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Plastics: Terahertz testing with a handheld scanner

Suitable measurement and inspection techniques for process monitoring and quality control are still lacking in some areas of industrial manufacturing. Researchers at the Fraunhofer Institute for Industrial Mathematics in Kaiserslautern have found a promising solution to this challenging problem based on mobile terahertz technology.

Although traditional methods like X-ray, ultrasound, thermography, eddy current, and many others can be very useful, they have their limits when used for structural analysis and anomaly detection, especially, for sandwich or hollow constructions or modern fiber-reinforced or foamed plastics. For example, ultrasound cannot be used to inspect pipes directly after the extrusion process during manufacture; because of the high temperature of the material and the plastic fluid core of the not-yet solidified pipe.

Penetrating thick electrical insulators

In comparison, terahertz technology is a relatively new, non-destructive testing method that is proving especially promising in the field of plastics. The terahertz frequency range is between 100 Gigahertz (GHz) and 10 Terahertz (THz), which corresponds to wavelengths of 3 mm to 30 μm . At this wavelength, special properties include the ability to penetrate electrical insulators made from ceramics, glass, and plastics.

More advantages

Terahertz spectroscopy has recently become even faster and more robust, especially, for industrial applications; Compared to established test methods, it has a number of advantages:

- No need for coupling medium
- Measurements possible even with one-sided access
- Suitable for inspecting fired and green ceramics, foamed plastics, hollow structures and composite sandwich structures

In most cases, the penetration into thick components enables 3-dimensional volume testing for pores, bubbles, and delamination and even allows the imaging of internal structures.

Handheld scanner: Terahertz testing to go

ITWM researchers have successfully developed a completely mobile, terahertz testing system in the form of a handheld scanner. The sensor is encased in a dust and waterproof housing for use in non-destructive testing in a manufacturing environment. The computer integrated touch screen ensures easy operation.

The handheld scanner is already inspecting stationary samples as well as being successfully used at various test stations in manufacturing, for example, for quality control of plastic pipes after joining. Since this test is generally performed outside the production hall, a mobile inspection system is required.

Locating hidden pipes and cables

Another use case is in the construction industry and the inspection of drywalls: When drilling a hole, you want to be sure not to hit any pipes or cables. It is important to know not only about the presence of any metals, plastics, and structural timber, but also their location – especially the depth – in the wall. The new handheld scanner reliably detects any material.

Our researchers are exhibiting the handheld scanner at the JEC World 2019 in Paris on March 12-14, 2019. Visit them in Hall 6, Stand H78 to learn more about the use of terahertz waves in industrial environments.

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**Handheld terahertz sensor for mobile operations with touchscreen uses standard power socket.
No further equipment required for operation. ©Fraunhofer ITWM**

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