Supplementary Information

Efficient Light Harvesting in Hybrid Quantum Dot – Interdigitated Back Contact Solar Cells via Resonant Energy Transfer and Luminescent Down Shifting

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1. IBC Solar cell parameters

Table 1. J-V parameter of solar cell under illumination of AM1.5G spectrum.

Hybrid IBC Solar cell	Efficiency(%)	FF(%)	Voc(V)	Jsc(mA)
Reference PV cell without QDs	8.8±0.02	79.29±0.02	0.610	18.19±0.02
6nm QD layer	9.07±0.11	78.53±0.57	0.607±0.008	19.01±0.18
30nm QD layer	10.3±0.09	78.42±0.55	0.612±0.007	21.46±0.26
64nm QD layer	11.75±0.05	78.85±0.12	0.622±0.002	23.94±0.11
71nm QD layer	12.15±0.02	78.74±0.09	0.622±0.0001	24.80±0.05
83nm QD layer	12.33±0.02	78.40±0.24	0.619	25.37±0.14
96nm QD layer	12.19±0.02	78.5±0.25	0.621±0.0001	24.9±0.08

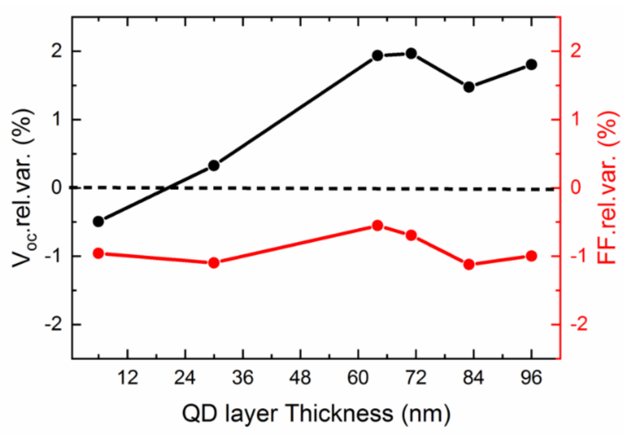

Figure S1. Relative variations of V_{oc} and FF with QD layer thickness

Table 1 shows the solar cell parameter of Figure 3(b). The same IBC solar cell was recycled for different QD thickness to avoid any disparity resulting from sample variations. The relative variations in open-circuit voltage (V_{oc}) and Fill-factor is given Figure S1. The The V_{oc} reduces slightly after initial application of a 6 nm thick QD film. This is also within one standard deviation of the measurement error. As the thickness of the QD layer is increased further, the V_{oc} increases by 2%. This can be attributed to improved scattering from aggregated QDs[1], which changes the propgation of light, enhancing overall optical pathlength within this silicon absorber . After hybridization, the FF drops by 1% due to an increase in series resistance resulting from contamination of metal contacts by QDs during spin deposition.

2. Modelled reflectance for QD layer on Si

Figure S2 (a), shows the modelled reflectance (using OPAL2 [2]) of 18nm AlOx on planar Si for different thickness of QD layer. The optimized QD layer for lower reflectance was achieved at ~ 82nm, the Figure S2(b) shows the aggrement beween modelled and experimental data. The difference in longer wavelength between modelled and experiment, is due to the simulation assuming a semi-infinite subtrate, i.e. no back reflection.

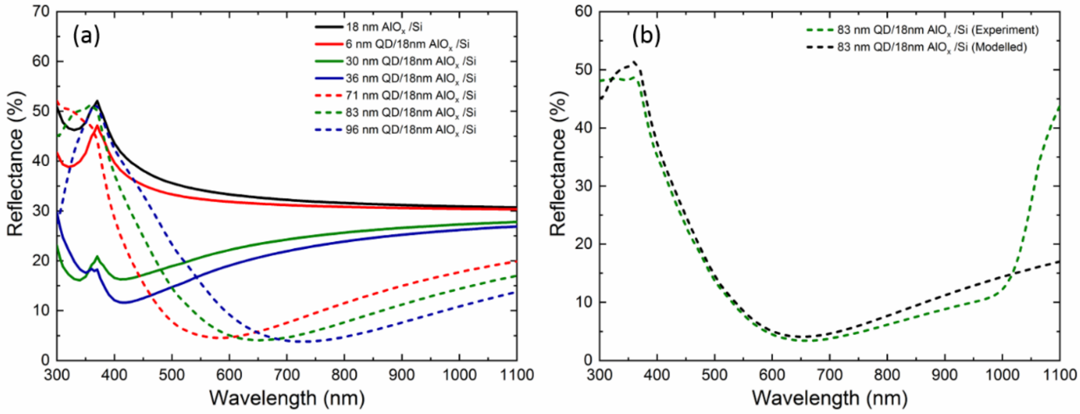

Figure S2. (a) Modelled reflectance of a sample with 18 nm AlOx on planar Si and the changes in reflectance with different QD layer thickness, (b) shows the agreement in reflection between simulation and experiment for 83nm thick QD layer on 18nm AlO_x on planar Si.

References

1 Y.-K. Liao, M. Brossard, D.-H. Hsieh, T.-N. Lin, M. D. B. Charlton, S.-J. Cheng, C.-H. Chen, J.-L. Shen, L.-T. Cheng, T.-P. Hsieh, F.-I. Lai, S.-Y. Kuo, H.-C. Kuo, P. G. Savvidis and P. G. Lagoudakis, *Adv. Energy Mater.*, 2015, **5**, 1401280.

2 K. R. McIntosh and S. C. Baker-Finch, in *2012 38th IEEE Photovoltaic Specialists Conference*, IEEE, 2012, pp. 265–271.