Cost-effective System for Inline Coating Evaluation in R2R Processes

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Agenda

1. Markets and Applications
2. Measuring Head
3. Software
4. System Overview

Why we measure

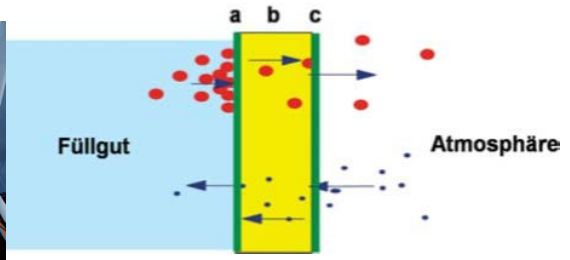
Examples of applications

Automotive Film Control)

Solar Control and Solar Energy

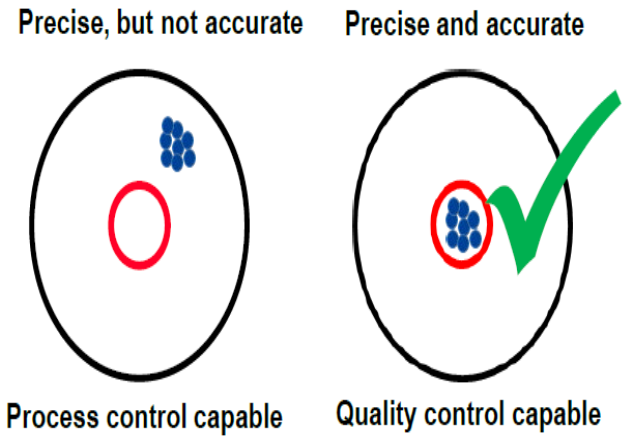
Shanghai Museum of Glass

Bank note –Coating on Paper



Barrier coatings

The challenge of going from quality to production control



Tolerances may be influenced by such factors as:

- Measurement System
- Reference Method
- Calibration Standards
- Process Conditions
-

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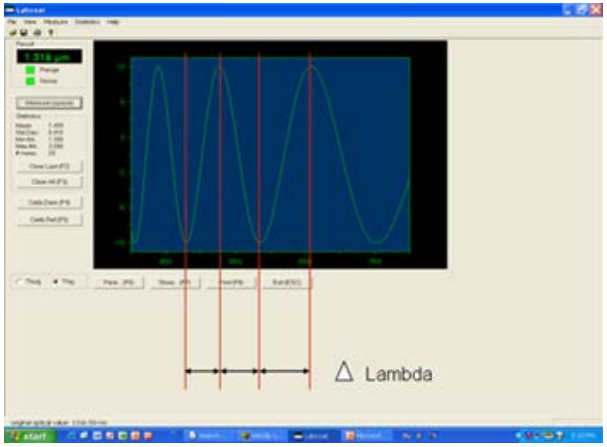
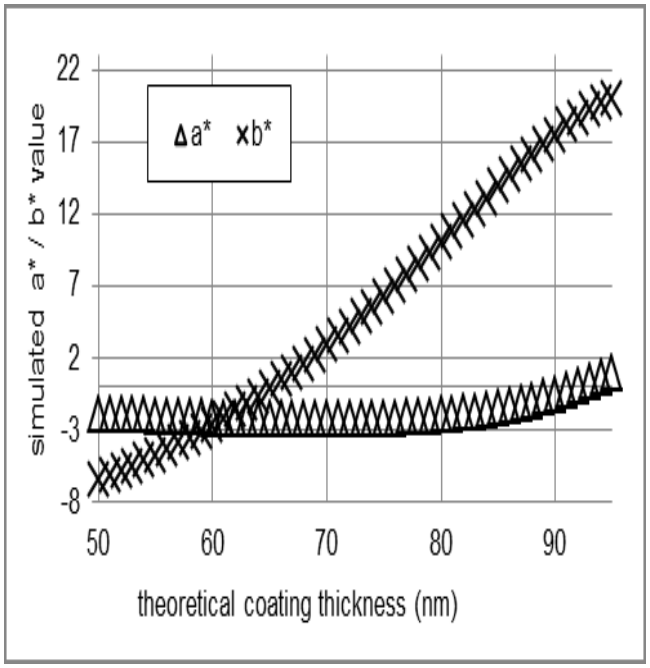
White light interference



- Illuminating the sample with white light results in interference spectrums
- Mathematical methods evaluate this interference in respect of optically transparent layers in the form of optical and geometric layer thicknesses.
- The layer thickness is calculated from the periodicity of the interference spectrum
- Scaleable diagrams, result views, trends

Colormetric Correlation to Thickness



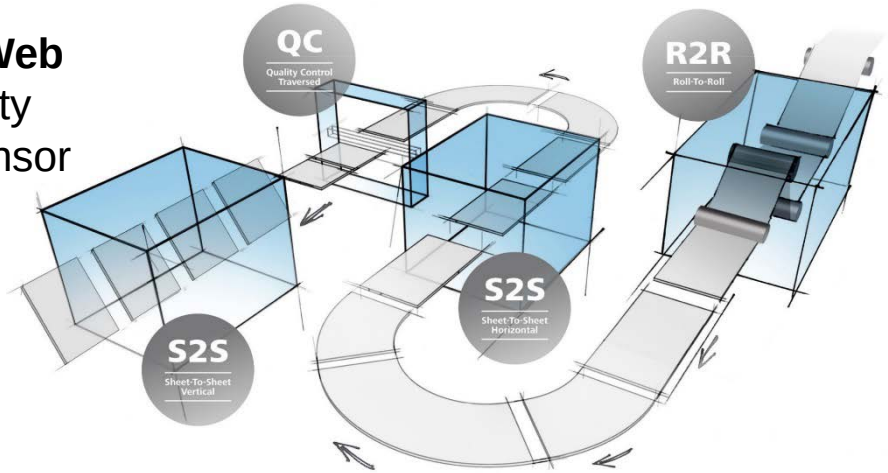
- For simple layer designs a correlation of the thickness and a color value may exist

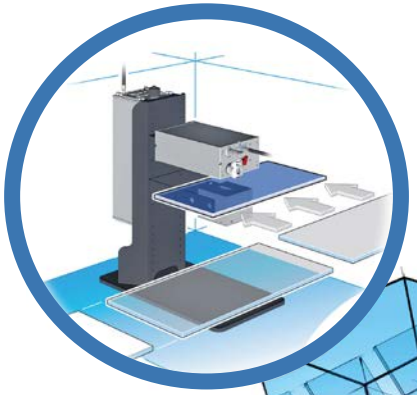
- A theoretical calculation is performed using modeling software prior to any real measurement.

  - The layer thickness is calculated from the periodicity of the interference spectrum

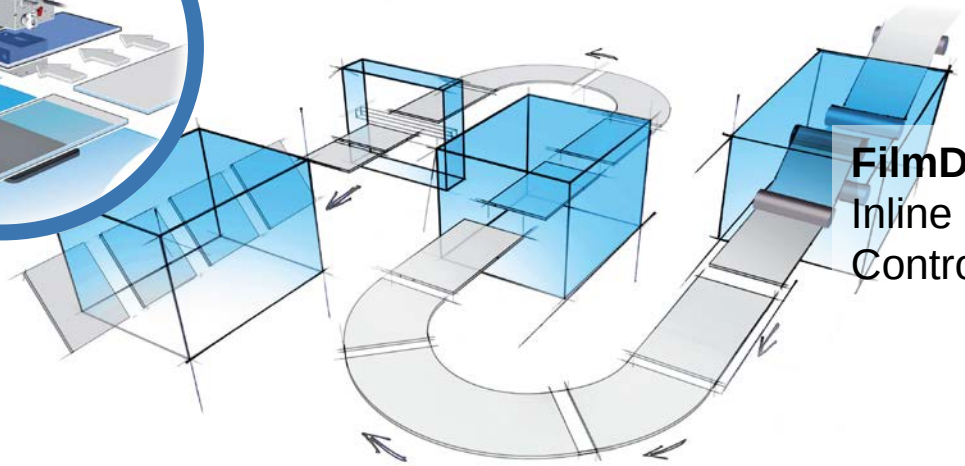
In-Line and At-Line Process and Quality Control

ThinProcess ® P/R/Q/Web
Inline Process and Quality Control with complex sensor layouts



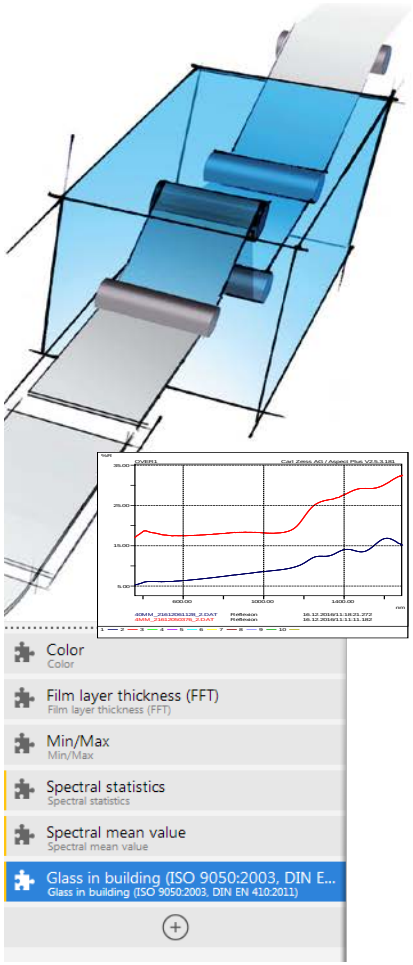


FilmDetect ® QC
At-Line Quality Control



FilmDetect ® S
Inline Process and Quality Control with single Sensor

FilmDetect S in a R2R Coater



- Time and Trigger Based measurements
  - Measured values: Spectral reflectivity and transmissivity (360 nm – 1050 nm / 1650 nm)
  - Derived / calculated values: color metrics (L*a*b*), coating thickness, spectra characteristics (min, max, …)

- One (or more[1]) measuring positions
  - Spectral reflectivity
  - Spectral transmissivity
  - Combination or reflectivity / transmissivity within one position
  - Sheet resistance

- Integrated reference concept
  - OFR A10 measuring head (see later slide)

[1] without correlation between the different positions

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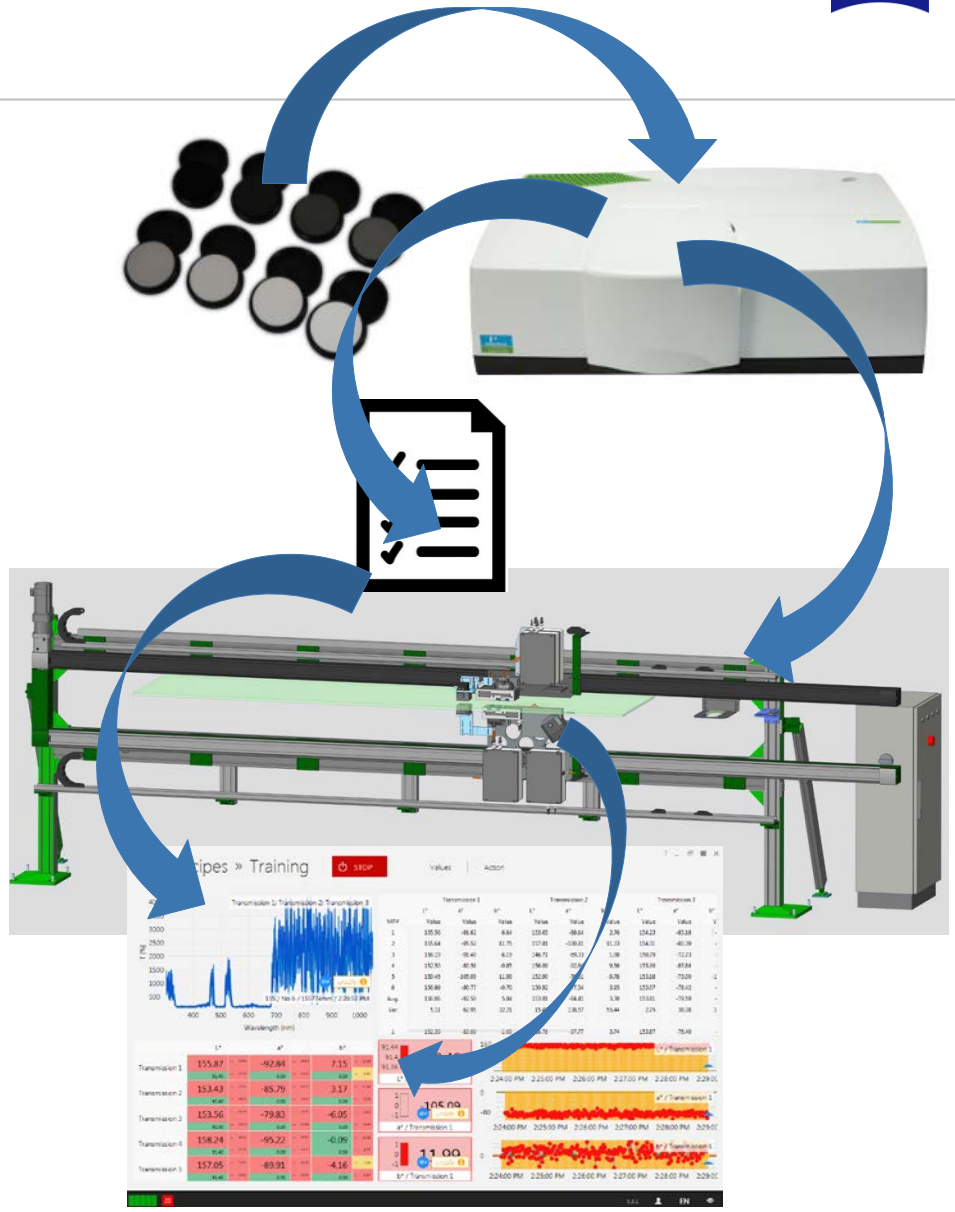
The In-Line Challenges

- Robustness
- Ease of use
- Operator's skills
- […]

- **Calibration**
  - Complex calibration chain hitching systems which includes
    - diffuse or specular calibration standand –
  - reference instrument / reference method –
  - certificate file
  - in-line instrument calibration
  - physical measurement
  - No "national standard" available

  - This chain is usable in lab-instruments; difficult use in in-line instrumentation (except traversing solutions)

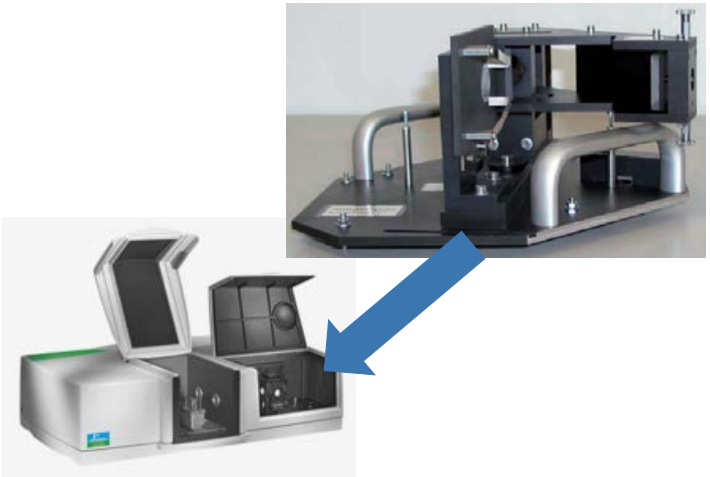


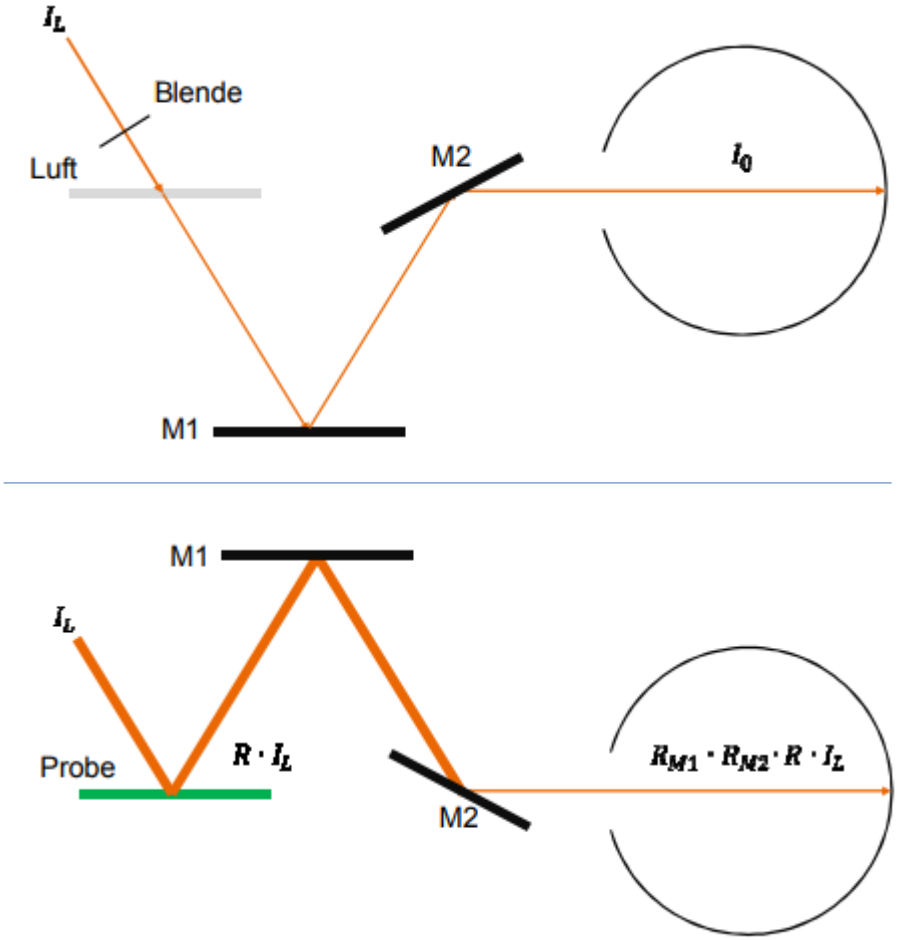
Fraunhofer IOF VN - Configuration

Know approach: VN configuration for Perkin-Elmer Lambda spectrophotometers [1]

Uses same optical elements for both, calibration and measurement path

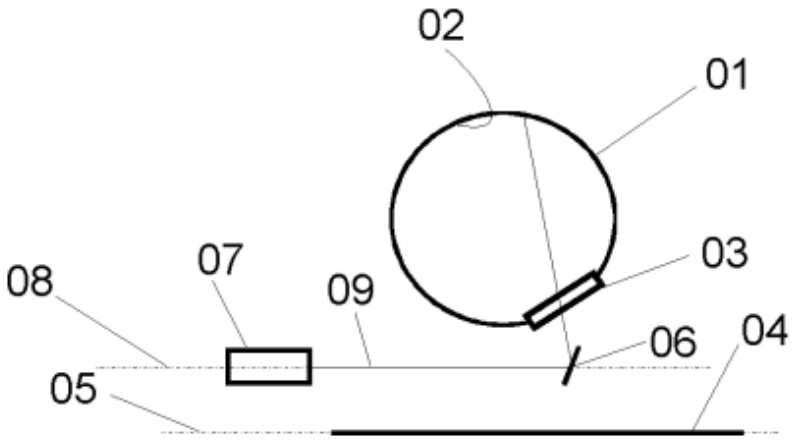
Mirror M1 moves across sample plane: Not usable for in-line applications

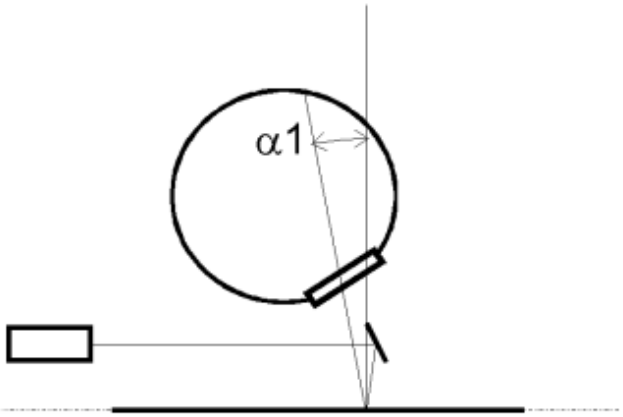




ZEISS OFR A10 Configuration

- Only one mirror sliding and rotating
  - initial position to calibrate for reflectance
  - sliding and rotating to measure sample
- Extendable to transmission measurements
- Multiplexing (%R | %T | bypass
- Extendable to transmission measurements





Patent pending DE 10 2014 215 193 A1
additonal utility models

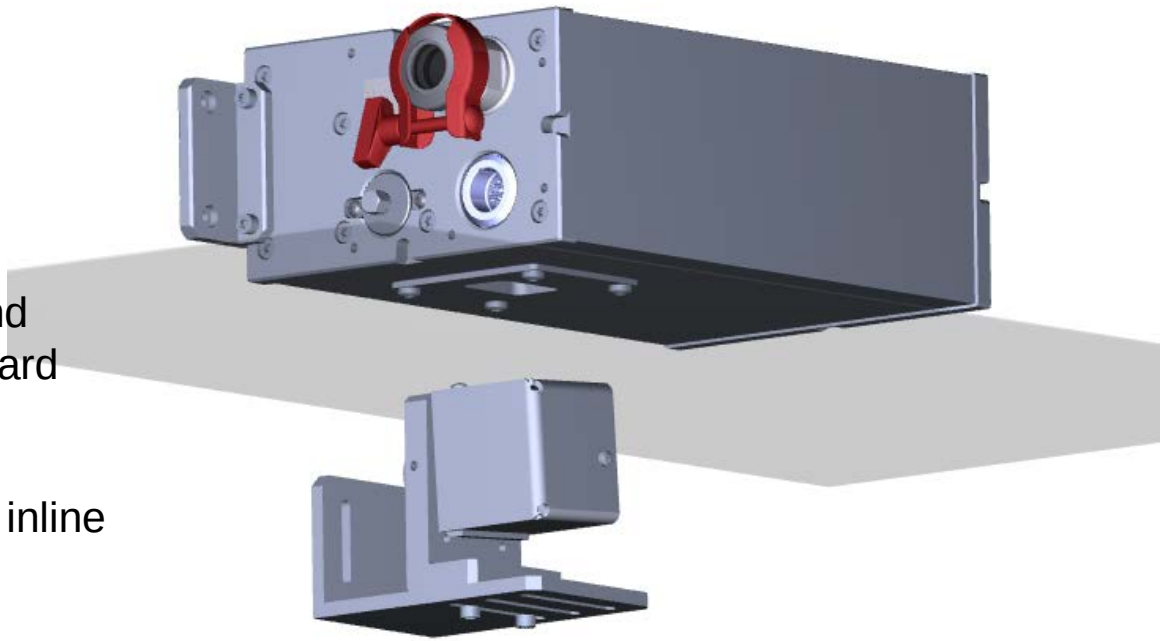
In-Line and At-Line capable measurement probe

- **Multiplexing by mirror switching**:
  1 spectrometer for:
  - Reflectivity
  - Transmissivity
  - Bypass channel

- **Absolute measurements**

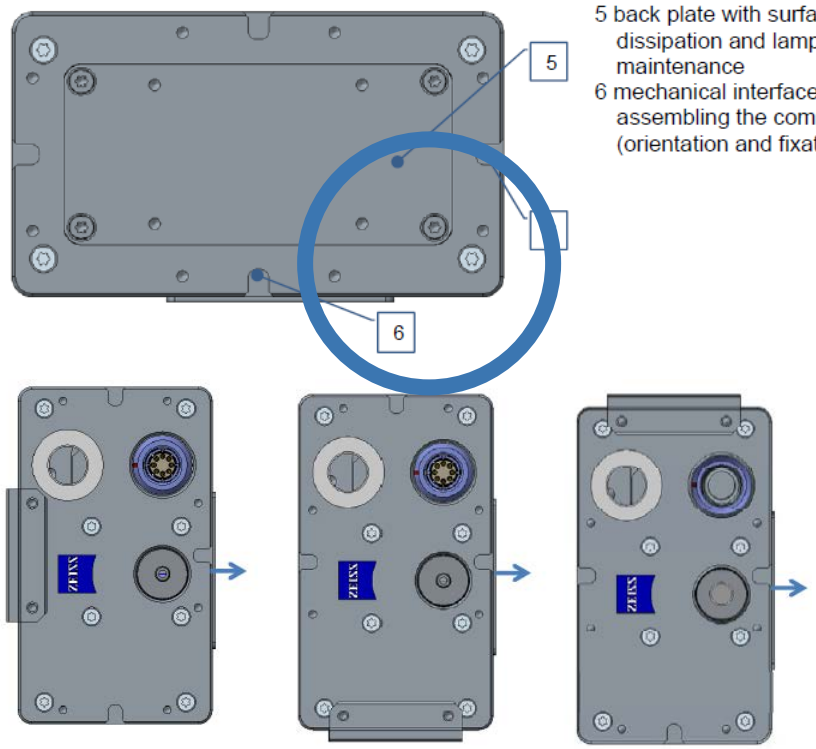
7d / 24 h In-Line applications

- Fully automated operation and calibration, no external standard
- Fast, reliable
- Extended lamp lifetime
- Installations in R2R and S2S inline coating lines under operation



“Mobile” Mounting Concept

- Flexible Mounting concept
- OFR A10 is aligned using mounting brackets
- The head can be easily mounted in different positions along the line (if there is a aligned mounting bracket)



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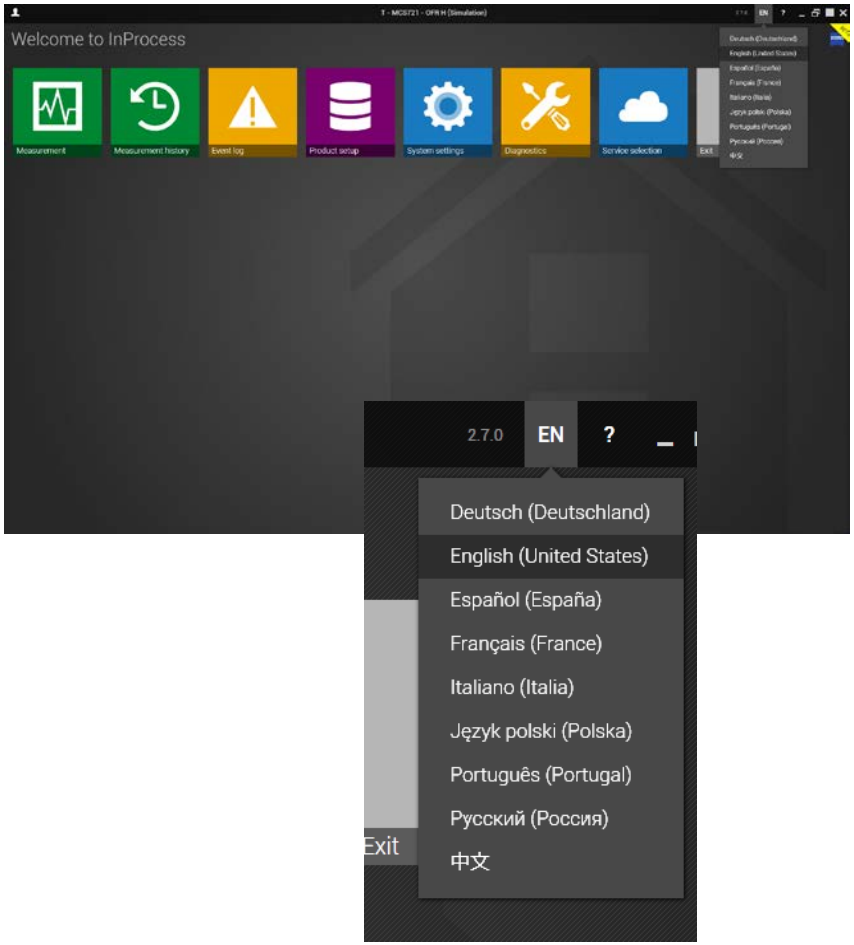
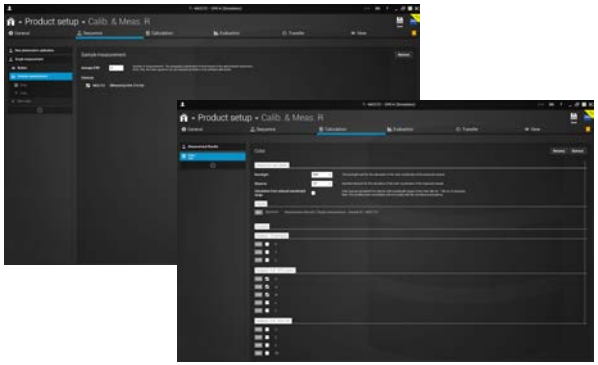
InProcess for ThinFilm: The Software



Touch Panel optimized software

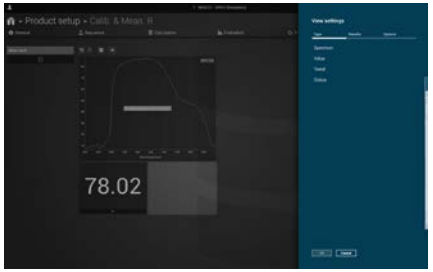
- Multilingual
- Recipe Driven
- All configuration done with separated Management Console Program

Recipe Driven Software



- Freely configurable Measurement Sequences
- Configurable calculations

- Data and signal transfer to PLC



- Scaleable diagrams, result views, trends


ZEISS