Electronic Supplementary Information

Quantum Dots-Induced Improved Performance of Cadmium Telluride (CdTe) Solar Cells without Cu Buffer Layer

Jiajie Li, a Yumin Zhang, a Tangling Gao, b Chang Hu, c Tai Yao, d Quan Yuan, e Xianjie Wang, e Ping Xu, e Zhihua Zhang, f Jikang Jian, g Xinghong Zhang * a and Bo Song * c d

a. Centre for Composite Materials and Structures, Harbin Institute of Technology, Harbin 150001, China. E-mail: zhangxh@hit.edu.cn
b. Institute of Petrochemistry, Heilongjiang Academy of Sciences, Harbin 150040, China.
c. Department of Physics, Harbin Institute of Technology, Harbin 150001, China.
d. Academy of Fundamental and Interdisciplinary Sciences, Harbin Institute of Technology, Harbin 150001, China. E-mail: songbo@hit.edu.cn
e. School of Chemistry and Chemical Engineering, Harbin Institute of Technology, Harbin 150001, China. E-mail: pxu@hit.edu.cn
f. Liaoning Key Materials Laboratory for Railway, School of Materials Science and Engineering, Dalian Jiaotong University, Dalian 116028, China.
g. School of Physics and Optoelectronic Engineering, Guangdong University of Technology, Guangzhou 510006, China.

S-1
Fig. S1 Raman spectra of CdTe QDs before and after thermal treatment
Fig. S2 XRD pattern of the as-synthesized CdTe QDs
Fig. S3 EDX spectrum of CdTe QDs
Fig. S4 XPS spectra of Te for CdTe QDs before (a) and after (b) thermal treatment
**Fig. S5** TEM images of CdTe QDs deposited for 10 s (a), 20 s (b), 30 s (c), and 40 s (d) after thermal treatment at 170 °C for 40 min.
**Fig. S6** Average Eff for a batch of CdTe devices with Cu and CdTe QDs deposited with different time as buffer layers after thermal treatment
Fig. S7 (a) EQE curves for CdTe cells with CdTe QDs deposited for 20, 30, and 40s as buffer layers.
Fig. S8  Average $V_{OC}$ for more than 14 CdTe devices with Cu and CdTe QDs deposited with different time as buffer layers after thermal treatment.
Fig. S9 Average $J_{SC}$ for more than 14 CdTe devices with Cu and CdTe QDs deposited with different time as buffer layers after thermal treatment
Fig. S10 Average FF for more than 14 CdTe devices with Cu and CdTe QDs deposited with different time as buffer layers after thermal treatment
**Fig. S11** I-V curves of CdTe cells with CdTe QDs/Au and copper/Au without and with diffusion
Fig. S12 The dependence of $R_s$ for CdTe cell with CdTe QDs and Cu as buffer layers.
**Fig. S13** Voc, Jsc, FF, and Eff as a function of temperature for CdTe cell with CdTe QDs as buffer layer
**Fig. S14** The band gap of CdTe determined from the EQE curve, the band gap of CdTe is $\sim 1.49$ eV
**Fig. S15** Ultraviolet photoelectron spectrometer (UPS) of CdS, CdTe, and CdTe QDs
Fig. S16 Efficiency degradation for both CdTe QDs and copper contacted devices as a function of the time from October, 2015 to August, 2016.
Table S1 Summary of the growth condition for both CdS and CdTe

<table>
<thead>
<tr>
<th>Content</th>
<th>CdS:O</th>
<th>CdTe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>Room temperature</td>
<td>272 °C</td>
</tr>
<tr>
<td>Target-Substrate distance (cm)</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>RF power density (W/cm²)</td>
<td>0.88</td>
<td>1.32</td>
</tr>
<tr>
<td>Ar (SCCM)</td>
<td>28.3</td>
<td>28.3</td>
</tr>
<tr>
<td>Deposition pressure (Pa)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Oxygen (SCCM)</td>
<td>0.25</td>
<td>0</td>
</tr>
<tr>
<td>Thickness (μm)</td>
<td>0.1</td>
<td>2.0~2.3</td>
</tr>
</tbody>
</table>