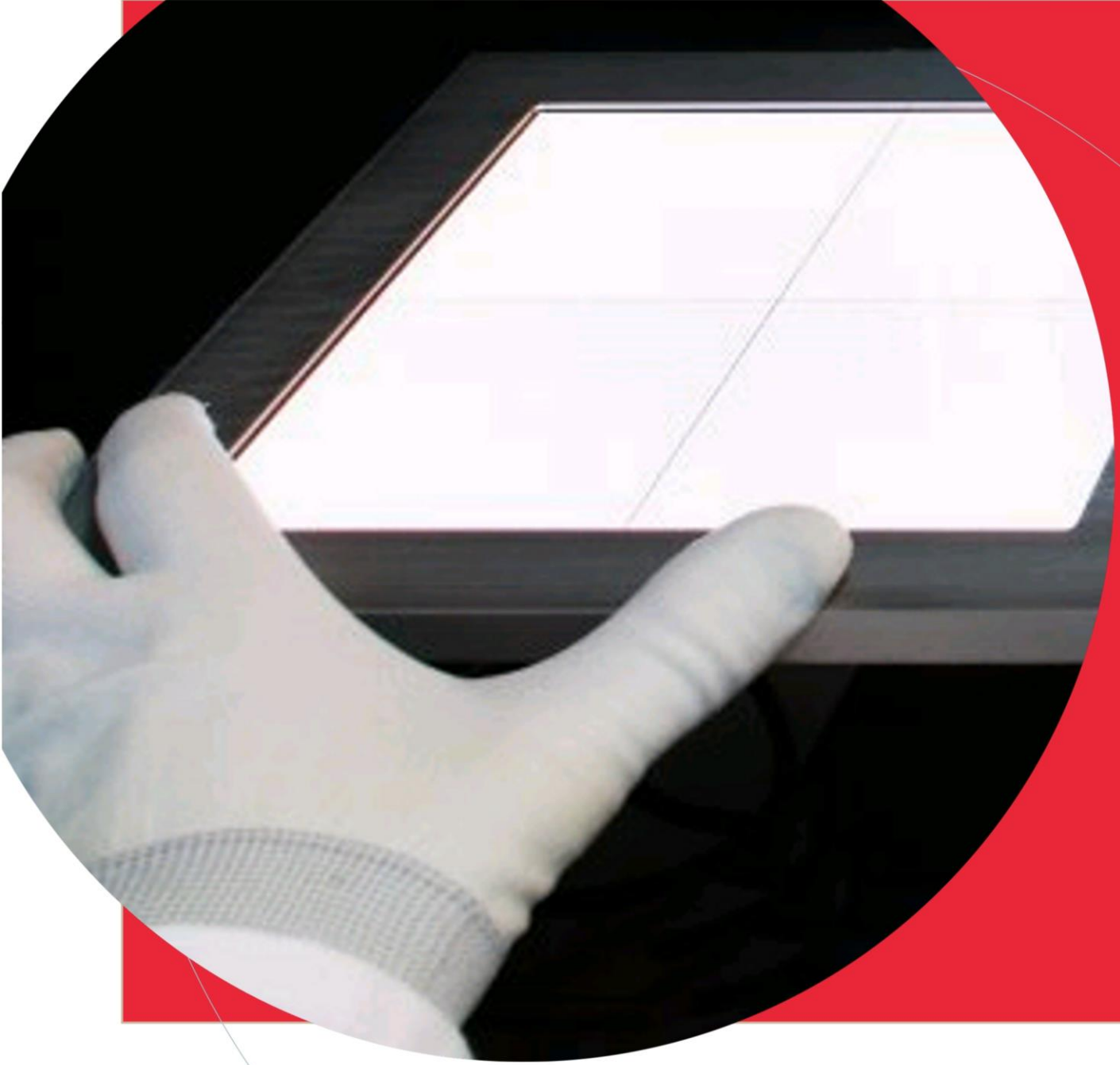


Xelas SCAN-oled
Xelas LAB-oled

OLED measurement systems for
organic layer stacks and ITO

Xelas SCAN-oled and LAB-oled: Measurement of OLED samples – Thickness and n&k from Layers and

Patented RT-Method!

Production of organic light-emitting diodes (OLED) is based on thin film coatings of many different materials, such as Indium-Tin-Oxide (ITO) or organic layers, ranging in thickness from approx. 2 nm to 500 nm. Small molecule and polymer technology is currently used in OLED production.

Here various process parameters during deposition have a strong influence on the layer thickness and the optical constants n&k of organic layers. Conductivity of ITO layers as well as surface roughness change the optical properties of the OLED samples. Homogeneous layer distribution and the absolute thickness is a crucial point with regard to the OLED quality. Therefore, detailed knowledge about the optical constants n&k and accurate control of thicknesses during the production is essential.

Solution for OLED offline measurements

NXT offers unique equipment to measure the layer thicknesses as well as refractive index of any kind of layer or stack, taking surface roughness into account. The system is designed and optimized for offline testing and is upgradable to future demands.

Highlights of Xelas-oled

Measurement of all OLED layers:

- Layer thickness 2nm-500nm
- Spectral material properties n(λ)/k(λ)
- Surface roughness
- Refractive index profiling for ITO

Works for production and R&D!

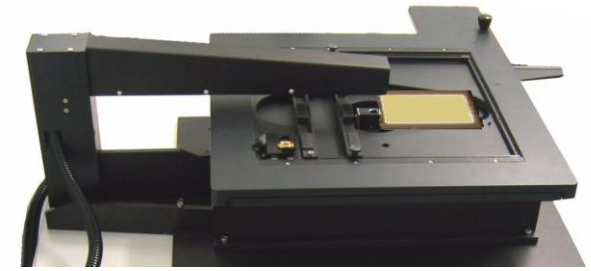
- Offline testing of standard samples and special development cases
- Contactless and non-destructive
- SCAN: x-y-mapping, one-directional scans and single-point measurements

Proven for all relevant layers and stacks

- Organic materials
- Dielectric layers
- Metallic and conductive layers

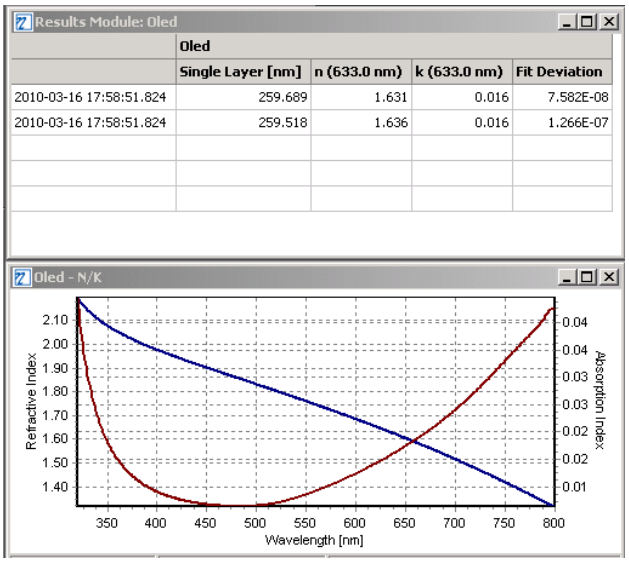
Upgradable to Optical Modelling

- Unique NXT oscillatory model : Design of own parameter sets for n&k

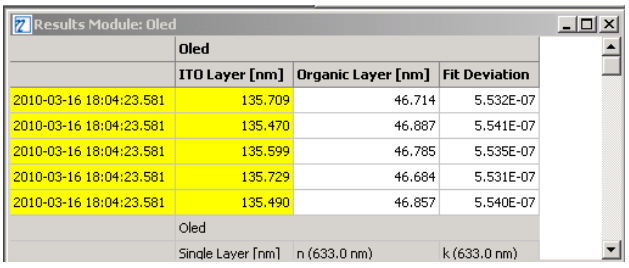


Offline measurement of an OLED sample

Offline testing of thicknesses and n&k

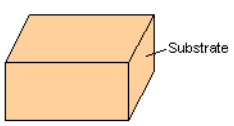


ITO layer thickness and spectral refractive/absorption index **n(λ)/k(λ)**, *measured with* ***Xelas SCAN/LAB-oled*** *on a glass substrate*

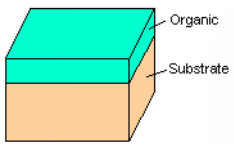


Xelas SCAN *: Layer thicknesses evaluation of an OLED stack*

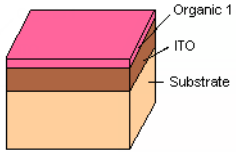
Process Steps in which Xelas SCAN/LAB-oled is used



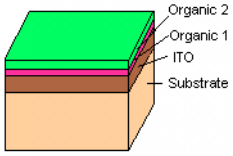
Substrate: glass or foil



after ITO or organic coating



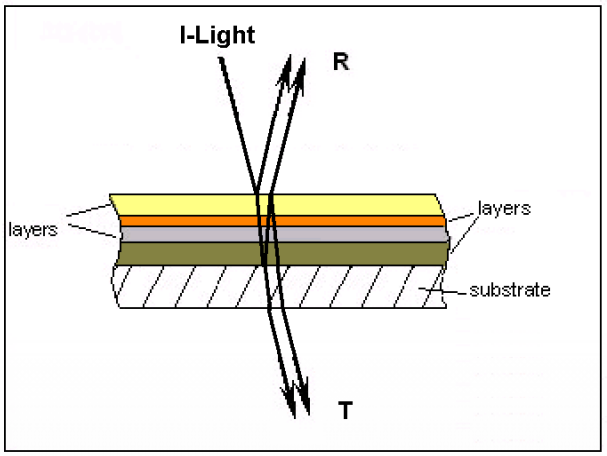
after organic 1 coating



after organic 2, 3, 4... coating

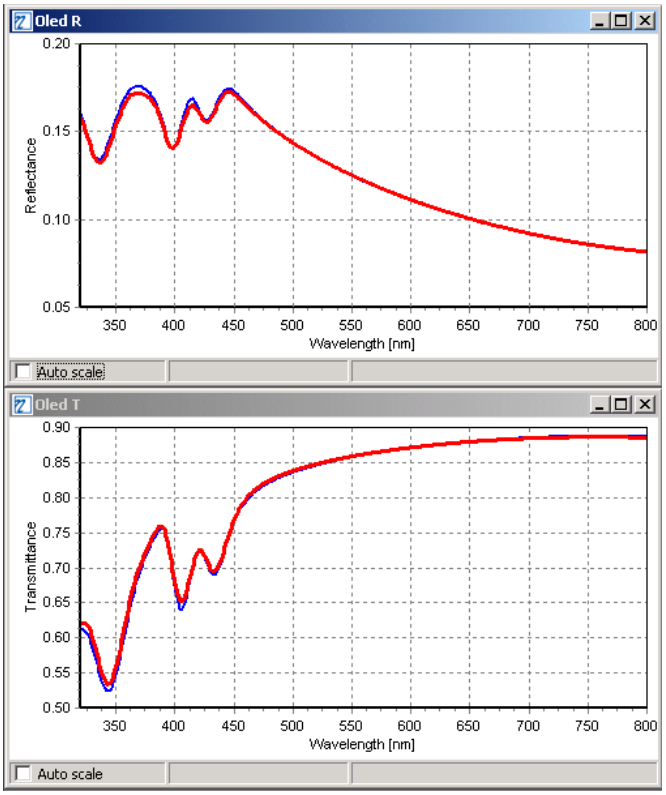
Principle of Measurement

Phase differences between the front and rear side reflection of thin layers cause interference. Absorption inside each layer changes light wave amplitude. Both of these phenomena can be used together to measure the layer thickness and refractive and absorption index n&k of thin layers.



Reflectance R and transmittance T at a layer stack

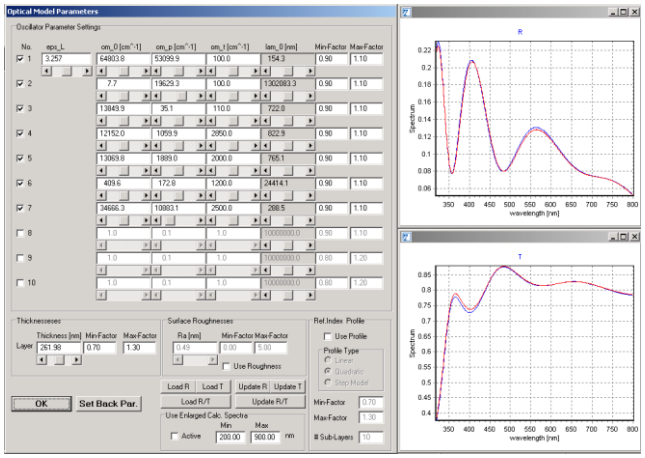
After recording the specta of the sample, a mathematical calculation is performed in which the layer thicknesses and the parameters for the optical properties n&k are varied until model and measurement match perfectly.4



Spectral fit of R and T of an organic coating on a glass substrate (measurement = blue / model simulation = red)

Our proprietary algorithms use a special type of oscillatory model which is applicable to all kind of materials. Further, they take surface roughness of the substrate or layers into account.
Precise modelling of all component from the substrate to each layer is the key to measure extremely thin layers down to 2nm on substrate, as well as very small variations of layers within a stack.

By the additional software option Optical Modelling, all parameters can be set and a database of pre-configured material setups is delivered. Refractive index profiling, a change of refractive index in vertical direction along build-up the layer, can be simulated for three different profile types.



Setup for Optical Modelling of all kind of materials

Offline measurement of thickness and n&k is the key to:

- → High OLED layer homogenity
- → Material and process design
- → Detailed coating analysis

Xelas-oled enables producers of OLED to:

- Keep production conditions stable and increase production/process yield
- Control the product quality by detailed knowledge of local variations and thickness drift, as well as changes in material properties
- Design new materials, processes and layer stacks by the advanced, unique function Optical Modelling

Product Specifications

MEASUREMENT	
Measurement Parameters	Layer thicknesses of single layers and stacks / spectral refractive + absorption index (n&k)
Wavelength Range	320 ~ 800nm (other ranges on request)
Thickness Range	2 ~ 500nm
Refractive Index Range	0.01 ~ 10.00 (all materials possible)
R+T Accuracy	± 0.4%
Thickness Accuracy	± 0.5nm (range 2nm-40nm) ± 1.0nm (range 40nm-200nm) ± 2.0nm (range 200nm-500nm)
Thickness Repeatability	3σ < 0.1nm
Refractive Index Accuracy	ITO + metallic layers : ± 0.03 ; Organic layers : ±0.02 ; Dielectric layers : ±0.02
Refractive Index Repeatability	3σ < 0.01

HARDWARE	
Measurement Geometry	White light reflectance (R) and transmittance (T) in normal incidence (0°)
Measurement Spot Size	~ 1mm
Measurement Speed	≤ 1.0 sec. / point for thickness ; approx. 0.3-1.0 min. / point for n&k
Sample Sizes	10x10mm to 300x300mm (larger sample sizes are possible on request)
Required Positioning Accuracy of sample	Within ± 1.5mm height and within ± 0.4° tilt
Environment	Temperature range: 5-45°C (50-90°F), Humidity: < 80% (non-condensing)
Power	AC 100 ~ 240V; 50/60 Hz
Typical Dimensions (Width/Depth/Height)	Spectrometer and light source rack : W= 553mm ; D= 600mm ; H= 822mm Manual x-y-table : W= 670mm ; D= 842mm ; H= 269mm Housing for automated x-y-scanning table: Depending on sample size

PC / SOFTWARE	
Measurement Functions	Layer thicknesses / refractive + absorption index / value history / mapping
PC Requirements	Windows® 7 / 8 / 10, 8 GB RAM, >500 GB hard disc space

* Photo on title page supplied by Fraunhofer IPMS/Dresden-Germany

Setup Types

Xelas LAB-oled

Spectrometer and light source rack with manual x-y-table (Xelas LAB)

Xelas SCAN-oled

System with motorized x-y-scanning table and rack, 600mm x 600mm (Xelas SCAN)

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