F-Camera
Detecting contaminations and defects in high resolution

Imaging, quantitative measurement directly on the component surface

The F-Camera imaging inspection system detects surface contamination and defects in a laboratory setup or directly in the production line.

The quality and functionality of products are determined by the quality of their components' surfaces. Component and product surfaces for instance can be neatly joined or coated only if they are clean and free of defects. Fraunhofer IPM's F-Camera inspects surfaces for contaminations and defects directly in the production line.

Fluorescence measurement systems plus bright field/dark field imaging

Fraunhofer IPM's F-Camera measures contaminations and detects defects non-contact and imaging at production speed. Using UV light, the system excites undesirable organic substances to fluoresce, thus detecting residues down to a few 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 and in real time using image processing algorithms. If a defect or contamination exceeds a predefined limit value, the component can be automatically segregated off or cleaned again. The F-Camera supplies both images and quantitative measurements of shape, position and quantity of contamination or defects. This is how space-resolved evaluation assists optimization of production workflows. The results can also be saved to the customer's own QM system in order to document quality characteristics.

Advantages at a glance

- 100% inline inspection of surfaces
- Space-resolved analysis for detecting critical areas
- Available as inline or lab system
- Classification of various defect and contamination types thanks to automated image processing
- Quality-assurance documentation (images, defect class and position)
- Clear, intuitive user control
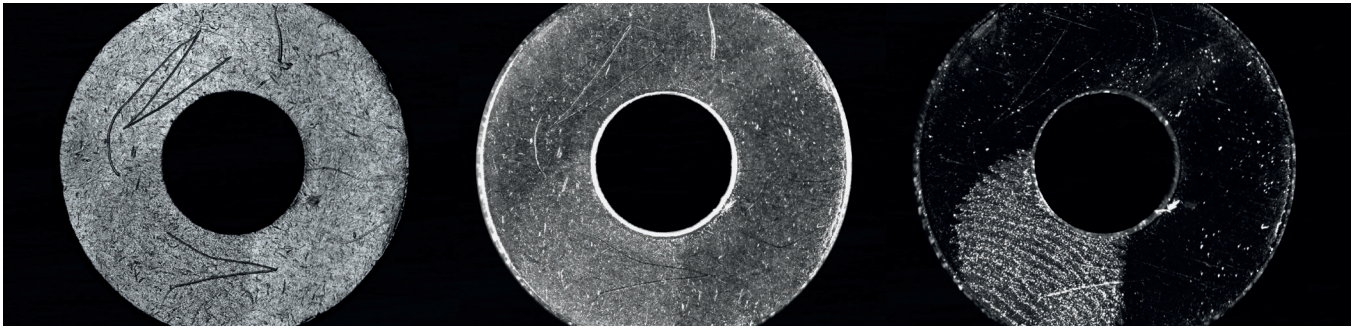
Three imaging methods for inspecting defects and contamination: bright field (left) and dark field (mid) reveal shape defects, particles, and scratches. Fluorescence (right) reveals organic contamination.

Fluorescence reveals what otherwise remains concealed

The F-Camera makes use of a simple principle: oils, greases, lacquer, 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. The F-Camera lends itself for various applications:

- Detecting unwanted residue of lubricants, greases, oils, adhesives, parting agents or cleaning agents
- Insulation inspection of wires and hairpins
- 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

Selecting 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	280, 365, 450, 530 nm (tunable)	405 nm
Detection area	some cm²	some cm² up to some m²
Optical resolution	approx. 20 µm	approx. 250 µm
Speed	down to 3 ms exposure time	up to 400 lines per second
Size of measuring head (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	

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