Metrology of Dye-sensitized Solar Cells

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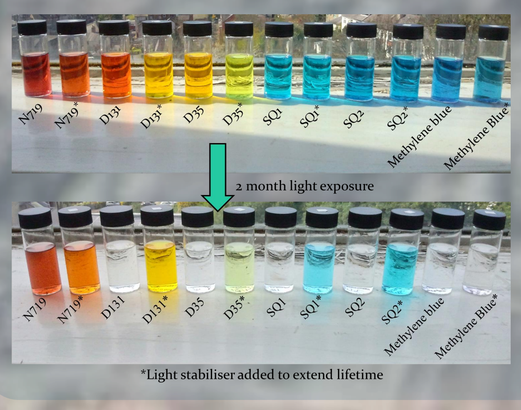


*Light stabiliser added to extend lifetime

Metrology of Dye Solutions

Two vials of each dyes (+/- stabiliser) were exposed to natural light for 2 months.

Most dyes with the stabiliser showed a significantly slower degradation than those without. This was most noticeable in D131 dye, which was stabilised over 2 months.

Rose – Standard Image

Rose – UV Photograph

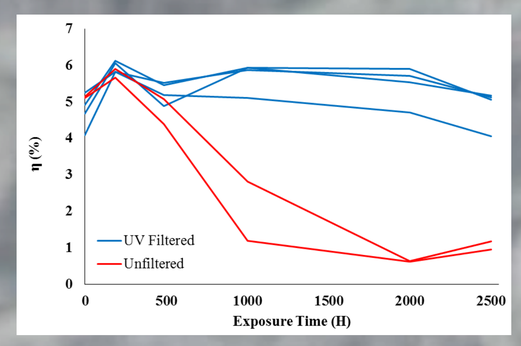
UV-Imaging

Cameras with UV capabilities can reveal more can be seen with the naked eye. We are currently investigating UV imaging of DSC devices.

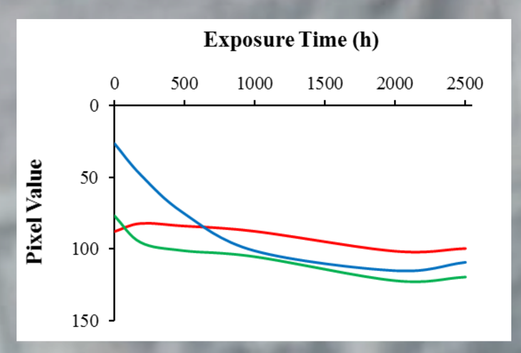
Imaging of devices

The stability of DSC devices can be successfully monitored using imaging. This can reveal the degradation mechanism, such as electrolyte degradation in devices without UV-filtration and dye degradation from light soaking.

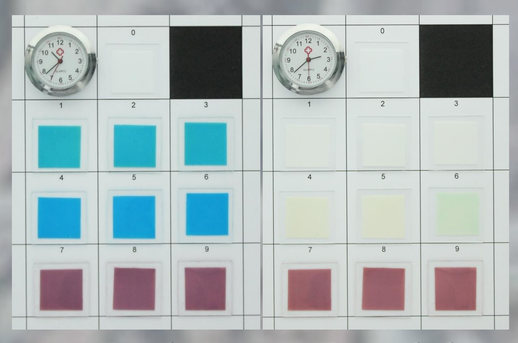
The efficiency drop for cells without UV filtration showed a clear link with an increase in blue colour, which indicated bleaching of the electrolyte.



N719 Device Efficiency



Electrolyte Color of Unfiltered Devices



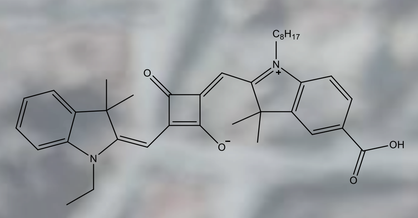
Dyed Electrodes

Degraded Electrodes

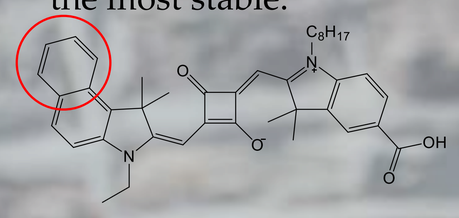
Degradation under artificial light exposure

TiO_2 electrodes were dyed in SQ1, SQ2 or N719 dyes and exposed to light in a light box. Images were taken every 20s for 4h and the RGB pixel data were analysed.

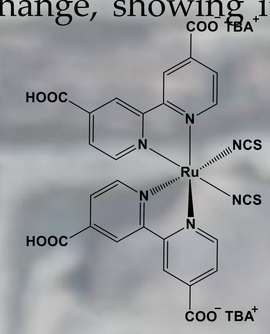
The data show significant SQ1 degradation after 30m. SQ2 was more stable with degradation after 2h. N719 gave little colour change, showing it was the most stable.



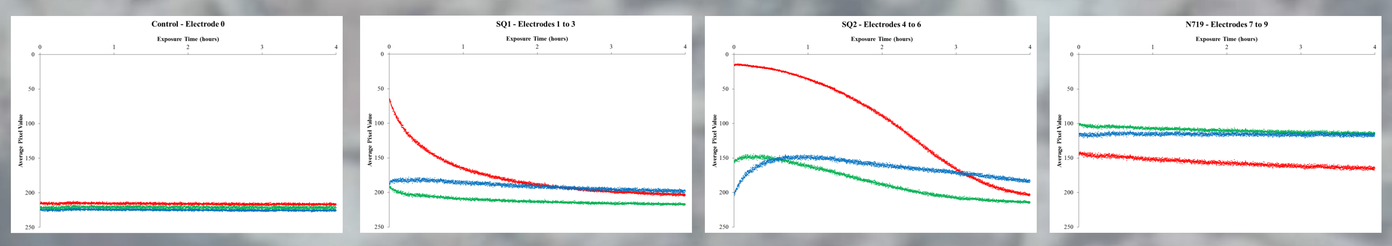
SQ1



SQ2



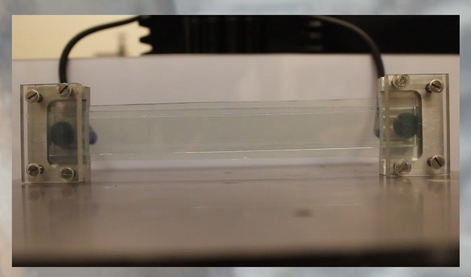
N719



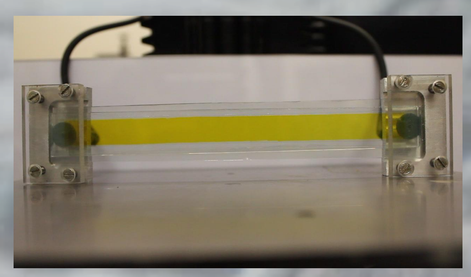
Pixel values for the electrodes, gradient show degradation rate

Metrology of Sensitization

Dye uptake was monitored with a camera taking images at regular intervals before analysis to monitor colour changes.

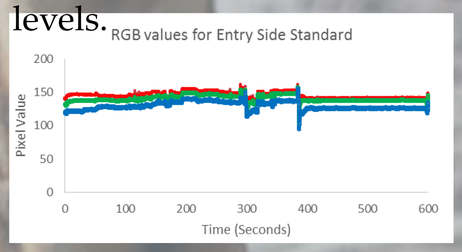


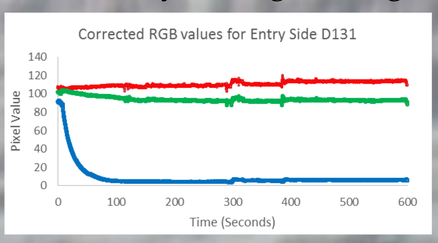
Before fast dye



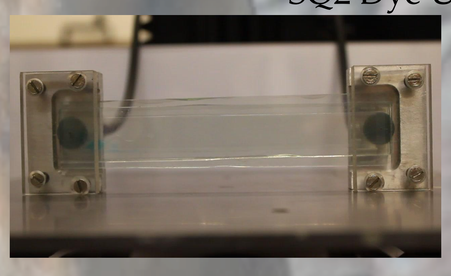
After fast dye with D131

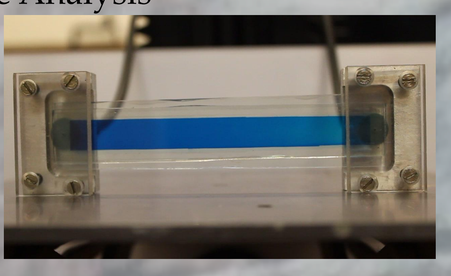
Images were analysed using a macro *versus* a control taken from the edge of the cell to counteract any change in light levels.

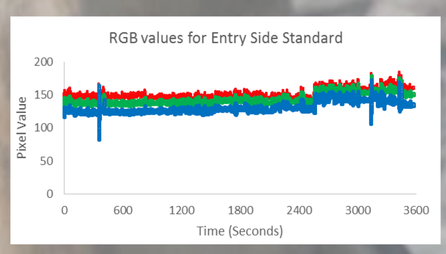


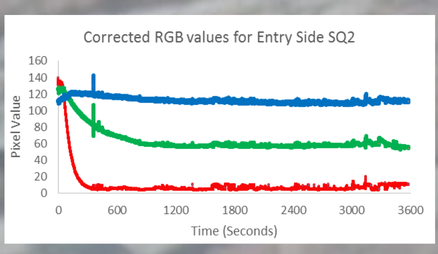


SQ2 Dye Uptake Analysis









Conclusions

- Stabilisers can successfully slow dye solution degradation.
- Rates of degradation vary significantly between different dyes with SQ1 degrading faster than SQ2 and N719 being the most stable.
- Scale up of the fast dye process can be done successfully.
- Dye uptake can be monitored by image analysis.
- In-line metrology may provide continuous data in a real-time feedback loop, allowing greater control during processing.

Acknowledgments
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References

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