Supporting Information

Green-Solvent-Processed Hybrid Solar Cells Based on Donor-Acceptor Conjugated Polyelectrolyte

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**Figure S1.** Synthesis routes of PFBTBr: (k) \((\text{PPh}_3)_4\text{Pd, Toluene, K}_2\text{CO}_3\); (l) \(\text{CH}_3\text{CH}_2\text{Br, DMSO, THF, H}_2\text{O}\).
Figure S2. Synthesis routes of the monomers: (a) hexylbromide, diethyl ether, Mg, Ni(dppp)Cl$_2$; (b) n-BuLi, THF, tributylchloro-stannane, -78°C to -30°C; (c) HBr, Br$_2$; (d) THT, PdCl$_2$(PPh$_3$)$_2$; (e) NBS, THF; (f) FeCl$_3$, Br$_2$; (g)DMSO, Bu$_4$NBr, NaOH(50%),n-C$_6$H$_{13}$Br (h) DMSO, Bu$_4$NBr, NaOH(50%), NaOH(s), (CH$_3$)$_2$N(CH$_2$)$_3$·HCl (i) & (j) THF, n-BuLi, 2-Isoproxy-4,4,5,5-tetramethyl-1,3,2-dioxaborolane, -78°C
Figure S3. UV-vis absorption of PFBTBr without and with annealing.
Figure S4. UPS spectra of PFBTBr: (a) cutoff regions and (b) Fermi-edge regions. The HOMO level value was calculated by subtracting the onset of the low-binding-energy photoemission from the onset of the secondary electron energy cutoff and then subtracting the excitation photoenergy (21.2 eV).
Figure S5. TEM images of (a) as-prepared CdTe NCs, (b) the optimized active layer.
Figure S6. EQE curve of the PFBTBr:CdTe NCs based HSCs.
Figure S7. J-V curve of the PFBTBr:CdTe NCs based HSCs in dark.
Table S1. Photovoltaic performances of the cells with different donor/acceptor ratio.

| Weight ratio | $V_{oc}$ (V) | $J_{sc}$ (mA cm$^{-2}$) | FF (%) | PCE (%) |
|--------------|--------------|-------------------------|--------|---------|
| 1:5          | 0.57         | 6.06                    | 22.04  | 0.76    |
| 1:10         | 0.61         | 14.76                   | 32.68  | 2.96    |
| 1:20         | 0.59         | 15.00                   | 29.89  | 2.63    |
| 1:40         | 0.55         | 12.86                   | 33.79  | 2.38    |

Table S2. Photovoltaic performances of the cells with difference concentration of the PFBTBr:CdTe NCs solution concentration.

| Concentration (mg mL$^{-1}$) | $V_{oc}$ (V) | $J_{sc}$ (mA cm$^{-2}$) | FF (%) | PCE (%) |
|------------------------------|--------------|-------------------------|--------|---------|
| 73.3                         | 0.59         | 15.10                   | 36.80  | 3.30    |
| 88.0                         | 0.54         | 14.47                   | 38.55  | 2.98    |
| 109.7                        | 0.50         | 12.14                   | 33.66  | 2.05    |
| 132.0                        | 0.51         | 7.21                    | 36.15  | 1.31    |

Table S3. Photovoltaic performances of the cells with the active layer annealed at different temperature.
| Annealing temperature(°C) | $V_{oc}$(V) | $J_{sc}$(mA cm$^{-2}$) | FF(%) | PCE(%) |
|--------------------------|-------------|------------------------|-------|--------|
| 300                      | 0.57        | 12.27                  | 30.85 | 2.16   |
| 350                      | 0.58        | 13.52                  | 40.39 | 3.16   |
| 400                      | 0.57        | 13.34                  | 41.52 | 3.10   |
| 450                      | 0.57        | 10.40                  | 28.57 | 1.70   |

Table S4. Photovoltaic performances of the cells with the active layer annealed at 350 °C for different time.

| Annealing time(min) | $V_{oc}$(V) | $J_{sc}$(mA cm$^{-2}$) | FF(%) | PCE(%) |
|---------------------|-------------|------------------------|-------|--------|
| 5                   | 0.62        | 11.99                  | 41.07 | 3.03   |
| 10                  | 0.62        | 13.99                  | 42.45 | 3.67   |
| 15                  | 0.60        | 12.45                  | 43.95 | 3.26   |
| 20                  | 0.57        | 10.81                  | 50.08 | 3.09   |

Table S5. Photovoltaic performances of the cells with different MoO$_3$ thicknesses.
Table S6. Photovoltaic performances of the cells without and with MgCl$_2$ treatment.

| MgCl$_2$ treatment | $V_{oc}$ (V) | $J_{sc}$ (mA cm$^{-2}$) | FF (%) | PCE (%) |
|-------------------|--------------|--------------------------|--------|---------|
| w/o               | 0.62         | 16.34                    | 44.29  | 4.49    |
| with              | 0.64         | 20.09                    | 39.17  | 5.03    |