.
Figure S2. The measured absorption spectrum of ICxA, best fit using equation (1) and the individual components as determined by the fitting procedure.