Coating Thickness Measurement System

INTRODUCTION

Designed to meet the needs of industry, the LABCOAT system provides a simple and precise way to measure transparent coatings and films.

- Transparent coating and film thickness measurement
- Non-contact / Non-destructive
- Fast, Accurate and Precise
- Easy to use

The system is based on white light interference effects caused by reflection from the top and bottom surfaces of the coating. This results in constructive and destructive interference at various locations in the spectrum. Analysis of this spectral pattern, along with the material's refractive index, allows the calculation of the coating thickness.
An innovative Solid-State Diode Array spectrometer is at the heart of the system. Based on an award winning design, this unit provides stability, speed and precision without maintenance.
A flexible fiber-optic probe allows remote hand-held operation . The measurement area size can be selected to meet a variety of applications. Industrial use of protective coatings,dielectric films, etc. is growing rapidly. Control of thickness is a key to good coating performance. The LABCOAT system can provide this valuable thickness information for both R&D and Quality Control in application areas such as Automotive, Plastics, Paint, Chemical, Packaging and Microelectronics.

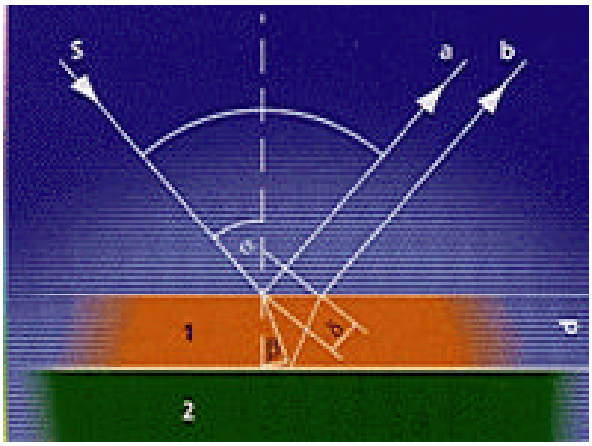


Figure 1: White light interference

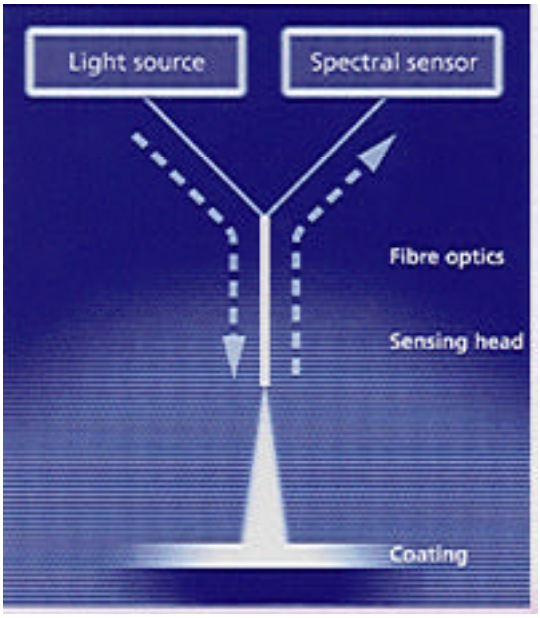


Figure 2: LABCOAT System

THE SYSTEM

Measurement:

- Technique: white light interference
- Measuring in transmission or reflection
- Measurement area size: 2 mm typ.
- Thickness range: 0.3 to 80 micron
- Repeatability: 0.5% typ.
- Measurement time: < 1 second
- Fiber probe: distance up to 25 meters possible

Spectrometer: MCS 500 series

- Type: Solid-State Diode Array
- Grating: Concave holographic (no moving parts)
- Wavelength: (220) 380 to 1000 nm
- Resolution: 0.8 nm / diode
- Integration time: 0.01 to 1seconds

Minimum computer requirements:

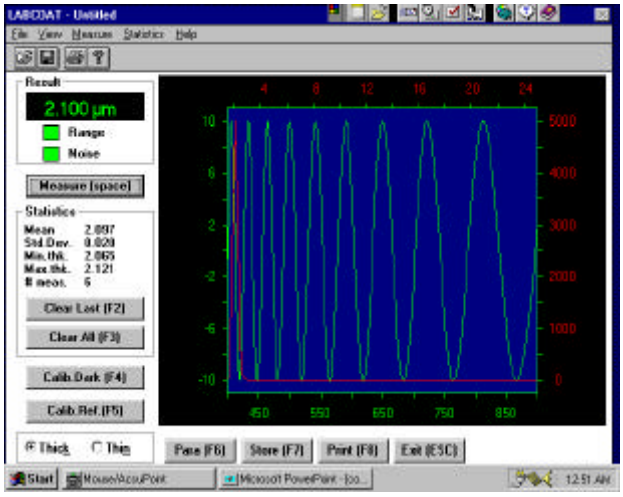
- Processor: Pentium
- Memory: 16 Megabyte RAM
- Adapter slot: PCI or PCMCIA

System software:

- Zeiss LABCOAT software program
- Windows 9x, Windows NT

On-line Process:

- Dedicated systems can be customized for on-line process control.



THE SOFTWARE

- "Labcoat" software provides simple yet powerful evaluation of the spectral interference pattern for high performance thickness measurement.
- Selectable coating type.
- Selectable thickness range.
- Single key stroke measurement.
- Display of measurement confidence.
- Statistical analysis.
- Data compatibility.

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Layer thickness measurement of anodized coatings on aluminium plates and tapes

Lab and on-line measurements

INTRODUCTION

The coating of aluminium with aluminum oxide or other protective or design coatings must be kept in controlled quality limits during the coating technology,in order to guarantee the functionality of the layers and thus to comply with the customers' requirements.
The testing of samples from the on going production process can be performed as random sampling or on-line measurement.The coating parameters of the coating plant can therefore be reset very quickly and, as a result, at low cost (quality and material consumption).However, this measuring procedure is only suitable for transparent layers, not for diffusely scattering layers.

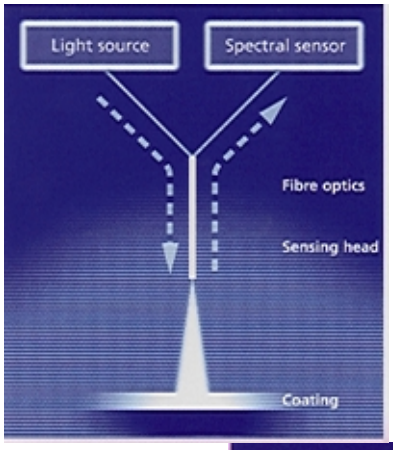
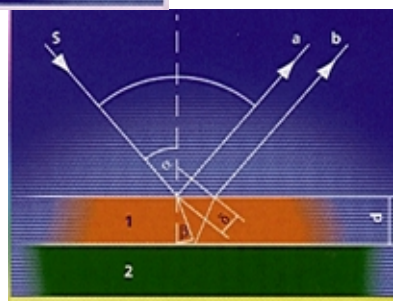


Fig.1



THE METHOD

Coated tapes or plates are measured using reflected light.Interferences (white light) are generated from the reflection signals. The optical layer thickness is reliably evaluated by means of FFT algorithms. (Fig.1)
The geometric layer thickness is determined on the basis of the mathematical relationship between the optical and the geometric thickness, and the refractive index function n=f (wavelength).
Results are provided with utmost reproducibility and absolute accuracy which is due to the superb optical and thermal stability of the ZEISS diode array polychromators.
Thin layers between <500nm and a few nm can be measured, calibrated and integrated in automatic processes by means of special evaluation algorithms. These methods are generally applicable to all other coatings which are physically suited for being measured with our systems.

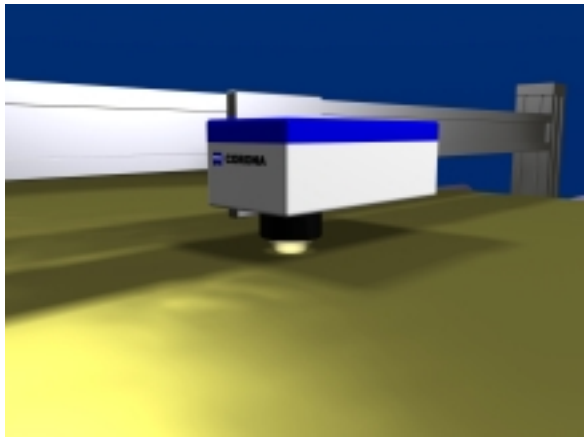


Fig.2 CORONA in use

THE SYSTEMS

There is the possibility to use fibre coupled (MCS 500) or fibreless systems (CORONA Fig.2).The diode array spectrometer systems are based on the time-tried ZEISS MCS polychromator technology. The multi-channel spectrometers provide spectral information with a resolution of 0.8nm/pixel and 3.3nm/pixel, respectively.
An RS422 interface, 4-20mA, and shortly an RS232/alternatively RS485, or a trigger input and output can be used as interfaces, for example.
PCs are used for controlling the systems. The spectrometers can be cascaded, e.g. so that the visual spectral range and the NIR spectral range are measured simultaneously. This permits the measurement of different multi layer systems.

THE SOFTWARE

A possible software option is our ASPECTPLUS Windows standard software (supported by Windows 3.11/ 95/ 98 and Windows NT) in conjunction with the software module Layer Thickness.
For special, customized applications we recommend a solution under LabVIEW.
DLLs for C++ and LabVIEW drivers allow the user to program his own software interfaces, or to integrate our measuring systems in overall procedures

THE BENEFITS

- Fast high-precision measurement
- Excellent reproducibility of layer thickness data
- Time-tried measuring systems and techniques
- High reliability and low maintenance requirements, as no moving parts are use
- Easy software operation
- Detailed spectral information provided at high speed
- Flexible installation due to fibre-coupled or fibreless technology and a wide range of accessories
- Measurement of several measuring points by combination with optical multiplexer or traversing unit
- Fibreless systems directly driven over traversing unit

SPECIFICATION

Wavelength range	200 – 1020 nm (900 – 1700 nm optional, or cascaded)
Wavelength resolution	0.8nm/Diode (2.4 nm Raleigh) / 3.3nm/diode (10nm Raleigh)
Wavelength reproducibility	<0,05 nm
PC interface	RS 422; RS 232 res. RS 485 for CORONA
Distance between PC and system	up to 80 m with standard cable up to 2.5 km with light guide transmission
Optical fibres	quartz, 600 µm core, SMA connections
Housing	19" housing or 19" rack mount 19" protective housing Corona (fibreless) in cast housing

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Applications Information

MCS 500

Thickness measurement

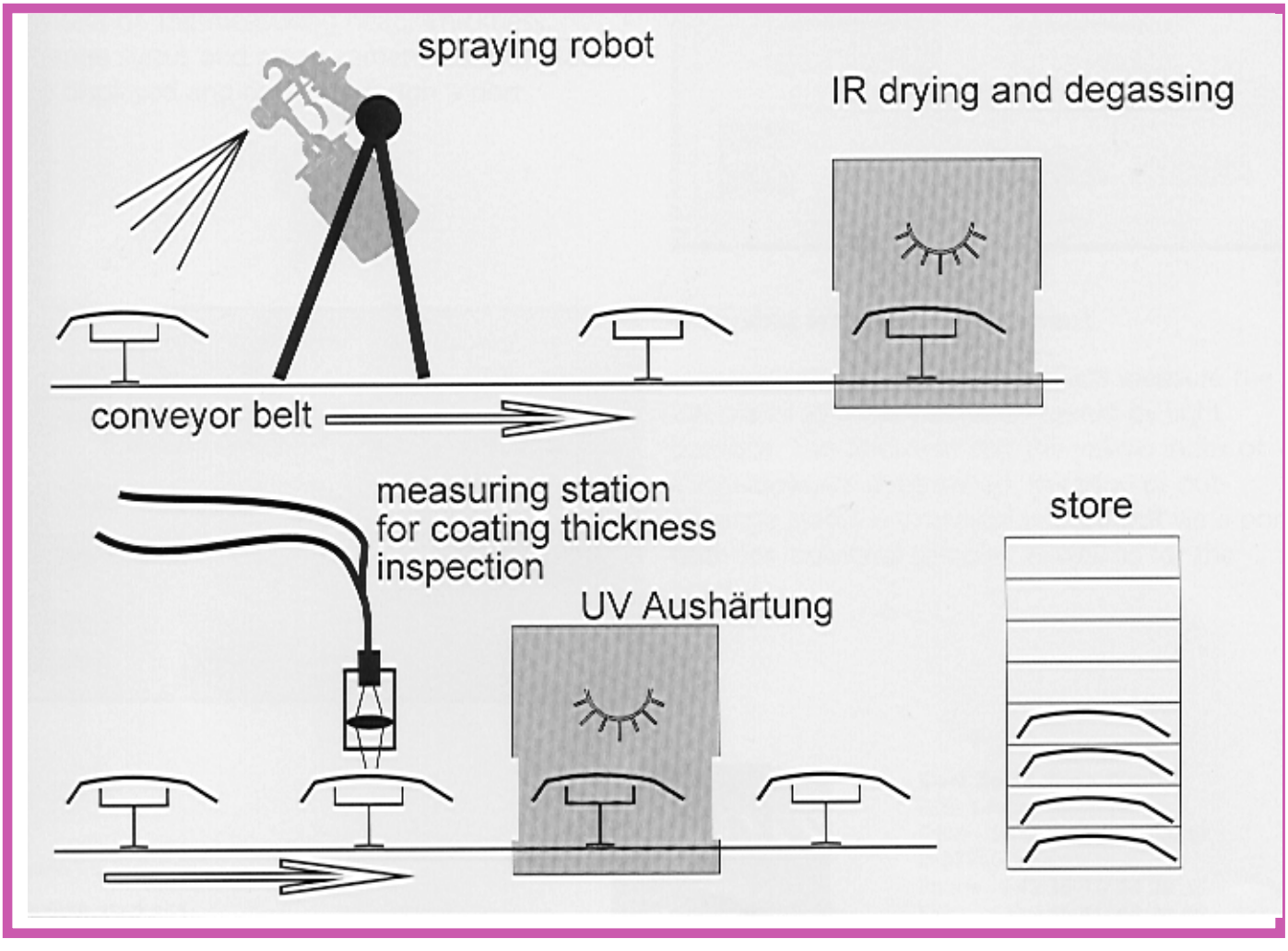
Headlight coating

Process description

On most automobile models,the protective window of headlights is made of plastic.To protect the surface against scratches and yellowing by UV light,it is coated externally in the production process with a protective coating. The coating is applied by spraying. Subsequently it is dried and cured by IR and UV irradiation.To keep the reject rate low,it is important to check the thickness of the coating in the production process.If the coating is too thick,there is the risk of peeling and cracking. If the coating is too thin,it will not provide sufficient protection.The entire process can be fully automated.

The coating thickness measuring system automatically detects the arrival of a sample on the conveyor belt.
The system measures the coating thickness and transfers the results to a process computer for evaluation.It is possible to select rejects and record the trend of the batch.In general,there are two decisive reasons for the in-line use of the measuring system:

a) Optimisation and inspection of coating parameters,such as spraying density,curing time and UV illuminance
b) Quality certification to ISO 9000 standards for automobile subsuppliers



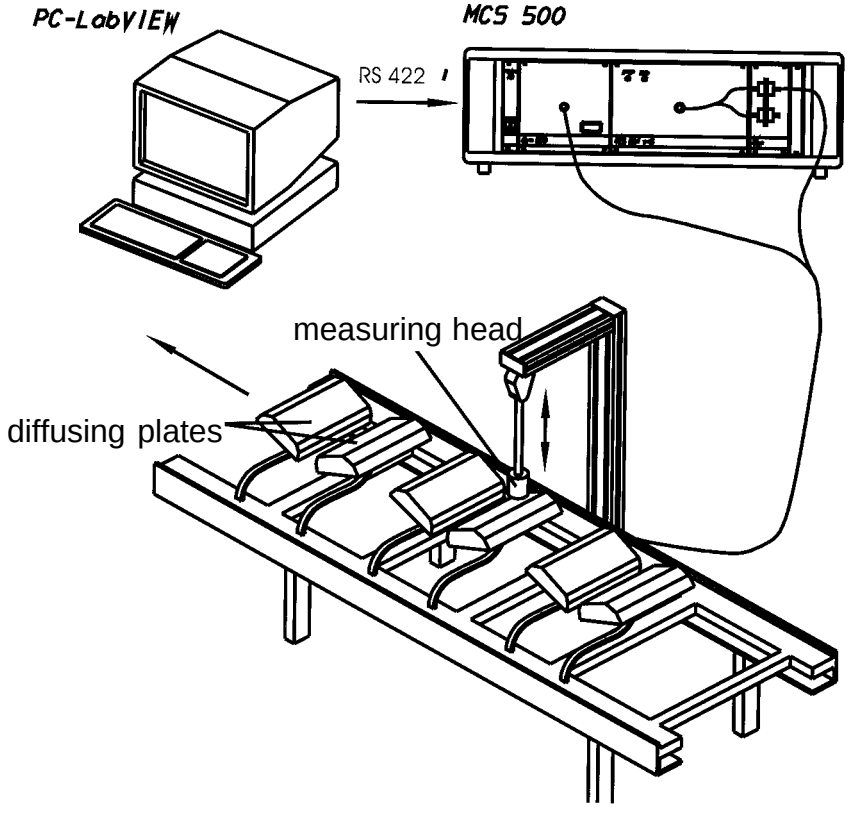
System description

Coating thickness measurement is based on the principle of white light interference.
A halogen lamp (CLH 500) illuminates the sample through optical fibres and subsequently arranged optical elements. The light reflections from top and bottom side of the protective coating interfere with each other.
The interference spectrum is detected by a fast diode array spectrometer (MCS 551 VIS) and evaluated.

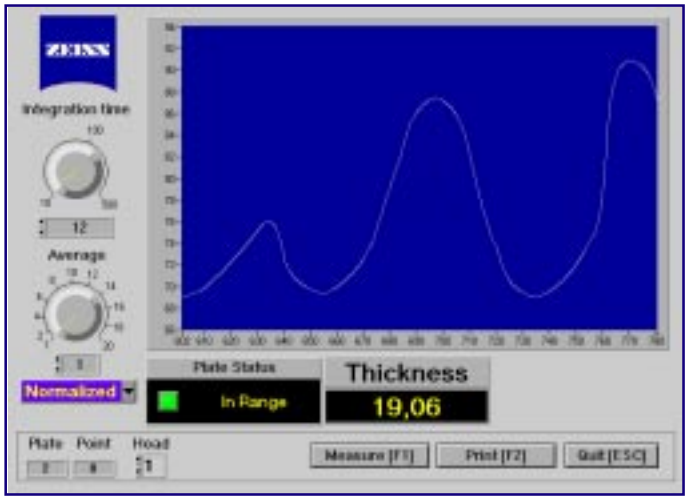
The spectra are transmitted to the PC through a serial interface (RS 422). The PC calculates the coating thickness (FFT). Additionally, status data is transmitted informing of plausibility and current system parameters.
An open-end terminal program (LabView) provides easy integration of the system in existing processes.

Specifications

Spectral range	600 ... 1,000 nm
Measuring range	2 ... 100 µm
Measuring accuracy	20 nm
Measuring time/data point	< 300 ms
Size of measuring spot	approx. 3 mm



Software



Manual measurement program

This program module serves for manual thickness measurement using the hand-held measuring head (reflection). Integration time and averaging are selectable. The program measures dark current, reference and sample individually. The interference curve is displayed. As result of measurement, the thickness appears along with information whether the result is in or outside the tolerance range.

Flat plate measurement

This program module measures one thickness per diffusing screen (reflection measurement). The measurement is released through a switching contact on the measuring head. Thickness, inrange status and measurement standby state are displayed and output through a port.

Diffusing screen measurement

Two transmission measuring heads measure the flat plates at three points (triggered by light barriers). The thickness and the yellow index of the sample are determined. In-range or out-of-range status is displayed and output via a port both for individual samples as well as for the batch.

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