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1+2 *A fluorescence imaging measurement system by Fraunhofer IPM detects contamination or defects on surfaces directly in the production line.*

IMAGING FLUORESCENCE MEASUREMENT

LARGE-AREA SURFACE ANALYSIS FOR INLINE INSPECTION

Production steps which are crucial to the quality of a product must be inspected ever more frequently and with higher precision. Only clean surfaces can be joined or coated reliably. Fraunhofer IPM's automatic imaging fluorescence measuring systems carry out surface inspection directly in the production line.

Fluorescence reveals hidden details

The »F-Scanner« laser scanner scans surfaces point by point with UV light. Many organic materials, in particular lubricants, oils, adhesives and parting agents, display strong fluorescence activity at these wavelengths. They convert some of the UV light to visible light. By contrast, most inorganic materials – metals in particular – do not display this behavior. The fluorescence of these substances can be measured with high contrast and clearly by using a spectral filter. This allows only a few milligrams per

square meter of an organic substance to be detected – regardless of whether it is contamination or a wanted deposit, e.g. an oil coating. Fraunhofer IPM already uses imaging fluorescence measuring equipment in various applications:

■ Detecting unwanted residue of lubricants, oils, adhesives, parting agents, cleaning agents or photoresists
■ Analyzing oil films on metal strips
■ Monitoring functional coatings such as adhesion promoters

Detecting critical points by imaging

Using a fast laser scanner, the »F-Scanner«, for the first time, makes it possible to conduct spatially resolved 100% inspection of large areas during production. The laser scanner allows recording of around 200 lines per second with an optical resolution of around 250 μm. This permits

Fraunhofer Institute for Physical Measurement Techniques IPM

Heidenhofstrasse 8
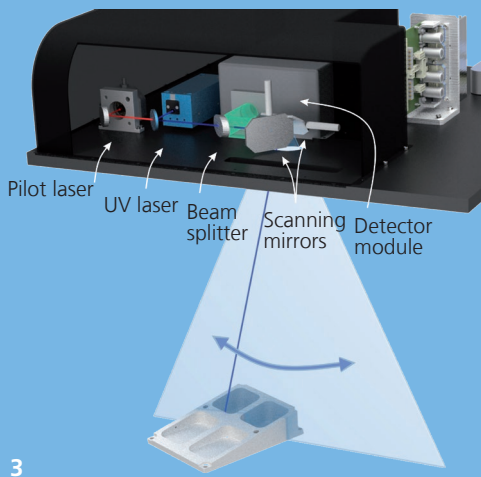D-79110 Freiburg, Germany

Contact

Dr. Albrecht Brandenburg
Group Manager
Optical Surface Analytics
Phone +49 761 8857-306
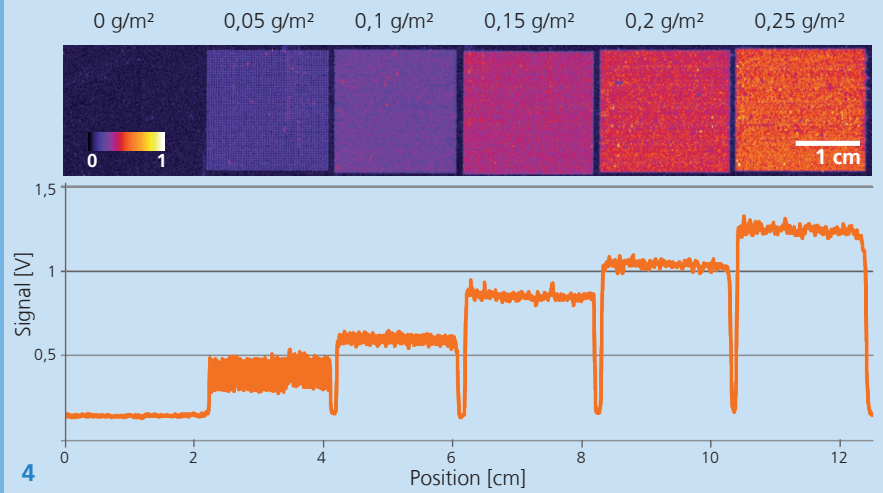albrecht.brandenburg@ipm.fraunhofer.de

www.ipm.fraunhofer.de/en

a high area throughput with simultaneous high sensitivity. The signals detected are combined to form a spatially resolved overall image. Thanks to its collimated laser beam, the system features a considerable depth of field. Beside its application for monitoring rollstock, the system also allows reliable detection of critical points on complex components.

System concept to match the task

Selection of the right technology is crucial to the reliability of the measuring system. Fraunhofer IPM offers the »F-Camera« to supplement its »F-Scanner«. »F-Camera« can be used for the analysis of planar objects up to postcard size with optical resolutions of a few micrometers. In electronics

production for instance, this camera-based fluorescence measuring system detects extremely small residual contamination such as flux on PC boards. Combined with a dark field illumination system, this technique can also be used to detect surface flaws such as scratches or pinhole defects.

Fraunhofer IPM disposes of an extensive range of laboratory equipment. The right optical components can be selected by recording fluorescence spectra and determining quantum efficiency. Moreover, it is possible to reliably estimate the detection limits of a possible system at an early project stage. Besides fluorescence analysis, Fraunhofer IPM also uses infrared spectroscopy, Raman spectroscopy or scattered light measurement depending on the particular substance.

Image processing for process control

Automatic image processing is an essential part of Fraunhofer IPM's fluorescence measuring systems. The fluorescence image is evaluated automatically in real-time by means of pattern recognition. If defects or also wanted deposits exceed a defined limit, the next process step is adapted: The component is separated off, cleaned again, or the oiling quantity is adapted. The pattern-recognition system can be programmed specifically depending on the application. This is how spatially resolved evaluation helps to ensure optimum inspection, documentation and thus long-term optimization of production workflows.

F-Scanner at a glance

- 100% inline inspection of surfaces
- Spatially resolved analysis for identifying critical areas
- Measurement speed in the m/s range
- Analysis of complex 3D components
- Flexible positioning during production
- Classification of various defect types thanks to automated image processing
- Quality-assurance documentation (images, defect class and position)
- Clearly arranged, intuitive user control
- Full CE documentation
- Eye-safe since enclosed

Characteristics	Scanner System F-Scanner	Camera system F-Camera
Fluorescence excitation	typ. 405 nm	typ. 365 nm
Detection	typ. > 420 – 520 nm	typ. > 400 nm
Detection area	some m²	some cm²
Optical resolution	approx. 250 µm	approx. 10 µm
Speed	up to 200 lines per sec.	down to 3 ms exposure time
System dimensions (L × W × H)	60 × 60 × 30 cm³	30 × 30 × 20 cm³
Sensitivity*	< 0,01 g / m²	< 0,01 g / m²
Inline-capable pattern recognition	Measurement of the position, shape, and / or amount within 30 milliseconds	
Detectable Substances	Processing agents e.g. oils, fats, cleaning agents, photoresist materials	
Surface materials	e.g. metals, various polymers, glass	

* Reference material for determination of detection limit: lubricant oil BAM K009 certified by the Federal Institute for Materials Research and Testing (BAM).

3   *Functional principle of the »F-Scanner«.*

4   *Analysis of different oil coatings: Quantitative analysis of the fluorescence signals.*