A comparative study of low hydrogenated amorphous silicon with commercially available thin film silicon solar cells

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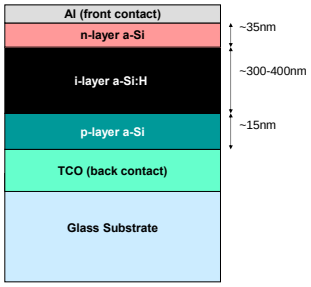
Introduction

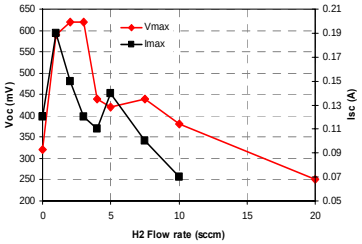
❖ Plasma Quest Ltd. (PQL) , University of Southampton and Romag are in collaboration to demonstrate 6% efficient, flexible, A4 thin film solar cells using the high target utilisation sputtering (HiTUS) deposition technique pateneted by PQL.

❖ Hydrogenated amorphous silicon solar cells were sputtered onto TCO coated glass at PQL. The hydrogen dilution levels for the i-layer of the p-i-n solar cell were varied. The cell with the highest efficiency had a very low hydrogen dilution of 1 sccm (standard cubic centimetre per minute). This result suggests that these solar cells may have a high stability against long-term light soaking effects due to the "Staebler Wronski" effect.

❖ At the University of Southampton long term light soak tests are being carried out on the low hydrogenated amorphous cells developed by PQL along with commercially available thin film solar cells. The initial period of long term testing are presented in this poster as a funtion of maximum power (Pmax) verses time.



Schematic of hydrogenated amorphous silcon p-i-n solar cells deposited onto TCO coated glass substrates.



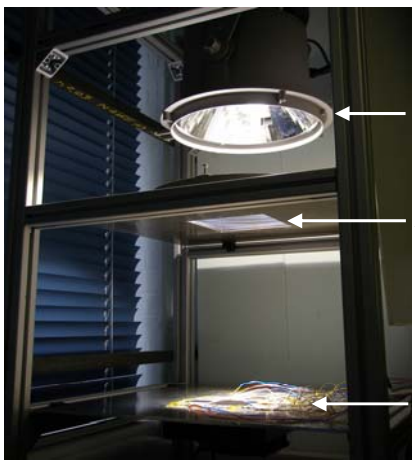
Voc and Isc as a function of hydrogen flow rate during deposition of the i-layer.

HiTUS Technique

❖ The HiTUS sputtering process is a low cost, non-toxic and potentially low temperature technique which is capable of producing very high quality thin film materials with excellent reproducibility, very low stress and excellent adhesion on glass, plastic or metal substrates.

❖ For furhter information on this technique visit the website: **http://www.plasmaquest.co.uk**

Light-soaking Measurement



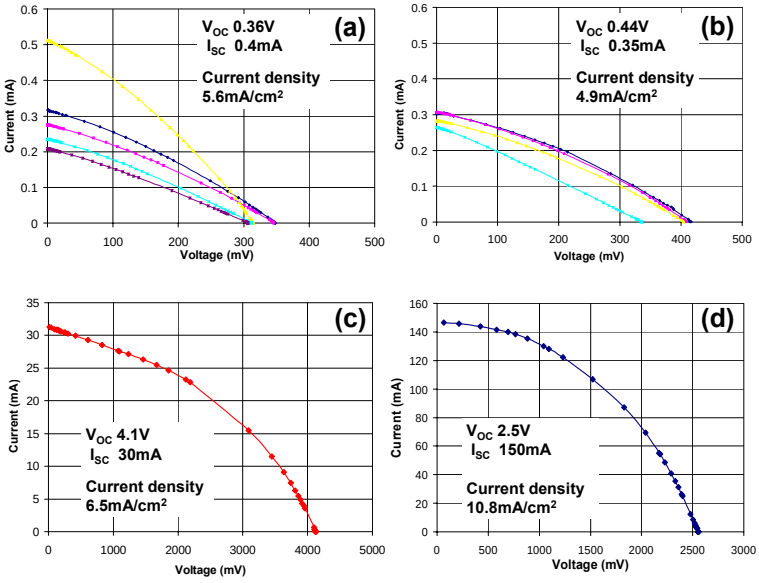
❖ The light-soaking tests are currently being conducted using the above equipment. The samples are subjected to a constant light source of 1000W/m^2 at 25^{o}C ±2^{o}C.

❖ The light-soaking tests are being conducted to reflect standard test conditions. The lamp uses a 400W metal halide bulb having a narrow beam to deliver a uniform irradiance across the samples. An AM 1.5G filter is used to obtain a spectrum as close to natural daylight.

❖ The lamp is calibrated using a calibrated ISET thin film silicon solar cell daily to maintain an incident power density of 1000W/m^2.

Comparison of IV with Commercially Available Solar Cells

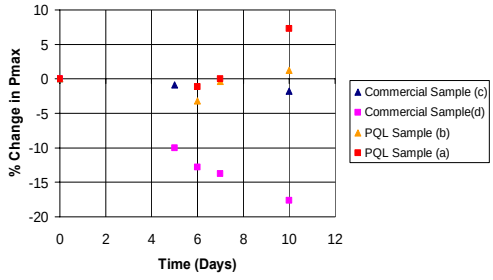
❖ Two PQL Samples were measured over the full area (35 x 37mm) at various points each point being 3mm in diameter. The individual IV curves for each point are shown in charts (a) and (b). Two commercial amorphous silicon solar cells were also measured over their full areas of 23.7cm^2 and 42.3cm^2 shown in (c) and (d), respectively.



Light Soaking Results

❖ The samples have been soaked for an initial period of 10 days. During this period the IV characteristics and Pmax verses voltage have been measured daily.

❖ The percentage change of Pmax as a function of time is plotted below for all samples.



❖ The two commercial samples show a reduction in Pmax as a function of time. Commercial sample (d) shows the highest reduction of approximately 17%. PQL Sample (b) shows little change over 10 days whereas sample (a) shows a slight increase in Pmax. Small variations may be due to changes in the lamp across the sample area.

Conclusions

❖ Commercial sample (c) and both PQL samples show little reduction in power over 10 days at an intensity of 1000W/m^2. These initial results show promise for long term stability of PQL samples.

❖ The light soak measurement will be run for a further 8 months. From these stability tests we hope to show that by having low hydrogen dilution an improvement to the stability of amorphous silicon solar cells is achieved.

Acknowledgements

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