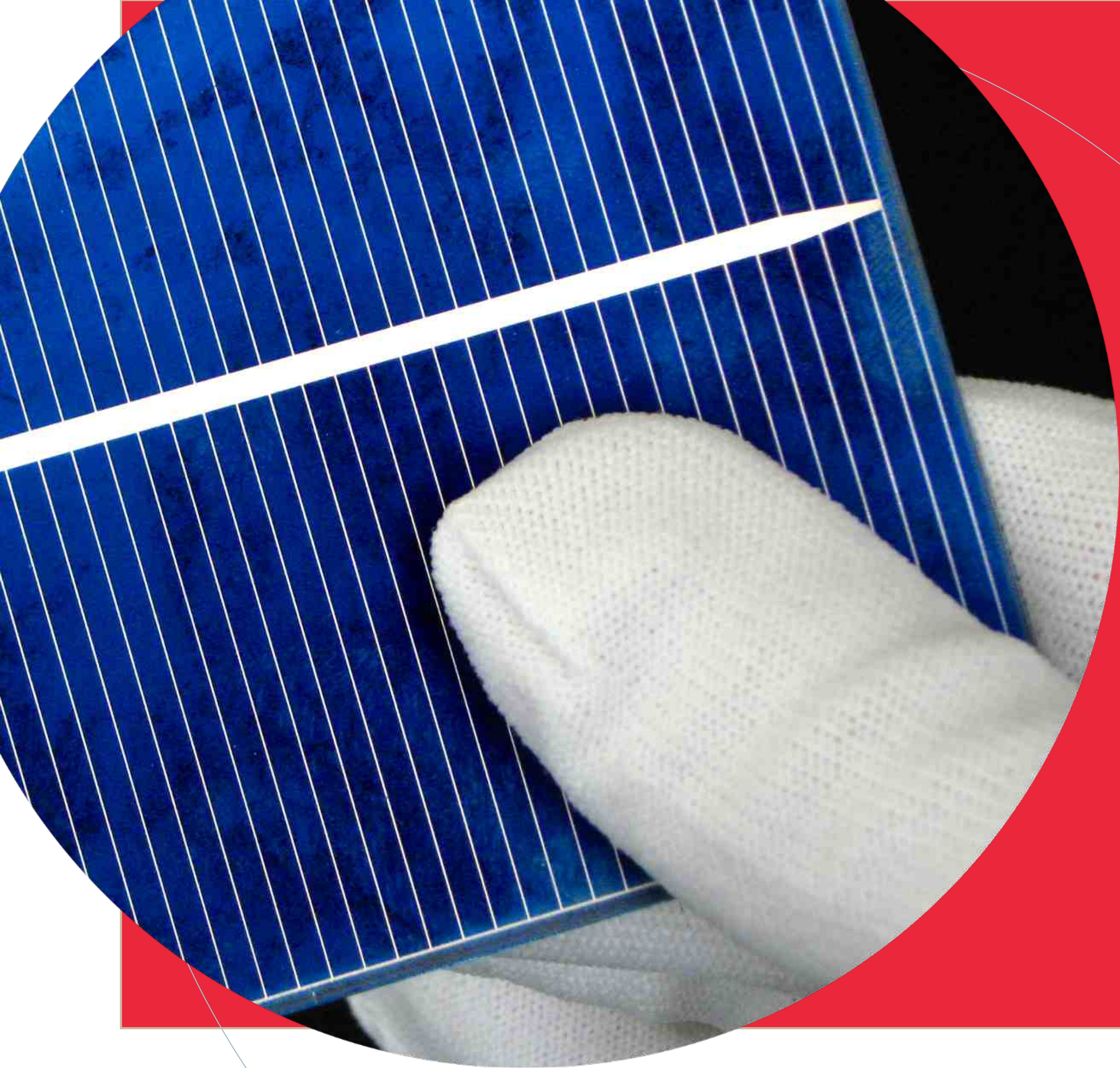


Helios LAB-rc

Texture and Coating Control of Solar Cells
Total Reflectance, Color and Layer Thickness of Coated and Uncoated Silicon Solar Wafers

NXT

Helios LAB-rc

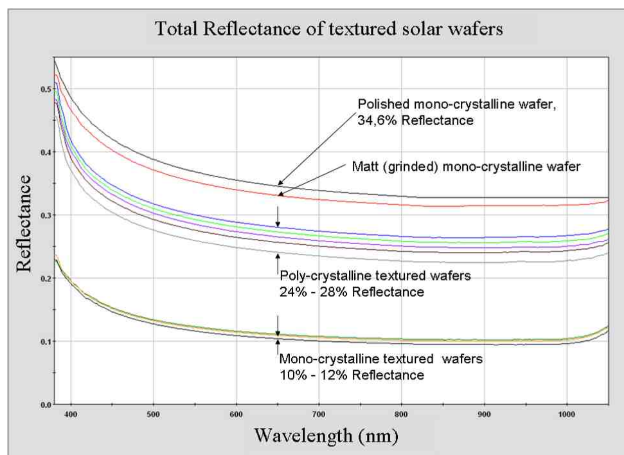
The surface texturing of crystalline solar cells plays an important role to achieve high solar cell efficiencies. The texturing reduces reflectivity losses significantly and has a strong impact on the passivation of the cell. In addition to the texturing process step itself, the quality of the silicon material and the wafer sawing process have impact on the texture. Therefore, it is essential to gain detailed knowledge of the texturing. This knowledge and process control can be achieved by precise measurement of the total reflectance of the textured cells.

NXT's Helios LAB-rc is the perfect tool to measure, analyze and optimize the widely used chemical texturing processes.

It measures the total reflectance of bare and coated solar wafers, as well as the color and layer thickness of coated solar wafers.

Measurement of the Total Spectral Reflectance

Measurement of the total spectral reflectance is a good and accepted method for maintaining a stable texturing process. The texturing affects the average level of the Reflectance and also the amount of spread/variation of the Reflectance over the wafer. Both, the average Reflectance level and the variation of the Reflectance over the wafer, are important and need to be controlled.



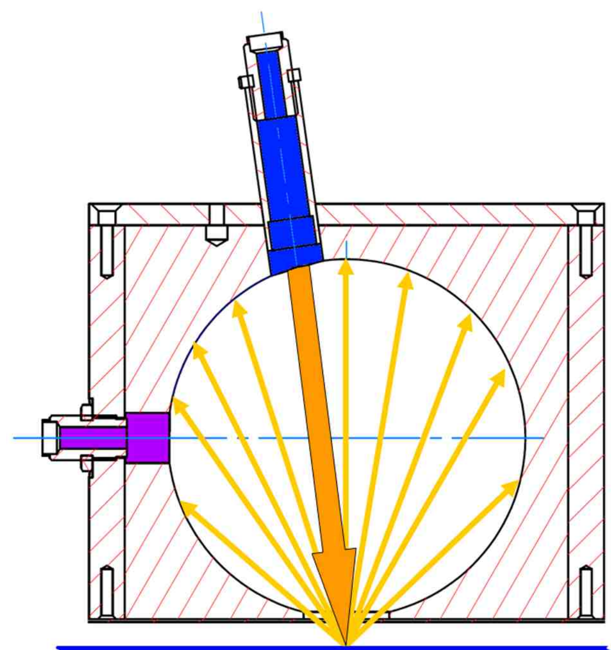
Sample measurements on different polished and rough (grinded) mono-crystalline wafers as well as on different textured poly- and mono-crystalline wafers

Principle of Measurement

Reflected light from a broadband halogen light source is collected and detected by a special designed integrating sphere. The exit port of the sphere is connected via fiber optic cable to a spectrometer. No matter if the sample surface is rough, textured or polished, all reflected or scattered light will be measured. The amount and the variation of this "Total Reflectance" allows you to control the texturing of the uncoated solar wafer and also to measure the total reflectance losses of the coated solar wafer.

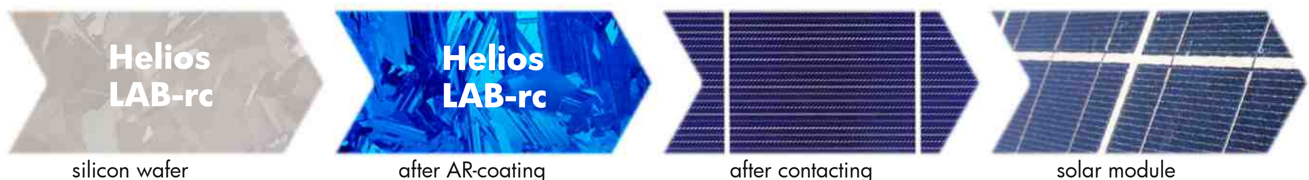
The color of the coated wafer is calculated after measuring the reflectance spectrum. Standardized algorithms are applied for calculating the color values in a selectable color space, for example Lab, xyY or LCH.

Phase differences between the front- and rear-side reflection of a thin layer cause interference. The frequency of this interference is proportional to the thickness of the layer. This phenomenon is used to evaluate the layer thickness of the coating on the solar wafer. The best match of the measured reflectance spectrum with mathematically calculated spectra is providing the layer thickness.



Cross-section of the integrating sphere. All reflected and scattered light is collected and detected by a spectrometer that is connected by fiber optics

Process Steps in which Helios LAB-rc is used



silicon wafer | after AR-coating | after contacting | solar module

Functions of Helios LAB-rc

The new Helios LAB-rc All-In-One Version includes all hardware components in one compact housing. It is an easy to use manual measurement system that enables you to measure the total reflectance of polished and textured solar wafers. In addition it measures the color and the layer thickness of coated wafers.

Function	
Manual single axis table	√
Integral total spectral reflectance measurement	√
Wavelength and reflectance value at lowest reflectance	√
Reflectance at user-definable wavelength	√
Average Reflectance within a selectable wavelength interval	√
Color evaluation	√
Coating layer thickness	√
User-definable quality limits	√
Good / Bad indication	√
Integrated fixed reference	√
Single-point measurement	√
Manual full wafer mapping	√

Highlights of Helios LAB-rc

MEASUREMENT OF BARE AND COATED WAFERS
- offline
- contactless and non-destructive
- static point by point measurement

MEASUREMENT PARAMETERS
- Total Reflectance: r (integral)
- Color: c (Lab, xyY, ...)
- Layer Thickness: t (for coated wafer)

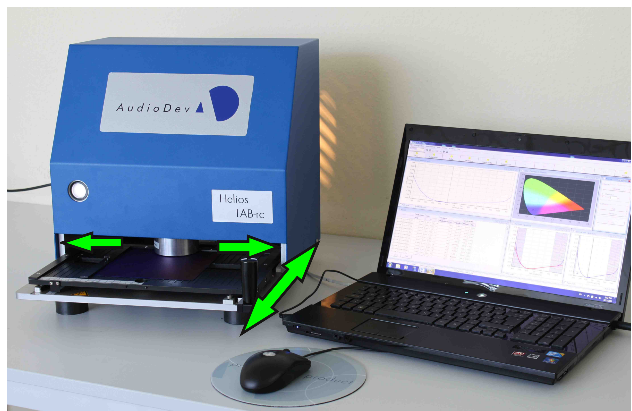
WORKS FOR ALL RELEVANT WAFER TYPES
- mc-wafers (polished, rough or textured)
- pc-wafers (polished, rough or textured)
- 125x125mm / 156x156mm / round / others

WORKS FOR ALL RELEVANT KIND OF TEXTURES
- isotropic chemically etched
- anisotropic chemically etched
- RIE (Reactive Ion Etched)

EASY OPERATION
- Integrated reference standard
- Manual single-axis table for full wafer mapping
- Easy line scan

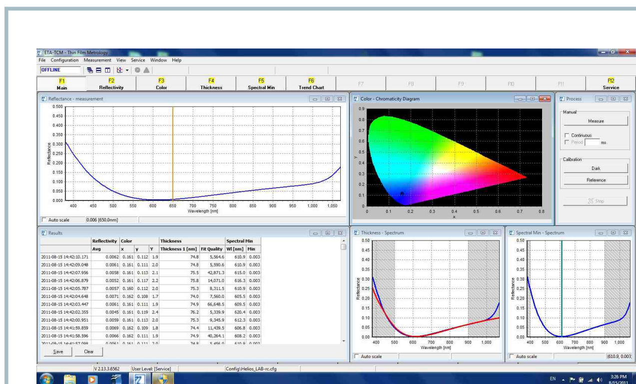
Helios LAB-rc, a good investment!

The Helios LAB-rc system can be operated without any special skills. It is very easy to operate. With the integrated manual single-axis table a line scan on a solar wafer can be perfomed very fast. The special designed sample table allows to measure on every position on a six inch wafer.
Dark position and Reference sample at a fixed position are integrated in the manual single-axis table. This allows quick dark and reference measurement within a few seconds. After that, the user may run a continuous measurement while moving the sample, or just measure a few specific points on the sample. The software allows to make a measurement report and data storage for each measured wafer in a comfortable way.

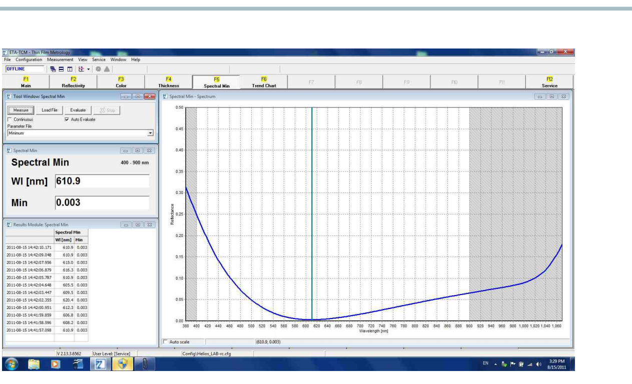


The new Helios LAB-rc All-In-One version includes all hardware in one housing. A solar wafer can be shifted left and right and the whole table can be moved forth and back. This allows quick positioning to every measurement position on a 6 inch solar wafer

Presentation Examples



Reflectance spectrum, minimum reflectance position, color and thickness presentation of a monocrystalline solar wafer sample: color in xyY presentation



Reflectance spectrum, minimum reflectance position of a monocrystalline solar wafer with SiN coating

Product Specifications

MEASUREMENT

Measurement Parameters	Reflectance / Layer thickness / Color
Reflectance Range	0 ~ 100 %
Wavelength Range	380 ~ 1050 nm
Thickness Range (SiN) (SiO)	25 ~ 120 nm 35 ~ 160 nm
Reflectance Accuracy	±0.1 %
Reflectance Repeatability*	<0.05%
Thickness Accuracy	±1 nm
Thickness Repeatability*	±0.2 nm
Color Measurement	Lab / xyY / XYZ / Lch
Color Accurracy	x,y 3σ ±0.004 / Y 3σ ±0.5
Color Repeatability*	x,y 3σ <0.002 / Y 3σ <0.2

HARDWARE

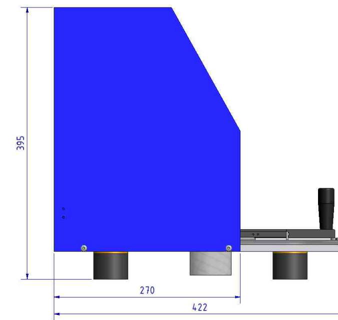
Measurement Geometry	Integrating sphere (reflected light in all angles is measured)
Measurement Spot Size	~ 8 mm
Measurement Speed	< 0,8 s / point
Wafer sizes	156 x 156mm / 125 x 125mm / round and smaller wafers
Sample Table	310 x 160mm
Environment	Temperature range: 15-35°C (50-90°F), Humidity: <80% (non-condensing)
Power	AC 100 ~ 240V; 50/60 Hz

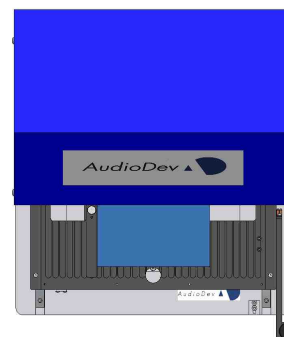
PC / SOFTWARE

Measurement Functions	Total spectral reflectance / Position of minimum reflectance / Color / Layer thickness
PC Requirements	Windows® 7 / 8 / 10, 8 GB RAM, >500 GB HDD

* 100 successive measurements at one single static position

System Dimensions





System Dimensions for Helios LAB-rc Measurement system (All-In-One Version, excluding operating PC)

Product specifications are subject to change without notice. © NXT, 2017 www.nxt91.com

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