Electronic Supplementary Information (ESI)

Photon energy transfer by quantum dots in the organic-inorganic hybrid solar cells through FRET

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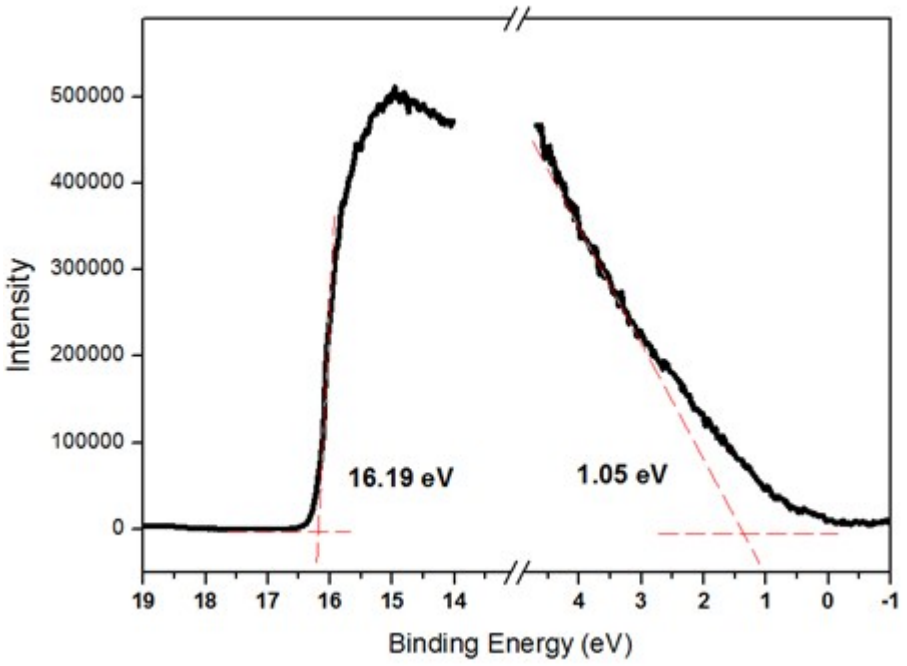

Figure S1. Properties of InP QDs. Ultraviolet photoemission spectroscopy (UPS) to determine energy levels of InP QDs.

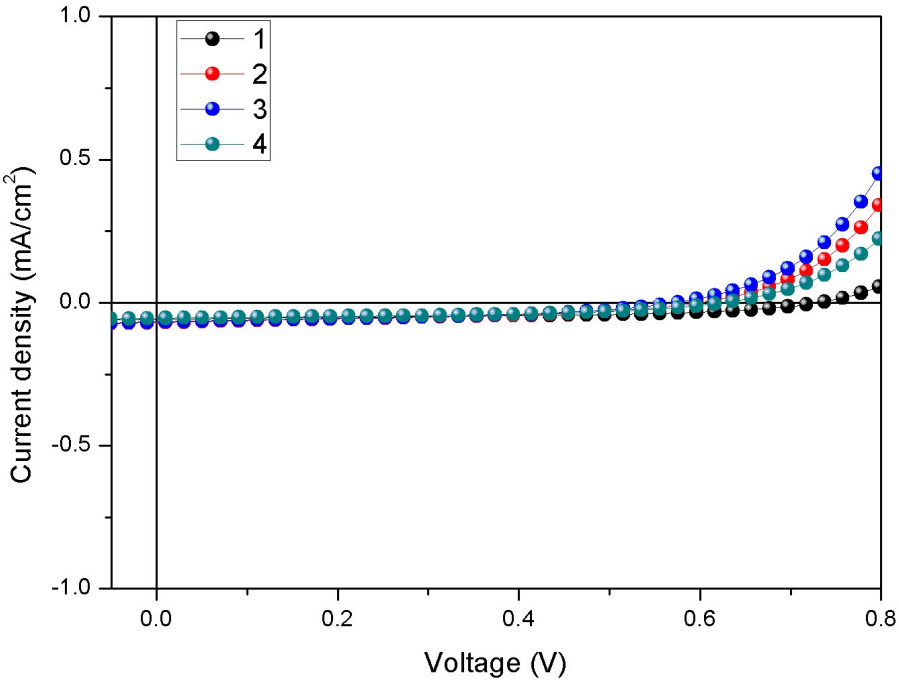

Figure S2. Performance optimization of BHJ + QDs hybrid solar cells : Current-density versus voltage (J-V) characteristics of conventional InP QDs + PC71BM BHJ solar cells under AM 1.5 G illumination with an irradiation intensity of 93 mW cm^{-2}

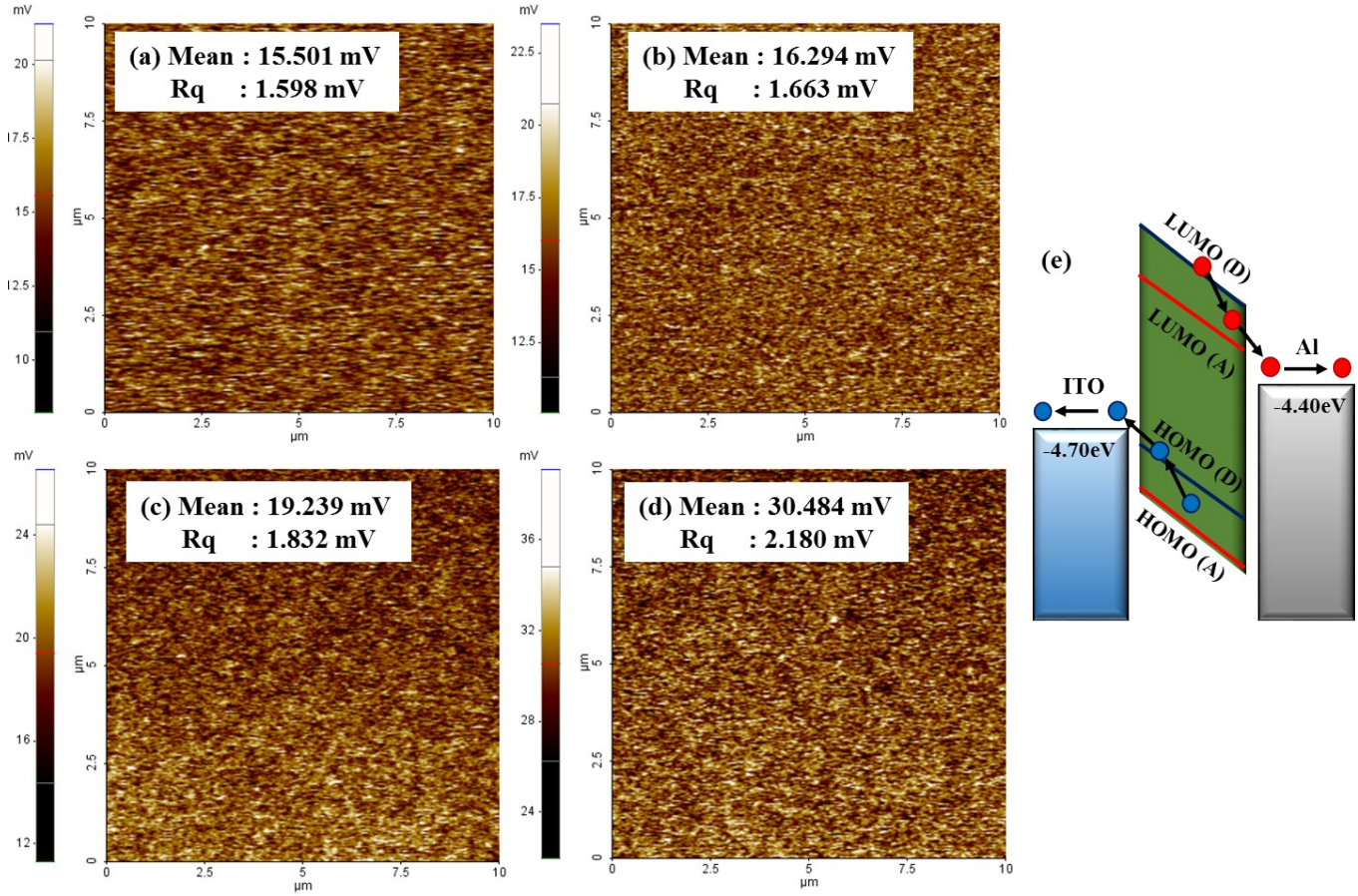

Figure S3. Electrostatic force microscopy (EFM) characteristics of (a) BHJ active layer, (b) BHJ + QDs hybrid active layer, (c) BHJ active layer with PFN interlayer and (d) BHJ + QDs hybrid active layer with PFN interlayer and (e) surface potential alignment in energy diagram in conventional structure solar cells.

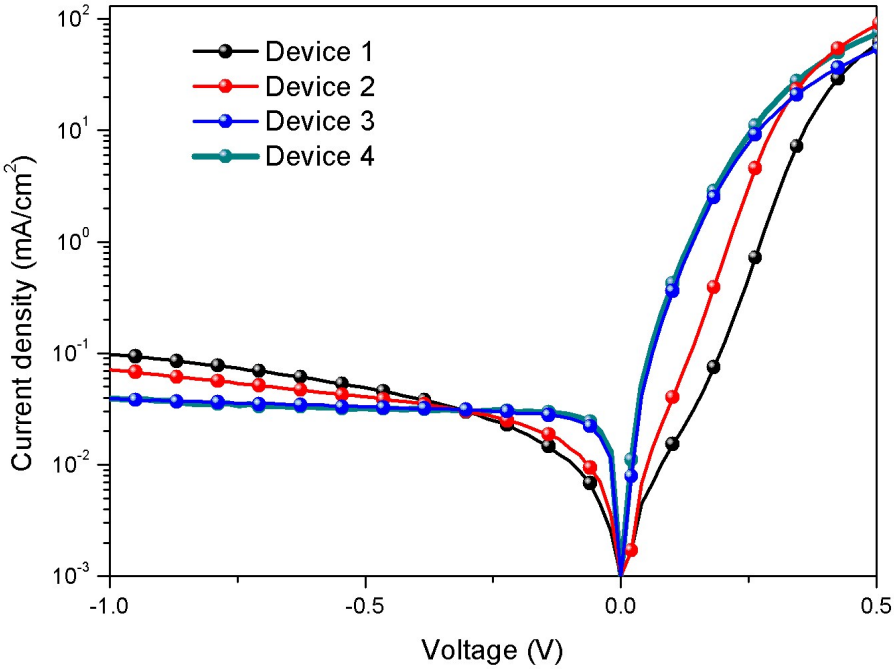

Figure S4. Dark current characteristics of BHJ + InP QDs hybrid solar cells under AM 1.5 G illumination with an irradiation

intensity of 93 mW cm^{-2}

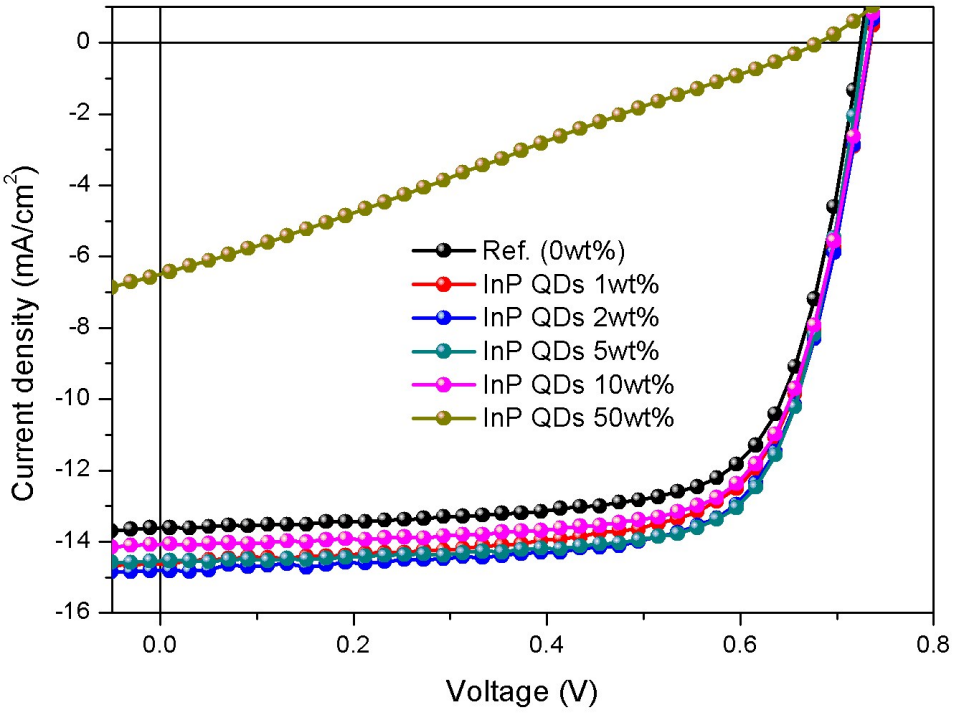

Figure S5. Ratio optimization of BHJ + QDs hybrid solar cells : Current density versus voltage (J-V) characteristics of conventional InP Qs + $PC_{71}BM$ solar cells under AM 1.5 G illumination with an irradiation intensity of 93 mW cm^{-2}

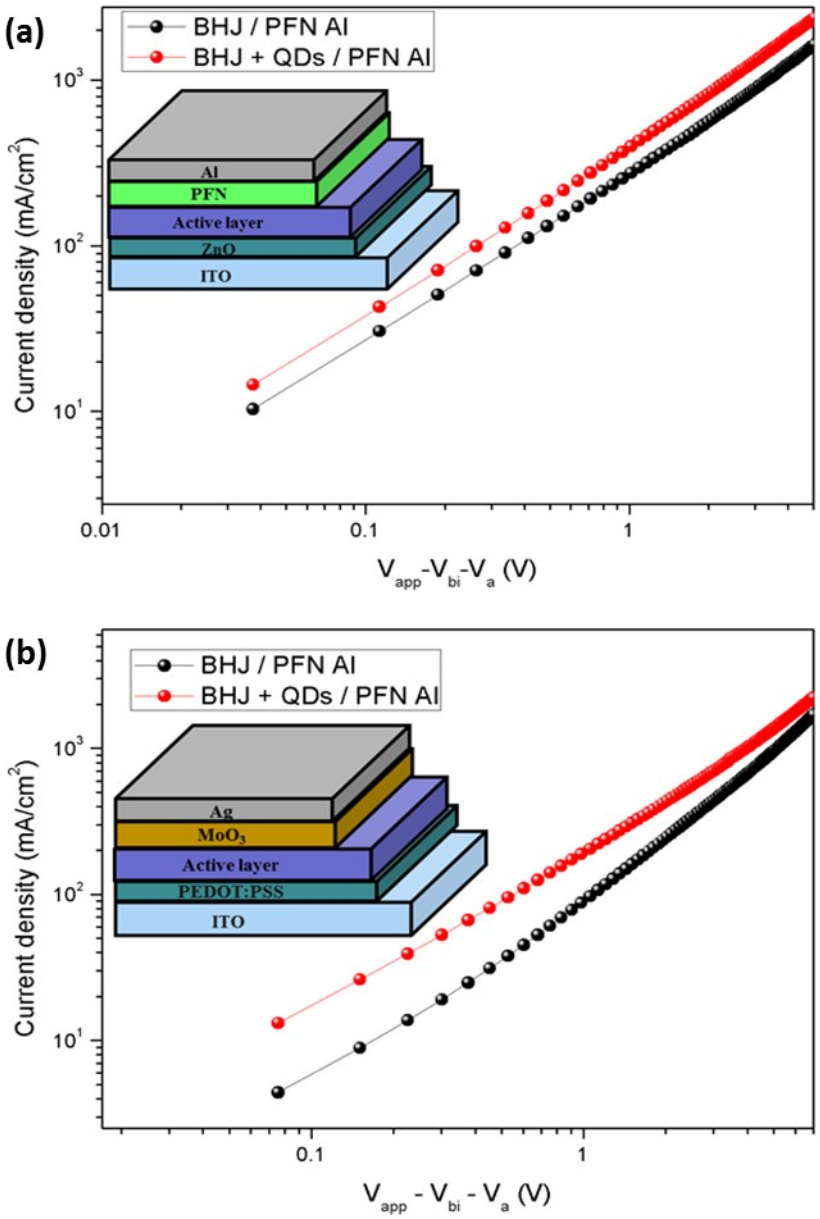

Figure S6. (a) Electron mobility, (b) Hole mobility of BHJ active layer and BHJ + QDs hybrid active layer devices calculated by Mott-Gurney space charge limited current (SCLC) method.

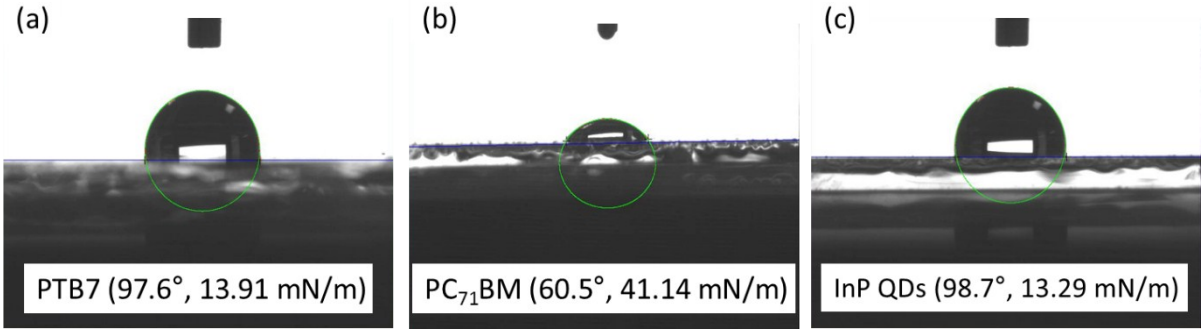

Figure S7. Contact angle and surface energy characteristics of (a) PTB7, (b) $PC_{71}BM$ and (c) InP QDs.

Supplementary Table

Table S1. Photovoltaic performances of InP QDs + $PC_{71}BM$ BHJ solar cells

Device structure	Jsc [mA/cm^2]	Voc [V]	FF [%]	PCE [%]
Device S1	0.039	0.696	45.4	0.013
Device S2	0.037	0.636	45.2	0.011
Device S3	0.057	0.737	49.5	0.022
Device S4	0.067	0.595	42.5	0.018

Fabricated solar cells structure : ITO/PEDOT:PSS/active layer(InP + $PC_{71}BM$)/Al

Table S2. Photovoltaic performances of InP QDs + $PC_{71}BM$ BHJ solar cells with respect to InP QDs ratio optimization.

Device structure	Jsc [mA/cm^2]	Voc [V]	FF [%]	PCE [%]
BHJ (Device 4)	13.6	0.717	72.2	7.6
BHJ + 1 wt% InP QDs	14.6	0.737	69.2	7.9
BHJ + 2 wt% InP QDs	14.8	0.737	70.7	8.1
BHJ + 5 wt% InP QDs	14.5	0.737	72.6	8.4
BHJ + 10 wt% InP QDs	14.1	0.737	71.1	7.9
BHJ + 50 wt% InP QDs	6.4	0.676	26.5	1.2

Fabricated solar cells structure : ITO/PEDOT:PSS/active layer(InP + $PC_{71}BM$)/PFN/Al