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Next – generation interdigitated back-contacted silicon heterojunction solar cells and modules by design and process innovations

NextBase - Deliverable report

D7.5 High Efficiency module showing an energy conversion efficiency above 22%

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Publishable summary

With this final deliverable, we demonstrate the feasibility of **the integration of the IBC-SHJ cells into PV modules with >22% efficiency** using advanced cell interconnection technology and module materials. By combining all developments made both at cell and module level, the excellent results obtained and described in this deliverable also contribute to fully validate different technological choices/optimizations made all along the project timeframe:

- Optimized Co-design of the 6-inch IBC cell metallization and insulation pattern and interconnection for SWCT
- Proper choice of materials for metallization, insulation pads and encapsulation, all allowing to successively pass DH and TC reliability tests (1x IEC requirements)
- Validation of AR-glass coating with improved performance
- Validation of module integration design, interconnection scheme and associated process steps
- Compatibility of final module integration scheme with cost objective (< 6ct/cell interconnection material cost)

Upon first validation and compatibility studies, we have thus selected the following materials for further development and final record module demonstration:

- Full industrial M2 size IBC wafers provided by MBR
- Adapted Smart-Wire interconnection scheme by CSEM
- Thermo-plastic encapsulant materials (commercial)
- Anti-Reflective Glass, provided by DSM

With the SmartWire Connection Technology we were thus able to demonstrate 23.8% (~96% CTM) efficient 1-cell laminates approaching current world record for single junction 6-inch silicon wafer-based samples. We have further demonstrated a 22% efficient 2x2 mini-module and assembled a 60-cell proof-of-concept module. All these samples are prepared with reliability proven materials passing the IEC standard 61215 for thermal-cycling between -40°C and +85°C and damp-heat at 85°C and 85% relative humidity with less than 5% degradation. Anti-reflective coated module glass developed in the WP also plays a significant role in achieving this performance in standard conditions and will enable further boost to the module performance in real-life conditions thanks to the improved light in coupling properties of the coating. The robustness of this coating has been validated on 60-cell modules in damp heat conditions as well as in highly accelerated test conditions required by the market.

With the results described in this final deliverable, we demonstrate that the work package achieved mostly all its challenging innovation goals, managing to successfully integrate the innovation on material and cell level in high performance reliable and cost-competitive mini-modules and full-area 60-cell demonstrator module.