TCM µScope: Spectrometric Measurement with versatile Microscope Measurement Head,
Color Measurement - Layer Thickness Measurement

TCM µScope

In many applications where spectrometric measurement is needed, the samples are micro structured in the sample plane. For example the measurement within single pixels of Flat Panel Displays (TFT-LCD, Plasma Display, OLED Display) or the measurement on micro structured wafers in the semiconductor industry require very small spot sizes of the measurement spot. In other applications coatings on substrates have to be measured, where the coatings are very inhomogeneous even in lateral distances of a few microns. In such cases it is necessary to measure with microscope measuring heads in Reflectance and/or Transmittance and to combine such microscope heads with Spectrometer systems and light sources, for allowing microscopic measurements of spectra, color, layer thicknesses and optical constants n&k. Measurements with spot sizes of 125µm, 50µm, 25µm, 12.5µm and 5µm can be made with such systems.

Specifications of µScope-Head

Microscope objectives
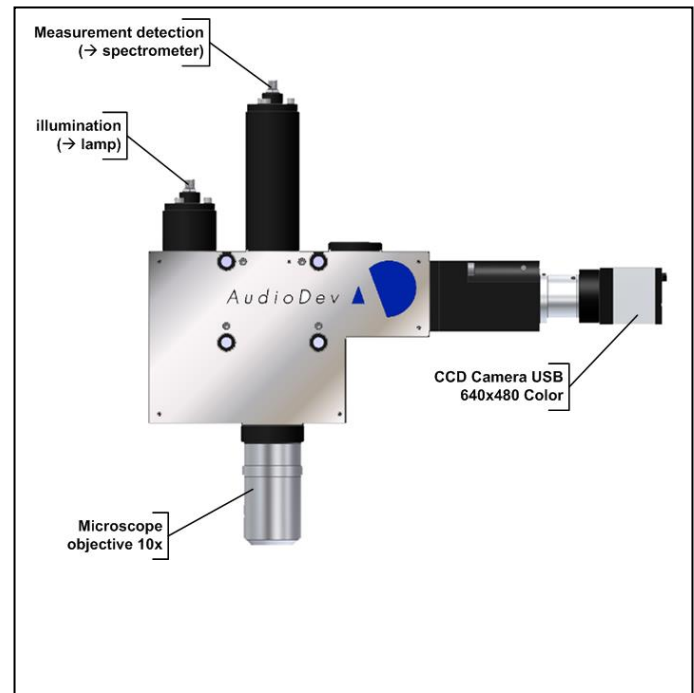
Type	Long distance, infinity corrected
Magnifications	10x (standard), 2x, 5x, 20x, 50x (optional)
Turret (optional)	Manual and motorized available
Measurement spot sizes	125µm (2x), 50µm (5x), 25µm (10x), 12.5µm (20x), 5µm (50x),
Chromatic Correction	380nm-1050nm

Camera

Type	640x480 CCD, USB-Interface

Dimensions

Size	230mm x 200mm x 50mm (WxHxD)
Size (with camera & objective)	300mm x 280mm x 50mm (WxHxD)

Highlights of the System:

Versatile Microscope Measurement System

- **Measurements on microscopic spot sizes**
  - Spectral Reflectance & Transmittance
  - Color-R, Color-T
  - Layer Thicknesses of single layers and stacks

- **Integrated CCD-camera**

- **Microscope objectives**
  - Long distance objectives
  - Chromatically corrected for wide spectral range 380nm – 1070nm
  - Infinity corrected
  - 2x, 5x, 10x, 20x, 50x magnifications available
  - Manual or motorized Turret available
  - Measurement spot sizes from $125\mu m - 5\mu m$

- **High Modularity by fiber optic coupling**
  - Spectrometer systems and light source are coupled by fiber optic cables to the microscope Head(s). Fiber optic cables with various lengths and core diameters

- **Optional Transmittance channel**

- **Optional manual xyz-stage**
  - Different movement ranges

- **Optional motorized xyz-stage**
  - Different xy-movement ranges available, up to 600mm x 600mm
  - Autofocus module
  - Automatic pattern matching functionality

NXT

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NXT is a world leader in comprehensive quality assurance solutions for specialized industries. We offer high-precision analyzers, proactive customer support and training, and Test-Centers around the world.

For different industries, our ETA™, Helios and Xelas instrument families are perfect tools for protecting quality and production efficiency. With a large installed base of testers worldwide, NXT has achieved recognition as a perfect and reliable partner for optical measurements solutions.

For producers of solar cells, OLEDs, optical medias, flat panel displays, precision optics, automotive glass, consumer packaging and other thin film applications, our solutions provide comprehensive, non-destructive quality assurance that is both time- and cost-efficient.

Our headquarter is located in Heinsberg, Germany, with subsidiaries in Sweden, USA, China and Taiwan, plus a service and support network of agents worldwide. In 2016 NXT GmbH was renamed from the formerly well known AudioDev GmbH, also known as ETA-Optik GmbH before 2007.


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- Head office and subsidiaries
- Associated companies
- Agents

Example 1:
System for Measurement of layer thicknesses of coatings outside and inside of CAN's
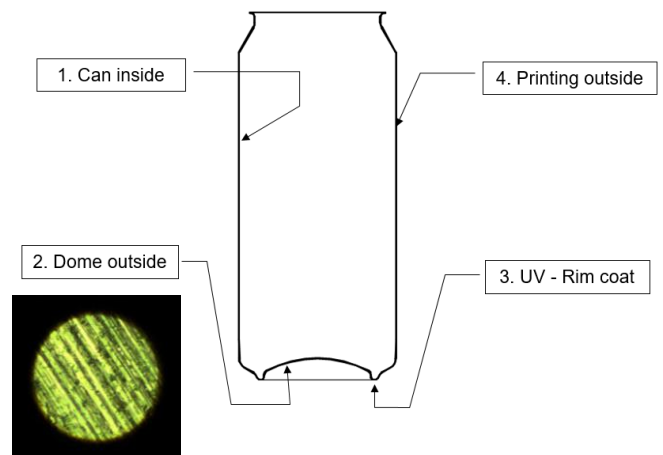

System:	**TCM µScope-LITE**
Model:	**VIS-R (optional: NIR-R)**
Measured Parameters:	**Reflectance, Color-R, Thick layer thickness (1-25 µm)**

Measurement Example

Thickness [um]:
2.942

Profile: over-varnish
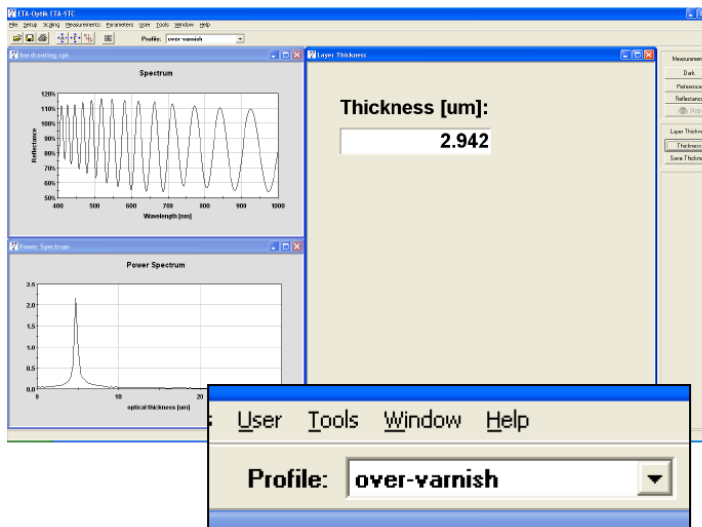
Layer Thickness of Overvarnish

1. Can inside
4. Printing outside
2. Dome outside
3. UV - Rim coat

Measurement of Lacquer Thickness at different positions

Product Specifications

System:	TCM µScope-LITE
Model:	**VIS-R (optional: NIR-R)**
Measured Parameters:	**Reflectance, Color-R, Thick layer thickness (1-25 µm)**

Measurement

Measurement parameters	Spectral Reflectance (R) Color-R Layer thicknesses of "thick" single layers and double layers

Spectral Measurement

Wavelength range (λ-range)	VIS NIR	380nm - 1050nm 850nm - 1700nm (optional)
R Accuracy		$\pm$ 0.4% (for λ > 400nm)

Thickness Measurement of thick layers

Thickness range for thick layers (FFT method) Thickness accuracy Thickness repeatability Maximum no. of layers	1µm - 25µm $\pm$ 0.05µm 3σ < 0.005µm 2

Color Measurement (Reflectance)

Chromaticity accuracy (xyY)	x,y 3σ < 0.002 Y 3σ < 0.5
Chromaticity repeatability	x,y 3σ < 0.001 Y 3σ < 0.1
Measurement geometry	White light Reflectance (R) in normal incidence (0°)
Measurement speed	< 200ms
Light Source	Halogen, 50W, > 2000h lifetime, 3000K color temperature
Spectrometer (VIS)	512 pixel Silicon diode line detector, 380nm-1070nm spectral range, 16 bit digitalization, Transmittance holographic grating, LAN-Interface
Spectrometer (NIR)	256 pixel InGaAs diode line detector, 850nm-1700nm spectral range, 16 bit digitalization, Transmittance holographic grating, LAN-Interface

Microscope Head

Objective/Magnification Measurement spot size	10x (2x, 5x, 20x, 50x optional; Turret optional) 25µm (125µm, 50µm, 12.5µm, 5µm optional)

Sample Table

Type xy size	LITE: Static manual table with manual height adjustment 100mm x 100mm (other sizes on request)

Example 2:
System for Measurement of color and layer thicknesses of thin films on wafers
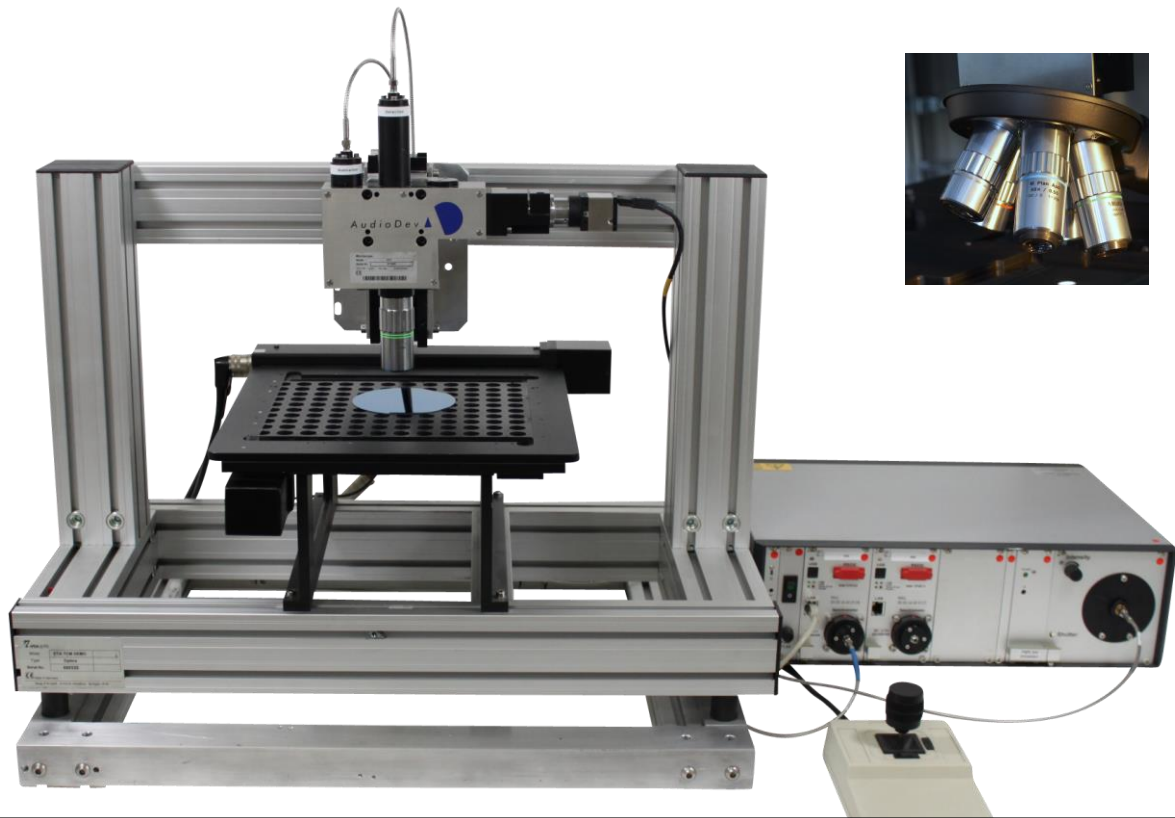
System:	**TCM µScope-SCAN**
Model:	**VIS-R-X200_Y200 (optional: NIR-R)**
Measured Parameters:	**Reflectance, Transmittance, Thick layer thickness (1-25 µm), Thin layer thicknesses (2nm-3000nm), Color-R**

Options: Additional Transmittance channel, Color-T, Optical constants n&k

Measurement of layer thicknesses on micro-structured wavers, suited for

- Substrates: Si, GaAs, SiO_2, Sapphire, Al, Ti, ….
- Coatings: SiN_x, SiO_x, SiO_xN_y, α-Si, poly-Si, µ-Si, dielectric layers, organic layers, PR-layers, ITO, metallic layers….
- Spin-coated photoresist layers for Lithography
- Inkjet printed coatings
- Vacuum coatings (MOCVD, PECVD, Sputtering, ALD…)
- MEMS, SAW-filters, photovoltaic, Display, ….

Product Specifications

System:	**TCM µScope-SCAN**
Model:	**VIS-R-X200_Y200 (optional: NIR-R optional VIS-T)**
Measured Parameters:	**Reflectance, Thick layer thickness (1-25 µm),**
	Thin layer thicknesses (2nm-3000nm),

Measurement

Measurement parameters	Spectral Reflectance Color_R Layer thicknesses of single layers and stacks

Spectral Measurement

Wavelength range (λ-range)	380nm - 1050nm 850nm - 1700nm (optional)
R&T Accuracy	± 0.4% (for λ > 400nm)

Thickness Measurement of thick layers

Thickness range for thick layers (FFT method)	1µm - 25µm
Thickness accuracy	± 0.05µm
Thickness repeatability	3σ < 0.005µm
Maximum no. of layers	2

Thickness Measurement of thin layers

Thickness range for thin layers (fit method)	2nm - 3000nm
Thickness accuracy	± 0.5nm (range 2nm-40nm)
	± 1.0nm (range 40nm-200nm)
	± 2.0nm (range 200nm-3000nm)
Thickness repeatability	3σ < 0.1nm (range 2nm - 200nm)
	3σ < 0.5nm (range 200nm - 1000nm)
	3σ < 1.0nm (range 1000nm - 300nm)
Maximum no. of layers	3

Color Measurement (Reflectance)

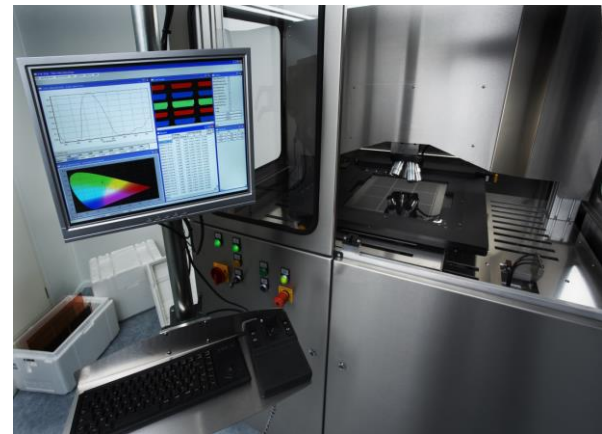|	
Chromaticity accuracy (xyY)	x,y 3σ < 0.002 Y 3σ < 0.5
Chromaticity repeatability	x,y 3σ < 0.001 Y 3σ < 0.1
Measurement geometry	White light Reflectance (R) in normal incidence (0°)
Measurement speed	1 s (for 1 layer and 2 layer thickness measurement)
Light Source	Halogen, 50W, > 2000h lifetime, 3000K color temperature
Spectrometer (VIS)	512 pixel Silicon diode line detector, 380nm-1070nm spectral range, 16 bit digitalization, Transmittance holographic grating, LAN-Interface
Spectrometer (NIR)	256 pixel InGaAs diode line detector, 850nm-1700nm spectral range, 16 bit digitalization, Transmittance holographic grating, LAN-Interface

Microscope Head

Objective/Magnification	10x (2x, 5x, 20x, 50x optional; Turret optional)
Measurement spot size	25µm (125µm, 50µm, 12.5µm, 5µm optional)
Autofocus function (by software)	Yes, with motorized z-axis
Pattern matching function (by software)	Yes
Measurement spot visualization	Yes

Sample Table

Type	SCAN: Motorized xy-table
Movement range	200mm x 200mm (other sizes on request)
Sample plate	Removable plate with holes (other sample plates on request)

Example 3:
System for Measurement of color, layer thicknesses and optical constants of thin films on Flat Panel Displays


System:	**TCM µScope-SCAN**
Model:	**VIS-RT-X450_Y450**
Measured Parameters:	**Reflectance, Transmittance, Thick layer thickness (1-20 µm), Thin layer thicknesses(2nm - 3000nm), Optical constants n&k, Color-R, Color-T**

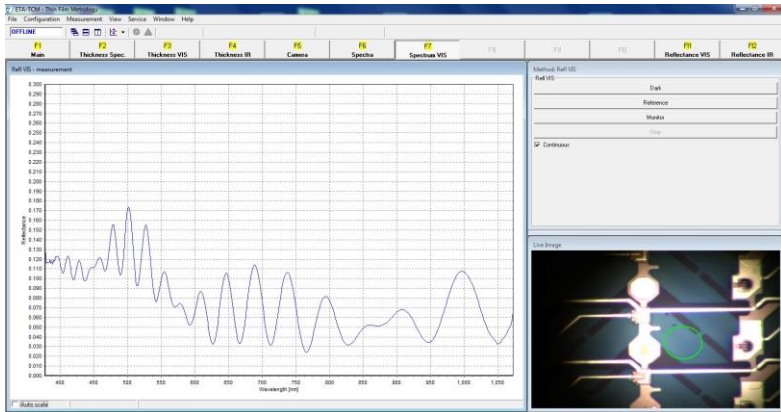**Measurement of layer thicknesses on micro structured display panels, for the measurement of**

- Spectral Reflectance & Transmittance
- Color measurement of single R, G, B pixels
- Luminous Transmittance
- Thickness measurement of
  - single RGB pixels
  - MVA layers
  - ITO
  - Overcoat (OC)
  - MVA
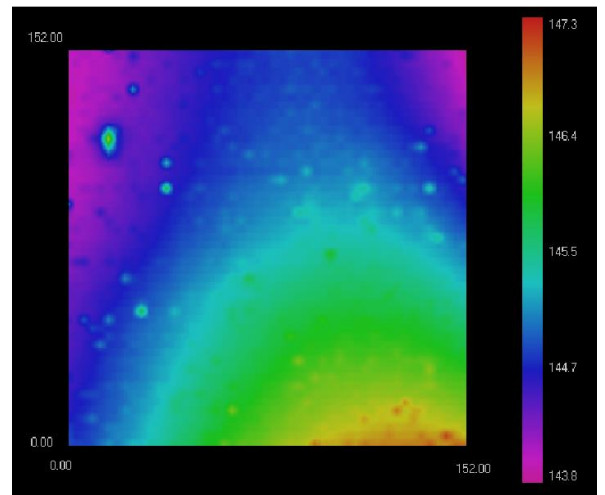 - Photospacer (PS)
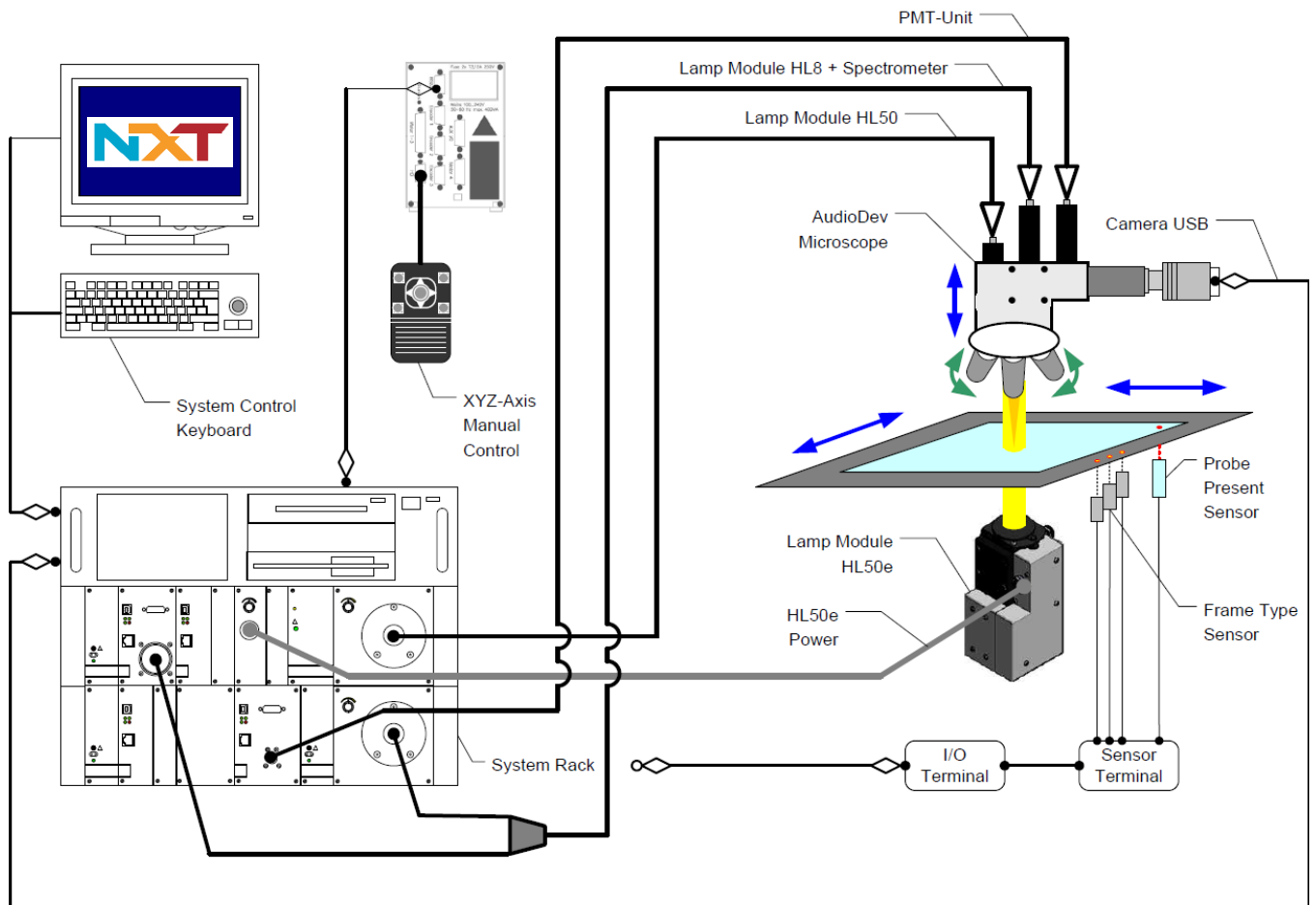 - Alignment layer
  - Cell gap
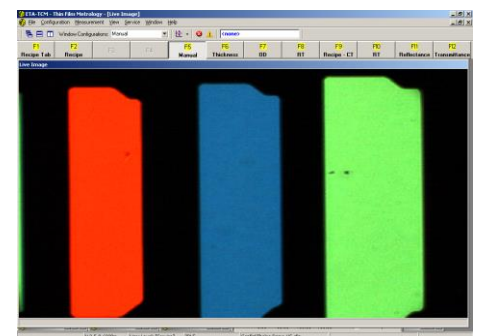
RGB-pixels
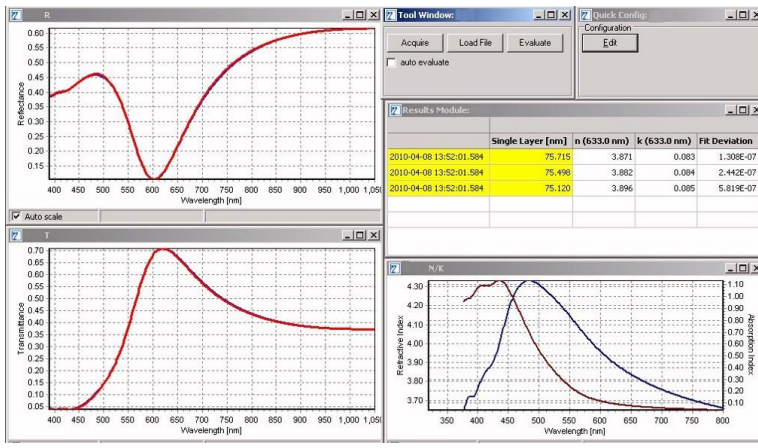
Thickness and n&k-measurement of α-Si

2D-mapping of ITO-thickness

3-layer thickness measurement, incl. PI and color filter

System Layout

Product Specifications

System:	**TCM µScope-SCAN**
Model:	**VIS-RT-X450_Y450**
Measured Parameters:	**Reflectance, Transmittance, Thick layer thicknesses (1-20 µm), Thin layer thicknesses (2nm - 3000nm), Optical constants n&k, Color-R, Color-T**

Measurement

Measurement parameters	Spectral Reflectance Spectral Transmittance Color-R Color-T Layer thicknesses of single layers and stacks Optical Constants n&k (spectral refractive index and absorption coefficient)

Spectral Measurement

Wavelength range (λ-range)	380nm - 1050nm 850nm - 1700nm (optional)
R&T Accuracy	$\pm$ 0.4% (for λ > 400nm)

Thickness Measurement of thick layers

Thickness range for thick layers (FFT method)	1µm - 25µm
Thickness accuracy	$\pm$ 0.05µm
Thickness repeatability	3σ < 0.005µm
Maximum no. of layers	2

Thickness Measurement of thin layers

Thickness range for thin layers (fit method)	2nm - 3000nm
Thickness accuracy	$\pm$ 0.5nm (range 2nm-40nm)
	$\pm$ 1.0nm (range 40nm-200nm)
	$\pm$ 2.0nm (range 200nm-3000nm)
Thickness repeatability	3σ < 0.1nm (range 2nm - 200nm)
	3σ < 0.5nm (range 200nm - 1000nm)
	3σ < 1.0nm (range 1000nm - 300nm)
Maximum no. of layers	3

Refractive index Measurement

Refractive index accuracy	Silicon-layers : $\pm$ 0.03 ; Conductive layers : $\pm$ 0.03 ; Dielectric layers : $\pm$0.02 ; Others $\pm$ 0.03
Refractive index repeatability	3σ < 0.01

Color Measurement (Reflectance and Transmittance)

Chromaticity accuracy (xyY)	x,y 3σ < 0.002 Y 3σ < 0.5
Chromaticity repeatability	x,y 3σ < 0.001 Y 3σ < 0.1
Measurement geometry	White light Reflectance (R) and Transmittance (T) in normal incidence (0°)
Measurement speed	1 s (for 1 layer and 2 layer thickness measurement)
Light Source	Halogen, 50W, > 2000h lifetime, 3000K color temperature
Spectrometer (VIS)	512 pixel Silicon diode line detector, 380nm-1070nm spectral range, 16 bit digitalization, Transmittance holographic grating, LAN-Interface
Spectrometer (NIR)	256 pixel InGaAs diode line detector, 850nm-1700nm spectral range, 16 bit digitalization, Transmittance holographic grating, LAN-Interface

Microscope Head

Objective/Magnification	10x (2x, 5x, 20x, 50x optional; Turret optional)
Measurement spot size	25µm (125µm, 50µm, 12.5µm, 5µm optional)
Autofocus function (by software)	Yes, with motorized z-axis
Pattern matching function (by software)	Yes
Measurement spot visualization	Yes

Sample Table

Type	SCAN: Motorized xy-table
Movement range	450mm x 450mm (other sizes on request)
Sample plate	Removable plate with holes (other sample plates on request)