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FRAUNHOFER INSTITUTE FOR MATERIAL AND BEAM TECHNOLOGY IWS

PRESS RELEASE

The Sound of the Perfect Coating

Fraunhofer IWS Transfers Laser-based Sound Analysis of Surfaces into Industrial Practice with “LAwave”

(Dresden, 27.03.2024) Sound waves can reveal surface properties. Parameters such as surface or coating quality of components can be analyzed non-destructively using lasers and sensors. In research and some industrial laboratories, this laser-induced surface wave spectroscopy has already become an established measurement technology. With “LAwave”, the Fraunhofer Institute for Material and Beam Technology IWS in Dresden will present the second generation of a user-friendly measuring device at the International trade fair for quality assurance “Control” in April 2024, which will pave the way into industrial practice.

“This technology enables us to examine coatings and surfaces non-destructively, quickly, and very accurately,” explains project manager Dr. Stefan Makowski, who heads the Coating Characterization Group at Fraunhofer IWS. “With LAwave, we are now taking the step towards industrial application.” Specific fields of application can be automotive engineering, surface coating and microelectronics. For instance, laser-induced surface acoustic wave spectroscopy can evaluate cracks and pores on thermally sprayed surfaces without destroying the component, as with conventional cross-sectional examinations. Removing damage layers on silicon surfaces can be examined in the semiconductor industry. LAwave technology provides a suitable method for quality control of PVD coatings, such as wear-resistant and friction-reducing coatings made of diamond-like carbon on motorcycle chains and engine components.

Potential for Environment and Health

LAwave-supported analysis of the latest brake disc generations opens up great potential for protecting the environment and health: The vehicle industry is gradually moving towards coating steel discs with particular coatings of hard metal, ceramic, or other materials to reduce abrasion and corrosion. This should ensure that cars and motorcycles meet the EU's increasingly strict particulate matter limits. On the other hand, manufacturers are preventing unwanted side effects by switching to electric drives: Electric vehicles often only use the engine brake to recharge their batteries via recuperation. They use the conventional wheel brakes less often – and these consequently corrode earlier. The additional layers mentioned above can significantly

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reduce both problems, although they cannot yet be tested non-destructively. This is where LAwave steps in.

Continuous Development and Improvement

Early measurement systems of this type required complicated evaluation and were usually only operated by specialized scientists. Over the past 20 years, universities and non-university institutes have used those systems. Since then, however, Fraunhofer IWS has continuously developed and improved the technology and software and collaborated with partners to improve the design's user-friendliness. A cooperation between Fraunhofer IWS and the Chair of Technical Design at the Technical University of Dresden (TUD) contributed to this.

Fraunhofer IWS is currently developing further technological improvements to open up new fields of application for LAwave. For example, artificial intelligence can significantly improve the quality of analysis even further. A mobile LAwave measuring head also is on the agenda. Its design will allow the surface analysis of internally coated tubes, rollers, and other particularly heavy, large, or complex-shaped machine components that cannot be handled in a stationary device.

The current LAwave measuring system will be on display from ***April 23 to 26, 2024*** *at* ***"Control"****, booth 8201 in hall 8 at Messe Stuttgart. Visit us also from* ***April 29 to May 1, 2024*** *at* ***"ITSC Expo"****, booth 111 at Milan, Italy or from* ***September 2 to 5, 2024*** *at* ***"PSE 2024"*** *in Erfurt.*

Info Box

How Laser-induced Surface Wave Spectroscopy Works

Researchers in Dresden have continued to refine the principle over decades: they use a special laser that excites inaudible sound waves on a component surface under examination. In doing so, they send frequencies with the highest possible bandwidth across the surface of the work piece. Depending on the frequency, these waves propagate at varying speeds at different depths in the material. At the other end of the measuring section, sensors on the surface record the arrival and speed of the waves. The sum of the measured values for the different sound frequencies results in a "fingerprint" of the examined surfaces and layers, which special software evaluates and processes. From the signature determined in this way, conclusions can be drawn about the effective mechanical properties and defects of the analyzed work piece. Every crack, every pore, or every

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accumulation of foreign atoms in the material ultimately influences the path of the sound waves on the surface or through the applied layer.

Info Box

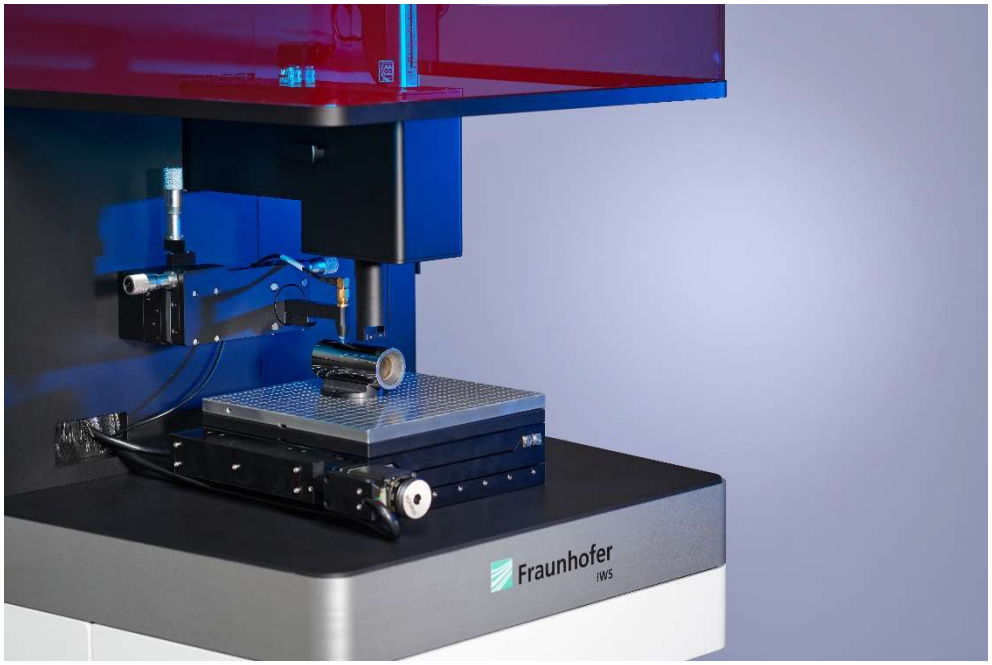
Starting Signal "LAwave": Dresden DesignLab as a New Contact Point for Product Design at Fraunhofer

The latest LAwave device generation development marked the starting point for the collaboration between the Fraunhofer IWS and the Chair of Technical Design at TU Dresden. This resulted in design ideas and principles that also formed the basis for developing the first "Corporate Product Design Manual" within the Fraunhofer-Gesellschaft. In addition to the latest ergonomic findings, this Fraunhofer IWS design manual also incorporates design principles that ensure clear recognition effects. These include, for example, the "white shell, black core" principle, tested using LAwave and established at the Dresden Institute, as well as iconic curved corners and silver-colored clasps with an integrated institute logo. In further steps taken within the Fraunhofer network "Wissenschaft, Kunst und Design", the researchers uncovered a great deal of dormant potential for product design in application-oriented research. In 2023, the Technical University of Dresden and the Fraunhofer-Gesellschaft founded the joint "Design Lab" on the initiative of the Fraunhofer Institutes IVI, IWS, and IWU to meet the resulting needs.

About the DesignLab

As a joint research institution of the TUD Dresden University of Technology and Fraunhofer-Gesellschaft, the DesignLab offers tailor-made design expertise and research from a single source for applied, technology-oriented research and transfer issues. It integrates design methods into today's development projects in a targeted manner and throughout the entire research process. The aim is to fully exploit the potential of the technologies and to place added value for society and users at the focus of development. This ensures a successful transfer of technologies from research to the market.

More information: https://designlab.works/



In the pictured configuration the LAwave measuring system allows the fast and non-destructive characterization of small and medium-sized components.
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The specially developed software with its intuitive user interface controls the measurement and allows reproducible and automated evaluation by means of a definable measurement recipe.
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