Supporting Information

High-Efficiency All Polymer Solar Cell with a Low Voltage Loss of 0.56 V

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Polymer solar cells fabrication and characteristic

PSCs device with a conversion configuration of ITO/PEDOT:PSS/Active Layer/PDINO/Al. Patterned ITO glass was cleaned by scrubing in detergent and sequentially ultrasonicating in detergent, deionized water, acetone, isopropanol for 20 min and using nitrogen gun dry the glass

then ultraviolet/ozone treat for 15 min before spin-coating about 30 nm PEDOT:PSS and subsequently dried at 150℃ for 15 min in air and transfer to glove box filled with ultrahigh nitrogen gas. Chloroform solution of PBDT-DFQX1:O-IDTBR (totally 19 mg/ml, 1:1.5 wt:wt) and PBDT-DFQX:N2200 (totally 12 mg/ml, 2:1 wt:wt, with 0.5% DIO by volume) were spin-coating on the prepared ITO glass to form a thickness of ca 100 nm active layer and thermal annealing at 110 ℃ for 3 min and 10 min for SMA and APSC respectively. And at the top of active layer spin-coating ca 10 nm PDINO as cathode modify layer, transfer to vacuum caber to vacuum evaporation deposit ca 100 nm Al as cathode at pressure of 1×10^{-5} Pa.

The devices current-voltage (J-V) measurement were conducted on a computer controlled Keithley 2450 Source-Measure Unite with light intensity of 100 mW/cm^2 xenon lamp simulated light filtrated with AM 1.5 filter as light source calibrated with a standard single-crystal Si photovoltaic cell.

Carrier mobility device fabrication and measurement

Hole mobility device with configuration of ITO/PEDOT:PSS/Active Layer/Au, and electronic mobility device with configuration of ITO/ZnO/Active Layer/PDINO/Al. Through Mott-Gurney equation to estimate carrier mobility, the equation describe as $J=\frac{9}{8}\varepsilon\varepsilon_0\mu\frac{(V-V_{bi})^2}{L^3}$ where ε is the dielectric constant of the polymer, ε_0 is the permittivity of the vacuum, μ is the mobility of hole or electron and L is the thickness of active layer, V is the voltage applied to the device and V_{bi} is the built-in voltage.

Fiure S1 show the synthetic route to the polymer. Monomer M1 (BDT-C8) and M2 (DFQX) were reported by our group[1, 2] and by still coupling polymerization between M1 and M2 to get

copolymer PBDT-DFQX1. The crude copolymer was purified by continuous extraction with methanol, hexanes and chloroform and vacuum evaporation to remove most chloroform and then deposition by pouring into methanol.

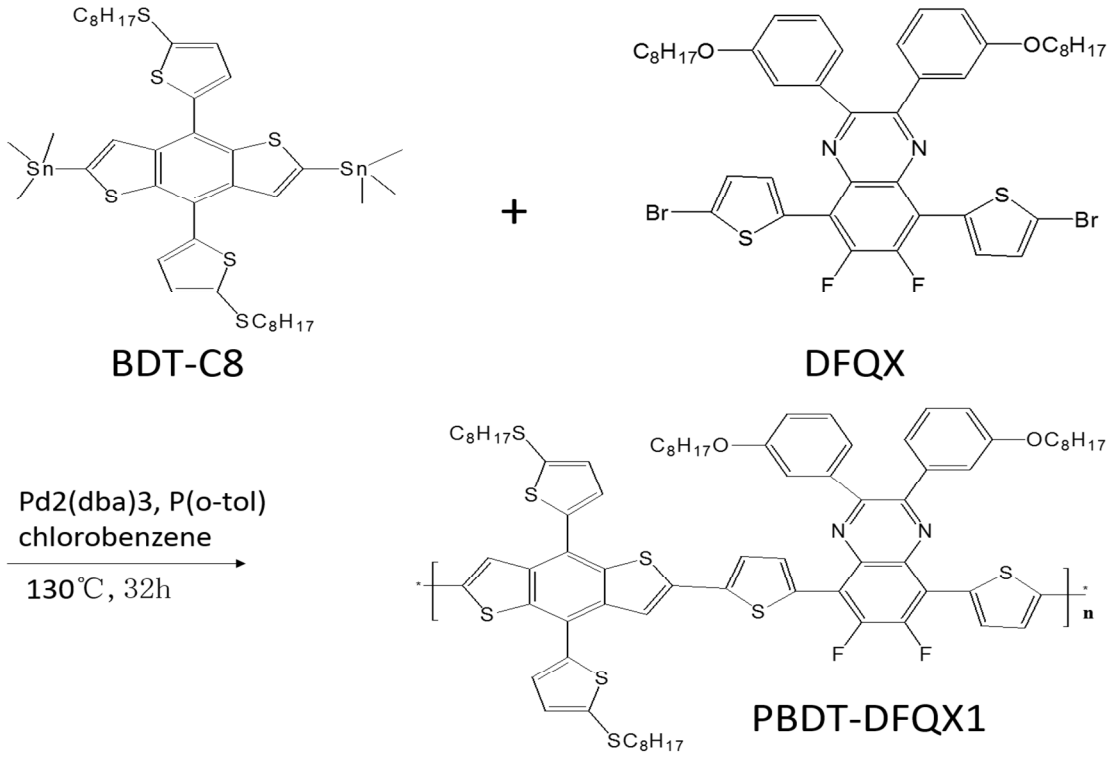

Figure S1. Synthesis route to polymer donor PBDT-DFQX1

CV Characteristic

The copolymer energy levels were measured by electrochemical cyclic voltammetry with Fc/Fc+ couple as internal reference and Ag/AgCl as reference electrode. The highest occupied molecular orbital (HOMO) energy levels (E_{HOMO}) was determined by using the equation: E_{HOMO}= -e(Eox+4.36) eV, where the E_{ox} is the onset oxidation potential was obtained from cyclic voltammogram of PBDT-DFQX1. And the lowest unoccupied molecular orbital (LUMO)

energy levels (E_{LUMO}) was calculated by using the equation of $E_{LUMO} = E_{HOMO} + E_{opt}$. The calculated E_{HOMO}/E_{LUMO} values were to be -5.46/-3.69eV.

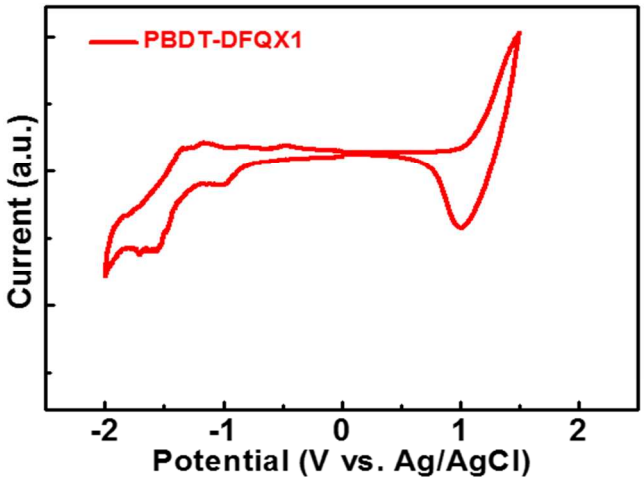

Figure S2. Cyclic voltammogram of PBDT-DFQX1

References

(1) Zhao, M.; Qiao, Z.; Chen, X.; Jiang, C.; Li, X.; Li, Y.; Wang, H., High Photovoltaic Performance of As-Cast Devices Based on New Quinoxaline-Based Donor-Acceptor Copolymers. *Polym.Chem.* **2017,** *8* (37), 5688-5697.

(2) Qiao, Z.; Wang, M.; Zhao, M.; Zhang, Z.; Li, Y.; Li, X.; Wang, H., Effect of Fluorine Substitution on the Photovoltaic Performance of Poly(Thiophene-Quinoxaline) Copolymers. *Polym.Chem.* **2015,** *6* (47), 8203-8213.