Are you already familiar with our industry-standard services?

- Accredited testing laboratory in accordance with DIN EN ISO/IEC 17025 for various NDT methods
- Certificate of competence of the accredited laboratory to qualify and validate (new) nondestructive testing methods for industrial testing practice in the field of ultrasonic testing
- Rapid transfer to market readiness for qualified, standard-compliant use in industrial applications, both for new developments (in-house developments) or for adaptations
- Our associated quality management system is certified in accordance with DIN EN ISO 9001

Contact

Fraunhofer Institute for Nondestructive Testing IZFP

Campus E3 1
66123 Saarbrücken

+49 681 9302 0

info@izfp.fraunhofer.de
www.izfp.fraunhofer.de

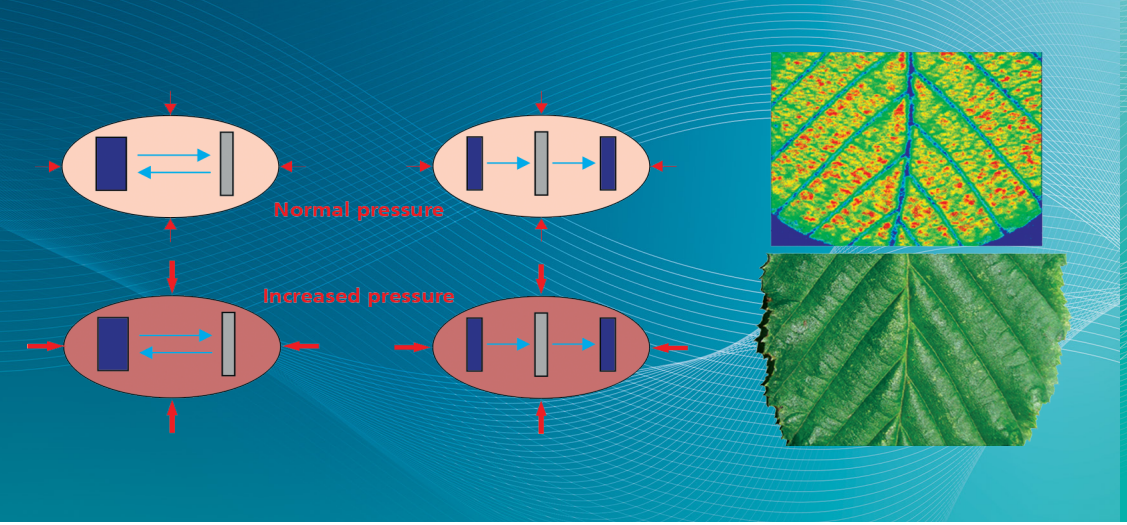
Fraunhofer IZFP

Sensor and Data Systems for Safety, Sustainability and Efficiency

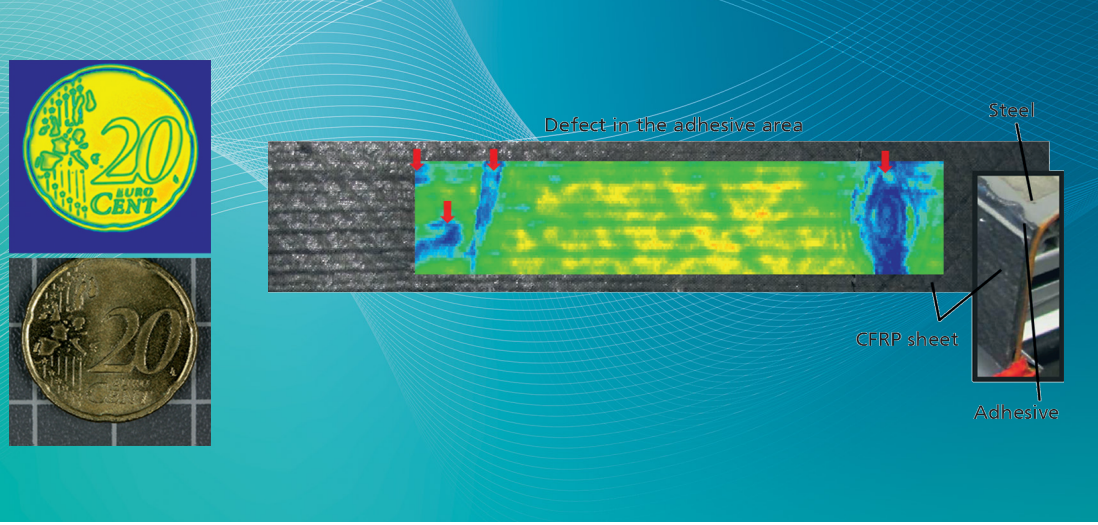
Air-coupled ultrasound sensor system (shown here in combination with laser sensors)

Contactless and contamination-free materials characterization

Air-coupled ultrasound inspection



Design schematic air-coupled ultrasound inspections, echo-/through-transmission mode; right: Resolution of air-coupled ultrasound inspection: Leaf from a beech tree, 500 kHz



Left: Resolution of air-coupled ultrasound inspection: Coin, 1 MHz; right: Custom probe design

Air-coupled ultrasound inspection – Contactless and contamination-free materials characterization

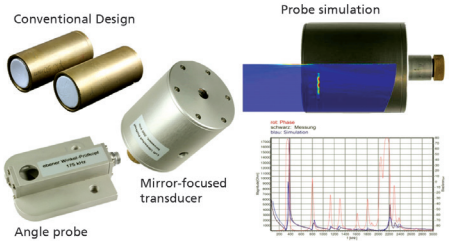
The structural components used in modern automobiles and aircraft manufacturing are subject to stringent requirements, such as having a lightweight, yet mechanically robust design. Among other things, this ensures structures with improved crash behavior and excellent vibration and sound damping properties. Adhering to such demanding specifications requires the use of innovative materials like carbon or glass fiber reinforced polymer, high-strength steel and lightweight metals, which are often combined into hybrid components.

Because they can quickly cause end products to fail, material flaws need to be uncovered at an early stage - and this is where nondestructive testing (NDT) plays a key role. To be effective, NDT processes must have sufficient flaw detection limits and be easy to automate without impacting the material under inspection.

To address these challenging requirements, Fraunhofer IZFP introduced and enhanced a NDT process based on air-coupled ultrasound technology, which enables contactless, contamination-free material inspections with excellent flaw detection resolution. In contrast to conventional ultrasound approaches, this solution eliminates the need to dry the material after inspection and avoids potential damage from couplants that penetrate the surface.

Benefits

- Contamination-free inspections
  - Contactless inspections
  - Gap between the test probe and surface can be up to several centimeters
  - Simple to automate
  - No water baths and subsequent drying, resulting in significantly lower inspection costs
  - Supports all conventional modes of operation including impulse, echo and through-transmission
- Extremely high flaw detection resolution
  - Resolution similar to that achieved with 2-3 MHz immersion methods but at 500 kHz: with thin components up to roughly 10 mm in thickness, the flaw detection resolution is determined by the intensity of the ultrasound, which is dependent on the wavelength. Together with the air-coupled low ultrasonic velocity, this results in improved resolution even at lower frequencies.
- Capability to inspect heavily damped materials such as hybrids
  - Inspection frequency between 500 kHz and 1 MHz (conventional: above 2 MHz)
  - Significantly less sound damping in the material compared to conventional inspection methods
  - Capability to inspect hybrid materials that otherwise cannot be examined with immersion methods because of the material's high damping properties.
- Customized probe design
  - Probe design takes into account various factors related to the application, including accessibility, flaw detection resolution, sensitivity to ambient influences, probe type (focused or unfocused, etc.)



With these aspects in mind, Fraunhofer IZFP develops custom, tailor-made air-coupled ultrasound transducers. Prior to assembly, the probe is designed with computer-aided tools and tested with special simulation software.