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Asymmetric, efficient π -conjugated organic semiconducting chromophore for bulk-heterojunction organic photovoltaics

M. Nazim^a, Sadia Ameen^{a*}, M. Shaheer Akhtar^b, Hyung Shik Shin^{a*}

^aEnergy Materials & Surface Science Laboratory, Solar Energy Research Center, School of Chemical Engineering, Chonbuk National University, Jeonju, 54896, Republic of Korea

^bNew & Renewable Energy Material Development Center (NewREC), Chonbuk National University, Jeonbuk, Republic of Korea

Abstract

A novel, asymmetric benzothiadiazole-core π -conjugated organic semiconducting chromophore (CF-BTz-ThR) containing an alkyl bithiophene donor and 3,5-bis (trifluoromethyl) benzene as acceptor unit was synthesized via Suzuki cross-coupling in a relatively cost-effective way. The synthesized chromophore was applied as an electron-donor material in the solution-processed fabrication of bulk heterojunction (BHJ) organic photovoltaics (OPVs). The presence of terminal hexyl chain in CF-BTz-ThR induced its solubility in common organic solvents. The energy levels of CF-BTz-ThR were calculated as -5.22 eV and -3.19 eV for HOMO and LUMO, respectively. The fabricated devices attained power conversion efficiency (PCE) of ~ 3.52 % for CF-BTz-ThR: PC₆₁BM (1:3, w/w) ratio with the short circuit current (J_{SC}) of ~ 10.38 mA/cm² and the open-circuit voltage (V_{OC}) of ~ 0.68 V. The reasonable J_{SC} and V_{OC} of the devices might be attributed to strong absorption and emission properties as well as the electrochemical properties due to the presence of strong electron-withdrawing benzothiadiazole as well as $-CF_3$ unit as electron-acceptor.

Keywords: Benzothiadiazole, 3,5-bis (trifluoromethyl) benzene, electrochemical properties, semiconducting chromophore, organic photovoltaics.

*Corresponding author. Tel: +82-63-270-2438, Fax: +82-63-270-2306

E-mail address: hsshin@jbnu.ac.kr (H.S. Shin), sadiaameen@jbnu.ac.kr

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