DEVELOPMENT OF ORGANIC POLYMER DONOR FOR EFFICIENT TERNARY ORGANIC SOLAR CELLS

In Hwan Jung

Department of Chemistry, Kookmin University, 77 Jeongneung-ro, Seongbuk-gu, Seoul 02707, Republic of Korea

Organic photovoltaics (OPVs) have received attention as a next-generation power technology due to their light-weight, low production cost, semi-transparency with various color. Organic non-fullerene acceptors containing rhodanine, malononitrile, and perylene diimide derivatives are replacing the fullerene derivatives, outperforming the fullerenes. Power conversion efficiency (PCE) of >13% has achieved by utilizing donor polymers and non-fullerene small molecule acceptors. Many recent studies accordingly have actively focused on developing wide-bandgap donor counterparts for narrow bandgap small molecule acceptors.

While the synthesis of wide-bandgap polymer donors has been widely reported, very limited numbers of synthesized wide-bandgap donors showed desired functions to be used with small molecule acceptors. One of the important criteria for designing donor materials is to achieve synergetic effects with small molecule acceptors in the solar absorption and nanomorphology of bulk-heterojunction type blend film.

To optimize the nanomorphology and solar absorption of an active layer, we synthesized a wide-bandgap polymer donor and developed ternary OPVs by utilizing binary acceptors composed of a fullerene and non-fullerene. The ternary OPVs effectively extended optical absorption and improved charge extraction in an active layer. Notably, the uniformly mixed fullerenes in continuous nano-network successfully mediated the ordering of nonfullerene acceptor without charge or energy transfer. As the result, the charge generation and extraction of the ternary devices were significantly improved and the PCE of 12.1% was achieved [1-2].

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[1] W. T. Hadmojo, F. T. A. Wibowo, D. Y. Ryu, I. H. Jung, S.-Y. Jang, Fullerene-free Organic Solar Cells with Efficiency of 10.2% and Energy Loss of 0.59 eV based on a Thieno[3,4-c]Pyrrole-4,6-Dione Containing Wide-Bandgap Polymer Donor, *ACS Appl. Mater. Interfaces*, 2017, 9, 32939–32945.

[2] W. T. Hadmojo, F. T. A. Wibowo, W. Lee, H.-K. Jang, Y. Kim, S. Sinaga, M. Park, S.-Y. Ju, D. Y. Ryu, I. H. Jung, S.-Y. Jang, "Performance Optimization of Parallel-Like Ternary Organic Solar Cells Through Simultaneous Improvement in Charge Generation and Transport", *Adv. Funct. Mater*. 2019, accepted.