Electronic Supplementary Information (ESI)

Quasi-solid-state quantum dot sensitized solar cells with power conversion efficiency over 9% and high stability

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Preparation of Zn-Cu-In-Se QDs

The oil-soluble Zn-Cu-In-Se (ZCISe) QDs were synthesized according to our previous method.[1] First, a DPP-Se precursor was prepared by dissolving Se powder (0.024 g, 0.3 mmol) into 0.8 mL of DPP and OAm (v/v, 3:5) at room temperature to form a bright yellow solution. And a $Zn(OAc)_2$ stock solution was prepared by dissolving $Zn(OAc)_2$ (0.011 g, 0.04 mmol) into 5 mL of OAm and ODE (v/v, 1: 4) at 120 °C. In the typical synthetic process, a mixture of CuI (19.0 mg, 0.1 mmol), $In(OAc)_3$ (29.0 mg, 0.1 mmol), OAm (2.0 mL), ODE (1.5 mL) and 0.4 mL of the above $Zn(OAc)_2$ stock solution were loaded in a 50 mL three necked flask. Under the protection of N_2, the mixture was heated to 200 °C followed by injecting 0.8 mL of the above DPP-Se precursor into the reaction system under stirring. The reaction was proceeded 5 min before cooled to 90 °C. The initial OAm-capped ZCISe QDs were purified by centrifugation and decantation with the addition of excessive ethanol and acetone. The purified oil-soluble ZCISe QD precipitate was redissolved in 10 mL of dichloromethane. The water-soluble MPA capped ZCISe QDs was prepared using similar method by replacing TGA with MPA.[1,2]

Preparation of the Zn-Cu-In-Se sensitized photoanodes

The ZCISe sensitized photoanodes were obtained by droping 45 μL of MPA-capped ZCISe QD aqueous dispersion onto the TiO_2 mesoporous film and standing for 2 h. The obtained photoanodes was then passivated by 6 ZnS layers (0.1 M $Zn(OAc)_2$ methanol solution and 0.1 M Na_2S aqueous solution for 1 min/dip).

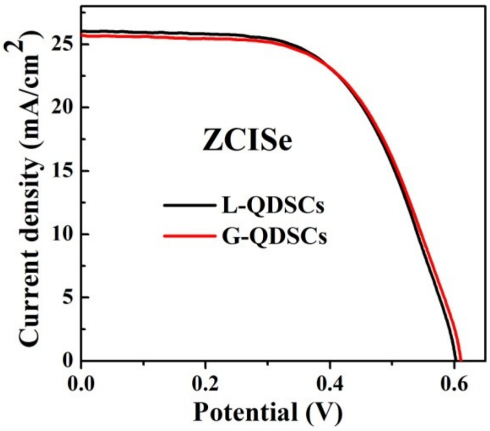

Fig. S1 *J-V* curves of ZCISe sensitized solar cells based on liquid and gel electrolytes.

Table S1 Photovoltaic parameters of ZCISe sensitized solar cells based on liquid and gel electrolytes.

Cells	J_{sc} (mA·cm^{-2})	V_{oc} (V)	FF (%)	PCE (%)
L-QDSCs	26.01(26.10)	0.601(0.602)	58.37(58.24)	9.12±0.02(9.15)
G-QDSCs	25.59(25.67)	0.609(0.611)	58.75(58.59)	9.16±0.04(9.19)

[a] Average parameters and standard deviation based on 5 solar cells in parallel. The numbers in parentheses represent the values obtained for the champion cells.

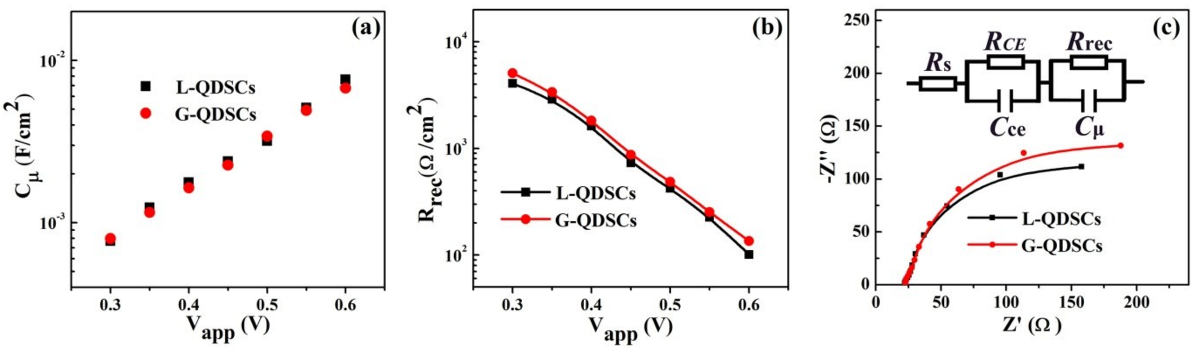

Fig. S2 EIS of ZCISe sensitized L-QDSCs and G-QDSCs: (a) chemical capacitance C_μ; (b) recombination resistance R_{rec}; (c) Nyquist plots at –0.60 V forward bias.

Table S2 Simulated values of resistance (R) and capacitance (C) under the forward bias of −0.60 V of ZCISe sensitized L-QDSCs and G-QDSCs.

The Cells	R_s ($\Omega\cdot cm^2$)	R_{CE} ($\Omega\cdot cm^2$)	R_{rec} ($\Omega\cdot cm^2$)	C_μ ($mF\cdot cm^{-2}$)
L-QDSCs	22.23	4.72	225.9	5.1
G-QDSCs	22.62	5.15	267.6	4.9

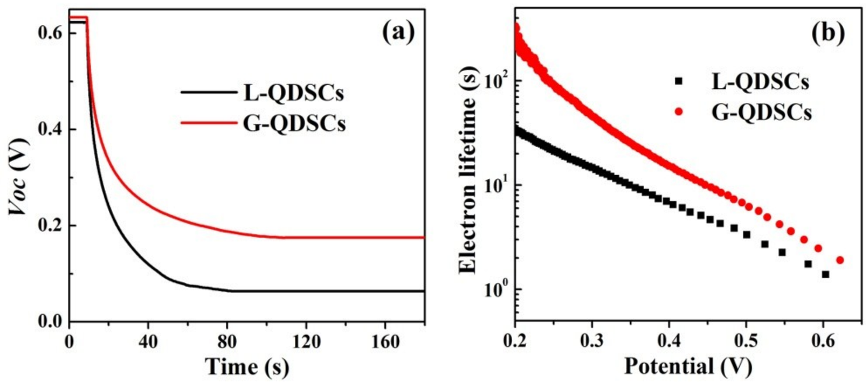

Fig. S3 Open circuit voltage decay (OCVD) measurements of ZCISe sensitized L-QDSCs and G-QDSCs: (a) the V_{oc} decay curves. (b) the electron life time extracted from OCVD.

References

1 J. Du, Z. Du, J.-S. Hu, Z. Pan, Q. Shen, J. Sun, D. Long, H. Dong, L. Sun, X. Zhong and L.-J. Wan, *J. Am. Chem. Soc*. 2016, **138**, 4201−4209.

2 W. Li and X. Zhong, *J. Phys. Chem. Lett*., 2015, **6**, 796−806.