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# Supporting Information

# Chloride Treatments for High Efficient Aqueous-Processed CdTe Nanocrystal Based Hybrid Solar Cells

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## List of Contents

**Calculation of the texture coefficients and standard deviation.** The texture coefficients, $C_{hkl}$, were calculated using Equation (1). And the standard deviation σ of the texture coefficients was calculated from Equation (2). $I_{hkl}$ is the intensity of the reflection from plane(hkl), $I_{r,hkl}$ is the relative intensity of planes for the powder, $n_p$ is the number of reflections shown in the diffractogram. The results were summarized in Table S3.

$$C_{hkl} = \frac{\dfrac{I_{hkl}}{I_{r,hkl}}}{\Big/ n_p \sum_{n_p=1}^{n_p} \dfrac{I_{hkl}}{I_{r,hkl}}} \quad (1)$$

$$\sigma = \sqrt{\sum 1/n_p (C_{hkl} - 1)^2} \quad (2)$$

**Figure S1.** Molecular structure of the conjugated polymer PFBTBr.

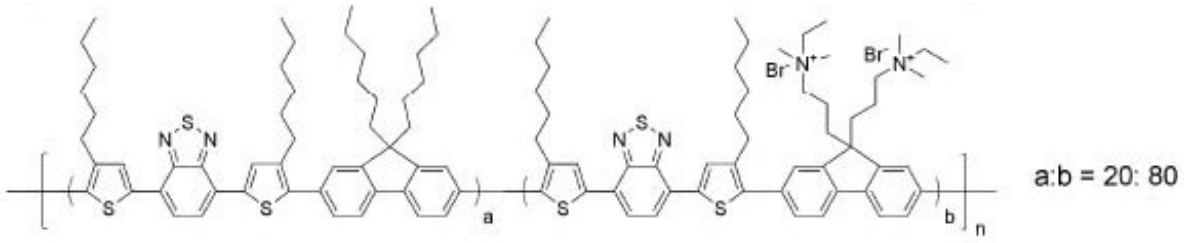

**Figure S2.** Optical micrographs and pictures of the CdTe films with $CdCl_2$ (a, d) spincoat, (b, e) dip and (c, f) drop treatment.

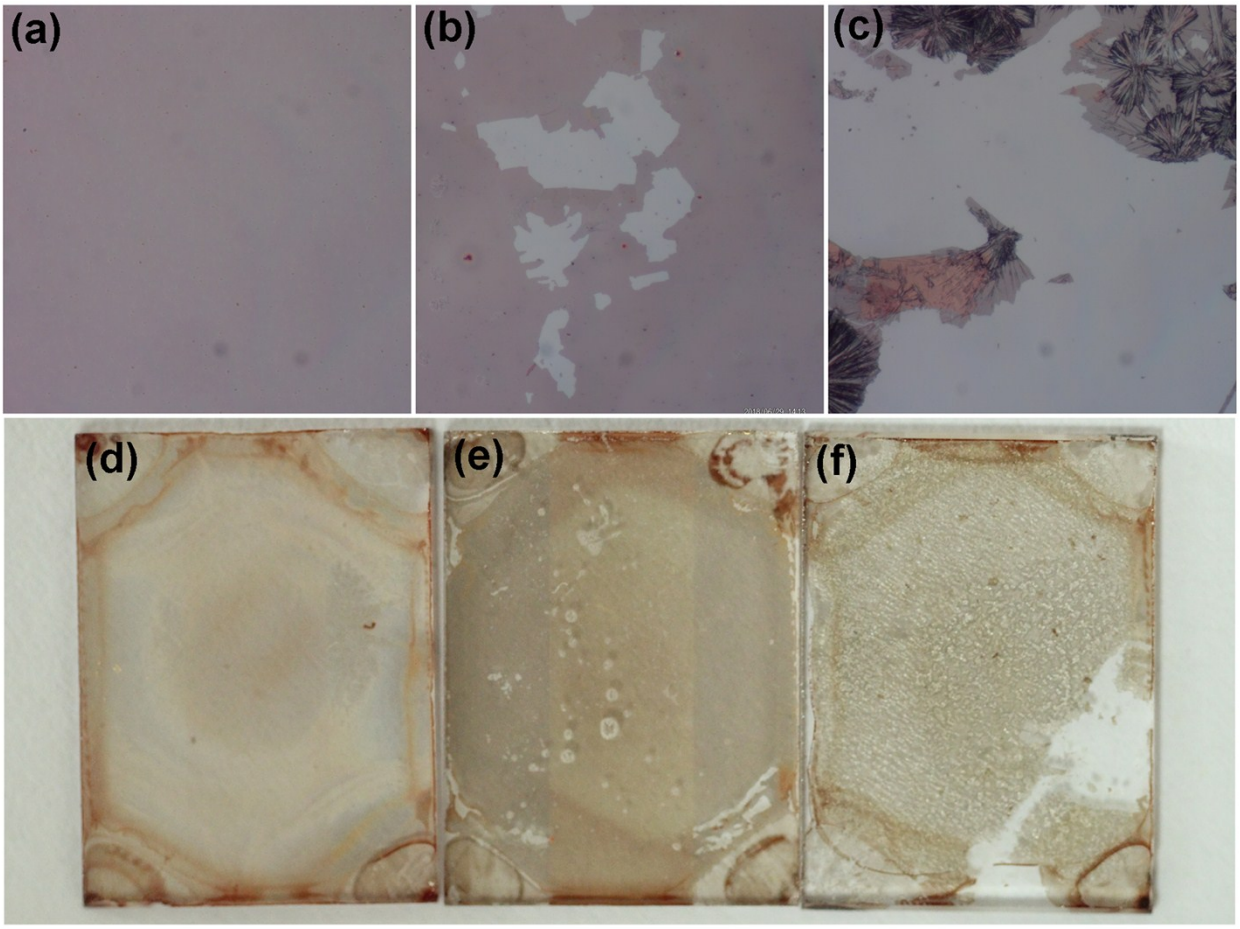

**Figure S3.** The histograms of the PCEs for the devices without (a) and with (c) $CdCl_2$ treatment.

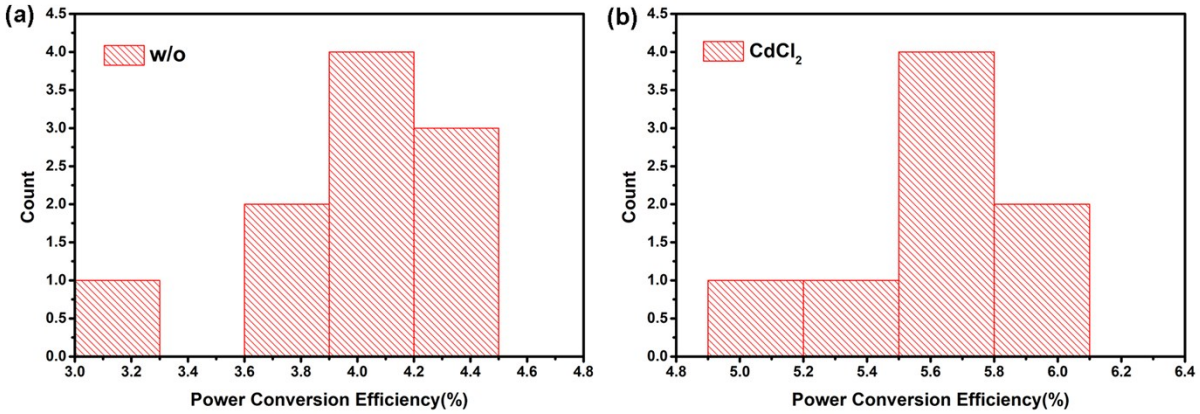

**Figure S4.** KPFM topology (left) and potential (right) images of the CdTe films without (a, b) and with (c, d) $CdCl_2$ treatment.

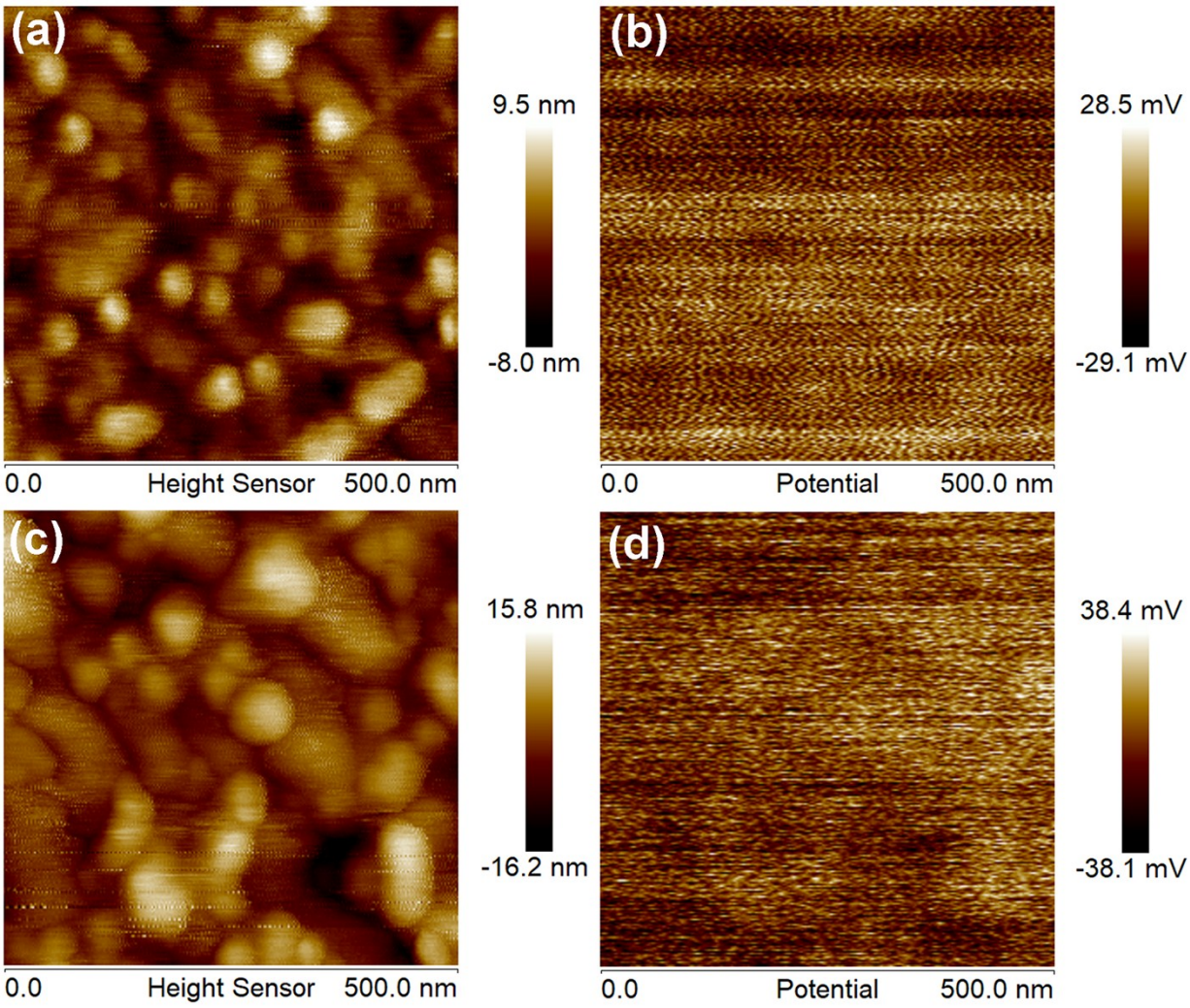

**Figure S5.** TG-DTG curves of PFBTBr.

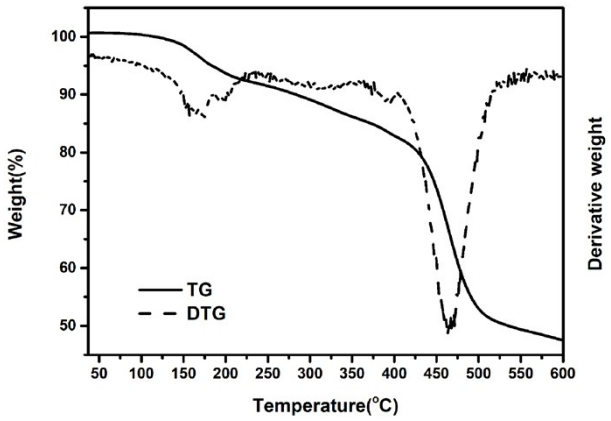

**Table S1.** Summary of the CdTe NCs based inorganic solar cells (ISCs), hybrid solar cells (HSCs) and quantum dot sensitized solar cells (QDSSCs) with literature reports.

| Material | Device | PCE | Solvent | Ref. |
|---|---|---|---|---|
| CdTe NRs | ISCs | 3.00 | Pyridine | *Science* 2005, **310**, 462-465. |
| CdTe NCs | HSCs | 0.421 | Chloroform: pyridine | *Solar Energy Materials & Solar Cells* 2006, **90**, 1849–1858. |
| $CdSe_xTe_{1-x}$ tetrapod | HSCs | 1.13 | Chloroform: pyridine | *Nanotechnology* 2006, **17**, 4041–4047 |
| CdTe NPs | HSCs | 0.06 | Pyridine: chloroform | *Solar Energy Materials & Solar Cells* 2009, **93**, 1482–1487 |
| CdSe/CdTe-tetrapod | HSCs | 0.62 | Pyridine: chloroform | *Adv. Mater.* 2009, **21**, 4461–4466 |
| CdTe QDs | QDSSCs | 2.20 | Water | *Solar Energy Materials & Solar Cells* 2010, **94**, 2046–2051 |
| CdTe NCs | HSCs | 3.20 | Chloroform: pyridine | *Adv. Mater.* 2011, **23**, 5451–5455 |
| CdTe NCs | ISCs | 6.90 | Pyridine:1-propanol | *Nano Lett.* 2011, **11**, 2856–2864 |
| CdTe/CdS QDs | HSCs | 3.80 | Water | *Chem. Sci.* 2011, **2**, 1396 |
| CdTe NCs | HSCs | 0.86 | Water | *ACS Appl. Mater. Interfaces* 2011, **3**, 2919–2923 |
| CdTe NCs | HSCs | 2.14 | Water | *Energy Environ. Sci.* 2011, **4**, 2831 |
| CdTe NCs | ISCs | 5.15 | Pyridine:1-propanol | *J. Mater. Chem.* 2012, **22**, 19207 |
| CdTe NCs | ISCs | 12.3 | Pyridine:1-propanol | *Nano Lett.* 2014, **14**, 670-675 |
| CdSe/CdTe tetrapod | HSCs | 3.30 | Toluene | *Adv. Funct. Mater.* 2014, **24**, 1904–1910 |
| CdTe NCs | ISCs | 11.3 | Pyridine | *ACS Nano* 2014, **8**, 9063-9072 |
| CdTe/CdSe NCs | ISCs | 5.81 | Pyridine:1-propanol | *J. Mater. Chem. C* 2015, **3**, 4227--4234 |
| CdTe NCs | ISCs | 10.3 | Pyridine | *J. Am. Chem. Soc.* 2016, **138**, 7464-7467 |
| CdTe NCs | HSCs | 3.61 | Water | *Adv. Energy Mater.* 2013, **3**, 433–437 |
| CdTe NCs | HSCs | 3.30 | Water | *Adv. Funct. Mater.* 2013, **23**, 4035–4042 |

| | | | | |
|---|---|---|---|---|
| CdS/CdTe NCs | ISCs | 3.98 | Water | *Adv. Energy Mater*. 2014, **4**, 1400235 |
| CdTe NCs | HSCs | 5.18 | Water | *J. Mater. Chem. A* 2015, **3**, 10969–10975 |
| CdTe NCs | HSCs | 4.32 | Water | *ACS Appl. Mater. Interfaces* 2015, **7**, 7146-7152 |
| $CdSe_xTe_{1-x}$ NCs | ISCs | 3.35 | Water | *ACS Appl. Mater. Interfaces* 2015, **7**, 23223-23230 |
| CdTe/CdS NCs | ISCs | 6.56 | Water | *ACS Appl. Mater. Interfaces* 2016, **8**, 900-907 |
| CdTe NCs | HSCs | 4.32 | Water | *ACS Appl. Mater. Interfaces* 2016, **8**, 7101-7110 |
| CdTe NCs | HSCs | 5.90 | Water | *ACS Appl. Mater. Interfaces* 2017, **9**, 31345-31351 |
| CdTe NCs | HSCs | 6.36 | Water | *Small* 2017, **13**, 1603771 |
| CdTe NCs | HSCs | 4.80 | Water | *ACS Appl. Mater. Interfaces* 2017, **9**, 17942–17948 |

**Table S2.** Photovoltaic performances of the cells with $CdCl_2$ treatment applied in four different methods on the CdTe layer.

| | $V_{oc}$(V) | $J_{sc}$(mAcm$^{-2}$) | FF(%) | PCE(%) |
|---|---|---|---|---|
| w/o | 0.620 | 16.34 | 44.29 | 4.49 |
| Spincoat | 0.638 | 20.76 | 45.34 | 6.01 |
| Dip | 0.606 | 18.00 | 41.29 | 4.50 |
| Drop | 0.587 | 9.65 | 31.60 | 1.78 |
| Vapour | 0.610 | 19.66 | 43.12 | 5.17 |

**Table S3.** Photovoltaic performances of the cells with $CdCl_2$ treatment applied on the CdTe and CdTe:PFBTBr layers through spincoat method.

| | $V_{oc}$(V) | $J_{sc}$(mAcm$^{-2}$) | FF(%) | PCE(%) |
|---|---|---|---|---|
| w/o | 0.620 | 16.34 | 44.29 | 4.49 |
| CdTe | 0.638 | 20.76 | 45.34 | 6.01 |
| CdTe:PFBTBr | 0.616 | 19.24 | 32.73 | 3.88 |

**Table S4.** Texture coefficients and the standard deviation of the cells without and with $CdCl_2$ treatment.

| | $C_{111}$ | $C_{220}$ | $C_{311}$ | σ |
|---|---|---|---|---|
| w/o | 1.28 | 0.88 | 0.84 | 0.20 |
| $CdCl_2$ | 1.88 | 0.53 | 0.74 | 0.53 |