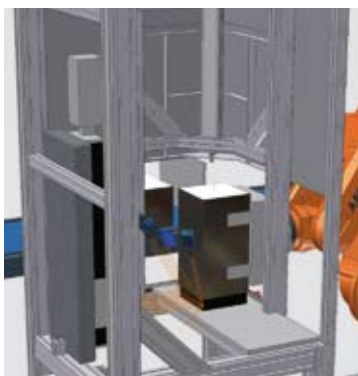


ORION: 3D Geometry Measurement and NIR Inspection of Silicon Blocks

Technical Data

Components of the inspection system

The manually operated optical inspection system consists of a linear transfer system moving the blocks from the loading position into the inspection unit. There the block can be rotated via a rotary table and the camera, lighting and/or laser units can be moved in vertical direction with a linear axis. For automatically operated inspection systems some of the actuating components can be omitted, depending on the integration into the production.



Sketch of the 3D geometry inspection system including a robot handling.

The evaluation unit is integrated into the system. Results are shown on a user monitor, where system parameters can be changed, inspection results can be supervised, and external operating signals can be tapped. The results are also communicated preferably via an OPC interface with the automation.

A permanent storing of the inspection results and of the optical image data in a storage loop is included. This, in combination with block numbers, allows for comprehension of the inspection results at a later point of time.

Performance data

Both systems can handle block sizes up to $210 \times 210 \times 800 \text{ mm}^3$ and have cycle times from 2 to 5 min per block depending on the block length and on the required accuracy.

A weighing station and a bar code scanner can also be integrated into the inspection systems. The results can be integrated in the statistic of the inspection system.

3D geometry measurement

- Measurement of length, width and height
- Ascertainment of angularity, rectitude and flatness
- Detection of defects, rills and stages
- Other geometry characteristics on request
- Generation of grinding proposals
- Maintenance free laser lighting at 660 nm

All measurements are performed point wise on a lattice with spacing of $500 \mu\text{m}$ in x-y-direction and with accuracy better than $20 \mu\text{m}$ also in z-direction. The angularity is therefore better than 0.05° . Higher accuracy is available on request.



Laser triangulation of the block surface.

NIR inspection

- Detection of smallest structures of SiN/SiC inclusions
- Generation of cutting proposals
- Maintenance free NIR lighting

The image resolution of the block is $200 \mu\text{m}$ and can be lowered to $100 \mu\text{m}$ on request. Also a 3D reconstruction of the inclusions of individual blocks and of whole ingots is possible.



NIR image with visible inclusions (dark).

Attention: Too rough surfaces lead to uncertainty of measurement. We offer to make a free feasibility analyses to judge the effect of the surface of your blocks.

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Area of application

In the manufacturing of solar cells and modules one has a variety of different high added value production steps. It is therefore reasonable to sort out faulty parts as soon as possible or even better to avoid processing them.

From the silicon raw material one grows a crystal ingot which is then sawed (band or wire) into the silicon blocks. After the block squaring follows a polishing step which gives the block the correct geometry for later processing (wafer sawing) and reduces induced stress from the squaring.

The 3D geometry measurement is located after the squaring process generating proposals for the polishing system to reduce the polishing effort.

Depending of the surface quality (see technical data), the NIR inspection can be combined with the 3D geometry measurement or must be designed as a separate system after the polishing step, where the block shows a clean smooth surface. The NIR inspection then generates cutting proposals for the wafer sawing process.

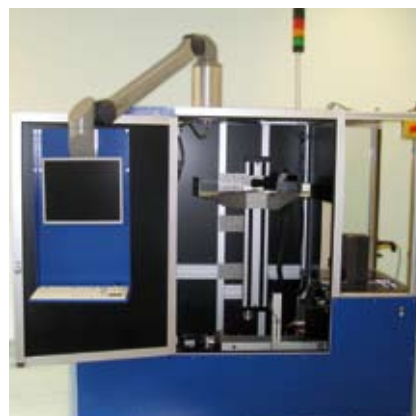


The blue regions are a 3D reconstruction of SiN and SiC impurities in a silicon block due to contaminations in the crystal growth process. These regions shall not be processed further.

Our silicon block inspection systems offer a fully automated solution for the inspection task before the two process steps polishing and wafer sawing.

Preconditions for deployment

The automatic inspection of silicon blocks is suitable for continuous automated production as well as for manual operation as a stand-alone system, e.g. for the laboratory.



Our silicon blocks inspection system covers both the 3D geometry measurement and the NIR inspection for inclusions in examination cycles of some minutes per block.

A cleaning station can be integrated to assure the purification of the block surface, e.g. to clean the residues from the polishing. Consequently, high pseudo-error rates caused by surface impurities are averted.

The optical probes incorporated in the inspection system are mostly housed to compensate for any variations in ambient lighting. As a result, no restrictions need to be made on the environmental lighting conditions.

The inspection system will be delivered with a complete internal transfer system. One side of the system is reserved for the loading and unloading. The supply can there either be managed by hand or by an automatic system integrated into the production.

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