Supporting Information (SI)

Facile one-step fabrication of CdS_{0.12}Se_{0.88} quantum dots with ZnSe/ZnS-

passivation layer for highly efficient quantum dot sensitized solar cells

Juan Hou,^{*a,b,c#*} Haifeng Zhao, ^{*b,c #*} Fei Huang,^{*d*} Long Chen,^{*b*} Qiang Wu,^{*a,b*} Zhiyong Liu,

^b Shanglong Peng,^d Ning Wang,^{c*} Guozhong Cao^{d*}

^aCollege of Science/Key Laboratory of Ecophysics and Department of Physics,

Shihezi University, Xinjiang 832003, P.R. China

^b School of Chemistry and Chemical Engineering / Key Laboratory for Green Process

of Chemical Engineering of Xinjiang Bingtuan, Shihezi University, Xinjiang Shihezi

832003, P. R. China

^c State Key Laboratory of Electronic Thin Film and Integrated Devices, University of

Electronic Science and Technology of China, Chengdu 610054, P.R. China

^d Department of Materials Science and Engineering, University of Washington,

Seattle, Washington 98195-2120, United States

These authors contributed equally to this work.

* Corresponding authors.

E-mail address: wangninguestc@gmail.com (N. Wang);

E-mail address: gzcao@u.washington.edu (G. Cao).



Fig. S1 The SEM top-view (a) and cross section (b) images of TiO_2 film, (c) the SILAR preparation process for CSS(ZSS) QDs and (d) the photographs of the film sensitized with CSS(ZSS) QDs

| Cd/Zn | Se/S | Samples | V _{oc} (mv) | J _{sc} (mA/cm ²) | FF(%) | PCE(%) |
|-------|-------|---------|----------------------|---------------------------------------|-------|--------|
| 1:10 | 1:10 | 6 C | 613.50 | 8.82 | 0.52 | 2.83 |
| | | 8 C | 594.31 | 11.36 | 0.50 | 3.38 |
| | | 10 C | 623.05 | 13.35 | 0.50 | 4.17 |
| | | 12 C | 622.03 | 15.81 | 0.51 | 4.99 |
| | | 14 C | 634.99 | 16.95 | 0.49 | 5.23 |
| 3:10 | 3:10 | 6 C | 602.20 | 14.04 | 0.55 | 4.63 |
| | | 8 C | 588.04 | 15.24 | 0.55 | 5.06 |
| | | 10 C | 584.64 | 17.58 | 0.55 | 5.62 |
| | | 12 C | 578.07 | 20.40 | 0.53 | 6.16 |
| | | 14 C | 561.64 | 20.75 | 0.52 | 6.06 |
| 5:10 | 5:10 | 6 C | 571.31 | 16.99 | 0.53 | 5.17 |
| | | 8 C | 556.69 | 19.80 | 0.50 | 5.54 |
| | | 10 C | 581.28 | 20.00 | 0.52 | 6.10 |
| | | 12 C | 572.17 | 20.85 | 0.51 | 6.11 |
| | | 14 C | 544.71 | 21.36 | 0.46 | 5.34 |
| 7:10 | 7:10 | 6 C | 582.09 | 18.46 | 0.52 | 5.61 |
| | | 8 C | 572.22 | 20.41 | 0.50 | 5.81 |
| | | 10 C | 582.36 | 20.62 | 0.51 | 6.14 |
| | | 12 C | 544.99 | 20.96 | 0.49 | 5.57 |
| | | 14 C | 507.51 | 22.60 | 0.42 | 4.77 |
| 9:10 | 9:10 | 6 C | 575.04 | 20.22 | 0.53 | 6.14 |
| | | 8 C | 545.42 | 21.55 | 0.52 | 6.14 |
| | | 10 C | 531.38 | 21.38 | 0.48 | 5.46 |
| | | 12 C | 503.29 | 22.31 | 0.44 | 4.92 |
| | | 14 C | 487.01 | 21.54 | 0.46 | 4.78 |
| 10:0 | 10: 0 | 6 C | 572.17 | 9.15 | 0.55 | 2.90 |
| | | 8 C | 548.56 | 10.13 | 0.57 | 3.15 |
| | | 10 C | 526.25 | 10.73 | 0.55 | 3.08 |
| | | 12 C | 497.22 | 11.12 | 0.56 | 3.12 |
| | | 14 C | 485.92 | 13.49 | 0.56 | 3.01 |

Table S1. The photovoltaic parameters of QDSCs based on CSS(ZSS) QDs under different feed ratios of Se/S and Cd/Zn

| Cd/Zn | Se/S | Samples | V <i>oc</i> (mv) | Jsc(mA/cm ²) | FF(%) | PCE(%) |
|-------|------|---------|------------------|--------------------------|-------|--------|
| 3: 10 | 1:10 | 6 C | 612.87 | 12.96 | 0.53 | 4.20 |
| | | 8 C | 609.16 | 15.21 | 0.55 | 5.10 |
| | | 10 C | 607.41 | 17.50 | 0.51 | 5.44 |
| | | 12 C | 601.74 | 18.33 | 0.54 | 6.00 |
| | | 14 C | 595.17 | 18.36 | 0.53 | 5.76 |
| 3:10 | 3:10 | 6 C | 602.20 | 14.04 | 0.55 | 4.63 |
| | | 8 C | 588.04 | 15.24 | 0.55 | 5.06 |
| | | 10 C | 584.64 | 17.58 | 0.55 | 5.62 |
| | | 12 C | 578.07 | 20.40 | 0.53 | 6.16 |
| | | 14 C | 561.64 | 20.75 | 0.52 | 6.06 |
| 3:10 | 5:10 | 6 C | 605.31 | 14.65 | 0.55 | 4.89 |
| | | 8 C | 596.02 | 16.87 | 0.56 | 5.61 |
| | | 10 C | 595.83 | 18.32 | 0.56 | 6.12 |
| | | 12 C | 584.65 | 18.63 | 0.56 | 6.10 |
| | | 14 C | 576.64 | 20.90 | 0.51 | 6.09 |
| 3:10 | 7:10 | 6 C | 594.89 | 14.24 | 0.54 | 4.59 |
| | | 8 C | 577.62 | 15.49 | 0.58 | 5.18 |
| | | 10 C | 574.86 | 16.22 | 0.57 | 5.35 |
| | | 12 C | 566.46 | 18.88 | 0.56 | 6.03 |
| | | 14 C | 569.18 | 20.29 | 0.51 | 5.85 |
| 3:10 | 9:10 | 6 C | 591.55 | 15.62 | 0.55 | 5.11 |
| | | 8 C | 571.57 | 16.93 | 0.58 | 5.60 |
| | | 10 C | 559.49 | 17.95 | 0.58 | 5.83 |
| | | 12 C | 561.30 | 18.89 | 0.57 | 6.07 |
| | | 14 C | 529.17 | 20.24 | 0.53 | 5.95 |

Table S2. The photovoltaic parameters of QDSCs based on CSS(ZSS) QDs under different Se/S ratios with a fixed Cd/Zn feed ratios.

| Cd/Zn | Se/S | Samples | V _{oc} (mv) | $J_{sc}(mA/cm^2)$ | FF(%) | PCE(%) |
|-------|------|---------|----------------------|-------------------|-------|--------|
| 1:10 | 3:10 | 6 C | 604.41 | 09.25 | 0.53 | 2.96 |
| | | 8 C | 603.72 | 10.73 | 0.53 | 3.42 |
| | | 10 C | 607.76 | 12.79 | 0.53 | 4.14 |
| | | 12 C | 604.37 | 13.70 | 0.54 | 4.50 |
| | | 14 C | 616.79 | 14.69 | 0.52 | 4.72 |
| 3:10 | 3:10 | 6 C | 602.20 | 14.04 | 0.55 | 4.63 |
| | | 8 C | 588.04 | 15.24 | 0.55 | 5.06 |
| | | 10 C | 584.64 | 17.58 | 0.55 | 5.62 |
| | | 12 C | 578.07 | 20.40 | 0.53 | 6.16 |
| | | 14 C | 561.64 | 20.75 | 0.52 | 6.06 |
| 5:10 | 3:10 | 6 C | 600.56 | 14.27 | 0.56 | 4.77 |
| | | 8 C | 584.98 | 16.18 | 0.56 | 5.33 |
| | | 10 C | 584.15 | 18.85 | 0.55 | 6.03 |
| | | 12 C | 567.55 | 19.51 | 0.55 | 6.10 |
| | | 14 C | 563.68 | 20.07 | 0.54 | 6.08 |
| 7:10 | 3:10 | 6 C | 592.24 | 14.75 | 0.56 | 4.94 |
| | | 8 C | 579.30 | 16.73 | 0.56 | 5.44 |
| | | 10 C | 577.30 | 18.11 | 0.55 | 5.78 |
| | | 12 C | 566.46 | 18.88 | 0.56 | 6.03 |
| | | 14 C | 562.99 | 19.59 | 0.54 | 5.98 |
| 9:10 | 3:10 | 6 C | 588.90 | 15.40 | 0.56 | 5.07 |
| | | 8 C | 564.29 | 17.11 | 0.57 | 5.52 |
| | | 10 C | 563.64 | 17.84 | 0.56 | 5.66 |
| | | 12 C | 565.00 | 19.51 | 0.55 | 6.04 |
| | | 14 C | 562.35 | 19.80 | 0.54 | 5.99 |
| 10:0 | 3:10 | 6 C | 556.05 | 9.34 | 0.59 | 3.12 |
| | | 8 C | 532.88 | 10.03 | 0.59 | 3.17 |
| | | 10 C | 514.74 | 11.61 | 0.58 | 3.50 |
| | | 12 C | 475.22 | 12.78 | 0.56 | 3.40 |
| | | 14 C | 465.01 | 13.34 | 0.52 | 3.22 |

Table S3. The photovoltaic parameters of QDSCs based on Cd-Zn-Se-S QDs under different Cd/Zn ratios with a fixed Se/S ratio.



Fig. S2 HRTEM of TiO_2 electrodes with sensitized QDs at different SILAR deposition cycles n = 6 (a) and n=12 (b).



Figure S3. Nyquist curves at different bias for 6C-14C ((a)-(e))