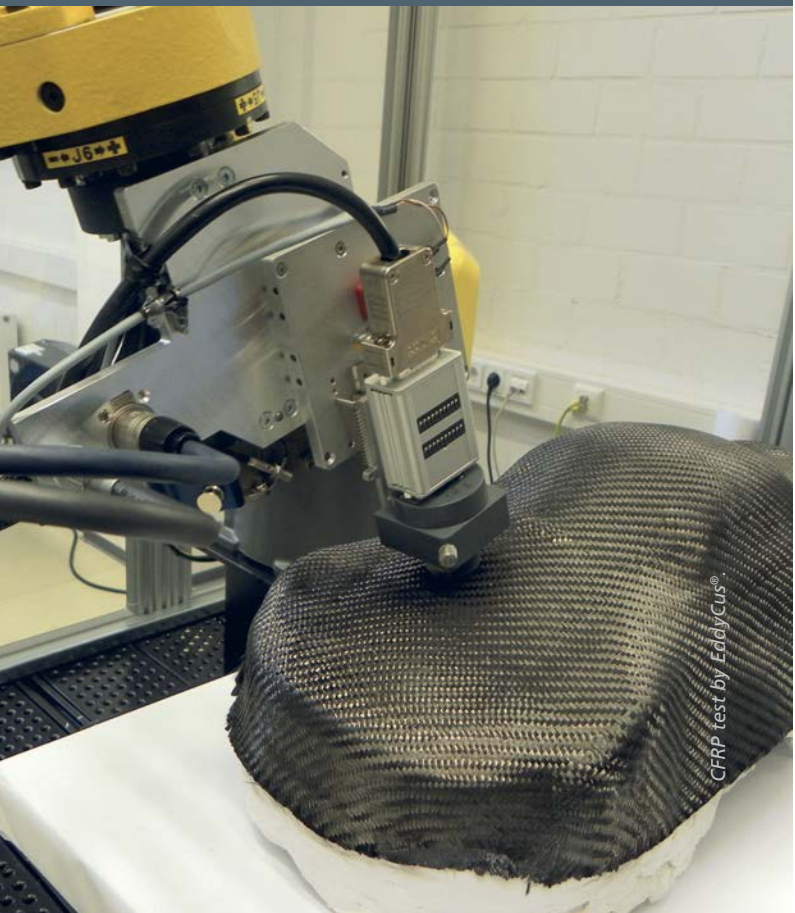
Fraunhofer
IKTS

FRAUNHOFER INSTITUTE FOR
CERAMIC TECHNOLOGIES AND SYSTEMS IKTS

MATERIALS DIAGNOSTICS



CFRP test by EddyCus®

SERVICES OFFERED

The Materials Diagnostics branch of Fraunhofer IKTS develops innovative methods and test systems to characterize material properties, to control the quality of products or to monitor manufacturing processes and plant components. Energy and environmental technology, metal industry, aerospace, transportation or electronics – scarcely any industrial branch gets along without non-destructive testing. Testing techniques based on acoustics, electromagnetics, optics, microscopy and radiation contribute significantly to the quality assurance of products and plants.

The portfolio of Fraunhofer IKTS-MD comprises:

- Structural health monitoring
- Optical diagnosis
- Micro- and nanoanalysis
- Ultrasonic test systems
- Electromagnetic test methods

Thus, it is possible to respond individually and flexibly to customer's needs – whether as service or in joint projects where customized systems are developed.

STRUCTURAL HEALTH MONITORING

Methods and measuring systems for structural health monitoring ensure the reliability and proper functioning of critical components and plants. Such systems provide support in the installation and commissioning of plants as well as later during operation by permanent condition diagnosis. Customized methods and measuring systems are designed for reliable operation under harsh conditions. They process acoustic, optical or electrical data. Wireless sensor nodes also provide information from non-accessible areas.

Services offered

- CoMoRanger, CoMoDetect (corrosion monitoring system, also for explosion protected areas and in high-temperature range up to 500 °C)
- HotSpotBlade (rotor blade monitoring system for wind power plants)
- Radio-based and structure-integrated monitoring system for composite structures
- Acoustic and optical multi-channel measuring systems for structural health monitoring
- Process and plant optimization by contactless vibration analysis with 3D laser vibrometric measurements

OPTICAL DIAGNOSIS

Optical methods offer an enormous potential for a rapid and cost-efficient condition diagnosis of materials and technical assemblies as well as the control of industrial processes. Optical systems are applied where measurements have to be carried out without contact or where extreme conditions dominate – for example high temperatures or electromagnetic load. Due to new technologies, optical methods are suitable for all material classes.

Services offered

- Ceramic luminophores for product labeling and charge tracing under extreme process conditions
- High-resolution microellipsometry
- Dosimetry for quality assurance of radiation processes (electron and gamma radiation, heat)
- Packaging technologies for optical sensor systems
- Optical tomography for quality assurance of transparent and semitransparent materials, e.g. ceramics
- Optical diagnosis methods for medical applications

MICRO- AND NANOANALYSIS

Novel materials and production technologies in thin-film- and nanotechnology as well as for biological and medical applications require new methods of testing. Fraunhofer IKTS continuously develops innovative, theoretically, experimentally and technologically oriented methods and devices to solve challenging tasks in fields like nanotechnology. In addition to the development of electronics, their application gains increasing importance.

Services offered

- Non-destructive, high-resolution analysis of material states by radiation techniques (x-ray, laser, infrared techniques)
- Characterization of micro- and nanostructures by microscopic methods (atomic force microscopy with/without ultrasonic excitation, ion, electron and acoustic microscopy)
- 3D x-ray microtomography, nanotomography
- Development of test devices and methods for micro- and nanostructures (indentation, adhesion evaluation, interconnect reliability testing)

ULTRASONIC TEST SYSTEMS

Fraunhofer IKTS develops customized ultrasonic test systems. This includes sensors, which can be adapted to different geometries, materials and other parameters, modular and high-performance electronics as well as modular and customizable software. Furthermore, new methods and applications are developed which, if required, can be validated by our accredited test center. Development work also includes a high-performance acoustic field simulation. Current projects focus on automatized ultrasonic testing of hollow and solid shafts of rail vehicles (both by conventional ultrasound and phased array), automatized test systems for inner pipe walls as well as customized test methods for joint connections.

Services offered

- Method development and method validation
- Feasibility studies for specific problems
- Acoustic field simulation
- Development and set-up of customized transducers
- Development and set-up of customized electronics
- Development of customized software

ELECTROMAGNETIC TEST METHODS

The proprietary EddyCus® device platform for eddy current inspections and imaging impedance spectroscopy in the frequency range from 100 kHz to 100 MHz offers our customers the possibility to flexibly test metallic materials, fiber composites (CFRP) and also electrically low-conductive materials. Ferromagnetic materials can be optimally evaluated with the test systems and evaluation algorithms developed by Fraunhofer IKTS for the analysis of Barkhausen noise and leakage flux measurements. Besides the measuring technique (electronics, sensors), an experienced team supports our customers in the development and implementation of individually tailored test algorithms.

Services offered

- Complex eddy current test systems (electronics, sensors, software, application)
- Imaging impedance spectroscopy, e.g. for testing of CFRP
- Evaluation software for impedance spectroscopy
- Micromagnetic diagnosis methods (Barkhausen noise)
- Development and set-up of customized electronics
- Development of customized software

COOPERATION MODELS

One-off contracts

The classic model of cooperation: A company perceives a need for research or development. A discussion with Fraunhofer identifies possible solutions and clarifies the form the partnership could take and the estimated cost.

Large-scale projects with multiple partners

Some challenges are so complex that they require multiple partners to develop a solution. Clients in this situation have access to the full range of Fraunhofer Institutes. It is also possible to incorporate external partners and additional companies.

Strategic partnerships and innovation clusters

Pre-competitive research which starts off without any ties to specific development contracts often results in long-term partnerships with companies on a regional and international level.

Spin-offs

Fraunhofer researchers often take the step towards independence by founding their own company. Fraunhofer itself only participates in these kinds of start-ups up to a certain extent. Sometimes the customer who commissioned the new development is interested in taking a stake in the spin-off company itself.

FRAUNHOFER IKTS

As one of 67 institutes and research units of the Fraunhofer-Gesellschaft in Germany, the Fraunhofer Institute for Ceramic Technologies and Systems IKTS develops state-of-the-art, application-oriented, high-performance ceramic materials, industrial preparation processes using powder technology, wet chemistry, and precursors, and prototype components and systems. With applied fundamental research as our basis and within the framework of R&D projects with partners, we develop concepts for product and process innovations in numerous trendsetting industry sectors, including energy and environmental technology, mechanical and plant engineering, microsystems and medical technology, and vehicle manufacturing.

The branch Materials Diagnostics IKTS-MD offers services and research cooperations for the diagnosis of materials and components, structural health monitoring, nanoanalysis and sensors as well as biological and environmental technologies. Current projects focus e.g. on quality assurance for light-weight engineering, the development of high-precision testing electronics, multi-scale material characterization as well as lifecycle management and reliability analysis. Another focus of research is on applied microelectronics including complex sensor systems with a special emphasis on electronic packaging.

CONTACT

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