#automotive #paint #terascope

Fully automated coating thickness measurement of paint layers on car bodies with terahertz waves

In the automotive industry, the requirements for painting car bodies are always increasing. In order to maximize the service life of the bodies under mechanical and environmental stress and also to achieve an even, attractive and durable colour appearance, they are coated with up to four different layers of paint. It is not only the material composition of the individual layers that determines their respective functionality, such as reliable protection against moisture and salt or resistance to UV radiation, extreme temperatures and stone chipping. The coating process in particular, in conjunction with the thickness of the individual paint layers, determines the overall quality of the product. At the same time, the automotive industry is increasingly optimizing its quality controls, especially in automated series production, as it does not want to apply more paint than necessary not only for cost reasons.

Focus on quality control – Status quo and current pain points

In order to check the coating thickness of paint coating systems on car bodies in automated series production, several painted car bodies per day and model are taken out of the production line as random samples. They are measured offline according to a defined test plan at an average of up to 100 measuring points, either manually or semi-automatically. Up to now, mainly contact measurement technologies have been used for coating thickness measurement. On the one hand, these prove to be unsuitable for measuring wet or still moist coatings. On the other hand, the magnetic induction method in combination with the eddy current method, for example, can only be used to measure the total coating thickness of a cured paint coating system, but not the individual coating thicknesses. To do this, car manufacturers have to use destructive measuring methods.
In quality control, cross-section or so-called "stripe car bodies" are therefore used to determine the single thicknesses of the different paint layers. Stripe car bodies are prepared approximately once a month. For this purpose, a car body in raw condition is elaborately masked for the paint line in a special way, so that the individual layers can be measured after painting with a tactile gauge. The costly striped car body is then scrapped after measurement.

With a throughput of up to 60 car bodies per hour, it is not possible to react quickly with the previous measuring methods for quality control if the paint job does not meet the required standards. In order to save material, labour and time, and to ensure consistently high quality, faster, more frequent and more precise measurement of the total and the individual layer thicknesses of paint coating systems on car bodies is desirable.

The TERASCOPE® – A new dimension in measurement technology

With the TERASCOPE®, the Helmut Fischer Group provides a highly innovative measuring technology that can precisely determine both the overall layer thickness of a paint coating system and the thickness of each individual paint layer in a completely contactless and non-destructive manner and within just one measurement – regardless of the base material. The revolutionary measurement system with market-leading measurement performance utilizes terahertz waves in an outstanding bandwidth of up to 6 THz[1] and is suitable for all surface and coating textures compared to tactile measurement methods. Whether flat or curved, hard or soft, wet, moist or dry, smooth or rough, optically transparent or non-transparent, the TERASCOPE® can be used for a wide variety of applications and thus opens up a completely new dimension in the field of coating thickness measurement on an industrial scale.

Want to learn more? Then find out more about the terahertz measuring method!

Innovative measuring head – Ideally suited for automated production

With a handy total weight of just 6 kg, the compact TERASCOPE® measuring head can be flexibly integrated into fully automated quality control processes, for example as a dual head system2 mounted on robots. For curved surfaces and complex component shapes, such as those of a car body, an optional ultrasensitive 3D scanner ensures optimum alignment of the measuring head to the measurement object. The 3D scanner is particularly important for automated series production, as the car bodies are not always positioned exactly the same due to the conveyor technology.
The measuring system is referenced fully automatically at predefined time intervals via a reference station. As the TERASCOPE® measuring head uses state-of-the-art electro-optical measurement technology, it is also extremely low-maintenance and therefore well suited for uninterrupted 24/7 use. Overall, with a sampling rate of 1.6 kHz1 and in combination with the patented Clean-Trace technology, the TERASCOPE® achieves an unbeatable measurement performance and delivers reliable measurement results even in harsh environments.

Coating thickness measurement on a painted fender with the TERASCOPE®

In order to demonstrate the fully automated coating thickness measurement of paint coating systems on car bodies using terahertz waves, a finished painted fender was measured with the TERASCOPE® at 15 predefined measuring points. Installed on a 6-axis robot, the measuring system first carries out a fully automatic referencing process over 10 seconds at the reference station. It then scans the individual measuring points on the fender. Using the 3D scanner, the TERASCOPE® measuring head is ideally aligned with the surface of the object to be measured at a measuring distance of 7 cm. The measuring system requires around 4 s per measuring point for alignment and an average of 1 s per measuring point for measurement. The measurement results in Figure 1 show whether the thicknesses of the individual paint layers on the fender are within the required tolerance range (CDP 16 - 19 µm, filler 36 - 40 µm, basecoat 20 - 24 µm, clearcoat 45 - 53 µm).

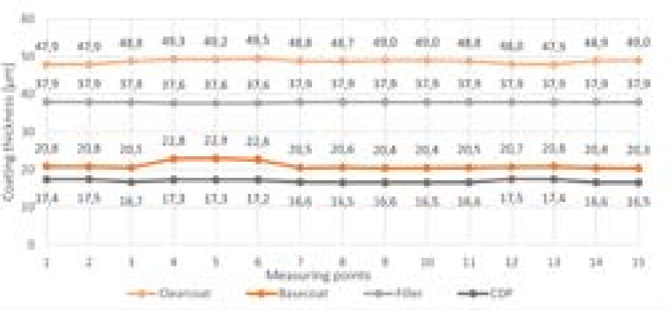

Fig. 1: Individual layer thicknesses of clearcoat, basecoat, filler and cathodic dip painting, measured at 15 different measuring points with a measuring precision of ±1 µm

The measurement results provided by the TERASCOPE® reveal the extent to which the individual paint layers vary in thickness across the different measuring points. This is due to variations during the painting process. This series of measurements showed that the basecoat was applied thicker at measuring points 4, 5 and 6, than at the other measuring points. Nevertheless, with a maximum measured layer thickness of 22.9 µm, the basecoat is still within the tolerance range (20 - 24 µm). Overall, the TERASCOPE® was able to demonstrate precisely, reliably and quickly that each individual layer of paint was within its respective tolerance range and that the painted fender and therefore also the painting process met the required quality standards in terms of layer thickness.

The TERASCOPE® enables a fully automated, non-destructive and contact-free type of quality control. The coating thickness of each individual paint layer can be determined with high precision and within a very short time, thus enabling fine adjustment of the painting processes. While cathodic dip painting is one of the cheaper coatings in terms of materials, the basecoat in particular can be especially costly due to special effect pigments and other expensive additives, such as aluminum flakes. The same applies to the clearcoat if it is to have special properties such as self-healing. Quality control with the TERASCOPE® can therefore save enormous material costs in the long term, create reproducible high quality and, above all, significantly minimize reworking and rejects.

[1] Depending on configuration.
[2] A double-head system consists of two TERASCOPE® measuring heads, each mounted on a robot system. By measuring in parallel, the measuring points on the measurement object can be covered more quickly, which makes quality control even more time-saving.

Maximum measurement precision and reliability thanks to uniquely high sampling rate

In addition, the TERASCOPE® is resistant to external mechanical vibrations that usually occur in production halls. This is due to the extremely high sampling rate of up to 1.6 kHz[1]. Figure 2 demonstrates that the measuring system delivers highly precise and reliable measurement results even in harsh production environments.

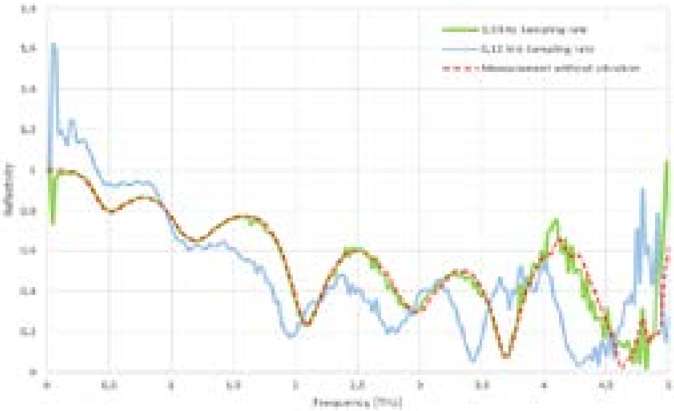

Fig. 2: Influence of the sampling rate on measurements with vibration compared to measurements without vibration

The reflectivity (the terahertz reflection signal) of two vibration measurements on a paint coating system is shown: The first was carried out with a high sampling rate of 1.6 kHz (green) and the second with a significantly lower sampling rate of 0.12 kHz (blue). The reflectivity of a measurement without vibration (red) is also shown as a benchmark. At a sampling rate of 0.12 kHz, the graph is visibly noisy and deviates in its entire course from the measurement without vibration. The local minima and maxima are clearly shifted, which has a negative effect on the subsequent layer thickness calculation and its repeatability. A higher sampling rate significantly improves the signal noise and the curve progression. For example, when measuring with a sampling rate of 1.6 kHz, the graph follows the graph of the benchmark measurement without vibration very well despite the vibrations.
The sampling rate determines the speed at which measured values are recorded at a measuring point. A measurement with a high sampling rate of 1.6 kHz is therefore significantly less affected by vibrations than a measurement with a lower sampling rate of only 0.12 kHz, because the measured values are recorded faster than the vibration oscillates. With its market-leading high sampling rate of 1.6 kHz1, the TERASCOPE® enables a coating thickness calculation that is significantly more precise, reliable and also more repeatable.

[1] Depending on configuration.

The TERASCOPE® is a quantum leap in paint layer thickness measurement for the rapidly developing automotive industry, where the highest quality and maximum efficiency are the measure of all things. The measuring system cleverly combines the innovative terahertz technology as a non-destructive and non-contact measuring method for determining the total and individual layer thicknesses of paint coating systems with the high requirements of modern, fully automated automotive production. The TERASCOPE® thus represents an enormous technological advance in terms of measurement performance in the field of terahertz measurement, offering manufacturers unrivalled control over their painting processes and the opportunity to raise their product quality to a new level.

Have we aroused your interest?

Find out more about the **TERASCOPE®**! Availability depending on region and country.

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