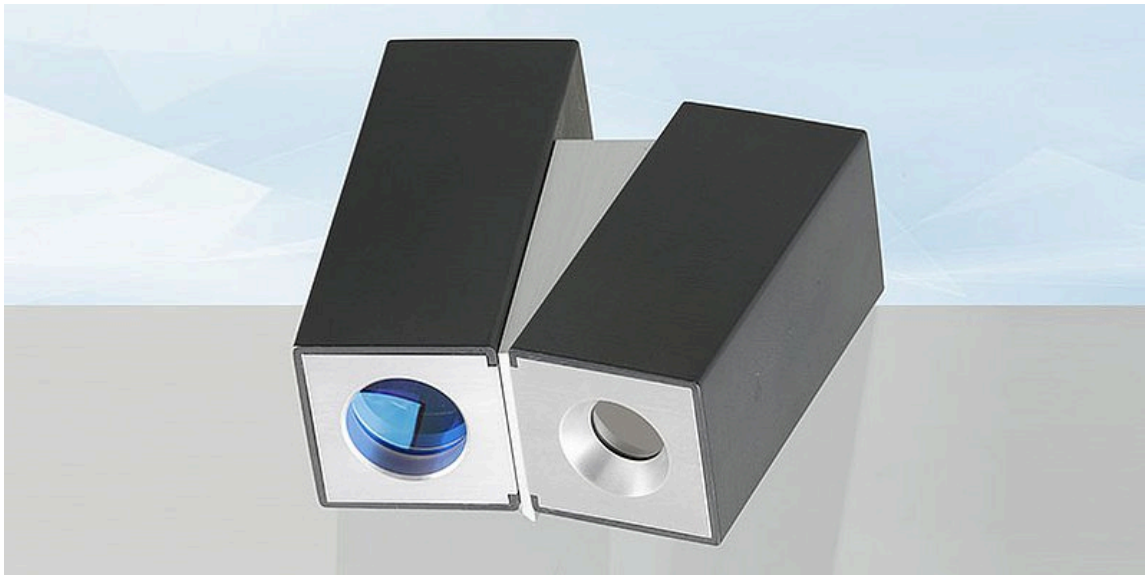
New scanning coating thickness measurement method: Measuring large-area and moving components with PaintChecker Move (Image: OptiSense)

Coating thickness measurement for large surfaces and moving components

A newly developed scanning photothermal coating thickness measurement process enables the surface inspection of endlessly long surfaces and moving objects without having to move along with the components.

The new PaintChecker Move scanning coating thickness measurement system from measuring system manufacturer OptiSense has a completely modular design so that the measuring device can always be optimally adapted to the respective

and moving objects without having to move along with the components. The new technology actively uses the movement between the workpiece and the sensor instead of compensating for it, as is the case with conventional devices.

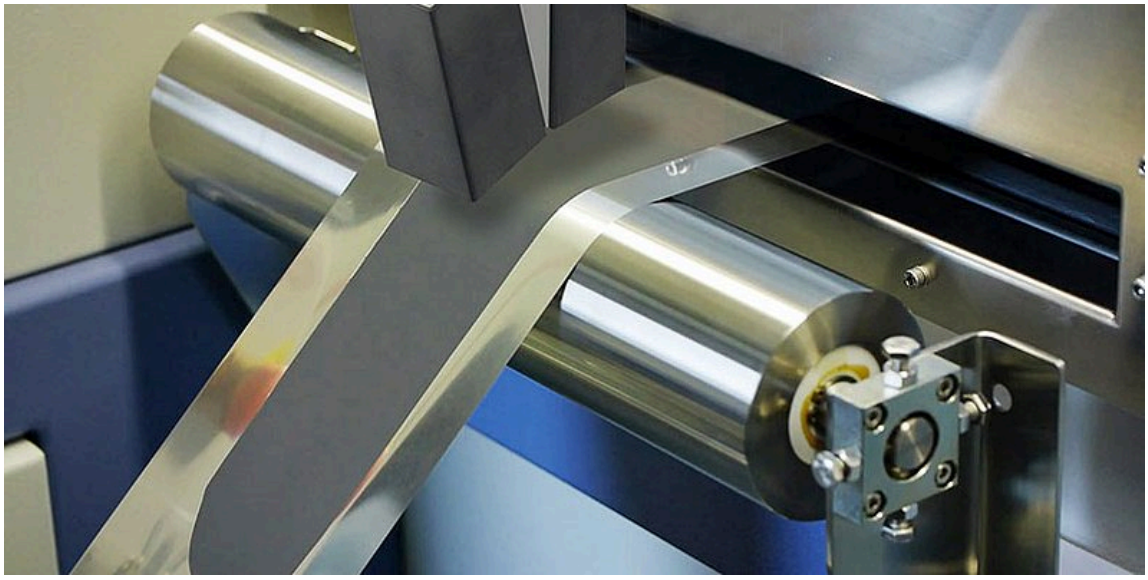


The new, scanning OptiSense system is called PaintChecker Move and has a completely modular design so that the measuring device can always be optimally adapted to the respective application. The excitation and detection modules are stand-alone and can be modified independently of each other (Image: OptiSense)

Status quo of coating thickness measurement of moving objects and in the surface

Cost-effectiveness, precision and surface quality have been among the dominant requirements in the coating industry for some time now. At the same time, however, it is still hardly possible in many companies to monitor a very decisive parameter in this context at an early stage and permanently: the amount of paint applied. It makes sense to check the coating thickness as a relevant parameter before it hardens, i.e. while it is still liquid or soft, as incorrect coatings can still be easily corrected at this stage.

seamless, as the production and subsequent use of battery modules and packs are associated with numerous safety risks that require special protective measures.



Coil coating of aluminum foils with liquid, so-called "slurry", where the layer thickness is measured in the wet state (Image: OptiSense)

How moving objects are tested today

To date, coating thickness testing of moving objects has been problematic, as the object is no longer within the detector's field of view after a short time. Of course, it is possible to move the entire measurement setup, but this approach is often technically complex and is not expedient where space is limited. In addition, no checks can be carried out while the coating thickness inspection system is moving back to the starting point in order to detect other moving objects. This "return gap" therefore does not allow seamless measurement.

To avoid this dilemma, the heating area is enlarged for measurements in motion. This gives the moving component sufficient time to absorb the necessary amount of heat. During the test time, the heated workpiece passes through the detector's field of view and the temperature curve is detected. The result is a

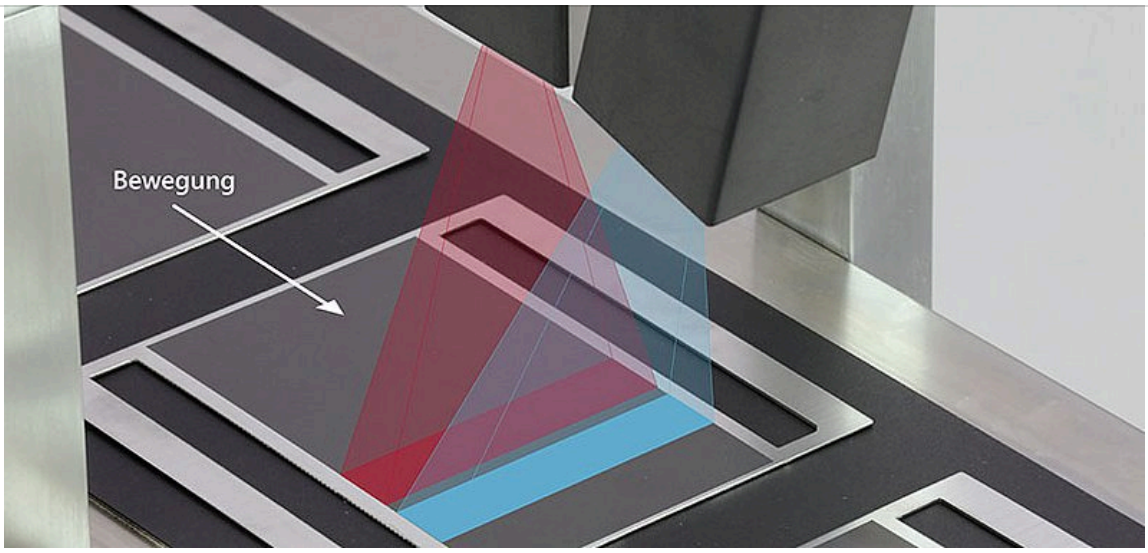
relatively low speeds, this is already several centimeters. The layer thickness determined then corresponds to the average value over this range, but small imperfections can no longer be detected.

The new, scanning 3D PaintChecker Move is flexible and user-friendly. It is easy to integrate into existing coating lines - even in the most difficult production environments (Image: OptiSense)

Coating thickness measurement of large areas

The situation is no better when checking the coating thickness of extensive surfaces: One current idea for inspecting large surfaces with spatial resolution sounds simple at first: the heating region is enlarged for this measurement task and an IR thermal imaging camera is used as a detector. However, this approach quickly becomes very complex. The larger the area, the greater the required excitation power, which often requires several energy-intensive light sources. In addition, the larger the area, the greater the demands on the camera and therefore the higher the costs. Another legal hurdle is that high-resolution IR cameras are often classified as dual-use goods, which leads to trade restrictions.

This means that reliably and continuously monitoring the coating thickness of large surfaces or moving objects before curing can



New scanning 3D inspection method: The component is moved along the sensor and first passes through an excitation zone (red), in which the coating is heated by a few degrees using light radiation. It then enters the measuring zone (blue), in which the local temperature is recorded at several hundred points simultaneously. As the component passes through the measuring zone, the cooling of the coating is measured periodically and the coating thickness is calculated from the temperature curve. The temporally overlapping evaluation results in continuous, uninterrupted recording (Image: OptiSense)

New scanning 3D inspection method meets all requirements

Dr. Fabian Gaußmann from the development department of measuring system manufacturer OptiSense was therefore looking for a solution that could check both large and moving objects for correct coating without contact, precisely, continuously and even before curing.

The result is a scanning measurement process that makes use of the movement between the component and the sensor instead of compensating for it at great expense. The object is not scanned once as a whole, but continuously as it passes through the measuring device. "The movement of the workpiece is therefore no longer an obstacle, but an elementary part of the process. The testing system can be guided along the stationary workpiece, the workpiece can move past the fixed sensor, or both the sensor and

measurement of moving and large-area workpieces."

Functionality of the new coating thickness measurement method for extended surfaces and moving components

The photothermal measuring method

As is well known, photothermal coating thickness testing is a non-contact method
for paints, powder coatings and glazes on metallic and non-metallic substrates. The different thermal properties of the coating and substrate are used to determine the coating thickness. The surface of the coating is heated up by a few degrees with a short, intense light pulse and then cools down again by dissipating the heat into deeper areas. The thinner the coating, the faster the temperature drops. The temperature curve over time is recorded by a highly sensitive infrared sensor and converted into the coating thickness. The process works contactlessly and non-destructively with both freshly applied and cured powder and paint coatings.

The scanning 3D test method

The new scanning 3D inspection method supplements previous fields of application with the non-contact, fast and precise measurement of large-area workpieces and moving objects.

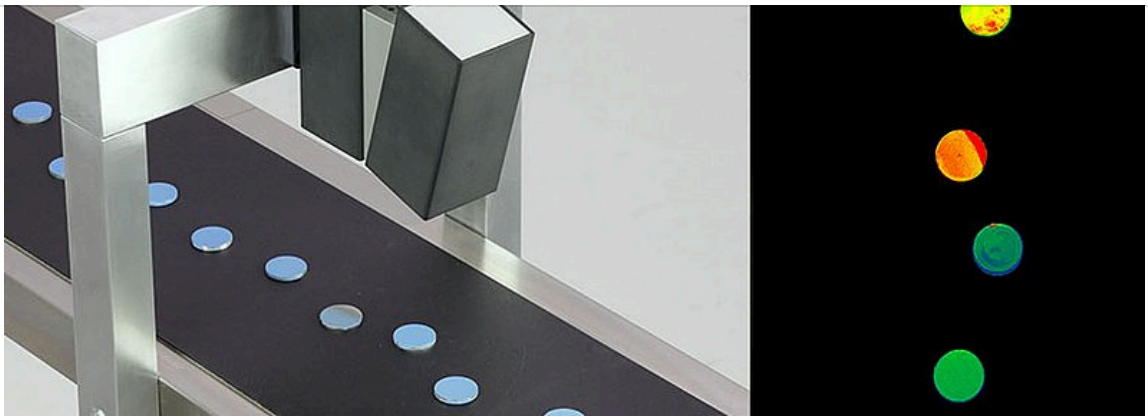
For the new method, the OptiSense development team extended the heating range of the inspection system to enable greater heat input. However - and this is revolutionary - with the innovation presented here, the heated area does not have to cover the entire surface to be tested, but only a small section, usually just a few centimetres. As an interesting side effect, it is also no longer necessary to stimulate with

The detector used is an integrated matrix of IR sensors with a relatively small field of view and a low number of pixels, which covers a measuring field approximately the size of the heating area.

The temperature curve is recorded on a pixel basis to determine the coating thickness with local resolution. In simple terms, the image of the previously excited (heated) workpiece moves from pixel to pixel in the sensor due to the relative movement. The temperature profile of each individual surface element of the workpiece can thus be determined through a continuous, time-staggered evaluation of the pixels. This temperature curve is then converted into the corresponding layer thickness, as with conventional photothermal technology.

The heated area passes under the detector

The layer thickness can be determined with spatial resolution in this way, whereby the spatial resolution is determined by the effective pixel size of the sensor. Typically, the resolution is in the range of approx. 1 mm/px. The final result is an image with the desired layer thickness information. The width of the image transverse to the direction of movement corresponds to the width of the excitation area or the width of the sensor field of view. The length of the image in the direction of movement is in principle unlimited.



The surface scan provides a full-surface image of the component coating, in which the coating thickness is displayed as a color. This makes it immediately apparent where the component has been undercoated (red) or overcoated (blue). Defective coatings can be distinguished from faultless components (green) at a glance and can be reworked before curing (Image: OptiSense)

The modular structure of the PaintChecker Move

The new, scanning OptiSense system is called *PaintChecker Move* and has a completely modular design so that the measuring device can always be optimally adapted to the respective application:

The excitation and detection modules are stand-alone and can be modified independently of each other. They are connected via an element that also contains the data cable connection and provides the mechanical connection to the customer's system. The angle of the connecting element is adapted to the respective test situation.

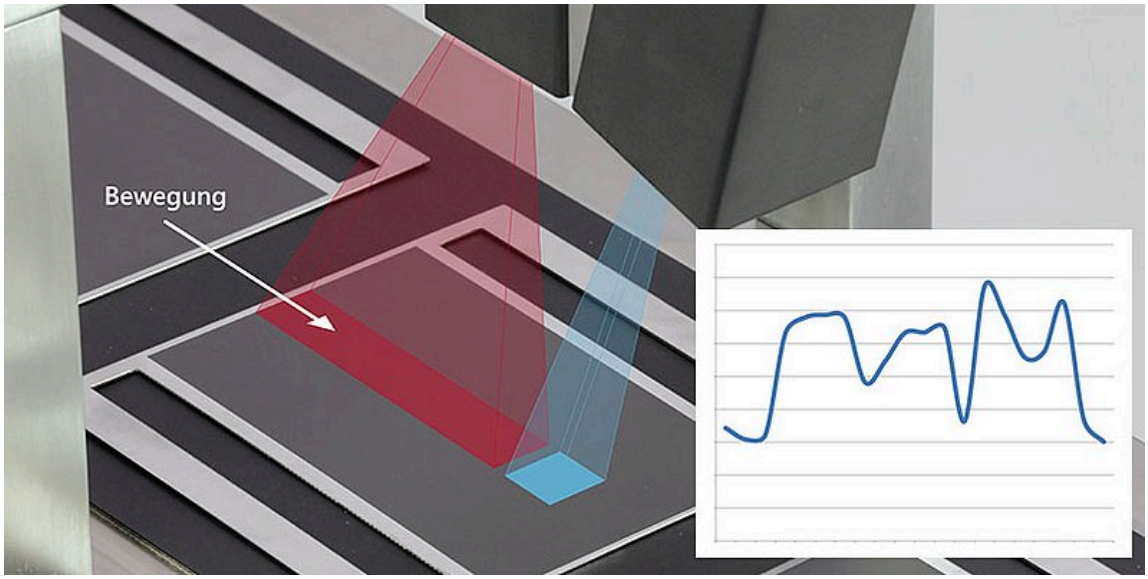
The excitation module contains the optical components for beam shaping. Depending on the measurement situation, different shapes of the excitation area on the workpiece surface are possible. In a standard configuration, a homogeneously illuminated rectangle with an edge length of up to 100 x 10 mm^2 is generated. The edge lengths can be configured independently of each other.

Lasers of different power classes and wavelengths are used as excitation sources. What all variants have in common is that the laser itself is installed in the external controller housing and is connected to the excitation module via an optical fiber. This means

plastic sheathing and is suitable for drag chains.

The detection module essentially contains the IR sensor matrix including imaging optics. Data communication takes place via cable. Power supply and communication take place via a 5 meter long cable.

The excitation and detection module have a footprint of 55 x 55 mm^2. The height is approx. 150 mm (excitation module) and 115 mm (detection module). The sensor weighs around 1.5 kg. The external controller housing has the same dimensions and type as the models currently used by OptiSense for industrial applications. The system is controlled via a PC connected to the controller via a network cable.



The light source is rotated by 90° on fast-moving belts or coatings that are difficult to heat, so that the component is in the excitation zone for longer. The measurement then captures a linear strip of the coating as a continuous, gapless coating thickness profile (image: OptiSense)

Measurement procedure and measurement variants

spatially resolved calculation of the coating thickness and display takes place seamlessly in real time. This allows the coating thickness to be determined in real time, even for continuous measurements such as coil coating, so that process parameters can be adjusted immediately if necessary.

There are three different versions of the modular concept:

High-resolution surface scan

This configuration enables the continuous measurement of coating thickness images; the test result is a 2D image with the spatially resolved coating thickness. The width across the scan direction is up to 100 mm. The length in the scanning direction is in principle unlimited.

High-resolution profile scan

In applications with a high relative speed between the sensor and the component, the available excitation power is redistributed so that less light power is applied to the width (transverse to the scan direction) and more to the length (along the scan direction) of the measurement object.

This arrangement makes it possible to address higher speeds or longer measuring times (equivalent to greater layer thicknesses). The detector field of view is also adjusted. The result is a 2D scan with a reduced width transverse to the scan direction or, in borderline cases, a profile scan. In both cases, the local resolution remains high along the scan direction.

Non-scanning profile inspection

A non-scanning mode is also possible. In this case, the matrix of IR sensors is replaced by a single, highly sensitive IR sensor. In this way, the accuracy of the coating thickness measurement can be further increased at the expense of

At its core, the PaintChecker Move sensor consists of an excitation and detection module. The modules are configured independently and optimally for the respective measuring task (Image: OptiSense)

Economic advantages and amortization

The PaintChecker Move is flexible and can also be easily integrated into existing production lines at a later date. In particular, the condition of the coating (wet, moist, soft, dry, baked) and the dimensions of the workpiece hardly play a role. It is even possible to accurately inspect objects of any size in a non-contact and repeatable manner with several measuring systems mounted next to each other.

The economic advantages of the OptiSense measuring system are considerable. The PaintChecker Move reduces material waste, optimizes production processes and increases product quality. Coating companies can also achieve significant cost savings. For example, reducing the reject rate by just 0.5 percent saves a medium-sized contract coater annual costs in the five-digit range.

At the same time, the system helps to increase production efficiency. Continuous monitoring guarantees more stable and efficient production, which minimizes downtime and increases the overall productivity of the systems. PaintChecker Move also significantly reduces the risk of complaints.

Furthermore, the PaintChecker Move's continuous data acquisition and analysis enables comprehensive process and quality monitoring. The data obtained can be used to identify weak points in the production process and take targeted improvement measures. Interest in the market is already very high. The evaluation phase with several pilot customers has already got off to a very good start and the measuring system will be available shortly.

The Optisense PaintChecker Move coating thickness inspection system offers coating companies a powerful solution for optimizing their production processes and ensuring and increasing their product quality (Image: OpiSense)

Conclusion

The PaintChecker Move marks a significant advance for the coating industry as a scanning 3D coating thickness inspection method. The precise and continuous measurement of coating thickness

Permanent and reproducible monitoring of the application ensures a uniform and consistent coating. This is particularly important to improve the durability and optical properties of the products and to meet the increasingly demanding quality standards and all necessary safety regulations. The latter are particularly crucial for products that are subject to liability, such as battery modules or highly stressed parts from the transportation industry, such as in the aircraft and automotive industries, railroads and bicycle production.

The new, scanning 3D PaintChecker Move is flexible and user-friendly. It is easy to integrate into existing coating lines - even in the most difficult production environments. The inspection system thus offers coating companies a powerful solution for optimizing their production processes and ensuring and increasing their product quality. *(OM-10/24)*

Contact

OptiSense GmbH & Co. KG
Annabergstraße 120
45721 Haltern am See (Germany)
Phone: +49 23 64 50 882-0
E-mail: info@optisense.com
www.optisense.com

About OptiSense

OptiSense is the world's leading provider of photothermal measurement systems for coating thickness on a wide range of substrates. The OptiSense portfolio consists of industrial testing systems for non-contact automated coating thickness

Topics

Topic Area

Topic Category

Website Search

Search for

Search

Advanced search

Rules

What is Surface Technology Online?

Oberfläche Online

Information

Contact | About us | Jobs
Imprint | Data Privacy
Media Data | Newsletter

What we offer

On Surface Technology Online, the surface technology magazine, you will find current news from the industry, technical articles, directories and more!

Deutsch **English**