Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

SUPPLEMENTARY TABLE & FIGURES

Supplementary Table 1. Material properties of CdS, ZnS, and calculated $Cd_{0.5}Zn_{0.5}S$[1, 2]

Material	CdS	Calculated $Cd_{0.5}Zn_{0.5}S$	ZnS
Crystal structure	wurtzite	hexagonal	wurtzite
Lattice constant (a / c)	4.14 / 6.71	3.98 / 6.485	3.82 / 6.26
Band gap	2.37 eV	2.85 eV	3.56 eV
Interfacial strain	$\frac{3.82-3.98}{3.98}\times 100\% =-4.02\%$ *at the interface between* $Cd_{0.5}Zn_{0.5}S$ *core QD and ZnS shell QD*		

The emitted 442-nm wavelength blue light would be produced via the exciton recombination process at the $Cd_{0.5}Zn_{0.5}S$ core QD and the red shift induced by the compressive strain at the interface between the $Cd_{0.5}Zn_{0.5}S$ core QD and ZnS shell QD. In order to understand this, we estimated the interfacial strain depending on core QD and shell QD materials. The interfacial strain of $Cd_{0.5}Zn_{0.5}S$/ZnS core/shell QD was calculated by using the references presenting the lattice constants of the $Cd_{0.5}Zn_{0.5}S$ core and ZnS shell QD, indicating a compressive strain of ~ 4.02%, as shown in Table 1. In addition, the energy band-gap of the $Cd_{0.5}Zn_{0.5}S$ core QD was calculated by using the Vegard's law, given by[3, 4]

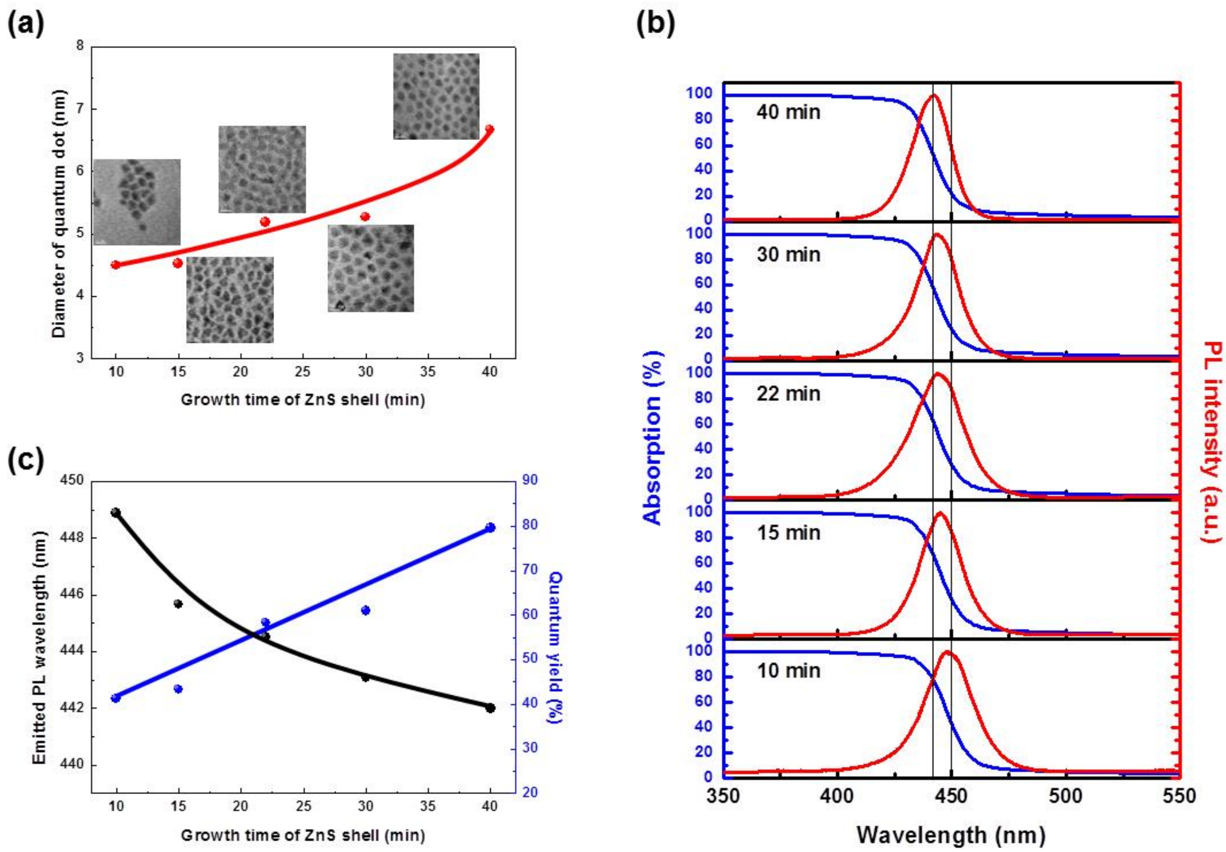
$$\alpha_{Cd_xZn_{1-x}S} = x\alpha_{CdS} + (1-x)\alpha_{ZnS}$$

$$E_{g,Cd_xZn_{1-x}S} = xE_{g,CdS} + (1-x)E_{g,CdS} - bx(1-x)$$

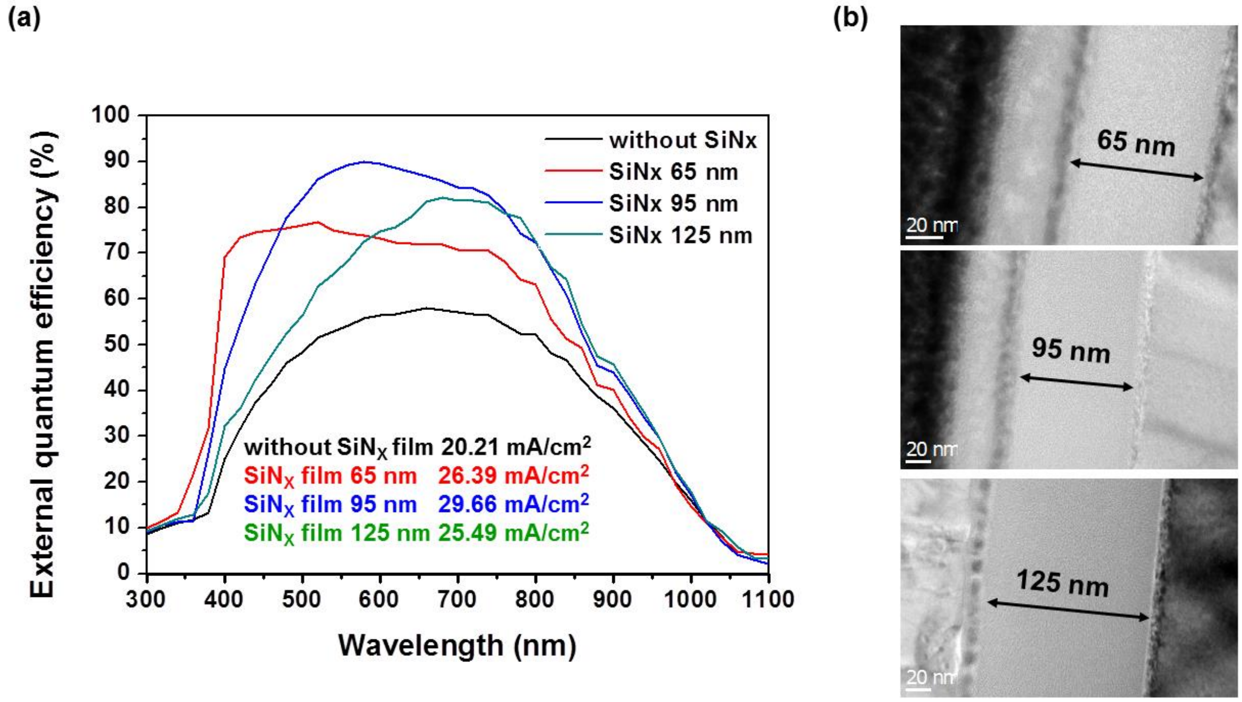
where $\alpha_{Cd_xZn_{1-x}S}$, α_{CdS}, α_{ZnS} are the lattice parameters of $Cd_xZn_{1-x}S$, CdS, ZnS and $E_{g,Cd_xZn_{1-x}S}$, $E_{g,CdS}$, $E_{g,ZnS}$ are band gap of $Cd_xZn_{1-x}S$, CdS, ZnS and b is the band gap bowing parameter of the $Cd_xZn_{1-x}S$. The calculated band gap of the $Cd_{0.5}Zn_{0.5}S$ core QD is 2.85 eV at 0.45 eV of band gap bowing parameter, which will emits a PL peak at 435-nm in wavelength.[1] However, the measured

PL (emitted blue light) of the $Cd_{0.5}Zn_{0.5}S/ZnS$ core/shell QD peaked at 442-nm in wavelength, corresponding to ~2.81eV. This wavelength difference (a red shift of ~ 7nm) would be originated from the interfacial compressive strain. Therefore, the 442-nm wavelength blue light was emitted by the red shift induced by the interfacial compressive strain from the electron-hole recombination at the energy band gap of the $Cd_{0.5}Zn_{0.5}S$ core QD (2.85 eV).

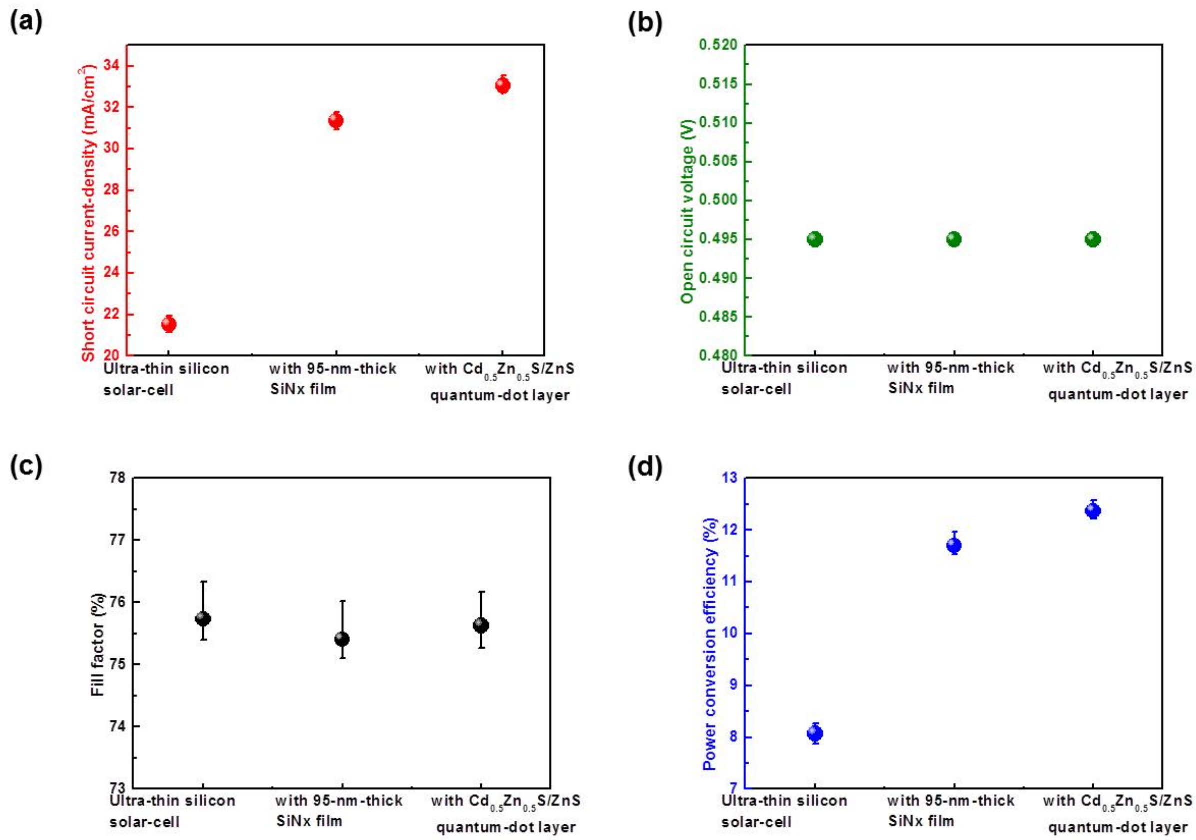
1. O. E. Jaime-Acuña, H. Villavicencio, J. A. Díaz-Hernández, V. Petranovskii, M. Herrera and O. Raymond-Herrera, *Chemistry of Materials*, 2014.
2. D. Strauch, in *New Data and Updates for several III-V (including mixed crystals) and II-VI Compounds*, ed. U. Rössler, Springer Berlin Heidelberg, 2012, vol. 44E, ch. 65, pp. 99-102.
3. Y.-K. Kuo, B.-T. Liou, S.-H. Yen and H.-Y. Chu, *Optics Communications*, 2004, **237**, 363-369.
4. L. Vegard, *Z. Physik*, 1921, **5**, 17-26.



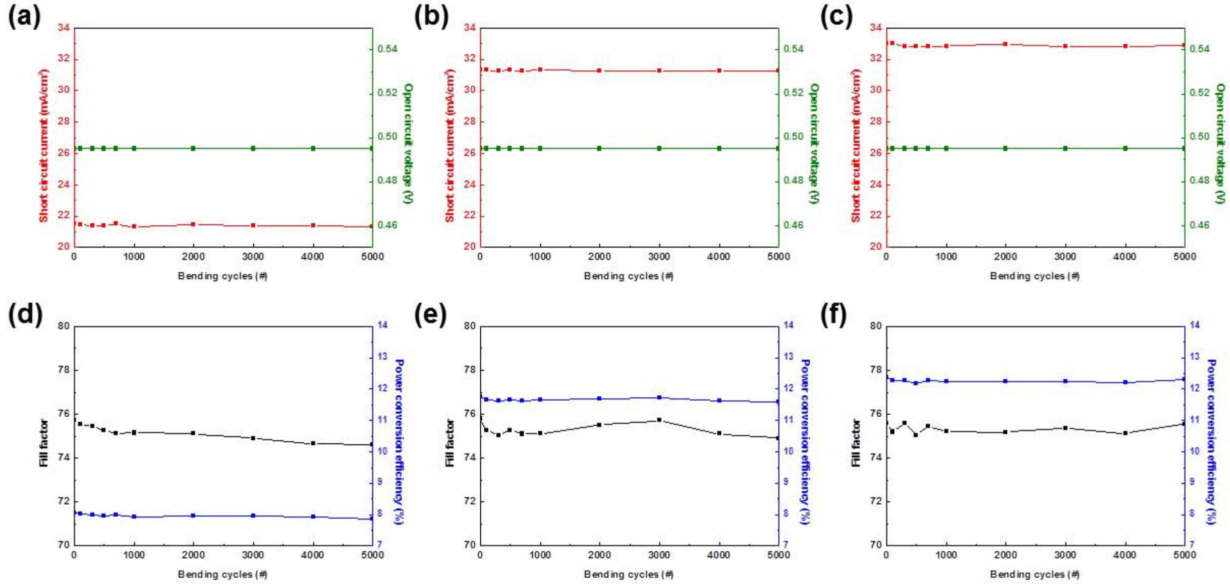
Supplementary Figure 1. Dependency of optical properties on the growth time of the ZnS shell in $Cd_{1-X}Zn_XS$/ZnS core/shell QDs. (a) Diameter of $Cd_{1-X}Zn_XS$/ZnS core/shell QDs calculated by observing TEM images, (b) Absorption spectrums and PL peaks, and (c) Emitted PL wavelength and quantum yield.



Supplementary Figure 2. Effect of the SiN_X anti-reflective film thickness on EQE and J_{SC}. (a) EQE as a function of wavelength and (b) TEM images as a function of the SiN_X anti-reflective film thickness.



Supplementary Figure 3. Photovoltaic performance for the flexible ultra-thin silicon solar-cells, flexible ultra-thin silicon solar-cells with SiN_X anti-reflective film, and flexible ultra-thin silicon solar-cells with SiN_X reflectvie film and $Cd_{0.5}Zn_{0.5}S/ZnS$ core/shell QDs. (a) J_{SC}, (b) V_{OC},(c) FF, and (d) PCE by the average (point), maximum (higher bar) and minimum (lower bar) among six samples



Supplementary Figure 4. Bending fatigue performance for flexible ultra-thin silicon solar-cells, flexible ultra-thin silicon solar-cells with SiN_X anti-reflective film, and flexible ultra-thin silicon solar-cells with SiN_X anti-reflective film and $Cd_{0.5}Zn_{0.5}S/ZnS$ core/shell QDs. (a), (b) and (c) J_{SC} and V_{OC}, (d),(e), and (f) FF and PCE as a function of bending cycles.