Fraunhofer
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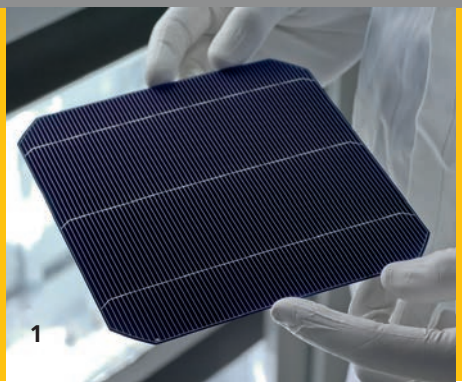
FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE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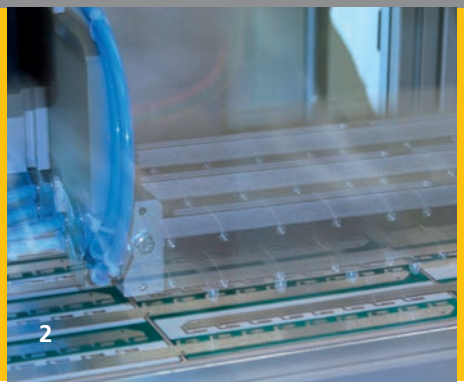
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1 *HIP-MWT solar cell with passivated rear side and laser fired contacts.*
2 *Automated MWT cell stringer for interconnection with structured ribbons.*
3 *Front of a MWT module.*

MWT SOLAR CELL AND MODULE TECHNOLOGY

Metal wrap through (MWT) solar cells provide higher conversion efficiencies under processes close to standard fabrication sequences. Therefore this concept exhibits an excellent perspective for large-scale PV market penetration.

In more than 8 years of research and development in the field of MWT technology, a profound expertise has been acquired at Fraunhofer ISE. In cooperation with industrial partners we have achieved:

- cell efficiencies greater than 18 % for mc-Si and greater than 20 % for Cz-Si (p-type)
- cell-to-module (CTM) power loss less than 1 % rel.

By getting your MWT products and equipment qualified by Fraunhofer ISE, you can also profit from our expertise and excellent infrastructure to achieve a successful PV market entry.

The Fraunhofer ISE HIP-MWT Concept
With the high-performance MWT (HIP-MWT) approach, we reach these high efficiencies with only one additional process step compared to passivated H-pattern cells. Processing of several thousand solar cells demonstrates the applicability for mass production. The MWT module design is based on structured interconnector ribbons for high compatibility with the standard module concept.

Research and Testing Facilities at Fraunhofer ISE
The Photovoltaic Technology Evaluation Center (PVTEC) and the Module Technology Center (MTC) are both ideal platforms for processing on a pilot line scale.
Our accredited characterization labs CalLab PV Cells and CalLab PV Modules enable high precision IV-measurements. At the Testlab PV Modules the reliability according to IEC 61215 is tested.

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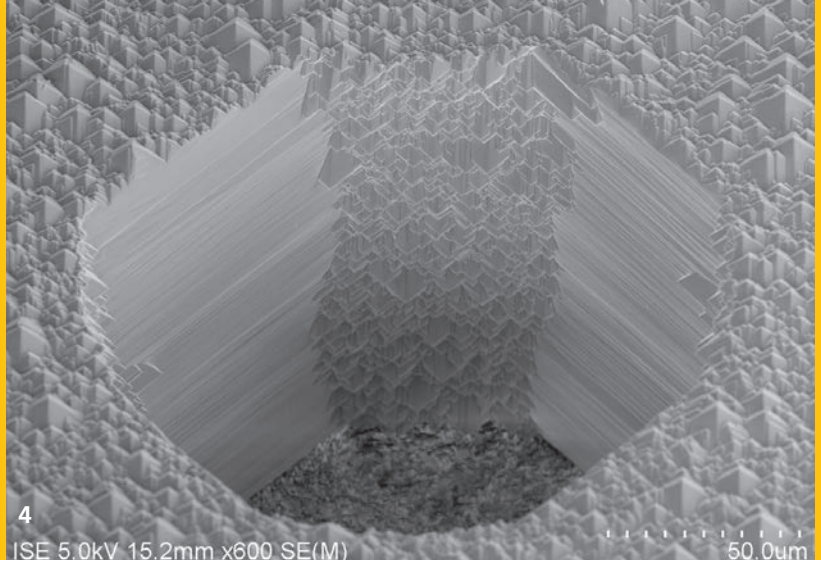
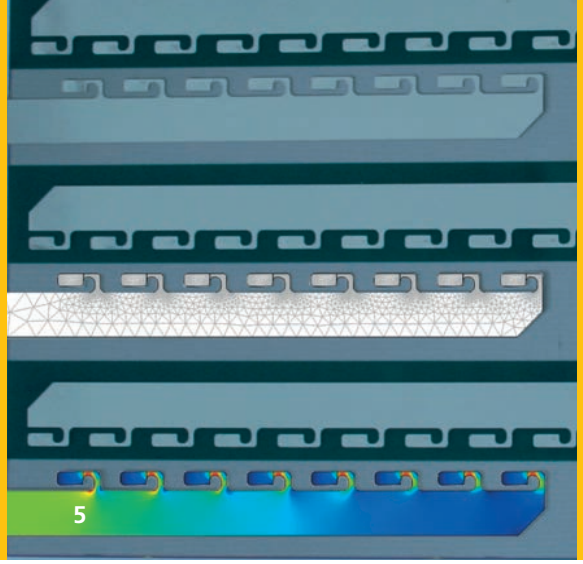




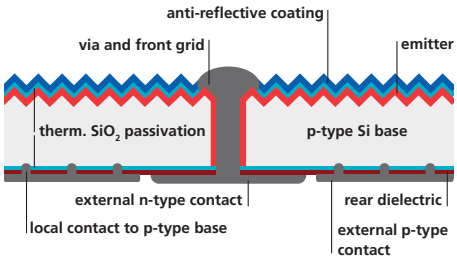
Expertise and Services for MWT Solar Cells

- individually adaptable process sequences for MWT cells with both Al-BSF and passivated rear side
- optimization of via drilling and the via metallization process
- detailed characterization of via metallization (including automated via resistance measurements)
- simplification of MWT structures and processes
- implementation of high-efficiency features (e.g. selective emitter, surface passivation)
- integration of novel metallization technologies (e.g. dispensing, plating, stencil printing)
- fabrication and measurement of customized MWT contact layouts
- MWT cells for concentrated illumination
- investigation and optimization of long-term reverse bias stability
- evaluation and qualification of MWT metal pastes
- MWT cell layouts for ribbon based interconnection and for conductive foil based interconnection
- cost of ownership analysis for MWT cells, modules and systems
- modelling and rating of optical, electrical and resistive losses

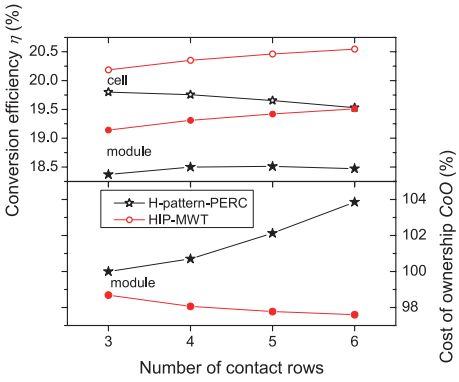
Expertise and Services for MWT Modules

- qualification of MWT cells for module integration
- detailed CTM-analysis and optimization of module designs
- IEC 61215 certification testing and outdoor monitoring
- individual reliability testing
- optimization of ribbon designs for back contact solar cells
- qualification of encapsulation sheets and back sheets
- optical, electrical and thermomechanical analysis and FEM-simulation of interconnection design
- fabrication of customized MWT module prototypes
- high accuracy power measurements (1.8 % in power)
- detailed characterization of soldering/ adhesive joints (REM, XRay, metallographic analyses)
- various contacting methods for MWT solar cells with different soldering techniques (laser, inductive, infrared, contact and ultrasonic soldering)
- automated MWT cell stringing
- yield measurements for MWT and standard H-pattern solar modules
- receiver development for MWT low concentrating systems

4 REM picture of a via after alkaline texturing.
5 Electrical FEM simulation of ohmic losses in ribbons.



Schematic cross section of a p-type high-performance MWT (HIP-MWT) solar cell, which only demands one additional process step compared to passivated H-pattern cells.



Evaluation of conversion efficiency and cost of ownership of screen printed HIP-MWT and H-pattern PERC solar cells and modules fabricated in Europe. All cells exhibit 9 solder pads per contact row. The finger witdh is reduced subsequently from 60 µm (3 BB) down to 45 µm (6 BB). The busbar width for H-pattern is 1.5 mm for all metallization layouts.