Electronic Supplementary Material (ESI) for Nanoscale.


**Supporting Information**

# All solution processed PbS quantum dot solar modules

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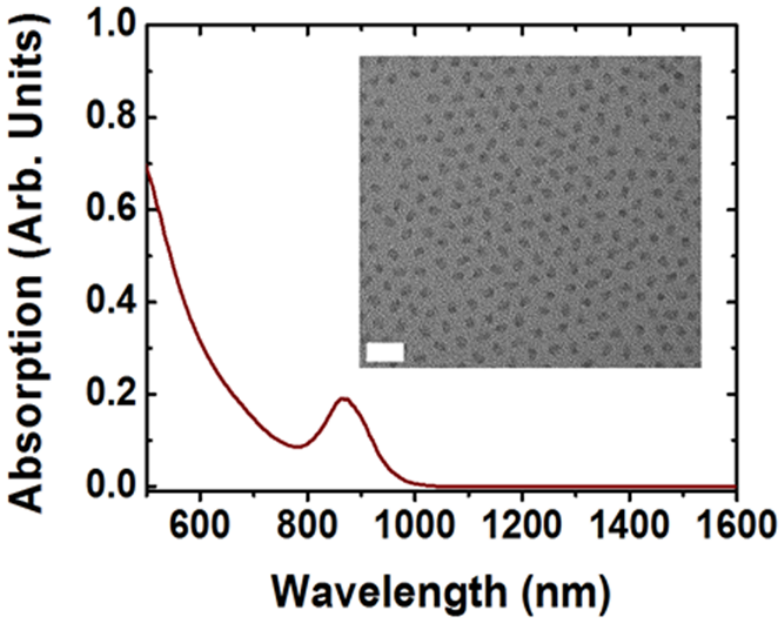


**Fig. S1** Absorption spectrum of PbS QD used in this study. Inset shows a TEM image (scale bar is 10 nm).

**Fig. S2** Picture of the PbS QD film on ITO glass (5 cm x 5 cm) after direct deposition of PEDOT:PSS

**Table S1.** J-V characteristics for the best efficiency cell with the active area of 1 $cm^2$.

| Sweep direction | $V_{oc}$ (V) | $J_{sc}$ (mA $cm^{-2}$) | Fill Factor (%) | PCE (%) |
|---|---|---|---|---|
| Reverse | 0.58 | 7.93 | 47.92 | 2.19 |
| Forward | 0.57 | 7.82 | 47.48 | 2.12 |

* Reverse direction: $V_{oc}$ (0.6 V) → $I_{sc}$ (0.0 V)
* Forward direction: $I_{sc}$ (0.0 V) → $V_{oc}$ (0.6 V)

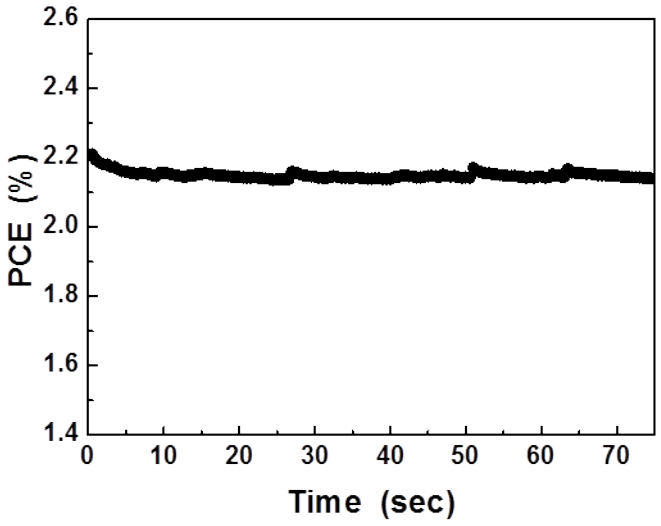


**Fig. S3** Steady-state PCE ranged between 2.1 ~ 2.2 % monitored for 75 sec.

**Table S2.** Comparison of performance parameters between solar cells fabricated from the different absorbing layer that have been coated by bar coating on the glass/ITO/$TiO_2$ substrate.

| Absorbing layer | $V_{oc}$ (V) | $J_{sc}$ (mA $cm^{-2}$) | Fill Factor (%) | PCE (%) |
|---|---|---|---|---|
| PbS QD | 0.58 | 7.93 | 47.92 | 2.19 |
| PCBM | 0.58 | 4.12 | 51 | 1.21 |

**Table S3.** Survey of materials for buffer layer of QD solar cells

| Compound | References | Cost per mass ($ $g^{-1}$) | Remarks |
|---|---|---|---|
| $MoO_3$ | 1 | 51.11 | $MoO_3$ Target ($t$ = 3 mm, $R$ = 25 mm) |
| P3HT | 2 | 8.64 | - |

**Table S4.** Calculated material cost-per-Watt ($ $W^{-1}$) and cost-per-active area ($ $m^{-2}$) for PbS QD solar cells incorporating $MoO_3$ or P3HT. It considers only the cost of buffer layer materials.

| Buffer layer material | References | Active area ($cm^2$) | Thickness (nm) | Total mass (μg) | Total cost (Cent) | Output Watt (mW) | Cost per Watt ($ $W^{-1}$) | Cost per active area ($ $m^{-2}$) | Density (g $cm^{-3}$) |
|---|---|---|---|---|---|---|---|---|---|
| $MoO_3$ | 3 | 0.0490 | 10 | 0.23 | 0.0012 | 0.027 | 0.4436 | 2.4490 | 4.69 |
| | 4 | | | | | 0.015 | 0.7854 | 2.4490 | |
| | 5 | 0.0300 | | 0.14 | 0.0007 | 0.006 | 1.0918 | 2.3333 | |
| | 6 | 0.0121 | 5 | 0.02 | 0.0001 | 0.002 | 0.5859 | 0.8264 | |
| | 7 | 0.0400 | | 0.09 | 0.0005 | 0.005 | 0.9530 | 1.2500 | |
| P3HT | Our devices | 1.0000 | 30 | 3.30 | 0.0029 | 0.196 | 0.1483 | 0.2900 | 1.10 |

## References


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