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INSPECT

WAF SCANNING System

Unique offline characterisation system WT2000 for lifetime, LBIC, reflectance, R_{spec} & R_{sheet} mapping

Situation

Where in most cases one single value is sufficient for a fast classification of a wafer or a solar cell, often information on the local behaviour of a measured parameter is helpful for identifying the source of a problem.

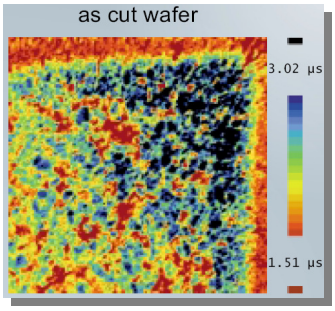
One of the most important parameters giving information on material quality is the excess carrier lifetime.

Mapping of the emitter sheet resistance after diffusion gives valuable information on dopant (gas or liquid) and temperature distribution in a diffusion process, needed for improving inline and batch diffusion quality. Where the SHR DIFF inline tool can scan up to three lines, automatic mapping using the same type of sensor with a higher spatial resolution gives more information.

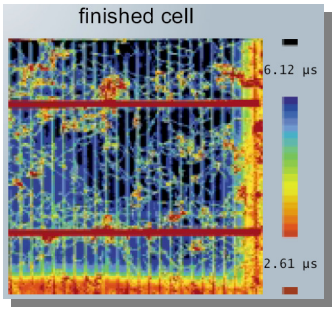
In the processed cell, local diffusion length deterioration due to contamination as well as the influence of local shunts, bad ARC coating, and losses in emitter and BSF can be identified by measurement of the local short-circuit current, and the determination of the local internal quantum efficiency.

The WAF SCAN System provides solutions for all these measurement tasks in one system, and allows for mapping of a wide range of material and device parameters.

Semilab WT-2000



As cut wafer



Finished cell

Description

The WAF-SCAN System is a unique scanning unit used worldwide in PV and semiconductor industry. It consists of a housing with a moving measurement stage and a moving sensor head, and an industrial control-unit PC.

Primary use is the measurement of excess carrier lifetime based on the µW-PCD (micro-wave detected photoconductance decay) method. A short laser pulse generates excess carriers in the sample. After the end of the laser pulse, the carriers recombine. This decay of photoconductance is detected by microwave reflection, making use of the fact that the reflected microwave energy depends on the amount of free carriers in the sample. The measurements are carried out in the dark by standard, a BIAS light option is available on demand.

Additional optional sensors can be integrated in the same measurement head, which are typical for photovoltaic applications, like LBIC, Rsheet, and Rspec sensors. Moreover, optional SPV-heads and surface potential mapping with Kelvin probe is available for special applications.

The LBIC sensor serves for measurement of the light-beam induced current (LBIC). This type of measurements is carried out on processed cells. The cell is contacted on front and rear side using a special contact pin. During measurement, the cell is illuminated locally using four lasers with different wavelengths, and the short circuit current is measured. Simultaneously, the system measures the local reflectance with an integrated detector, calculates the local IQE information of the solar cell and determines the local effective diffusion length from inverse IQE. As a result, the system gives reflection maps and LBIC maps for all four wavelengths, plus an addition Leff diffusion length map.

The Rsheet sensor serves for mapping the sheet resistance on the full wafer area, and hence allows for detailed analysis of homogeneity and quality of diffusion process. The Rsheet is based on surface photovoltage (SPV) measurement. Carriers are generated locally, and two concentric sensor rings around the excitation source pick up the local SPV. The sheet resistance of the emitter can then be determined from the voltage drop between the two rings.

The Rspec sensor is based on eddy current measurement, and serves for mapping the specific resistivity of a wafer.

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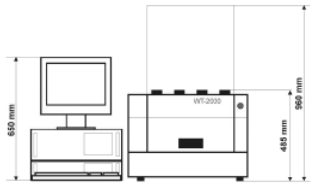
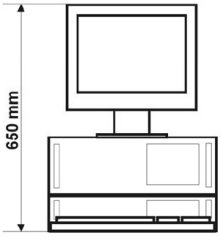
Specification

Topic	Description
Samples to be measured	▪ Mono- and multi-crystalline wafers ▪ Up to 210 mm edge length Lifetime: any type of silicon sample – the interpretation of the result depends on the sample preparation LBIC: processed solar cells with metallisation R_{sheet}: diffused silicon wafers R_{spec}: undiffused silicon wafers
Measurement range and accuracy	
Lateral resolution (map)	0.5 mm, 1 mm, 2 mm, 4 mm, 8 mm, 16 mm
Measurement time	Single point ~ 0.3...1.0 seconds, Full map 2 minutes to 24 hours (depending on resolution, accuracy, and measurement mode)
Lifetime measurement	
Measurement range	0.1µsec – 30msec
Repeatability	+/- 3 % or +/- 0.1 µs
Accuracy	10 % machine-machine correlation
Wavelength	904 nm
Pulse width	200 ns (10 ns)
Microwave frequency/range	10 GHz / 500 MHz
LBIC	
Wavelengths	Approx. 400 nm/650 nm, 880, 950, 980 nm (400 nm replaces 650 nm in "LBIC blue" option)
R_{sheet}	
Measurement range	10...200 Ohms/sqr
Repeatability	+/- 3 %
Accuracy	± 6 % (10...200 Ohms/sqr) ± 3 % (30...120 Ohms/sqr)
R_{spec}	
Measurement range	0.1...25 Ωcm 0.1 ... 12 Ωcm (for thicknesses ‹200 µm)
Repeatability	+/- 2 %
Accuracy	+/- 5 % or +/- 0.1 Ωcm (range 0.3 ... 8 Ωcm)
Dimensions (W x D)	Measurement unit 650 mm x 730 mm Height 485 mm / 960 mm (closed/open lid) PC and Keyboard 480 mm x 700 mm

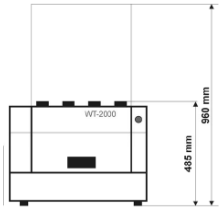
Note: some of the mentioned features are optional. Technical details subject to change without prior notice. Only technical specifications in quotations and duty books are binding.



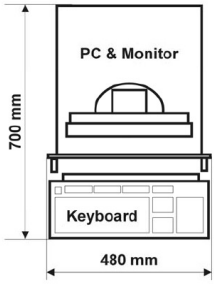
Front view WAF-SCAN System (height 960 mm with front lid open for loading/unloading)



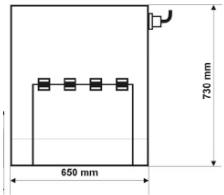
Front view PC



Front view WT 2000



Top View PC



Top View WT 2000

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