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A Novel Wide Bandgap Conjugated Polymer (2.0 eV) Based on Bithiazole for High Efficiency Polymer Solar Cells

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Abstract

An efficient wide bandgap conjugated polymer (PTZ6) based on alkoxyphenyl substituted benzodithiophene as donor unit and bithiazole as acceptor unit was developed for polymer solar cells (PSCs). The polymer exhibited a wide bandgap of 2.0 eV with strong absorption in the range of 300-620 nm, and a low-lying highest occupied molecular orbital (HOMO) energy level of -5.36 eV. The PSCs based on PTZ6: PC₇₁BM show a PCE of 8.1% with a V_{oc} of 0.96 V, a J_{sc} of 10.9 mA cm⁻² and a high FF of 76.7%, which is among the highest values for the fullerene PSCs based on conjugated polymer donors with bandgap near to 2.0 eV. Moreover, for this blend system, the photovoltaic performance of the devices changes little when the active layer thickness increases from 90 nm to 220 nm. More importantly, the non-fullerene PSCs based on PTZ6: ITIC exhibit a PCE of 10.3% with a high V_{oc} of 1.01 V, which should be the best value for the non-fullerene PSCs with the E_{loss} less than 0.6 eV to date. Our results indicate that PTZ6 is a promising wide bandgap polymer donor for the photovoltaic application in PSCs.

Graphical Abstract

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