Non-Conjugatd Unit Incorporated Polymer Donors Enable Superior Blend Miscibility for High-Performance and Mechanically-Robust Polymer Solar Cells

이진우, 정다현, 김동준[1], 김택수, 김범준†
KAIST; [1]kaist
(bjkim02@kaist.ac.kr†)

Here, we develop a series of novel polymer donors (P_Ds), with which highly efficient PSCs having remarkable mechanical reliability are demonstrated. By interposing a controlled amount of 1,10-di(thiophen-2-yl)decane flexible spacer (FS) into a PM6 backbone, we are able to significantly enhance the intermixing of the new P_Ds with a small molecule acceptor (Y7), affording sufficient pathways for efficient charge percolation and mechanical stress dissipation. As a result, PSCs based on the P_D containing 5 mol% FS units and Y7 exhibit a high power conversion efficiency (PCE) of 17% with a crack onset strain (COS) of 12% and a cohesive fracture energy (G_c) of 2.1 J m^{-2}, significantly outperforming reference PM6-based devices (PCE = 15%, COS = 2% and G_c = 1.0 J m^{-2}). Both the photovoltaic performance and mechanical robustness of these PSCs are among the best values reported to date. The rational design of the P_Ds demonstrated here presents a highly promising strategy to address the mechanical properties of SMA-based solar cells and their viable application in flexible/stretchable electronics.