



To ... Princess Elisabeth Station, Antarctica

RELIABILITY OF PHOTOVOLTAIC MODULES

What about new developments?

There are several possibilities to reduce the cost per power output:

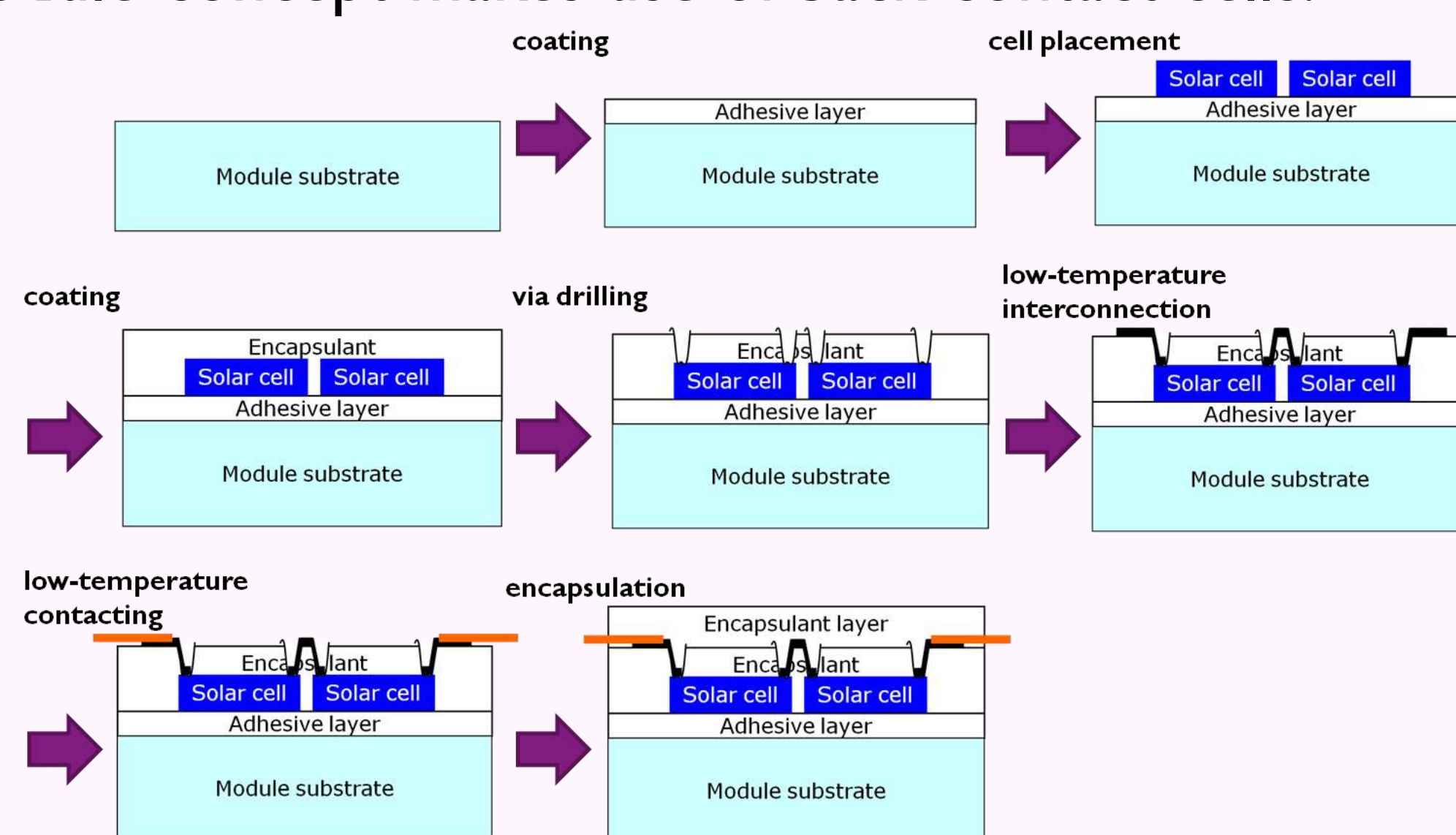
- New cell concepts and process techniques are developed and studied to increase the efficiency
- The production cost can be reduced by:
 - A reduced consumption of basic materials (thinner wafers, ...)
 - The introduction of alternative, low cost materials (replacement of Ag by Cu, ...)

Obviously, all modifications will have a strong impact on the final product reliability. Apart from standard testing, other accelerated stress tests are needed to verify the failure mechanisms and to create a better understanding of the effect of different testing parameters on the outdoor survival.

i-Module Concept

The i-module concept [3] eliminates the cell handling during solder tabbing and module fabrication which will lead to lower cell breakage and higher yield. Potential yield issues become even more stringent when thinner cells are used for future PV cells.

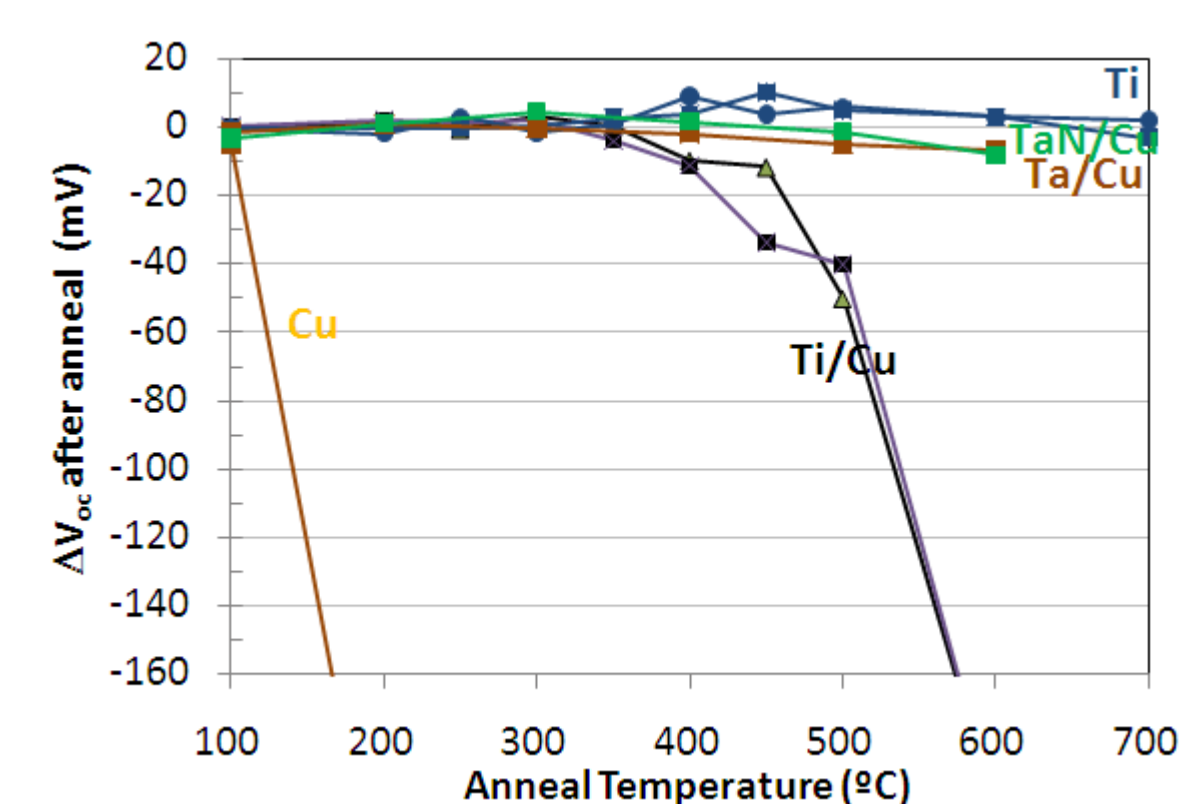
This module-concept makes use of back-contact cells.



Accelerated Testing

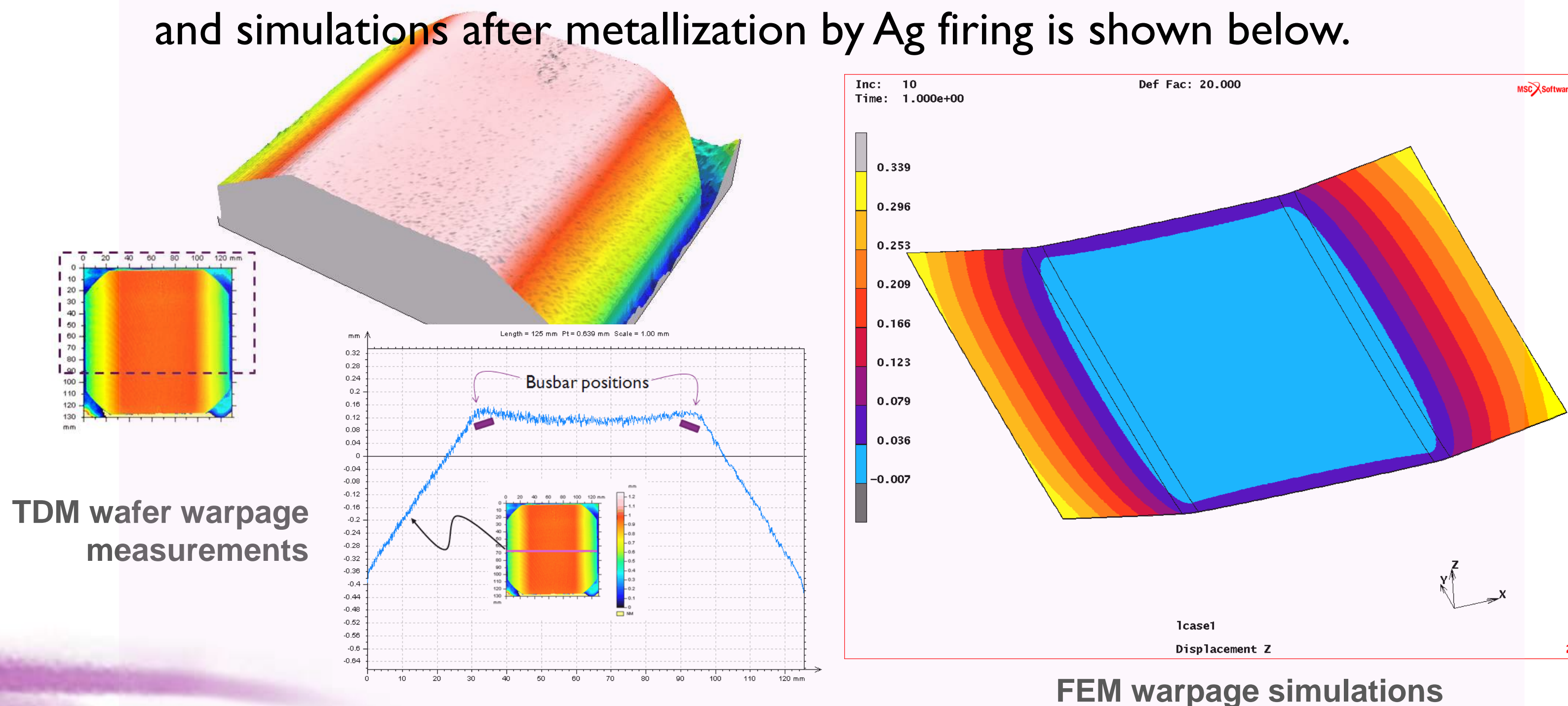
Cu electroplating is currently being investigated as a replacement for Ag screen printing. The advantages are a better aspect ratio of the fingers' line widths versus height (less shadowing), higher conductivity and lower raw material cost.

Introducing Cu may however generate other failure mechanisms. One critical issue is the control of the Si contamination. The performance of different barrier layers is tested for various annealing conditions [4].

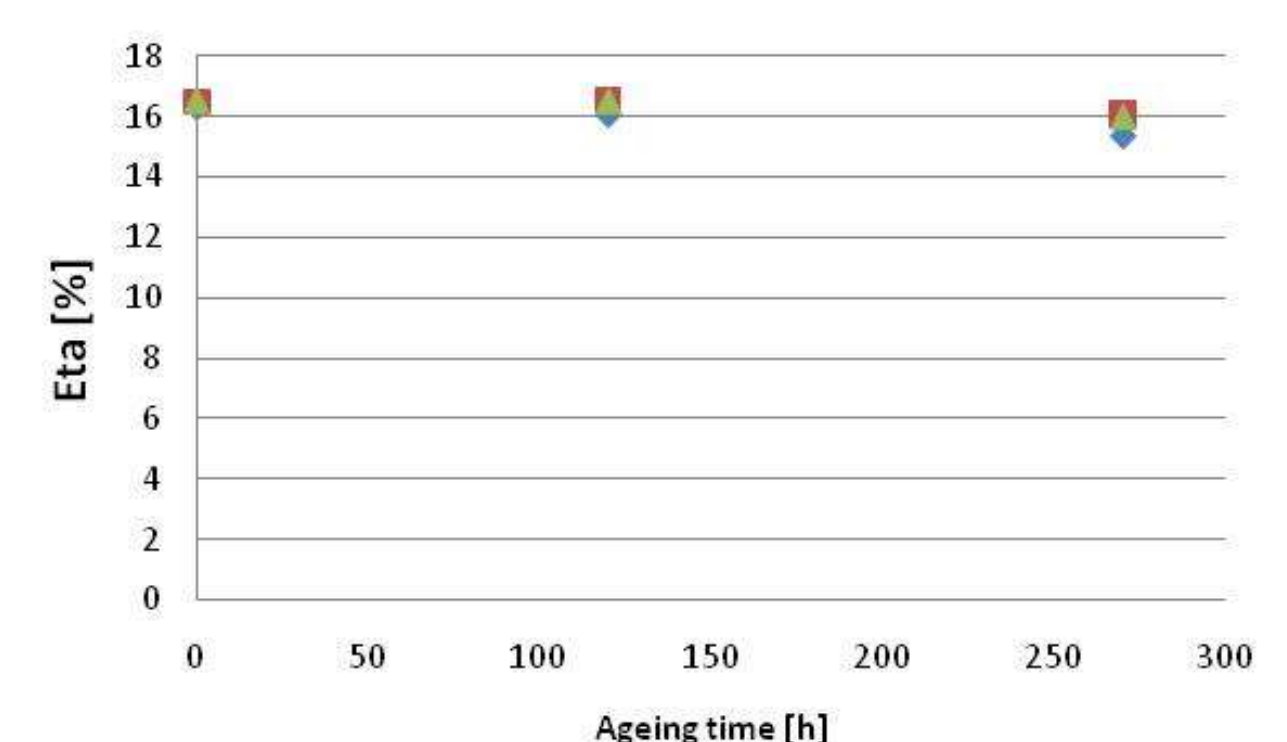


Testing and Finite Element Modeling (FEM)

The combination of experimental measurements and FEM simulations allow fitting the material properties, and later, estimating the deformation and internal stress in the solar cell and interconnections. An example of fitting the warpage measurements and simulations after metallization by Ag firing is shown below.



On top of contamination limitations, corrosion issues may be more pronounced as well. The resistance to corrosion is tested for different encapsulation materials.



Cell degradation as function of ageing time at 85 RH / 85°C



References

- [3] Govaerts et al., A novel concept for advanced modules with back-contact solar cells, 25th EU PVSEC, 2010
- [4] Hernandez et al. Application of CMOS barriers to Cu electroplated silicon solar cells, 25th EU PVSEC, 2010