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Communication

Donor-acceptor (D-A) terpolymers based on alkyl-DPP and *t*-BocDPP moieties for polymer solar cells

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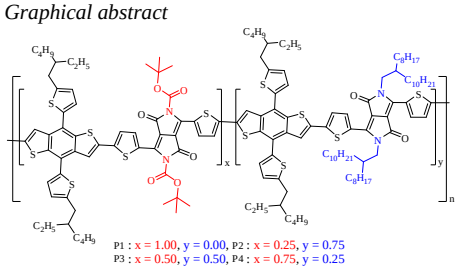
Graphical abstract



A series of low band gap terpolymers based on 4,8-bis(5-(2-ethylhexyl)thiophen-2-yl)benzo[1,2-b:4,5-b′]dithiophene (BDTT) and diketopyrrolopyrrole (DPP) with varied solubilizing groups (*i.e.*, *tert*-butoxycarbonyl, *t*-Boc and 2-octyldodecyl) are developed as electron donors for bulk heterojunction (BHJ) polymer solar cells (PSCs). The results reveal that the one with 50% *t*-Boc concentration (P3) performs better than the other terpolymers used in this study in conventional PSC devices with a power conversion efficiency of 2.92%.

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ABSTRACT

A series of low band gap terpolymers based on 4,8-bis(5-(2-ethylhexyl)thiophen-2-yl)benzo[1,2-b:4,5-b′]dithiophene (BDTT) and diketopyrrolopyrrole (DPP) with varied solubilizing groups (*i.e.*, *tert*-butoxycarbonyl, *t*-Boc and 2-octyldodecyl) are developed as electron donors for bulk heterojunction (BHJ) polymer solar cells (PSCs). The results reveal that the one with 50% *t*-Boc concentration (P3) performs better than the other terpolymers used in this study in conventional PSC devices with a power conversion efficiency of 2.92%

Keywords: Conjugated polymer Organic semiconductor Polymer solar cells Bulk heterojunction Diketopyrrolopyrrole

Organic semiconducting polymers gathered enormous attentions in developing polymer solar cells (PSCs) with characteristic features, *i.e.*, light-weight, flexibility and solution processabilities [1-5]. Backbone of conjugated polymers comprise of alternatively arranged push-pull configuration of electron rich donating moieties (D) and electron deficient accepting units (A), which facilitates the charge transfer over the entire back-bone. Thus, the optoelectronic properties of conjugated polymers can be finely tuned, which plays a vital role in obtaining good photovoltaic performance [6-9]. Over the past few years, the PSC power conversion efficiencies (PCEs) have been boosted over 12% [10-13].

Among the large numbers of molecular entities documented for PSCs, DPP pigment has attracted attentions of researcher due to its versatile properties, such as strong absorption, chemical and thermal stabilities, outstanding charge transporting capability *etc.* [14-26].

Considerable amount of responses have been rewarded to develop low bandgap polymers with benzo[1,2-b:4,5-b′]dithiophene (BDT) electron rich unit and DPP, due their strong absorption in near IR region and excellent hole-transporting ability [27-31]. However, one of drawbacks for DPP-based polymers has shown relatively strong aggregation in solution [32], which require various side chains being introduced into DPP polymers for good solution processibilities. Solid state features of polymers are influenced from the nature of various functionalities being introduced on the DPP lactam groups [33-37]. Besides of the straight and branched alkyl chains, it is interesting to note that dormant substituents (*i.e.*, *tert*-butoxycarbonyl, *t*-Boc) have been introduced to DPP units. Such *t*-Boc functionalities can be eliminated at elevated temperature, resulting in the possible formation H-bonding (N−H···O=C) between