

TCM μ Scope for Microscopic Spectrometric Measurements

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

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 $125\mu\text{m}$, $50\mu\text{m}$, $25\mu\text{m}$, $12.5\mu\text{m}$ and $5\mu\text{m}$ can be made with such systems.

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 $125\mu\text{m}$ – $5\mu\text{m}$
- **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

Specifications of μ Scope-Head

Microscope objectives

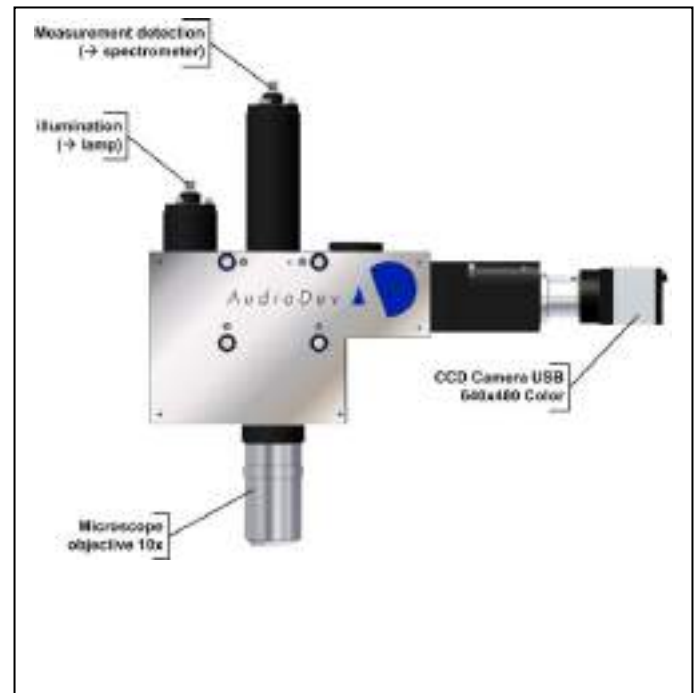
Type	Long distance, infinity corrected
Magnifications	10x (standard), 2x, 5x, 20x, 50x (optional)
Turret (optional)	Manual and motorized available
Measurement spot sizes	$125\mu\text{m}$ (2x), $50\mu\text{m}$ (5x), $25\mu\text{m}$ (10x), $12.5\mu\text{m}$ (20x), $5\mu\text{m}$ (50x),
Chromatic Correction	380nm-1050nm

Camera

Type	640x480 CCD, USB-Interface
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Dimensions

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



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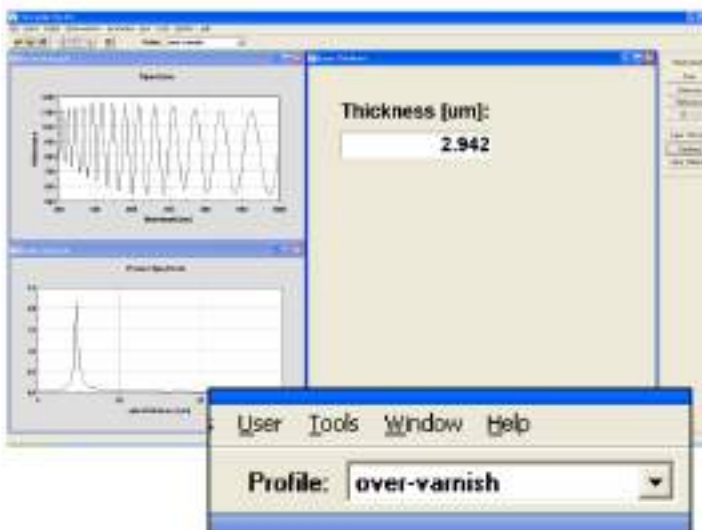
Example 1: System for Measurement of layer thicknesses of coatings outside and inside of CAN's

TCM μ Scope

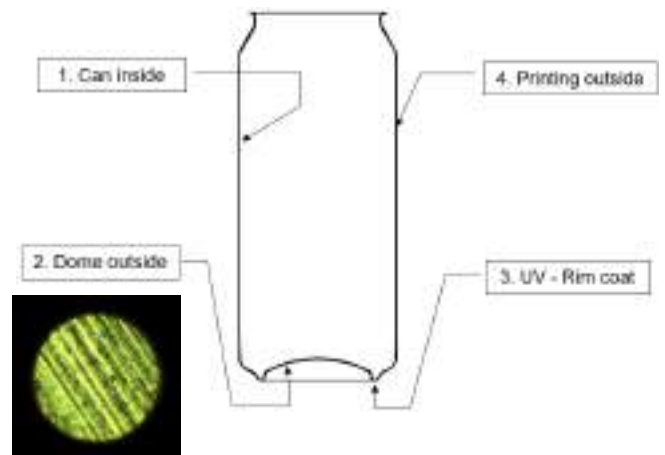


System: TCM μ Scope-LITE
Model: VIS-R (optional: NIR-R)
Measured Parameters: Reflectance, Color-R, Thick layer thickness (1-25 μ m)

Measurement Example



Layer Thickness of Overvarnish



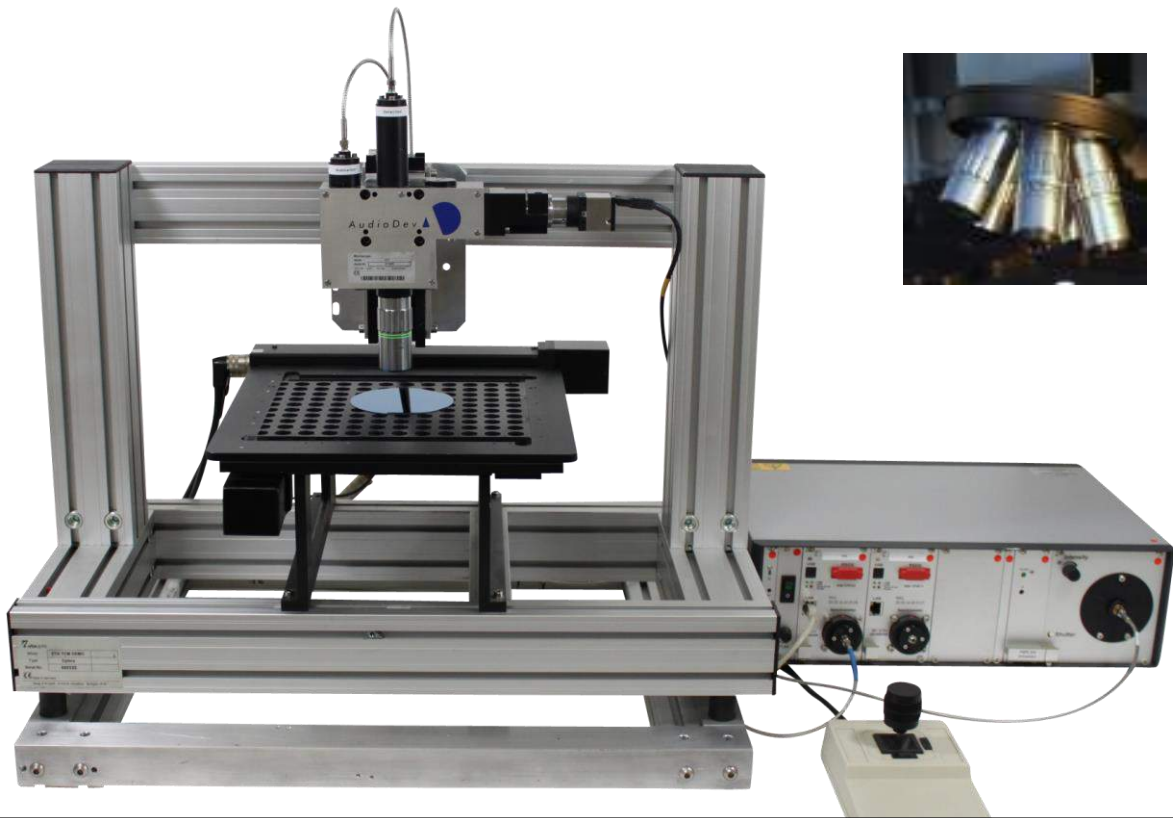
Measurement of Lacquer Thickness at different positions

Product Specifications

System: TCM μ Scope-LITE	
Model: VIS-R (optional: NIR-R)	
Measured Parameters: Reflectance, Color-R, Thick layer thickness (1-25 μ m)	
Measurement	
Measurement parameters	Spectral Reflectance (R) Color-R Layer thicknesses of "thick" single layers and double layers
Spectral Measurement	
Wavelength range (λ -range)	VIS 380nm - 1050nm NIR 850nm - 1700nm (optional)
R Accuracy	$\pm 0.4\%$ (for $\lambda > 400\text{nm}$)
Thickness Measurement of thick layers	
Thickness range for thick layers (FFT method)	1 μ m - 25 μ m
Thickness accuracy	$\pm 0.05\mu\text{m}$
Thickness repeatability	$3\sigma < 0.005\mu\text{m}$
Maximum no. of layers	2
Color Measurement (Reflectance)	
Chromaticity accuracy (xyY)	x,y $3\sigma < 0.002$ Y $3\sigma < 0.5$
Chromaticity repeatability	x,y $3\sigma < 0.001$ Y $3\sigma < 0.1$
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	10x (2x, 5x, 20x, 50x optional; Turret optional)
Measurement spot size	25 μ m (125 μ m, 50 μ m, 12.5 μ m, 5 μ m 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



TCM μScope

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 wafers, suited for

- Substrates: Si, GaAs, SiO₂, 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	$\pm 0.4\%$ (for $\lambda > 400$ nm)
Thickness Measurement of thick layers	
Thickness range for thick layers (FFT method)	1 μ m - 25 μ m
Thickness accuracy	$\pm 0.05\mu$ m
Thickness repeatability	$3\sigma < 0.005\mu$ m
Maximum no. of layers	2
Thickness Measurement of thin layers	
Thickness range for thin layers (fit method)	2nm - 3000nm
Thickness accuracy	± 0.5 nm (range 2nm-40nm) ± 1.0 nm (range 40nm-200nm) ± 2.0 nm (range 200nm-3000nm)
Thickness repeatability	$3\sigma < 0.1$ nm (range 2nm - 200nm) $3\sigma < 0.5$ nm (range 200nm - 1000nm) $3\sigma < 1.0$ nm (range 1000nm - 300nm)
Maximum no. of layers	3
Color Measurement (Reflectance)	
Chromaticity accuracy (xyY)	x,y $3\sigma < 0.002$ Y $3\sigma < 0.5$
Chromaticity repeatability	x,y $3\sigma < 0.001$ Y $3\sigma < 0.1$
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

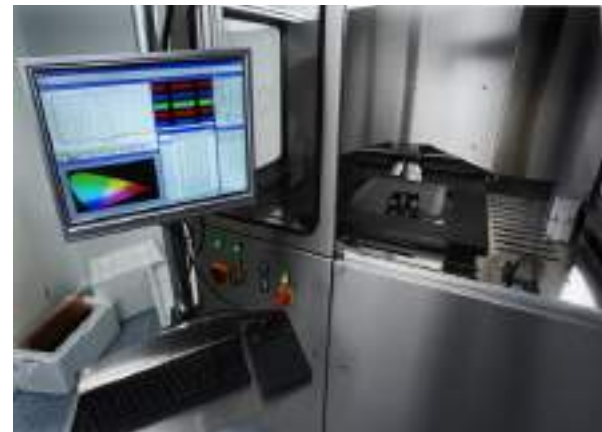
Objective/Magnification	10x (2x, 5x, 20x, 50x optional; Turret optional)
Measurement spot size	25 μ m (125 μ m, 50 μ m, 12.5 μ m, 5 μ m optional)
Autofocus function (by software)	Yes, with motorized z-axis
Pattern matching function (by software)	Yes
Measurement spot visualization	Yes

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

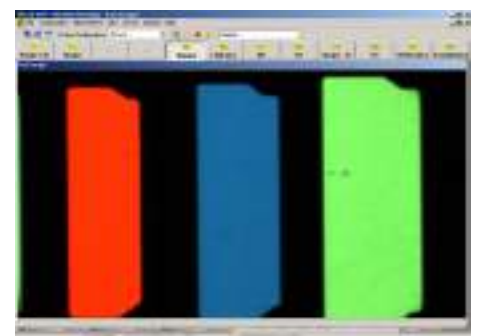


TCM μ Scope

System: TCM μ Scope-SCAN
Model: VIS-RT-X450_Y450
Measured Parameters: Reflectance, Transmittance, Thick layer thickness (1-20 μ m), 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

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 $\lambda > 400\text{nm}$)	
Thickness Measurement of thick layers		
Thickness range for thick layers (FFT method)	1 μ m - 25 μ m	
Thickness accuracy	$\pm 0.05\mu\text{m}$	
Thickness repeatability	$3\sigma < 0.005\mu\text{m}$	
Maximum no. of layers	2	
Thickness Measurement of thin layers		
Thickness range for thin layers (fit method)	2nm - 3000nm	
Thickness accuracy	$\pm 0.5\text{nm}$ (range 2nm-40nm) $\pm 1.0\text{nm}$ (range 40nm-200nm) $\pm 2.0\text{nm}$ (range 200nm-3000nm)	
Thickness repeatability	$3\sigma < 0.1\text{nm}$ (range 2nm - 200nm) $3\sigma < 0.5\text{nm}$ (range 200nm - 1000nm) $3\sigma < 1.0\text{nm}$ (range 1000nm - 300nm)	
Maximum no. of layers	3	
Refractive index Measurement		
Refractive index accuracy	Silicon-layers : ± 0.03 ; Conductive layers : ± 0.03 ; Dielectric layers : ± 0.02 ; Others ± 0.03	
Refractive index repeatability	$3\sigma < 0.01$	
Color Measurement (Reflectance and Transmittance)		
Chromaticity accuracy (xyY)	x,y $3\sigma < 0.002$ Y $3\sigma < 0.5$	
Chromaticity repeatability	x,y $3\sigma < 0.001$ Y $3\sigma < 0.1$	
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	25 μ m (125 μ m, 50 μ m, 12.5 μ m, 5 μ m 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)	