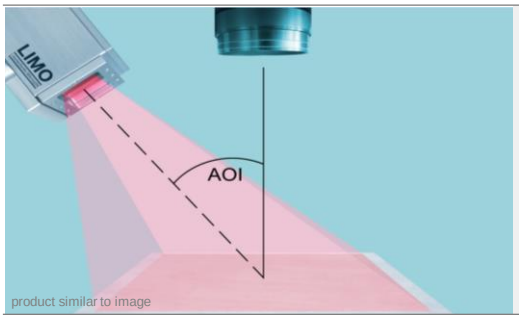
Optical Systems and Line Lasers for Fast Quality Inspection in Photovoltaics

- Photoluminescence Measurement -



General System Description: **| Advanced Optical Solutions |**

Optical methods like photoluminescence imaging can be used as a fast characterization tool for e.g. bricks, as-cut wafers and finished solar cells. The sample is illuminated homogeneously under a tilted angle. Different measurement setups are possible. Homogeneous field illumination as well as uniform line illumination are available.

Advantages of Quality Assurance by Photoluminescence:

- 100% quality control during full production speed
- Fast inline measurement
- Applicable at various inline production steps
- Contactless, non-destructive
- Suitable for bricks, wafers and cells

→ increases productivity and decreases costs per tested unit

Measurement Examples

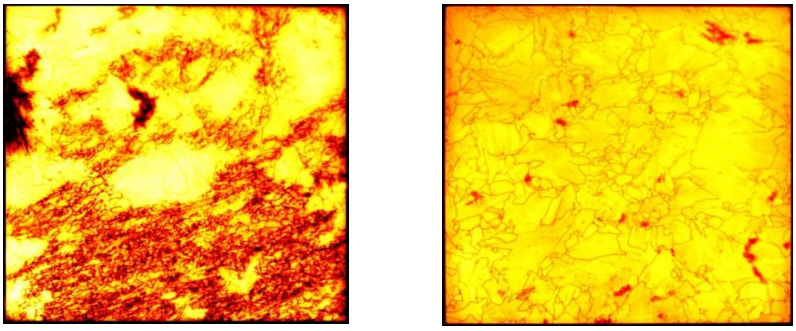


Fig. 1: Significant differences in the PL of two as-cut wafers (Courtesy of J. Haunschild, Fraunhofer ISE) - The wafer on the left has a low and the wafer on the right has a higher efficiency which is clearly marked by the poor luminescence in the left picture. These wafers were processed to finished solar cells (see Fig. 2).

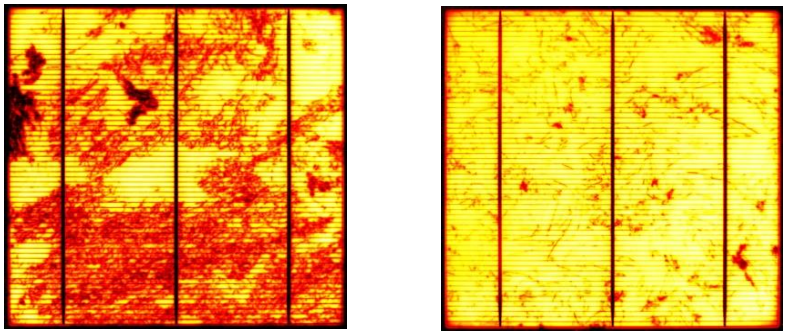


Fig. 2: PL properties of two solar cells (Courtesy of J. Haunschild, Fraunhofer ISE).

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LIMO Solutions:

Solution A - Laser & Homogenizer Module for
- Homogeneous Field Illumination -

The complete solar cell (size up to 156x156 mm²) can be homogeneously illuminated by means of LIMO optics and lasers. The beam shaping module generates a homogeneous field > 160x160 mm² under a well-defined angle. It can be easily plugged to the laser module by using an optical fibre.

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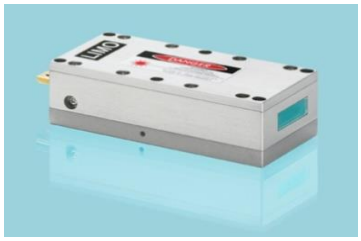
Technical Data[1]:

- Laser power: 30 – 200 W
- Wavelength: 790 / 808 nm
- Field size: > 160 x 160 mm²
- Working distance: ~ 600 mm
- Illumination angle: ~ 15°
- Inhomogeneity[2]: ≤ 7.5 %

Solution B - Line Laser for
- Homogeneous Line Illumination -

In this case a uniform line is generated on the solar cell which allows fast Inline scanning of the solar cell or wafer during the production process.
LIMOs compact line laser module generates a homogeneous line profile with a top hat profile along one axis.



Technical Data[1]:

- Laser power: 40 W
- Wavelength: 790 / 808 nm
- Field size: 165 x 3 mm²
- Working distance: ~ 750 mm
- Inhomogeneity[2]: ≤ 7.5 %

[1] Other technical data on request

[2] Inhomogeneity is specified as: (Imax-Imin)/(Imax+Imin)

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