All Organic Double Cable Polymers of a Polythiophene Donor with Rhodanine and Perylene Diimide Acceptors and Evaluation of Photocurrent Generation

Sana Iqbal

Department of Chemical engineering and biotechnology (CEB) University of Cambridge, UK.

Department of Chemistry and Chemical Engineering, Lahore University of Management Sciences (LUMS), Pakistan.

Ammar Ahmed Khan

Department of Physics, Syed Babar Ali School of Science and Engineering (SBASSE), Lahore University of Management Sciences (LUMS), Lahore-54792, Pakistan

Nauman Zaffar Butt

Department of Chemistry, Government College University (GCU), Lahore-54000, Pakistan

Raja Shahid Ashraf

Department of Electrical Engineering, Syed Babar Ali School of Science and Engineering (SBASSE), Lahore University of Management Sciences (LUMS), Lahore-54792, Pakistan

Basit Yameen*

Department of Chemistry and Chemical Engineering, Syed Babar Ali School of Science and Engineering (SBASSE), Lahore University of Management Sciences (LUMS), Lahore-54792, Pakistan

Abstract:

Photoactive interfaces derived from all organic double cable polymers (O-DCPs) consisting of covalently conjugated photoelectron donor (D) and electron acceptor (A) molecular components are being recognized as promising light energy harvesting systems. Compared to the limitations faced by the fullerene-based electron acceptors, organic non-fullerene acceptors (NFAs) offer superior properties. Expanding the toolbox of all organic DCP molecules, we have developed two distinct DCPs consisting of polythiophene (PTh) photoelectron D covalently conjugated to rhodanine and perylene diimide (PDI) based organic NFAs. Both the DCPs exhibited strong fluorescence quenching of the polythiophene component. The synthesized DCPs were employed as the photoactive layers in interdigitated gold electrode-based photodetector devices. The application of PTh-Rho-CH and PTh-PDI-CH as photoactive layers led to a strong enhancement (by a factor of ~8 and 16, respectively) of photocurrent generation compared to when PTh lacking acceptor species was employed as the photoactive layer. This work systematically contributes to the development of NFA-based DCPs for application in light harvesting and conversion technologies.

Keywords:

Organic Double Cable Polymers (ODCPs), Donor-Acceptor (D-A) Covalent Conjugates, Organic Semiconductors, Photocurrent Enhancement.