

# A New Type of Solid-State Dye-Sensitised Solar Cell Based On Polyiodides

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## Abstract

Efficient dye-sensitised solar cells (DSSCs) have been extensively studied for nearly 30 years and applications are emerging in both outdoor and indoor contexts. In the latter, cells scavenge ambient indoor light to power sensors and related devices for the “internet-of-things”, and DSSCs show one of the highest indoor power-conversion efficiencies of any photovoltaic technology, Tanaka et al [1]. The original efficient DSSCs, developed from the 1990s, used a liquid  $I^-/I_3^-$  electrolyte, however this liquid component causes poor device stability and extensive work has since gone into alternatives such as solid organic hole conductors, solid-state copper complexes and gels.

We have recently discovered that stable, solid-state DSSCs can be made by simply drying out the liquid  $I^-/I_3^-$  electrolyte to give a polyiodide-based conducting material, Tanaka et al [2]. It is remarkable that this had not previously been observed, despite several decades study of liquid  $I^-/I_3^-$  cells. We have demonstrated a power-conversion efficiency for the solid-state cell of over 5%, similar to that of the parent liquid cell before drying. We have also demonstrated negligible degradation of efficiency after 10 months storage in the dark without any encapsulation. We believe these findings open up a unique new approach to making stable, solid-state DSSCs of potential practical application, with efficiency able to be optimised up to around 10%.

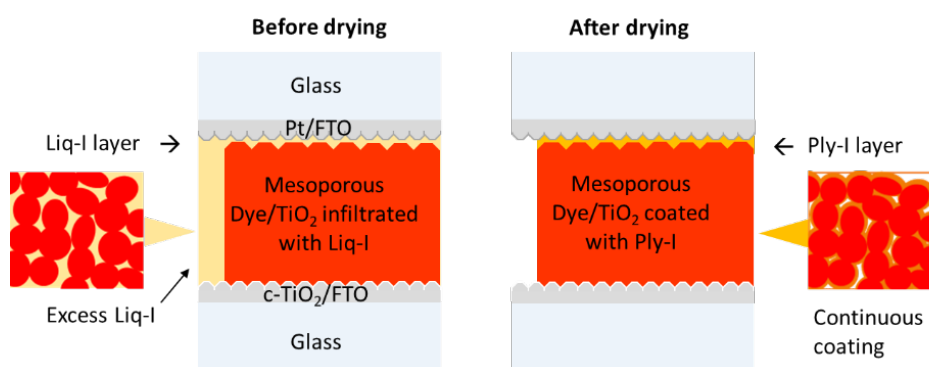


Figure 1: Schematic cross-section model of the liquid and the polyiodide DSSC

## References

- [1] E. Tanaka, H. Michaels, M. Freitag, N. Robertson, "Synergy of co-sensitizers in a copper bipyridyl redox system for efficient and cost-effective dye-sensitized solar cells in solar and ambient light," *J. Mater. Chem. A.*, 2020, 8, 1279 – 1287.
- [2] E. Tanaka, N. Robertson, "Polyiodide solid-state dye-sensitized solar cell produced from a standard liquid  $I^-/I_3^-$  electrolyte," *J. Mater. Chem. A.*, 2020, 8, 19991 – 19999