Synthesis and characterization of 2,1,3-benzoselenadiazole-based conjugated polymers for organic photovoltaic cells

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Abstract

Low-band-gap organic semiconducting polymers comprising two dialkoxy-substituted Benzoselenadiazole derivatives and two BDT derivatives as the electron acceptors and donors, respectively, were synthesized via Stille coupling for application as a donor material in organic photovoltaic cells. These polymers are soluble in common organic solvents, and can be spin-cast to form smooth, uniform thin films. The polymers were thermally stable, i.e., lost < 5% of their weight upon heating to ~ 300 ◦C. Intramolecular charge transfer between the electron-donating and -accepting blocks of the polymeric backbone induced a broad absorption from 300 to 750 nm. The optical band gap energies were 1.74–1.67 eV depending on the structure of the polymer. Solution-processed field-effect transistors fabricated using these polymers as the active layers showed p-type organic-thin-film transistor characteristics. Bulk hetero-junction photovoltaic devices using the polymers with [6,6]-phenyl-C_{71}-butyric acid methyl ester ($PC_{71}BM$) as the electron acceptor were fabricated; one device showed a high power conversion efficiency of 3.57% with an open-circuit voltage of 0.77 V, a short-circuit current of 11.03 mA/cm^2, and a fill factor of 0.42 under AM1.5G illumination (100 mW/cm^2).

References

[1] R.D. McCullough, R.D. Lowe, Journal of the Chemical Society, Chemical Communications1 (1992) 70.
[2] T.A. Chen, R.D. Rieke, Journal of the American Chemical Society 114 (1992) 10087.
[3] T.A. Chen, X. Wu, R.D. Rieke, Journal of the American Chemical Society 117(1995) 233.
[4] S. Cho, K. Lee, J. Yuen, G. Wang, D. Moses, A.J. Heeger, M. Surin, R. Lazzaroni, Journal of Applied Physics 100 (2006) 114503.
[5] B.S. Ong, L.Y. Wu, P. Liu, S. Gardner, Journal of the American Chemical Society 126 (2004) 3378.

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