



1 Production of a shingle module in matrix technique with pSPEER solar cells at Module-TEC, Fraunhofer ISE.

2 Shingled positioning of cells in a pre-structured EVA foil ("SlimLine", patent pending).

3 Electroluminescence image of a shingle solar cell module in matrix layout.

INCREASED EFFICIENCY WITH BIFACIAL SHINGLE MODULES

In shingle modules, rectangular cells are connected by edge overlap, an arrangement similar to roof tiles. The power output of shingle modules is increased by

- significantly enhancing the active cell area ratio within the module,
- decreasing shading losses,
- reducing cell interconnection losses.

Highest Efficiency with pSPEER and Matrix Technology

The front side efficiency of our bifacial shingle module targets 22,2%, with a bifaciality ratio of 80%. This leads to a power output density of 240 W/m² at 1000 W/m² front and 100 W/m² rear side irradiance.

To manufacture bifacial shingle solar modules with such a high power output, the "p-type Silicon shingled Passivated Edge, Emitter and Rear (pSPEER)" solar cell concept of Fraunhofer ISE is applied. The pSPEER cells are based on the Passivated Emitter and Rear Cell (PERC) approach and include a passivated edge. The module

design features a combination of series and parallel connections. This enables horizontal current flow and results in reduced shading losses and improved hot spot behavior.

Process Simplification with "SlimLine" Production Method

A pre-structured EVA foil supports positioning of the cells. Terrace steps serve for a precise definition of lateral cell position, overlap and step height. This method enables low temperature soldering or curing of electrically conductive adhesives during lamination, which reduces the number of process steps required for module production. The "SlimLine" process has been patented by Fraunhofer ISE.

Our Services

- development support for shingle cell and module
- shingle module prototyping
- detailed assessment of adhesive joints
- comprehensive reliability analysis

Fraunhofer Institute for Solar Energy Systems ISE

Heidenhofstr. 2
79110 Freiburg, Germany

Photovoltaic Modules and Power Plants – Module Technology

Dr. Holger Neuhaus
Phone +49 761 4588-5825
pvmod.tech@ise.fraunhofer.de

www.ise.fraunhofer.de