Ultra-thin PERC-based PV module that achieves Class A module efficiencies

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At this week's European Photovoltaic Solar Energy Conference and Exhibition (27th EU PVSEC, 24/08-28/08), imec and SolarWorld will present ultra-thin (100µm), large-area (156x156mm2) PERC-type mono-silicon solar cells integrated in a 255Wp class A module. The PERC-based modules, developed by imec and SolarWorld, were manufactured on SolarWorld's fully automated production line without significant wafer breakage. This feat proves the robustness of the PERC technology and the high quality of SolarWorld's module manufacturing. PERC-type silicon solar cells are promising candidates for next generation solar cell concepts for mass production because of their high conversion efficiencies combined with a reduced amount of silicon.

Although the price of silicon feedstock for PV has come down significantly, it still makes sense for cost and performance reasons to explore technology solutions for thin, high-efficiency crystalline Si solar cells. The production yield for thin cells is typically an obstacle hindering full industrial adoption. In addition to increasing the conversion efficiency for thin cells by improving surface passivation, PERC technology also reduces the internal stress in the cells. This potentially enables less critical handling of the thin wafers in manufacturing.

Imec and SolarWorld's modules each contain 60 randomly selected i-PERC cells, co-fabricated by imec's PV research group and SolarWorld Innovations (SWIN), starting from 120µm thin Cz-silicon wafer material. After surface decoupling and junction formation at SWIN,

imec performed rear side passivation and rear laser ablation. The rear aluminum metallization was deposited at SWIN, while imec conducted the silver screen-printing, co-firing and characterization.

An averaged cell efficiency of 18.5 percent (+/- 0.5 percent) has been measured, with a best cell performing at 19 percent efficiency. Finally, enough cells for module production with 18.5 percent (+/-0.2 percent) were implemented in 60cell class A standard modules using SolarWorld's module manufacturing line. Imec and SolarWorld's modules demonstrated a power higher than 255Wp measured at SolarWorld's Module Testing Lab.

"Despite the final thickness of the wafers of only 100µm, these cells could be run through SolarWorld's fully automated standard module mass production," said Johannes Kirchner, project manager at SolarWorld and department manager of the PV-Module Testing Lab.

Joachim John, R&D PV project manager at imec, stated: "We are delighted with this achievement as it is yet another demonstration of the industrial relevance of imec's PERC technology. The low breakage rate in the i-PERC production and in the fully automated module fabrication, together with the narrow processing distribution of the cell results, demonstrate that a serious reduction of silicon material is feasible in highly efficient PERC solar cell production."

Provided by IMEC