SEMICONDUCTING CONJUGATED POLYMERS BASED ON DIKETOPYRROLOPYRROLE FOR HIGH EFFICIENT POLYMER SOLAR CELLS

Jae Woong Jung[1], Won Ho Jo[1]
[1]Dept of Materials Science and Engineering, Seoul National University, Seoul, Korea,

Recently, diketopyrrolo[3,4-*c*]pyrrole (DPP) has emerged as an important building block of active layer materials for the optoelectronic applications including both organic field-effect transistors (OFETs) and organic photovoltaics (OPVs). Particularly, semiconducting conjugated polymers (SCPs) based on DPP exhibited high hole mobility up to 1.0 $cm^2 \cdot V^{-1} \cdot s^{-1}$ in OFETs and promising power conversion efficiencies (PCEs) of 4.5−5.5% in OPVs when DPP is copolymerized with electron-rich monomer such as thiophene, naphthalene and benzene.

Meanwhile, dithieno[3,2-*b*:2',3'-*d*]thiophene (DTT) has also received considerable attention as an electron-donating unit for synthesis of SCPs. Due to highly extended heteroarene structure of DTT, DTT-based semi-conductors exhibited high crystallinity, charge carrier mobility and excellent environmental stability. However, high performance has not been achieved in OEFTs and OPVs, although recent reports showed the possibility to use DTT as a building block for synthesis of SCPs.

We report synthesis of a novel low bandgap SCP, PDTTDPP, which has a donor–acceptor structure with dithieno[3,2-*b*:2',3'-*d*]thiophene (DTT) as an electron donating unit and DPP as an electron accepting unit, and its application to OFETs and OPVs. The PDTTDPP synthesized in this study showed a high hole mobility of 0.60 $cm^2 \cdot V^{-1} \cdot s^{-1}$ in OFETs and a promising PCE of 6.05% in OPVs with $PC_{71}BM$ without post-treatment.

Table 1 Photovoltaic properties with different ratio of PDTTDPP to $PC_{71}BM$

Ratio (PDTTDPP:$PC_{71}BM$)	Solvent	V_{OC} (V)	J_{SC} (mA/cm^2)	FF (%)	PCE (%)
1:1		0.61	8.8	41.4	2.28
1:1.5	CF/DCB	0.62	13.4	55.5	4.42
1:2		0.61	7.9	62.1	2.94
1:1.5[a]	CF/DCB/DIO	0.66	13.7	66.1	6.05

[a]2.5 vol% of DIO was added to the solution

Presenting author's email: whjpoly@snu.ac.kr