INVITED SEMINAR

Design of Electroactive Materials for Improving Thermal Stability and Voc in Polymer Solar Cells

- Speaker : **Prof. Bumjoon Kim**, Dept. of Chemical and Biomolecular Engineering, KAIST
- Host : Department of Energy Systems Engineering
- Date : **17:00, Thursday, June 7, 2012**
- Place : Room 301, Building 2, DGIST
- Abstract

Polymer based organic photovoltaics have attracted a great deal of attention due to the potential cost-effectiveness of light-weight and flexible solar cells. However, most BHJ polymer solar cells are not thermally stable as subsequent exposure to heat drives further development of the morphology towards a state of macrophase separation in the micrometer scale. Here we would like to show three different approaches for developing new electroactive polymers to improve the thermal stability of the BHJ solar cells, which is a critical problem for the commercialization of these solar cells. In the second part of talk, we will discuss the development of electroactive materials for improving the open circuit voltage (V_{OC}) in polymer solar cells. The ability to tune the LUMO/HOMO levels of electroactive materials in active layer of polymer solar cells is critical in controlling their optical and electrochemical properties because the HOMO and LUMO offsets between the polymer donor and the electron acceptor strongly affect charge separation and the open circuit voltage (V_{OC}) of a solar cell. First, we enable facile control over the number of solubilizing groups ultimately tethered to the fullerene by tuning the molar ratio between reactants from 1:1 to 1:3, thus producing *o*-xylenyl C_{60} mono-, bis-, and tris-adducts (OXCMA, OXCBA, and OXCTA) as electron acceptors with different LUMO levels. As the number of solubilizing groups increased, V_{OC} values of the P3HT-based BHJ solar cells increased from 0.63, 0.83, to 0.98 V. Second, we present a series of novel poly[3-(4-n-octyl)phenylthiophene] (POPT) derivatives (POPT, POPTT, and POTQT) as electron donors with different side-chain density. As a result of lower HOMO levels by decrease in the side-chain density of the polymers, the devices consisting of POPT, POPTT, and POPQT with PCBM showed increased V_{OC} values of 0.58, 0.63, and 0.75 V, respectively.

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