ORGANIC BULK HETEROJUNCTION SOLAR CELLS BASED ON BENZODITHIOPHENE AND BENZOTHIADIAZOLE CONTAINING CONJUGATED POLYMERS

Sultan Taşkaya Aslan[1], Şevki Can Cevher[1], Eda Bolayır[1], Özlem Ünal[2], Levent Toppare[1,2,3,5], Ali Çırpan[1,2,3,4]

[1]Department of Chemistry, Middle East Technical University, Ankara, Turkey

[2]Department of Polymer Science and Technology, Middle East Technical University, Ankara, Turkey

[3]The Center for Solar Energy Research and Application(GUNAM), Middle East Technical University, Ankara, Turkey

[4]Department of Micro and Nanotechnology, Middle East Technical University, Ankara, Turkey

[5]Department of Biotechnology, Middle East Technical University, Ankara, Turkey

Organic photovoltaics (OPVs) or so-called organic solar cells particularly hold promise for manufacturing solar energy due to their advantages in low cost and production processes. In order to understand and improve the performance of OPVs, intense efforts have been dedicated around the world [1]. In particular, conjugated polymers are attractive for OPVs due to the π-conjugated systems in the polymer backbone which generates and transport the charge carriers [2]. Therefore, the design and synthesis of novel conjugated organic polymers play important role to obtain higher photovoltaic properties and improve the power conversion efficiencies (PCEs) of the OPVs.

For this purpose, benzodithiophene and benzothiadiazole containing monomers were independently synthesized, then polymerized via Stille cross-coupling reaction to obtain **P1** and **P2** polymers. Oxidation and reduction behavior of the polymers were studied by cyclic voltammetry. Measurements indicated that the highest occupied molecular orbital (HOMO) levels were -5.25 eV for **P1** and -5.38 eV for **P2**. The optical band gaps of **P1** and **P2** were calculated via UV-VIS-NIR spectroscopy as 1.54 eV and 1.64 eV, respectively. Bulk heterojunction solar cells were constructed with these polymers as the donor moieties together with $PC_{71}BM$ as the acceptor in the active layer. The current/voltage measurements showed that the highest PCEs of these photovoltaic devices were recorded as 2.52% for **P1**: $PC_{71}BM$ (1:4, w/w) in 2% DIO and 1.67% for **P2**: $PC_{71}BM$ (1:3, w/w) in 3% DIO solution.

This work was funded through TÜBİTAK Project No:115M036.

References

[1] Yao, H.; Ye, L.; Zhang, H.; Li, S.; Zhang, S.; Hou, J. Molecular Design of Benzodithiophene-Based Organic Photovoltaic Materials. *Chem. Rev.* **2016**, *116* (12), 7397–7457.

[2] Winder, C.; Sariciftci, N. S. Low Bandgap Polymers for Photon Harvesting in Bulk Heterojunction Solar Cells. *J. Mater. Chem.* **2004**, *14* (7), 1077–1086.