Swiss Inno HJT: Pilot production and demonstration of innovative high performance Si-HJT PV cells, modules & systems

SWISS INNO HJT

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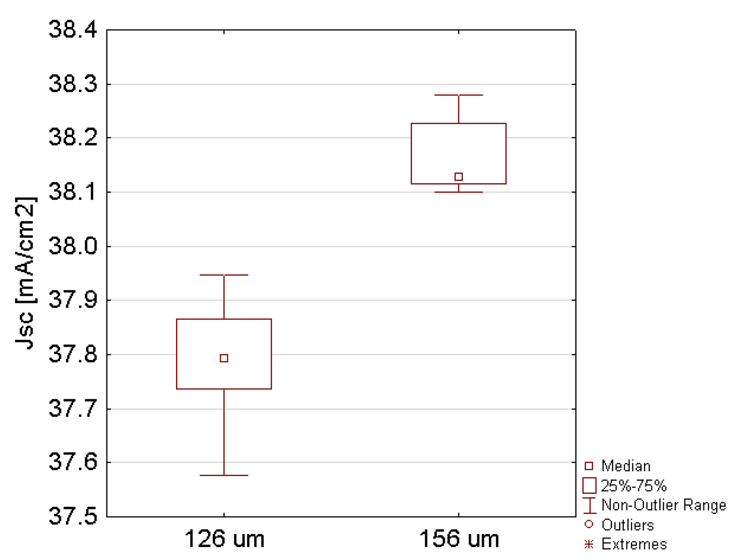
The *Swiss Inno-HJT* project

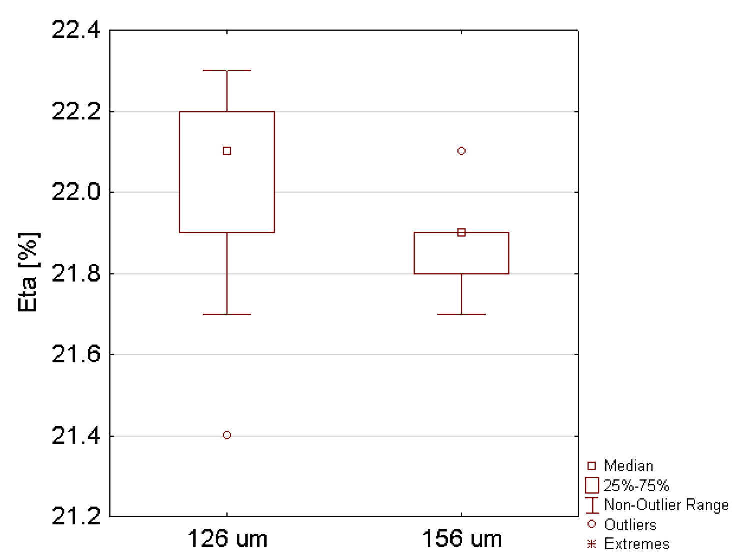
During the recent year, it has been proven that silicon heterojunction (Si-HJT) solar cells can achieve efficiencies above 25% using simple cell structure. However, most of these record cells have been achieved at the R&D scale and only few companies are producing Si-HJT cells and modules on a mass production scale. In light of this observation, Meyer Burger together with the PV-Center of CSEM and the contribution of the Swiss Federal Office of Energy and the State of Neuchâtel have started end 2013 a project to perform fully integrated R&D at the pilot scale with an overall budget of 10 millions CHF over 3 years. The *Swiss Inno-HJT* project brings together the development from the sawing of thin wafers using diamond wire technology, advanced cell concepts using proven Meyer Burger deposition equipments for Si-HJT cell production and low cost metallization by plating at pilot scale at CSEM. These cells are integrated in monofacial and bifacial modules using the SmartWire technology and are measured and monitored in outdoor conditions to show the benefits in terms of kWh produced by Si-HJT modules compared to commercially available modules.

Thin wafer sawing

Si-HJT cells is one of the few technologies that can be manufactured on thin wafers while keeping a high manufacturing yield thanks to the low temperature processes and without loosing efficiency. However, sawing thin wafers is challenging and can be achieved only using diamond wires technology. 143 ± 3 μm 6 inch wafers have been sawn succesfully on a Meyer Burger DW288+ tool with yield and TTV comparable to standard process used for standard wafer thickness of 180 μm.

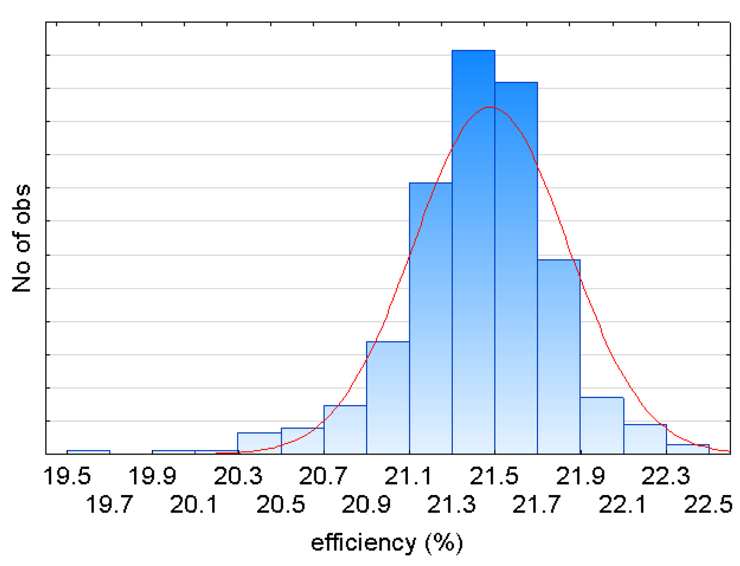
Bifacial cells were manufactured to qualify these thin wafers and benchmarked against thicker wafers. It is shown that despite the reduction of wafer/cell thickness by 30 μm, the loss in photogenerated current (-0.3 mA/cm²) is over compensated by the gain in both Voc (+5 mV) and FF (+1.1%$_{abs}$). The median cell efficiency over the full ingot length is of 22.1% for a cell thickness of 126 μm. This demonstrates that more W_p can be produced by ingot length thanks to the higher quantity of produced wafers per ingot without affecting the final cell efficiency.

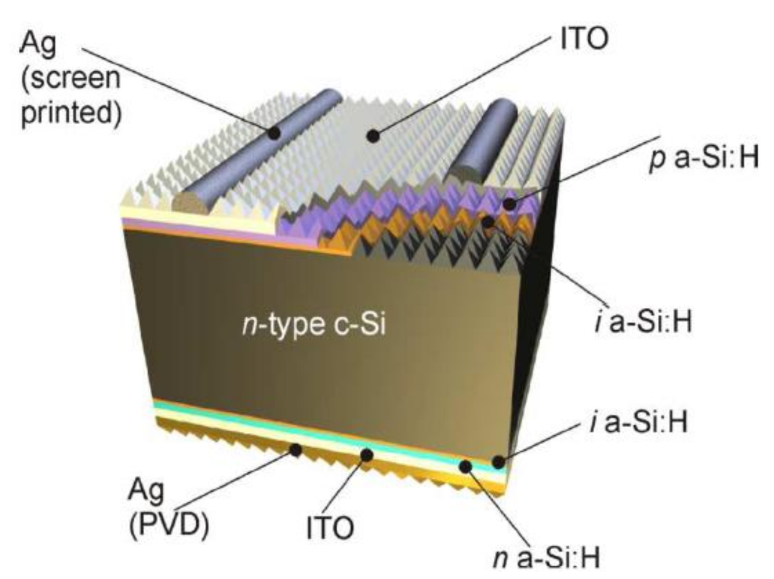




Gen 1 Si-HJT cells

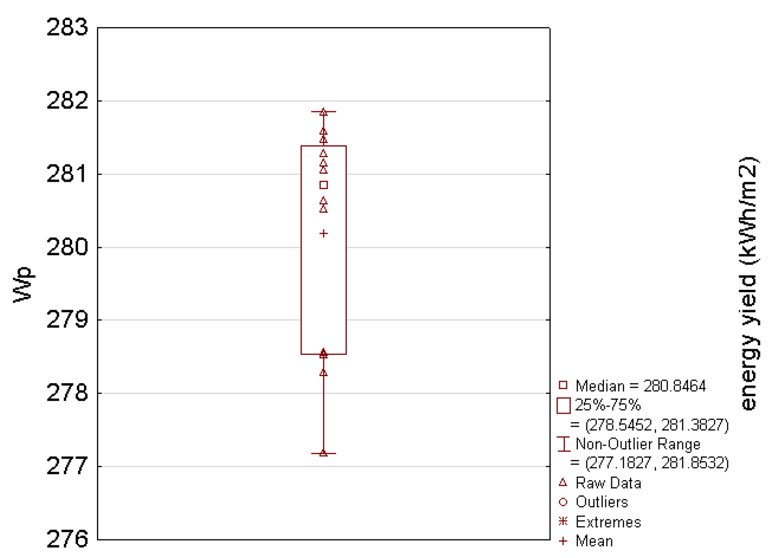
About 800 Gen 1 cells have been manufactured in the pilot line. The cell structure is a very standard monofacial cell with full sputtered ITO, silver and nickel layers at the back side optimized to reach the lowest manufacturing costs. The front side metallization has a bussbar less pattern. The median cell efficiency is 21.47% with best cell having an efficiency of 22.5% (80.7% FF, 38 mA/cm², 733 mV) as measured with the Grid^{TOUCH} contacting.

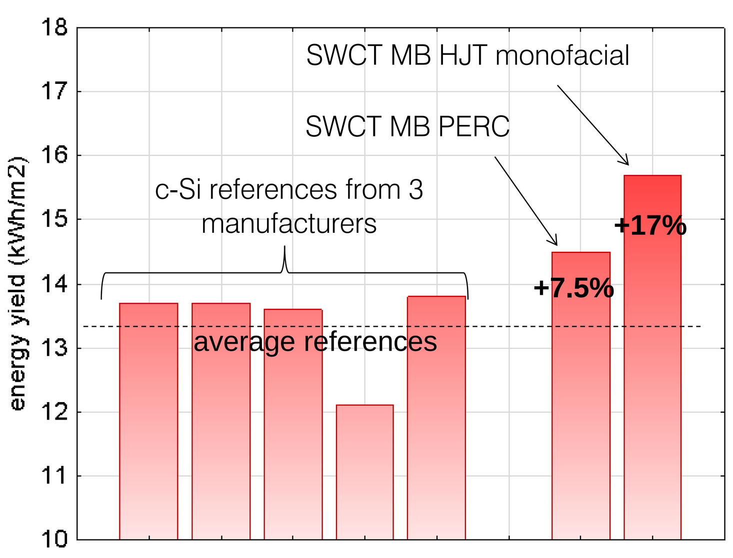




Gen 1 module

These cells have been integrated in monofacial modules with white back sheet. The cells were interconnected using the SmartWire Connection Technology with 18 wires of 200 μm each. The median module output power has been measured at 281 W. These modules have been installed outdoor and data acquisition started in January 2016. Preliminary outdoor testing (June 2015, Neuchâtel) have already shown the benefit of HJT modules amongst homojunction technology with a gain in energy yield of +17%.

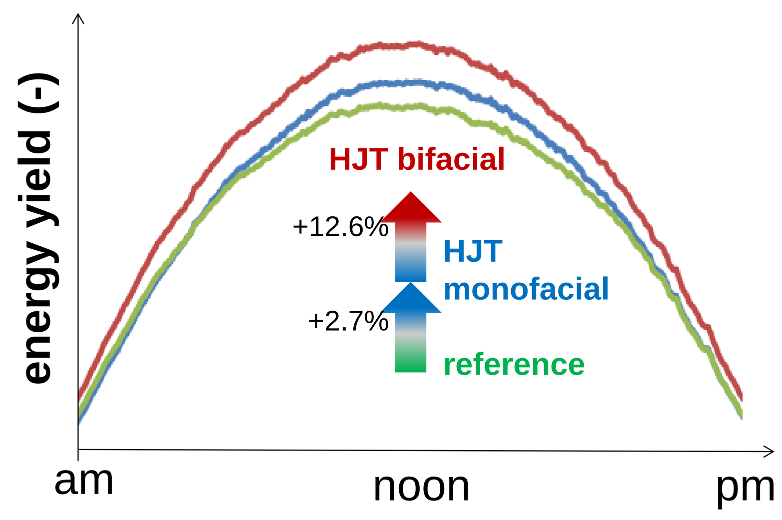




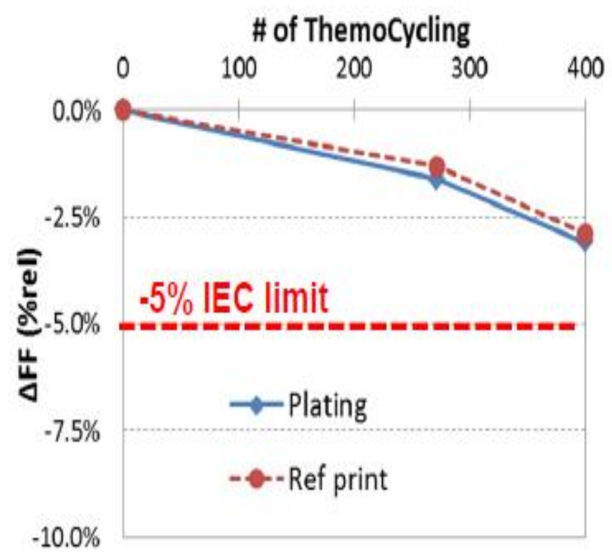
Next cell & module generation

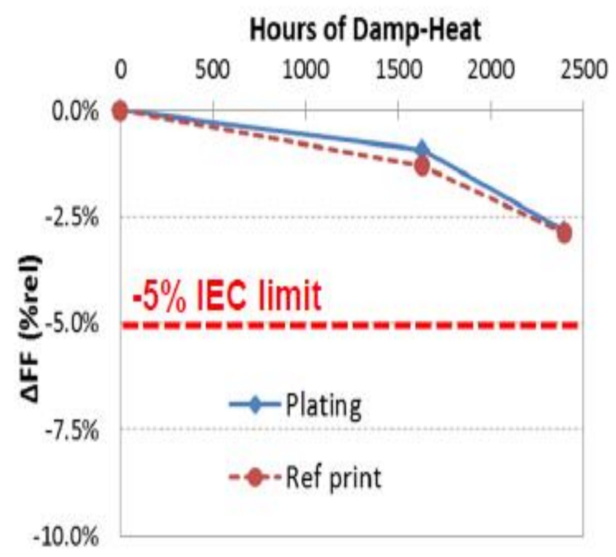
In parallel to the production of Gen 1 cells, the development of the 2nd and 3rd generation of cells and modules has been carried out by the different partners of the project.

The cells of 2nd generation have been produced early 2016 and consists of bifacial cells that will be integrated in bifacial modules. This technology has already shown in preliminary outdoor tests its huge potential. Indeed, a 10% increase of the produced kWh has been observed when compared to monofacial modules.



The 3rd generation will combine the bifaciality of the 2nd generation and advanced metallization using plated copper with low cost negative masking in order to increase the cell efficiency and further reduce the manufacturing cost. Test modules in which these silver free cells have been integrated have been stressed in climatic chambers (damp heat and thermo cycling). Results show that these modules behave in a similar way as with silver screen printed cells.





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