Synthesis and Characterization of Low Bandgap Polymers Containing 2,7-Dibenzosilole for High Open-Circuit Voltage in Organic Solar Cells

Introduction

- Energy level tuning of D–A type polymers
  - High donor-acceptor interaction
  - High hole mobility
  - Strong electron donating ability
  - Rigid coplanar structure

- Introduction of dibenzosilole (DBS) instead of dithienosilole (DTS)

Objectives

- To synthesize alternating low bandgap copolymer with dibenzosilole and benzoazadiazole for high V_{OC} polymer solar cells
- To compare the photophysical and photovoltaic properties of DBS-based polymers with those of DTS-based ones

Results

- Synthesis of monomers
  - dibenzosilole (DBS)
  - benzoazadiazole (BO)

- Synthesis of polymers

Optical and electrochemical properties of the polymer

- UV–vis absorption spectra
- Cyclic voltammogram

Photovoltaic properties of the polymers

- solvent: DCB + 2vol% DIO

Morphology of active layers

- {a} solvent: DCB
  - PC_{61}BM aggregation cause charge recombination
  - low J_{sc}, FF
- {b} solvent: DCB + 2vol% DIO
  - DIO reduced to PC_{61}BM aggregation
  - improved morphology

Conclusions

- BO–based low band gap copolymers, PDBSDTBO and PDTSDTBO were successfully synthesized by Suzuki and Stille coupling, respectively
- PDBSDTBO with deeper HOMO energy level showed enhanced V_{OC} (0.93 ev) and PCE (1.40%) than those of PDTSDTBO (V_{OC}: 0.70ev, PCE: 0.88%)
- Further optimization is required by changing solvent to get preferable morphology