

PRESS RELEASE

PRESS RELEASEOctober 5, 2021 || Page 1 | 3

Staggered and Arrayed: M10 Industries AG and Fraunhofer ISE Develop Matrix Shingle Technology to Industrial Maturity

M10 Industries AG and the Fraunhofer Institute for Solar Energy Systems ISE and have developed a matrix shingle concept for connecting silicon solar cells and a new stringer for manufacturing novel matrix shingle modules. The stringer, which arranges the shingle solar cells offset from each other similar to bricks in a masonry wall, was built within the Shirkan project, funded by the German Federal Ministry for Economic Affairs and Energy (BMWi). This shingle arrangement results in increased efficiency, a homogeneous appearance and improved shading tolerance of photovoltaic modules. The first prototypes for matrix shingle modules will be shown by Fraunhofer ISE at Intersolar Europe Restart 2021 (October 6-8, Messe München, Booth A6.370).

In shingle technology, the solar cell strips are connected completely lead-free. The individual cells are overlapped in a shingle arrangement using electrically conductive adhesives to form cell strings. Photovoltaic modules manufactured in this way are more efficient, since the currents are smaller than in half-cell modules and since there are no spaces between the solar cells of a string. However, the matrix shingle concept developed by Fraunhofer ISE goes one step further: The shingled solar cells are additionally arranged in an offset manner, which allows complete, homogeneous occupancy of the entire module area. Thus, matrix shingle modules are 2 to 6 percent (relatively) more efficient than modules with conventionally connected half-cell solar cells.

In addition, the matrix shingle technology shows a very high tolerance to partial shading. Because of the matrix arrangement, the current can flow around the shaded areas, producing up to 100 percent more power under partial shading compared to conventional PV modules. Fraunhofer ISE presented a [paper](#) on these effects at the 38th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC) in September 2021.

Matrix Shingle Modules Integrate Optimally into Façades

"Matrix shingle modules are predestined for integrated applications, especially in building façades," says Achim Kraft, head of group Interconnection and Encapsulation at Fraunhofer ISE. "Particularly in building integration, maximum area utilization, shading tolerance and appealing aesthetics are important." In combination with a MorphoColor® coating, the modules appear to disappear inconspicuously into the façade or can set architectural accents in a variety of possible colors. At the Intersolar

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Europe Restart 2021, photovoltaic modules with green and blue MorphoColor® coatings will be exhibited.

PRESS RELEASE

October 5, 2021 || Page 2 | 3

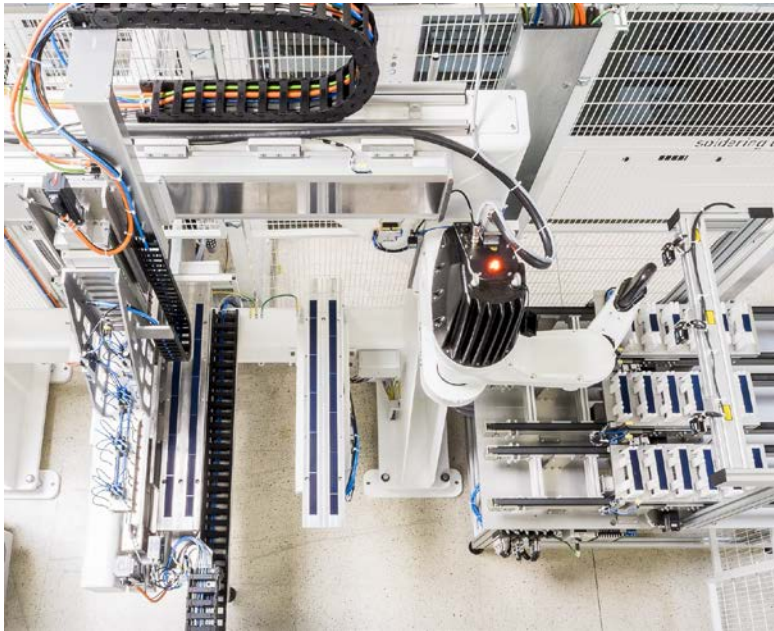
High-Throughput Due to a Completely New Machine Concept

The company M10 Industries AG has developed a stringer that enables the production of matrix shingle modules on an industrial scale. "The matrix approach has enabled us to implement a completely new machine concept. Our system has a much higher throughput than classic shingle stringers and is in no way inferior to conventional stringers in terms of megawatt output," explains Philipp Zahn, CEO of M10 Industries AG. The matrix stringer processes 12,000 shingle cells per hour in a fully automated process. The system can be integrated into conventional module production lines and connects the solar cells completely lead-free. The first prototype was put into operation in Freiburg after only seven months of development and is available there for further testing.



Matrix shingle modules are particularly suitable for integration into building facades with their high surface utilization, excellent performance under partial shading and aesthetic appearance. © M10 Industries AG

FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE



PRESS RELEASE

October 5, 2021 || Page 3 | 3

The company M10 and Fraunhofer ISE have jointly developed a system for interconnecting cells in matrix shingle modules. A robot arm arranges the shingle cells in a matrix and prepares them for the bonding process. © M10 Industries AG

Note for journalists: During the Intersolar Europe Restart 2021 in Munich, representatives of the project team will be available to answer your questions in person. If you would like to conduct an interview at the trade fair stand (A6.370), please simply contact us at presse@ise.fraunhofer.de

Further Information:

Interconnection Technologies for PV modules:

<https://www.ise.fraunhofer.de/en/business-areas/photovoltaics/photovoltaic-modules-and-power-plants/module-technology/cell-interconnection.html>

Fraunhofer ISE at the Smarter E Restart 2021:

<https://www.ise.fraunhofer.de/en/events-and-trade-fairs/Intersolar.html>

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