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Inspection of Solar Cell Edges (SCE) For Cracks and Chipping Oct 2009 STVision

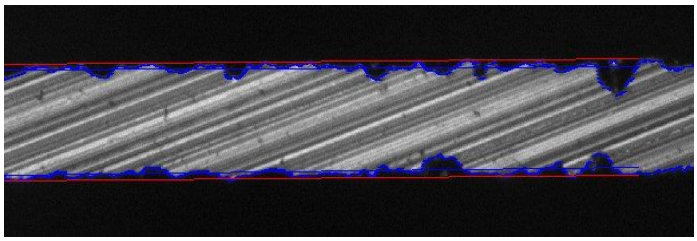
Solar cells are inspected directly after cutting from Ingots. The system scans around the complete cell contour and digitises images at resolution of 2 micron. During the scan, the system analyses the complete contour for

- Die chipping,
- Shell chips
- Deep cracks
- Micro cracks
- Edge Surface damages
- Dimension of die
- Die thickness
- Thickness distortion and waving
- Irregular die sawing.

This system helps to localize critical material weakness in the solar wafer. Large amount of chipping weakens the mechanical stability of the wafer, and increases the risk for cracks and broken die. Often these defects are invisible on the wafer surface, and later in the process the wafer may break or produce solar cells with low efficiency. And because the arrangement of solar cells in serial chains, a single weak cell cuts down the whole string of modules.

Risk for cracks and instability is best discovered from inspection of the edges. Many hurdles need be taken before the 600 mm wafer contour can be digitised and inspected in the production flow.

The SCE system is a complete stand-alone machine. The user loads a typical stack of 80, 100 or up to 250 wafers to the load stack and starts the machine. The system automatically loads each wafer into inspection position, scans around the complete edge contour of the wafer, and executes a series of test functions for each image of the contour edge:



The system finds the true die edge contour including all chipping effects. The average wafer thickness is calculated. Chipping is localized on the edge automatically. Chipping is separated into shell and deep cracks. While flat shell chips are uncritical, the hard cracks go deep into the material, and are a possible starting point for micro cracks of the material.

The system analyses chipping type, depth and density automatically, and checks against user defined tolerances. Any excess of tolerance creates a REJECT. Reject devices are sorted out on request. Alternately, you use the system to create statistical results without sorting.

The camera is mounted vertically, and is equipped with rotating mirror and illumination units. Using motorized XY axes, the camera scans around the die contour and grabs high-speed images on the fly.

The system includes a vacuum pickup nozzle set to load and unload wafers from 50 mm stack. The stack can load up to 250 wafers total. Two stacks are provided: Load stack, 50 mm height. The user loads new wafer packs for inspection.

Unload stack, 50 mm height, for the wafer after inspection.

Operation

The system is a motorized XY table with vertical camera mount. Camera is a vertical mount high definition high speed CMOS array camera with 1280 x 1024 pixel resolution and up to 100 images per second.

Optics is a manual or automatic 12.5 zoom in range 0.7 up to 10 micron per pixel.

The optics is equipped with rotating front mirror and illumination units. This allows camera view horizontally to the wafer edges on either side of the wafer.

Wafer size is up to 155 x 155 mm.

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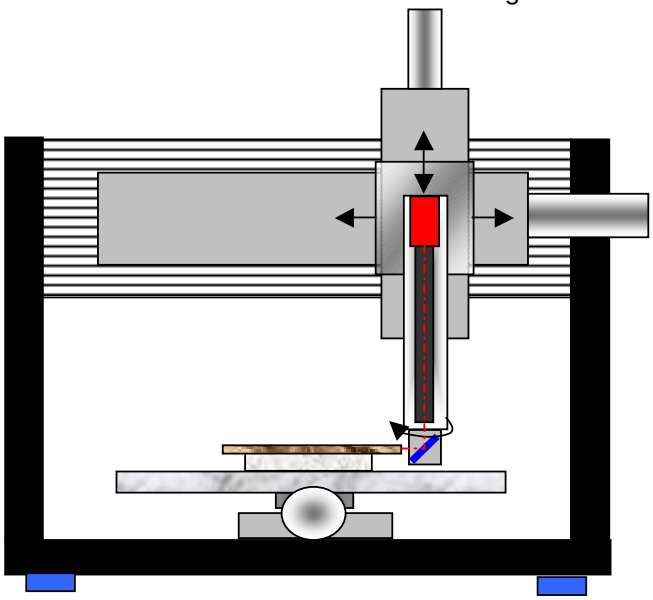
Unload stack, 50 mm height, for wafer unload after inspection. Each wafer is loaded from load stack into inspection position. Vacuum nozzles and a dedicated air separation unit are used. The wafer is vacuum fixed in inspection position. The vertical mount camera scans around the wafer in a software-programmed mode. Any shape or size of wafer is programmable, including rounded edges. During scan, the wafer edges are digitised at 80 images / sec into ca. 320 high-resolution images. The scan processing takes 5 seconds. Including loading and unloading of wafers from / to stacks, the total cycle time per wafer is approx. 10 seconds.

Misshaped wafers, non-flat edges, misalignment are compensated in the real time focus hardware correction.

Processing

On the fly, while scanning the images, the system analyses the data for chipping type, depth and density automatically, and checks against user-defined tolerances. Any excess of tolerance creates a REJECT. Reject devices are sorted out on request. Alternately, you use the system to create statistical results without sorting.



Technical Data

Camera for edge surface		
Resolution	1280 x 1024	Pixel
Image	2.6 x 2	Mm
Pixel size (configurable, example)	2 (range 0.7…10)	Micron
Min chipping size	>= 3	Micron
Scan speed	100	Mm/sec
Wafer xy pos. tolerance	+- 3	Mm
Wafer vertical tolerance	+- 1	mm
Strobe illumination	0.1 … 10000	Microsec
Spectral colour samples	4 (option: 8)	Colours
Interface to handler	24V parallel	
Throughput	10	Sec per die including handler