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Fluorinated NDI-based copolymers acceptors for efficient all-polymer solar cells: Morphology and Photo-physics

All-polymer solar cells employ an electron deficient conjugated polymer as an acceptor in lieu of the ubiquitous fullerene acceptor. All-polymer solar cells have seen a steady rise in efficiency over the past few years going from about 2% to 8.3% with the development of new donor and acceptor polymers. All-polymer solar cells have certain advantages over their fullerene counter parts in terms of tunability, morphological stability and possible cost benefits. It is due to these reasons that the study of various aspects like morphology, physics and chemistry of all-polymer systems is garnering more attention amongst the research community.

With an aim to further the development of polymer acceptors, we have developed and studied three new candidates P(NDITPhT), P(NDITF2T) and P(NDITF4T). These polymers are analogous to the well-studied P(NDI2OD-T2), with P(NDITPhT) possessing a phenyl ring between the two thiophene units, and P(NDITF2T) and P(NDITF4T) possessing fluorinated phenyl rings with increasing degrees of fluorination. When paired with the donor polymer PTB7-Th, we find that the overall power conversion efficiency (PCE) increasing with increasing degree of fluorination despite a systematic decrease in open-circuit voltage. With further optimisation of molecular weight, an efficiency of up to 5.5% is achieved with P(NDITF4T) as the acceptor, higher than that achieved with the benchmark P(NDI2OD-T2) (4.5%). The effect of fluorination of the morphology is studied using synchrotron techniques such as GIWAXS, NEXAFS spectroscopy and RSoXs and lab based AFM and TEM. Photo-physics is employed to discuss the effect of morphology on charge generation and geminate recombination in these blend. The effects of fluorination on morphology and the subsequent charge generation is discussed.

Keywords or phrases (comma separated)

Polymer solar cell, acceptor, GIWAXS, RsoXS, NEXAFS, morphology, photo-physics

Are you a student?

Yes

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No

Are you an ECR? (<5 yrs since PhD/Masters)

What is your gender?

Male

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