Synthesis of Electroactive Polymers for Improving Thermal Stability and V_{oc} in Polymer Solar Cells

김범준*
KAIST
(bumjoonkim@kaist.ac.kr*)

Polymer based organic photovoltaics have attracted a great deal of attention due to the potential cost-effectiveness of light-weight and flexible solar cells. And the ability to control the HOMO level of a conjugated polymer while maintaining its bandgap is critically important for producing highly efficient solar cells by minimizing wasted energy and maximizing the V_{oc}. We developed a series of novel POPT derivatives (POPT, POPTT and POPQT) with different side-chain density and investigated the effects of molecular structure on BHJ solar cell performance. It was found that decrease in the side chain density reduced their LUMO and HOMO levels. As a result of lower HOMO levels, BHJ devices consisting of POPT:PCBM, POPTT:PCBM and POPQT:PCBM showed increased V_{oc} values of 0.58, 0.63 and 0.75 V, respectively. The enhanced charge mobility in POPQT films and the morphological enhancement of POPQT:PCBM blends had synergistic effects on the J_{sc} and FF of the POPQT:PCBM device. Our simple approach of tuning the side chain density in the conjugated polymers provides a model system for investigating the effects on the LUMO and HOMO levels of polymers and suggests a design rule for higher V_{oc} and better device performance.