## Organometallic derived ZnO QDs for improved sollar 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 (**SG 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** | **SG 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** | **SG ZnO QDs** |
| Resistivity x $10^{-5}$ | 4.12 Ω•cm | 9.28 Ω•cm |
| Conductivity x $10^{3}$ | 24.27 $(\Omega \bullet cm)^{-1}$ | 10.77 $(\Omega \bullet cm)^{-1}$ |
| Carrier density x $10^{21}$ | 6.17 $cm^{-3}$ | 4.66 $cm^{-3}$ |
| **PSC performance** | **OM ZnO QDs** | **SG ZnO QDs** |
| Open circuit voltage ($V_{OC}$) | 1.129 V | 1.09 V |
| Short circuit current density ($J_{SC}$) | 22.93 $mA \bullet cm^{-2}$ | 21.95 $mA \bullet cm^{-2}$ |
| Fill factor (FF) | 77.52% | 74.34% |

| | | |
|---|---|---|
| Power convertion efficiency (PCE) | 20.05% | 17.78% |

| **PSC stability** | **OM ZnO QDs** | **SG ZnO QDs** |
|---|---|---|
| Long-term stability<br><br>*after 500h of storage in ambient conditions (25°C, approx. humidity 25%)* | 95% of original PCE | 75% of original PCE |
| Temperature stability<br><br>*after 250h of heating (85°C, RH=60%)* | 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