



AIR-COUPLED ULTRASOUND INSPECTION CONTACTLESS AND CONTAMINATION-FREE MATERIALS CHARACTERIZATION

By the way, you already know our industrial grade accredited inspection services?

- Accredited laboratory in line with DIN EN ISO / IEC 17025, to qualify and validate new non-destructive testing (NDT) processes for industrial applications
- Accelerated time-to-market and opportunity for qualified, norm-compliant deployment in industrial applications as well as for complete new in-house developments or custom adaptation of innovative NDT technologies, even in fields where norms have not been established
- Certification of the corresponding quality management system in accordance with DIN EN ISO 9001



Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren IZFP

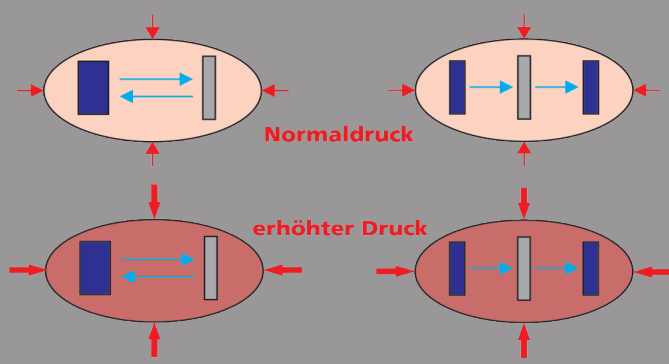
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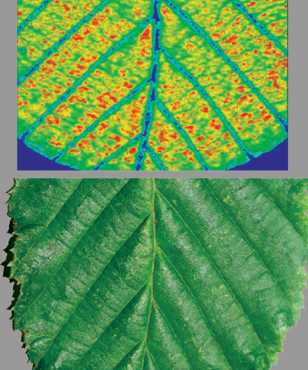
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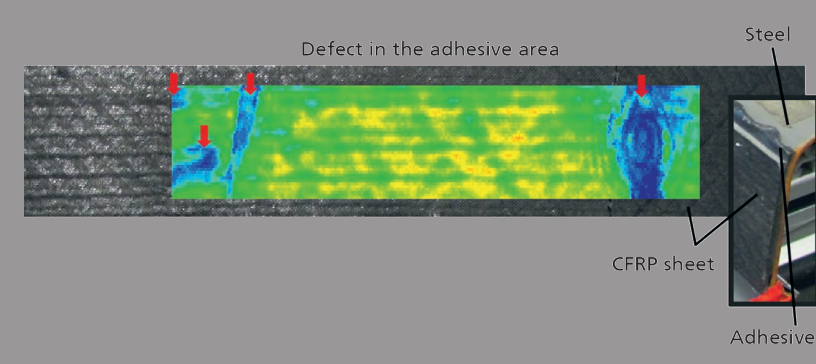
(1) Design schematic for air-coupled ultrasound inspections depicting echo mode (left) and through-transmission mode



(2) Resolution of air-coupled ultrasound inspection: Leaf from a beech tree, 500 kHz



Coin, 1 MHz



(3) Custom probe design

Situation

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.

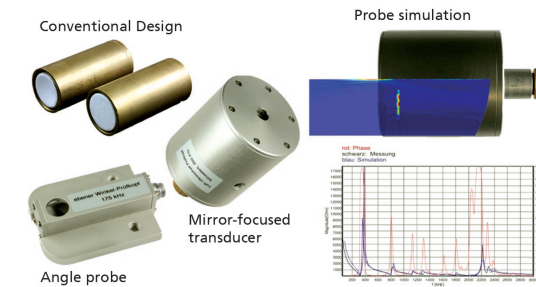
Because they can quickly cause end products to fail, material flaws need to be uncovered at an early stage - and this is where nondestructive testing (NDT) plays a key role. To be effective, NDT processes must have sufficient flaw detection limits and be easy to automate without impacting the material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

To address these challenging requirements, Fraunhofer IZFP introduced and enhanced an 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.

What does air-coupled ultrasound inspection technology have to offer?

- Contamination-free inspections (1)
 - Contactless, and thus contamination-free, inspections
 - Gap between the test probe and surface can be up to several centimeters
 - Simple to automate
 - Eliminates need for 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 (2)
 - 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 (3)
 - 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.



(4) Custom probe design

- Customized probe design (4)
 - The 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.