



## Organometallic derived ZnO QDs for improved solar cell performance

Recently it has been demonstrated that the introduction of Electron Transfer Layers (ETLs) consisting of organometallic-derived Zinc Oxide Quantum Dots (**OM ZnO QDs**) in perovskite solar cells (PSCs) leads to superior photovoltaic performance and enhanced stability in comparison to PSCs based on a standard sol-gel derived ZnO layer (**S-G ZnO QDs**). The following table shows the results of said study corresponding to the morphology and electrical properties of ETLs, as well as to the performance and stability of analogous PSCs:

Morphology	OM ZnO QDs	S-G ZnO QDs
roughness of the surface	smoother surface (RMS=14.84 nm)	rougher surface (RMS=20.86 nm)
surface defects	no defects, no organic and inorganic impurities	surface defects, residual acetate ligands, alkali metal contaminations

  

Electrical properties	OM ZnO QDs	S-G ZnO QDs
Resistivity x $10^{-5}$	4.12 $\Omega\cdot\text{cm}$	9.28 $\Omega\cdot\text{cm}$
Conductivity x $10^3$	24.27 ( $\Omega\cdot\text{cm}$ ) <sup>-1</sup>	10.77 ( $\Omega\cdot\text{cm}$ ) <sup>-1</sup>
Carrier density x $10^{21}$	6.17 $\text{cm}^{-3}$	4.66 $\text{cm}^{-3}$

  

PSC performance	OM ZnO QDs	S-G ZnO QDs
Open circuit voltage ( $V_{oc}$ )	1.129 V	1.09 V
Short circuit current density ( $J_{sc}$ )	22.93 $\text{mA}\cdot\text{cm}^{-2}$	21.95 $\text{mA}\cdot\text{cm}^{-2}$
Fill factor (FF)	77.52%	74.34%

Power conversion efficiency (PCE)	20.05%	17.78%
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<b>PSC stability</b>	<b>OM ZnO QDs</b>	<b>S-G ZnO QDs</b>
Long-term stability		
<i>after 500h of storage in ambient conditions (25°C, approx. humidity 25%)</i>	95% of original PCE	75% of original PCE
Temperature stability		
<i>after 250h of heating (85°C, RH=60%)</i>	54% of original PCE	complete desintegration

The presented comparison indicates that the application of OM ZnO QDs in ETLs:

- Allows for the formation of the uniform surface morphology with a reduced amount of surface defects
- Allows for low temperature processing
- Improves extraction of electrons
- Improves the ZnO/perovskite interface stability along with the perovskite film quality
- Reduced interfacial charge recombination and enhanced VOC and FF
- Superior photovoltaic performance of the PSC
- Enhanced long-term and thermal stability

For more information about the study, please follow the links:

- <https://doi.org/10.1002/adfm.202205909>
- [Supporting information](#)