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Naphthalene diimide-based molecular acceptors for organic solar cells

Organic photovoltaics (OPV) have received much attention due to the promise of low-cost, efficient processing of solar cells onto flexible substrates. Typically, OPVs consist of a polymeric donor and a fullerene acceptor material, however, fullerene shortcomings such as poor light harvesting ability and high synthesis costs have resulted in the exploration of alternative acceptor materials. Small molecule acceptors have recently gained attention due to their favourable absorption profile and inexpensive synthesis. While polymeric naphthalene diimide (NDI)-based materials have shown promise as alternatives for fullerenes – showing power conversion efficiencies (PCE) over 8% in some devices – their molecular counterparts have been less successful, with low initial performance resulting in their limited exploration as the highest reported device exhibits only 2.4% PCE. The lower efficiencies of NDI-based small molecules are attributed to weaker absorption in the visible wavelength range as well as susceptibility to forming large domain sizes. We report a series of NDI-based small molecule acceptors with different architectures and substitutional atoms with one material achieving the highest PCE to-date for any NDI-based molecular acceptor at 2.8%. A range of synchrotron-based techniques including grazing incidence wide-angle x-ray scattering (GIWAXS), resonant-soft x-ray scattering (R-SoXS), and near edge x-ray absorption fine structure (NEXAFS) have been used to characterize the active layer morphology for these devices. NDI-based small molecule acceptors are an attractive alternative to typical fullerene acceptors because their absorption profile can be favourably tuned to include visible wavelengths and their synthesis is both less tedious and less expensive than that of fullerene acceptors.

Keywords or phrases (comma separated)

organic photovoltaics, naphthalene diimide, molecular acceptors, GIWAXS, R-SoXS

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Yes

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Yes

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No

What is your gender?

Female

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