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# Supplementary information

## A facile approach to alleviate photochemical degradation in high efficiency polymer solar cells

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Table S1. Comparison of Integrated EQE values with short circuit currents.

| | Jsc ($mA/cm^2$) | Integrated EQE ($mA/cm^2$) |
|---|---|---|
| Conventionally prepared | 17.3 | 16.3 |
| Anti-solvent treated | 18.3 | 16.7 |

Table S2 Protocol for stability test

| | |
|---|---|
| Light source | Ambient room lighting (fluorescent tubes) |
| Temperature | Ambient (Room temperature ~25°C) |
| Relative humidity | Ambient |
| Environment | Ambient |
| Characterization light source | Solar simulator (AM 1.5)<br>The intensity is calibrated by a standard silicon cell |
| Load | Open circuit |
| Storage | On the bench |

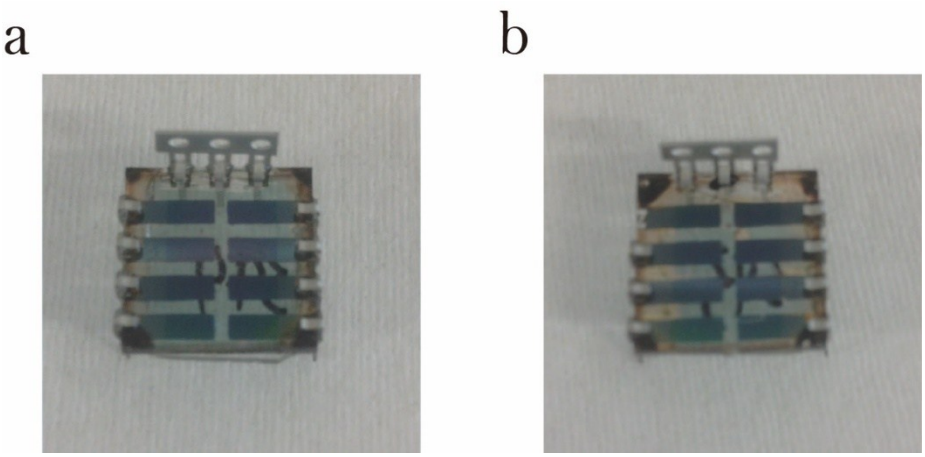


Fig.S1 Photos of conventionally prepared device stored in the ambient atmosphere after (a) 30 days (b) 60days

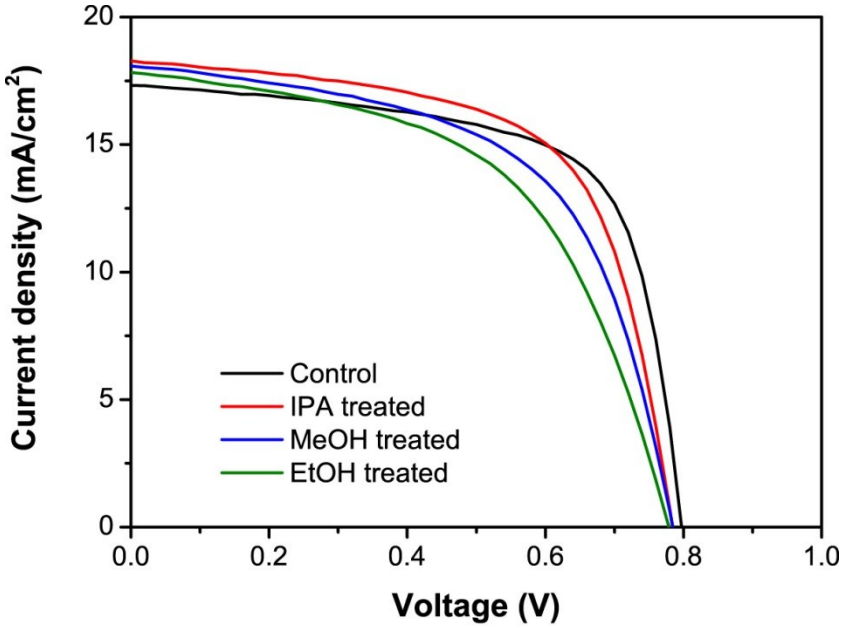


Fig.S2 Photovoltaic characterizations of device treated with different solvents.

Table S3 Photovoltaic parameters of organic solar cells constructed on PBDTTT-EFT/$PC_{71}BM$ blends, treated with different solvent

| Device type | $V_{OC}$ (V) | $J_{SC}$ (mA/cm$^2$) | FF | PCE (%) (average) |
|---|---|---|---|---|
| Control | 0.80 | 17.3 | 0.67 | 9.3% (9.1%) |
| IPA treated | 0.79 | 18.3 | 0.62 | 9.0% (8.5%) |
| MeOH treated | 0.79 | 18.1 | 0.57 | 8.2% (7.9%) |
| EtOH treated | 0.78 | 17.8 | 0.54 | 7.5% (7.1%) |

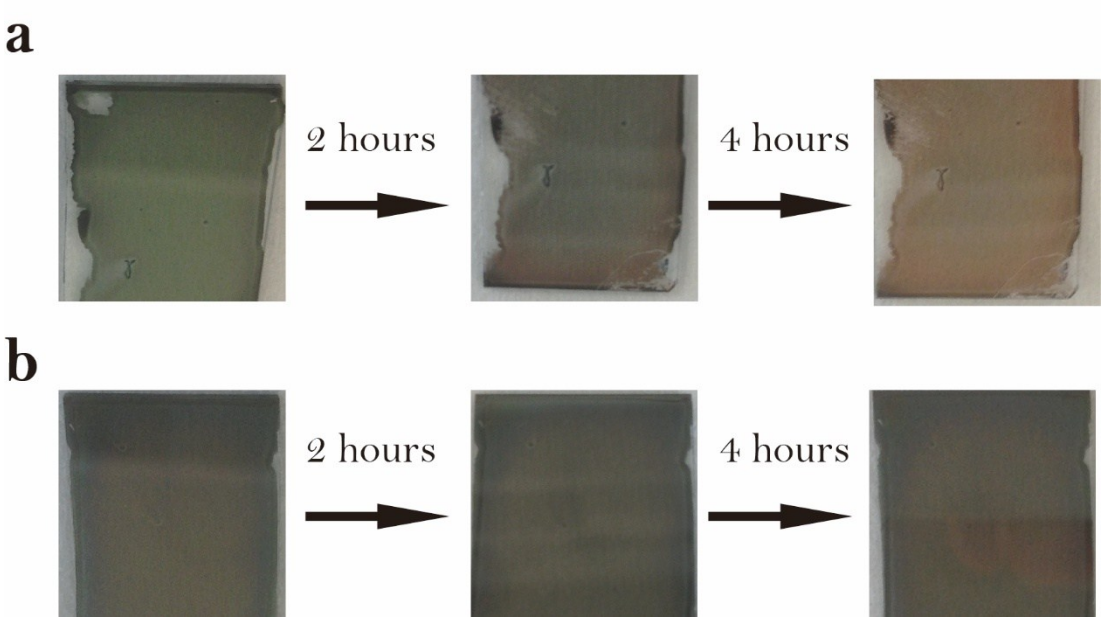


Fig.S3 The degradation of PBDTTT-EFT/$PC_{71}BM$ blend films (a) conventionally prepared film and (b) anti-solvent treated film.

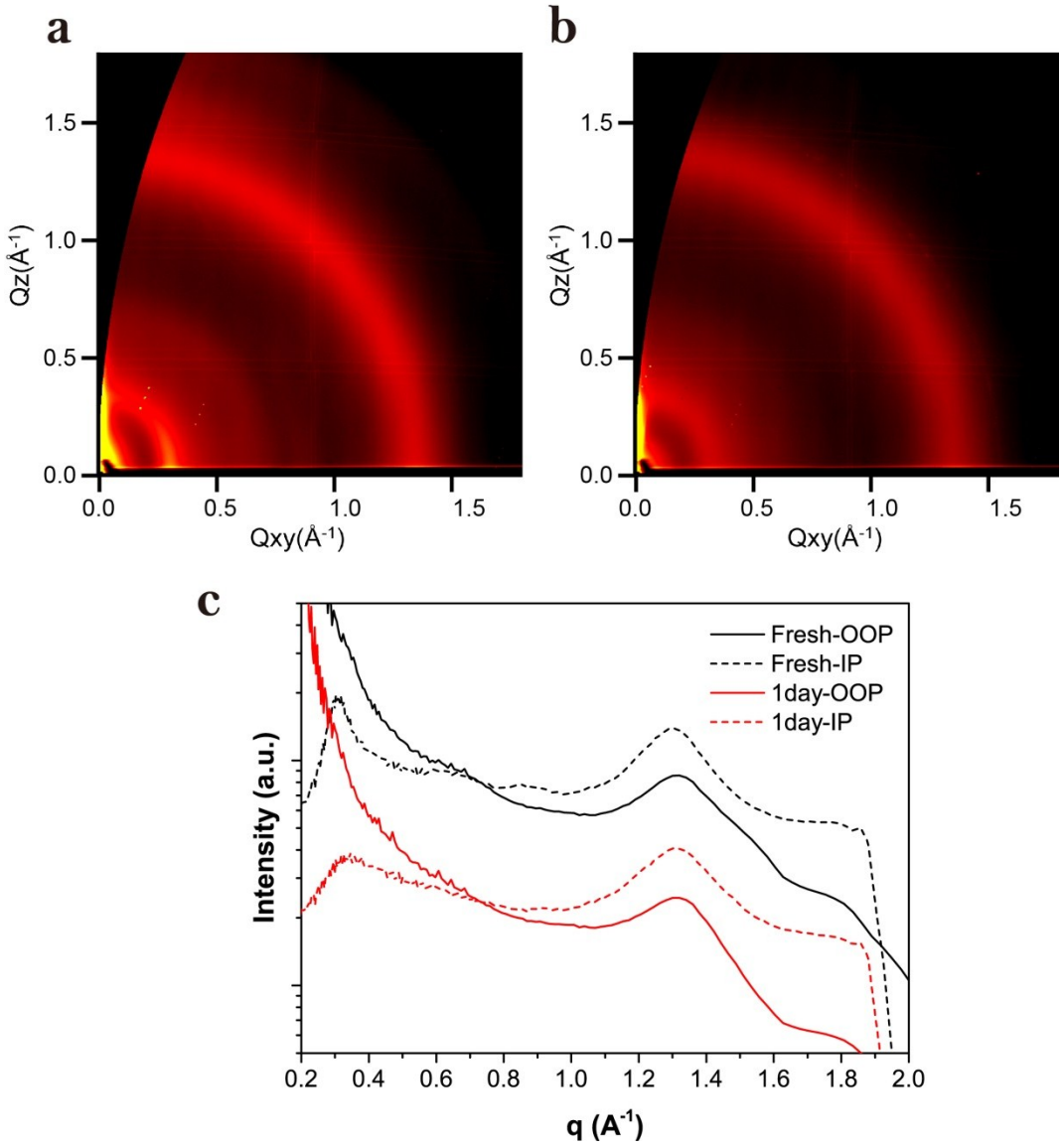


Fig.S4 2D GIWAXS images of (a) fresh PBDTTT-EFT/$PC_{71}BM$ films and (b) PBDTTT-EFT/$PC_{71}BM$ films under air and light exposure for 1 day. (c) out-of-plane (OOP) and in-plane (IP) line profiles of GIWAXS patterns.

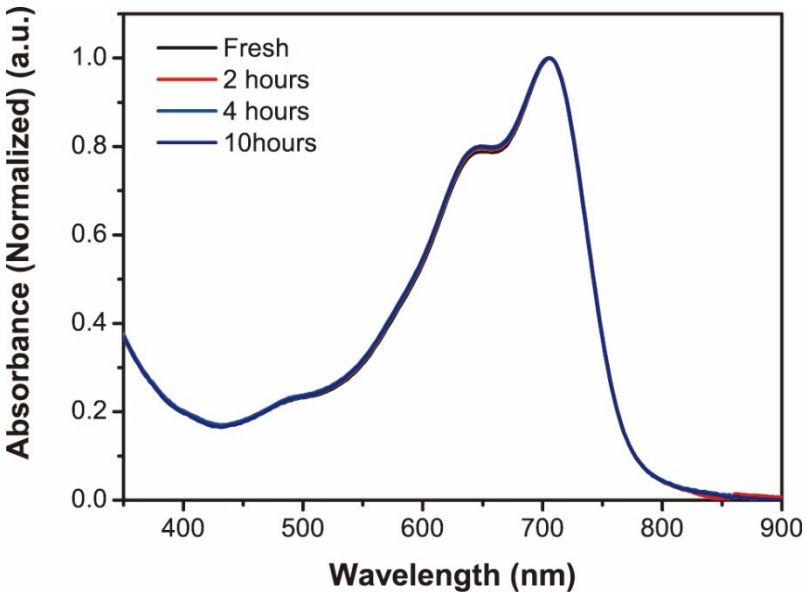


Fig.S5 UV-vis spectra of pristine PBDTTT-EFT processed with DIO followed by anti-solvent treatment as function of ageing time.

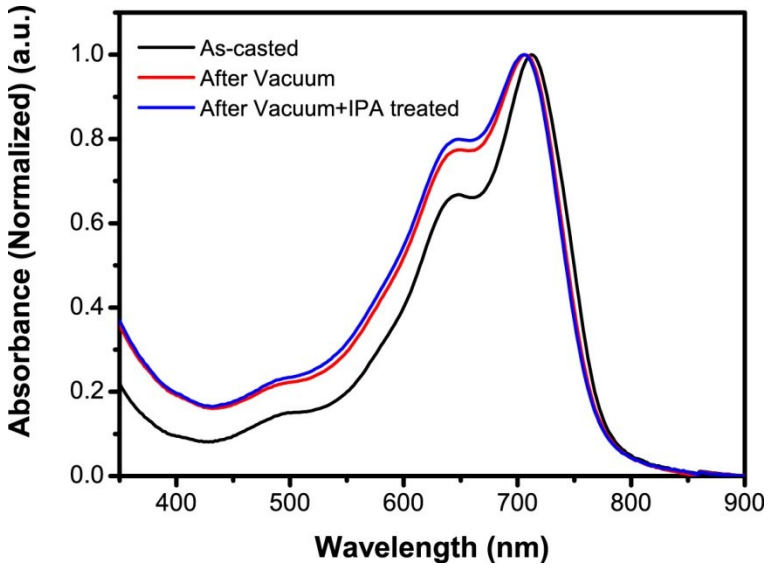


Fig.S6 UV-vis spectra of pristine PBDTTT-EFT. The increased absorption of pristine polymer film after vacuum is attributed by the evaporation of DIO. The same sample treated with anti-solvent treatment exhibits a further increase in absorption, indicating the DIO was not fully removed by vacuum.

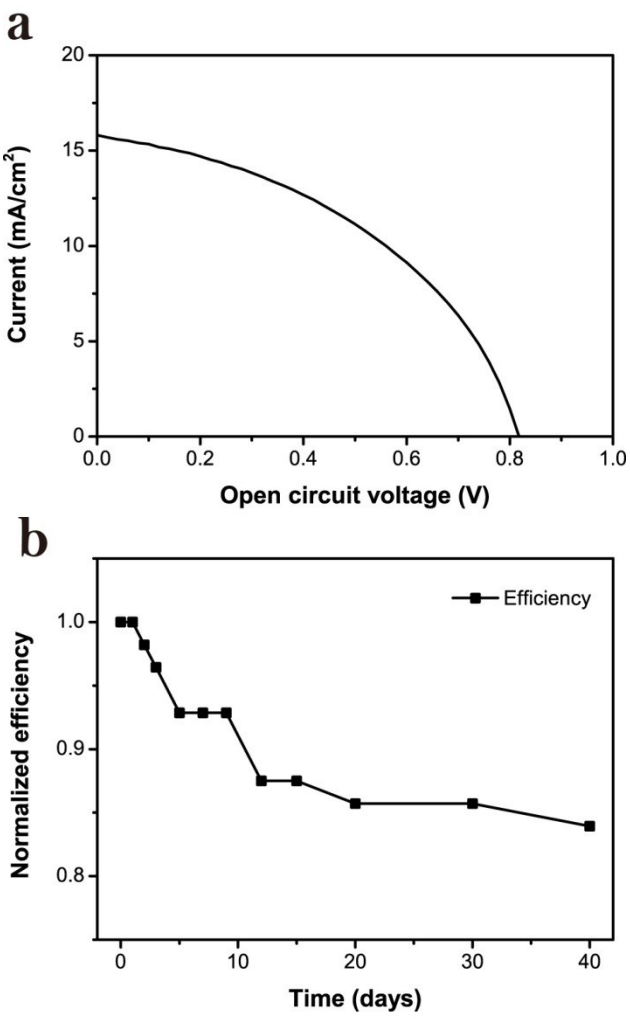


Fig.S7 Photovoltaic characterization of the polymer blend processed without DIO. (a) current-voltage (J-V) curve (b) normalized efficiency as a function of time.

Table S4. Fitted parameters for the GIWAXS profiles.

| | | Peak location ($Å^{-1}$) | D-spacing (nm) | FWHM ($Å^{-1}$) | Coherence length (nm) |
|---|---|---|---|---|---|
| **Conventional prepared** | OOP(010) | 1.52 | 0.41 | 0.283 | 2.22 |
| | IP (100) | 0.30 | 2.09 | 0.079 | 7.95 |
| **Anti-solvent treated** | OOP(010) | 1.52 | 0.41 | 0.291 | 2.16 |
| | IP (100) | 0.30 | 2.09 | 0.082 | 7.66 |

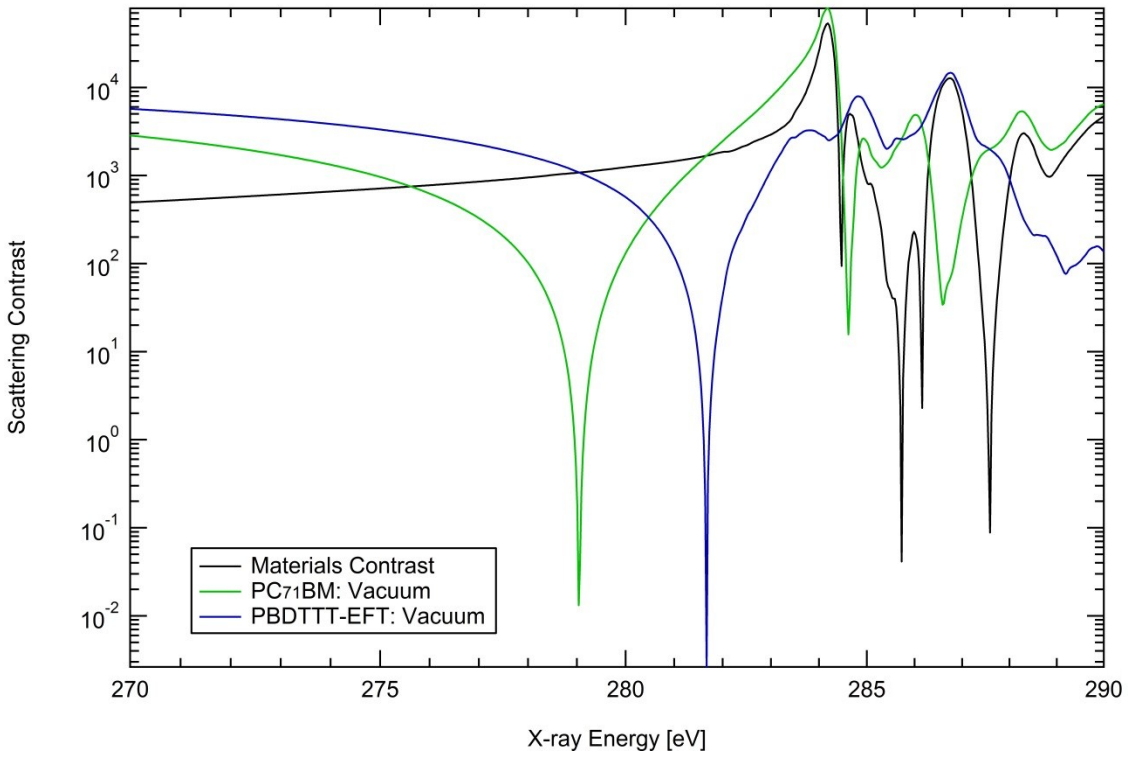


Fig.S8 Scattering contrast between polymer PBDTTT-EFT and $PC_{71}BM$.

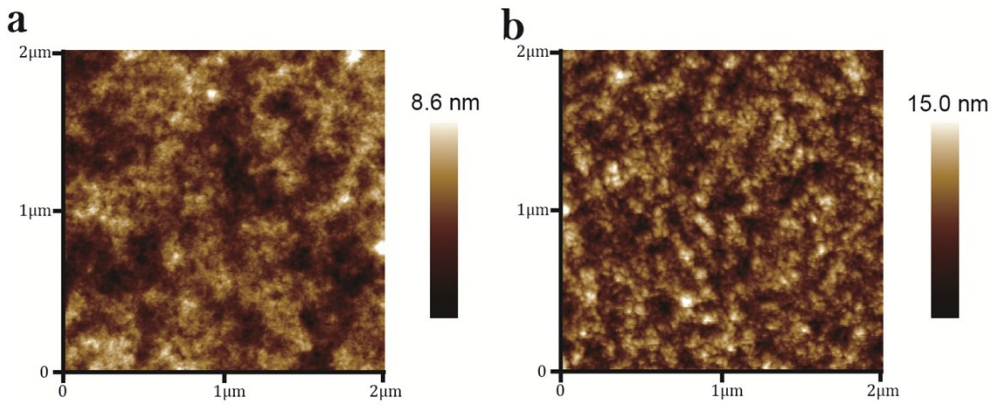


Fig.S9 AFM topography images of (a) convetionally prepared PBDTTT-EFT:$PC_{71}BM$ blend and (b) anti-solvent treated PBDTTT-EFT:$PC_{71}BM$ blend.

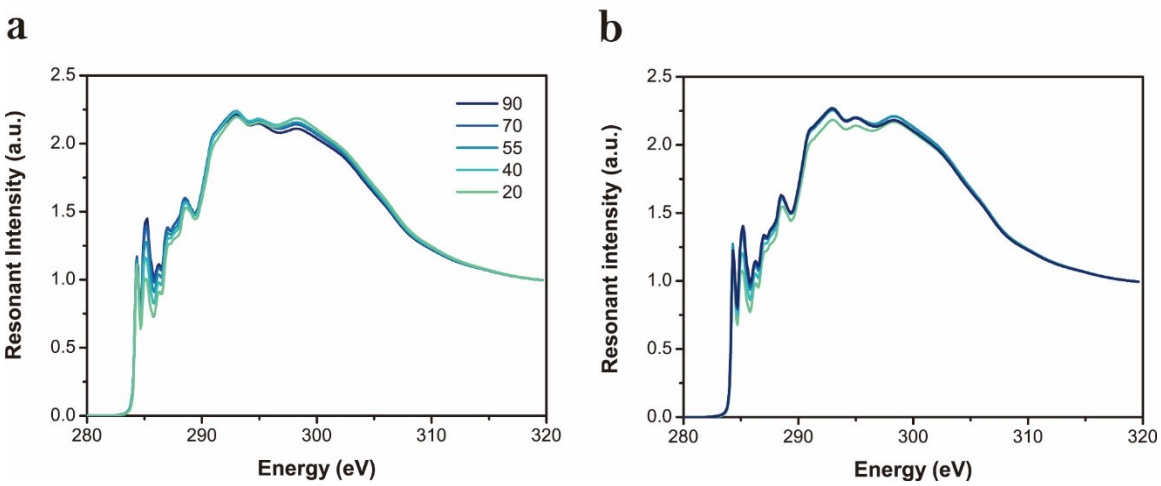


Fig.S10 Angle-resolved carbon K-edge NEXAFS spectra of (a) conventionally prepared and (b) anti-solvent treated PBDTTT-EFT/$PC_{71}BM$ blend.

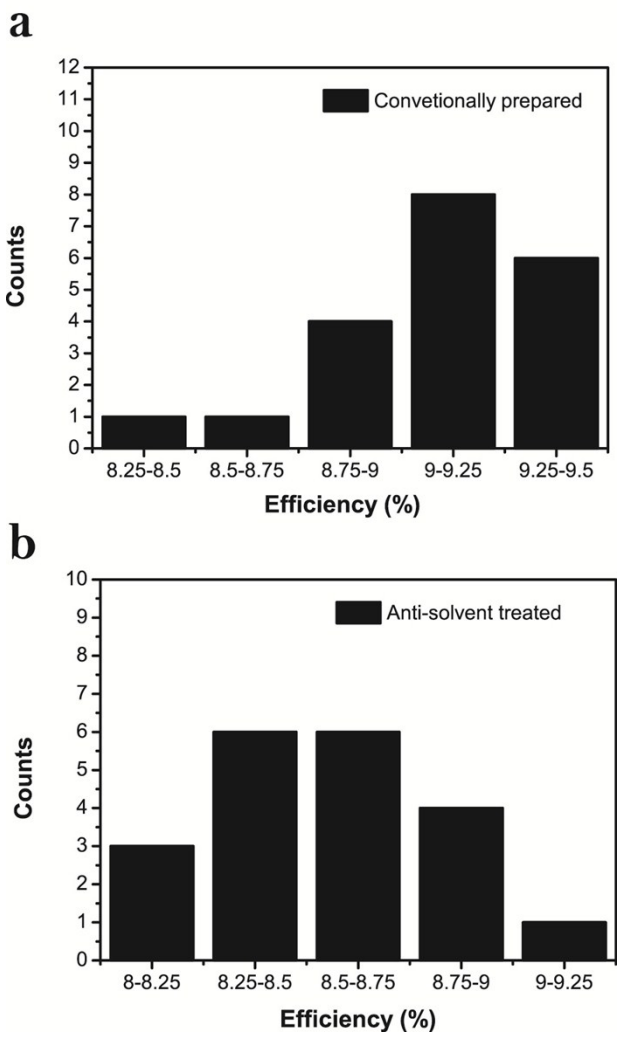


Fig.S11 Statistic data for device efficiency (20 devices) of (a) convetionally prepared PBDTTT-EFT:$PC_{71}BM$ blend and (b) anti-solvent treated PBDTTT-EFT:$PC_{71}BM$ blend.