1

1 mm

1 *Three imaging methods for inspecting for defects and contamination: bright field (left) and dark filed (mid) reveal shape defects, particles and scratches. Fluorescence reveals organic contamination (right).*

F-CAMERA
MEASURING SURFACE DEFECTS AND SURFACE CLEANLINESS IN HIGH RESOLUTION

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In view of more stringent requirements on the quality of components and products, production steps need to be inspected more and more frequently and with greater precision. Component and product surfaces for instance can be neatly joined or coated only if they are clean and free of defects. Fraunhofer IPM's automatic imaging measurement systems inspect surfaces for cleanliness and defects directly in the production line.

Fluorescence measurement systems plus bright field/dark field imaging

Fraunhofer IPM's non-contact imaging »F-Camera« measurement system measures contamination or defects at production speed. Using UV light, the system excites the auto-fluorescence of unwanted substances and thus detects residues in an order of magnitude of some milligrams per square meter. Additionally, bright field or dark field imaging, adapted to the measuring task, detects flaws such as scratches or pinhole defects with a resolution of around 20 µm. Combining the various methods allows inspection for defects and contamination in a single system.

Optimizing production workflows – documenting quality

The images are evaluated automatically in real-time by pattern recognition. If a defect or contamination exceeds a predefined limit value, the component is segregated off or cleaned again. The »F-Camera« supplies both images and quantitative measurements of the shape, position or quantity of contamination and defects. This is how space-resolved evaluation assists optimization of production workflows. The results can also be saved to the customer's own
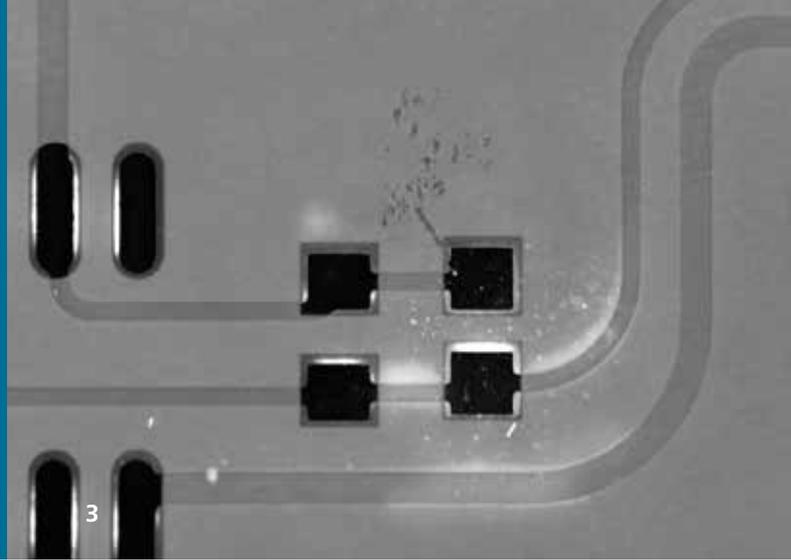
2 The »F-Camera« imaging fluorescence measuring system detects contamination or defects on surfaces directly in the production line.

3 Fluorescing contamination of a PC board: the imaging system detects residues down to one microgram per square centimeter.

QM system in order to document quality characteristics.

Fluorescence reveals what otherwise remains concealed

The »F-Camera« makes use of a simple principle: oils, greases or residues of wet chemical cleaning agents fluoresce if illuminated with UV light. This fluorescence can be measured with high contrast and unambiguously by means of spectral filtration. 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 coating, e.g. an oil coating. The »F-Camera« is already being used for various applications:

- Detecting unwanted residue of lubricants, greases, oils, adhesives, parting agents or cleaning agents
- Detecting lacquer or flux residues on PC boards
- Analyzing oiling of metal strips
- Monitoring functional coatings such as adhesion promoters
- System concept to match the task

Selection of the right technology is crucial to the reliability of the measurement system. The »F-Camera« allows high-resolution analysis of planar objects up to typically postcard size. Fraunhofer IPM also offers the »F-Scanner« for measurements on components with a size of several square meters or with a high area throughput. By using a fast laser scanner, the »F-Scanner« also allows inspection of components with complex geometries.

Fraunhofer IPM has an extensive range of laboratory equipment. The right optical components can be selected by recording fluorescence spectra and determining the quantum efficiency. Moreover, it is already 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 laser-induced plasma spectroscopy depending on the particular substance and task.

Characteristics	Camera System F-Camera	Scanner System F-Scanner
Fluorescence excitation	typ. 365 nm	typ. 405 nm
Detection	typ. > 400 nm	typ. > 420 – 520 nm
Detection area	some cm²	some m²
Optical resolution	approx. 20 µm	approx. 250 µm
Speed	down to 3 ms exposure time	up to 200 lines per second
System dimensions (L × W × H)	30 × 30 × 20 cm³	60 × 60 × 30 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).

»F-Camera« at a glance

- 100% inline inspection of surfaces
- Space-resolved analysis for detecting critical areas
- Flexible positioning in the line
- Classification of various defect and contamination types thanks to automated image processing
- Quality-assurance documentation (images, defect class and position)
- Clear, intuitive user control
- Full CE documentation