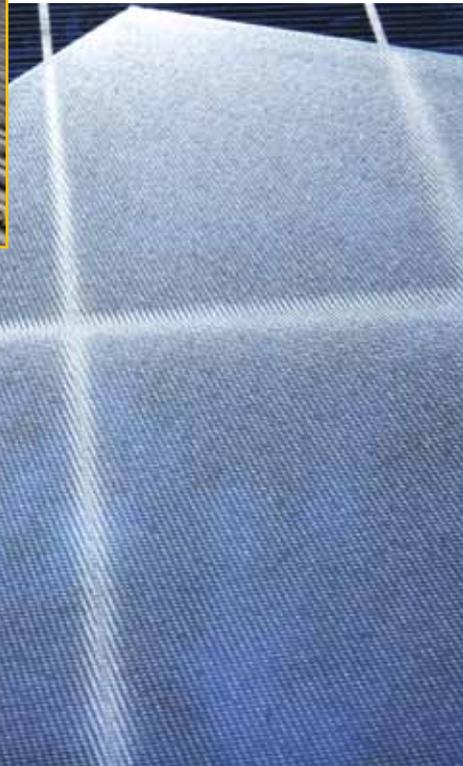


Solar Inspect



Innovative Inspection Solutions for
The Production of Crystalline Solar Modules



Inspection of Patterned Glass or
Anti-Reflective (AR) Coated Glass



Solar Glass

INSPECTION OF PATTERNED OR AR COATED SOLAR GLASS

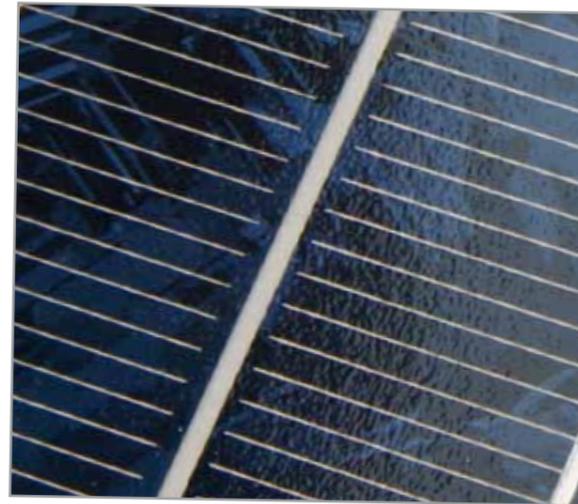
Glass as a substrate for solar modules

Manufacturers of crystalline silicon solar modules apply glass substrates on the front side of the solar modules. This front glass will either be a patterned glass or a glass with anti-reflective coating (AR).

Minimizing the risk of glass breakage & assuring highest quality standards

As in all other glass manufacturing processes, solar glass substrates are subject to defects during production. Depending on the defect type and intensity, the impact of these defects can range from a reduced transmission to a considerable negative influence on the mechanical glass characteristics.

Bubbles in the glass panel, for example, may induce a mechanical stress in the material that can lead to glass breakage during lamination or other processing steps. Especially critical are those defects that occur at the edges of the glass sheets – an area usually not covered by standard vision systems. Micro-cracks and chips of the solar glass panels are a major cause of glass breakage and their detection is important for assuring highest quality standards.

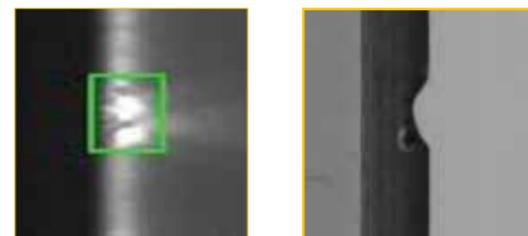


Apart from the cost for material loss, such defects can cause severe secondary costs, such as down time of production lines. The ability to detect defects in glass panels and to reject this material from further processing helps solar module manufacturers to optimize the production process.

To ensure the quality of the finished modules, the control of the dimensions and shape (rectangularity) of the glass substrates is essential. SolarInspect provides this capability parallel to the glass defect detection.

Furthermore, SolarInspect can detect glass defects at the edges of the substrate, which helps to avoid unexpected glass breakage in subsequent production and in the final product.

Edge defect detection using SolarInspect



Defect visualization on patterned glass

In the production of crystalline solar modules patterned glass substrates are used in lieu of bare glass. Patterned glass increases the amount of incoming sunlight. Common optical inspection systems for quality assurance and process control are mostly designed for unstructured glass. The surface structure, as used e.g. for glass substrates of silicon solar modules, tends to create similar or even stronger optical signals in the vision system than the actual inspected defect. Where other vision systems can only deliver limited results, Dr. Schenk has developed and manufactured SolarInspect, a system specialized to precisely distinguish between glass structure and defects covering 100 percent of the material surface including the edges.

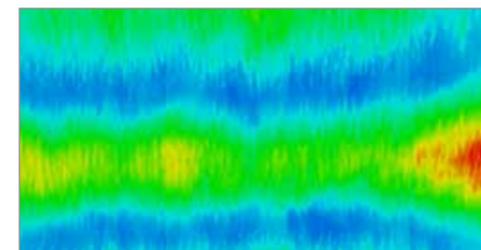
As illustrated by the grey scale images on the right, it is difficult to distinguish the defects from the glass structure. By applying an innovative optical set-up, the Dr. Schenk inspection system can clearly identify the glass defects and distinguish them from the glass structure.

Coating Defect Images



Inclusion

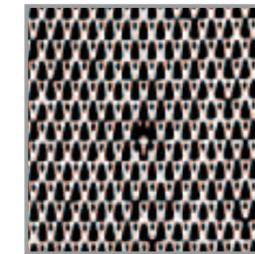
Pinhole



SolarMeasure map for control of the homogeneity of coating parameters

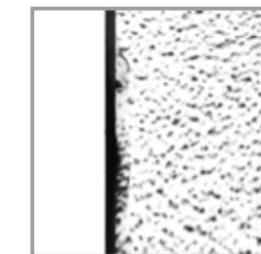
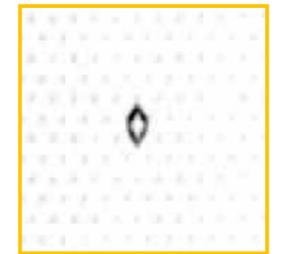
Glass Defect Images

With conventional inspection system



Bubble, round

With inspection system for patterned glass



Glass chip at panel edge



Defect visualization on AR coated glass

Anti-reflective coatings (AR coatings) are applied to the solar glass substrates to increase the amount of incoming sunlight. If the AR coating is missing or too thin in certain panel areas, the reflection of the sunlight results in a reduced cell efficiency.

Dr. Schenk SolarInspect will not only inspect the substrates for glass defects (e.g. bubble, edge chips), but will also pick up defects such as coating voids or pinholes in AR coating. Additionally, the SolarMeasure system monitors the coating homogeneity over the complete panel and helps to use only high quality substrates.

Solar Inspect Solar Measure

- Assures consistently high quality of the glass modules and by this supports you in satisfying your customers
- Controls your production process and enables early corrections
- Minimizes the risk of glass breakage during subsequent processing of the glass modules



Dr. Schenk's modern production site

Dr. Schenk GmbH, established in 1985, is an innovative high-tech company based in Munich, Germany. For the third decade now, the range of products and services offered by Dr. Schenk comprises comprehensive solutions for automated quality assurance and production process monitoring to the optical media, flat glass, film and foil, converting, paper, solar and semiconductor industries. In these areas Dr. Schenk continues to set new standards for the inspection of surfaces through the utilization of the latest technical advances in optics and electronics.

The company's primary objective is to achieve complete satisfaction of our customers on a long-term basis. This vision is realized by a perfect synergy between innovative solutions and practical ideas. Global sales and service facilities ensure local support, technical service, training and consulting at any phase of a project. From modular standard units to complex and highly customized systems – Dr. Schenk's high performance test and inspection products have precision in focus!

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