SONOTEC

Ultrasonic Transducers

Probes for Air-Coupled Ultrasonic Testing based on Piezocomposite Materials

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International Symposium on Piezocomposite Applications

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Ultrasound is our Strength

→ Ultrasonic Expert in the Field of Measuring Technology

Non-Invasive Fluid Monitoring

Non-Contact Flow Meters, Bubble Detectors, and Level Sensors

Preventive Maintenance

Digital Ultrasonic Testing Device for Preventive Maintenance

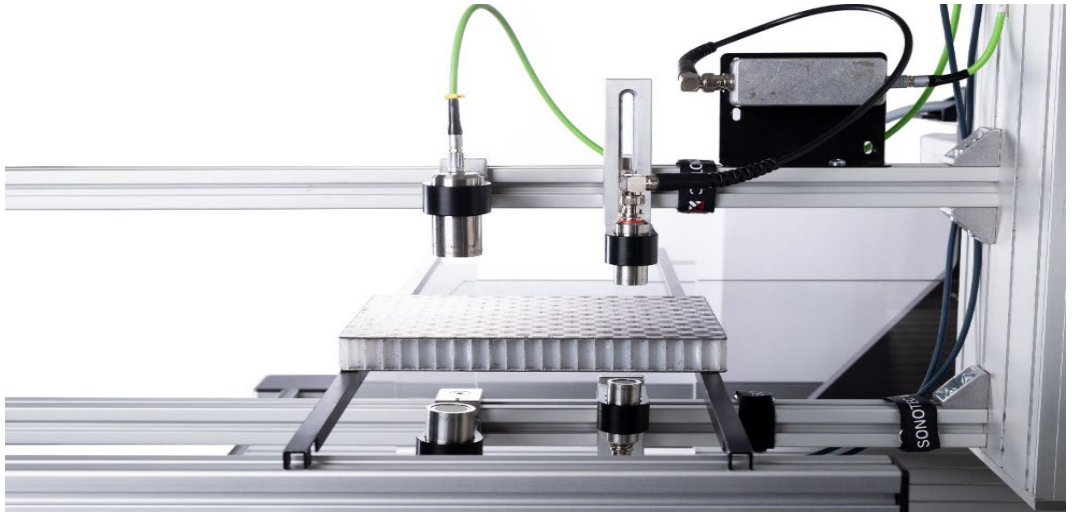
Non-Destructive Testing

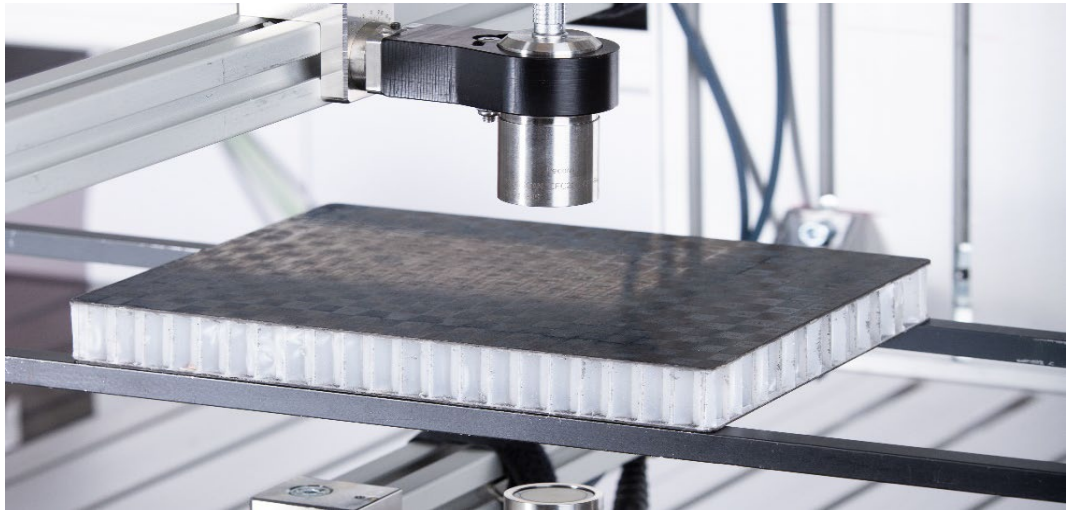
Thickness Measurements, Flaw Detection, and Weld Seam Testing

Air-Coupled Ultrasonic Testing

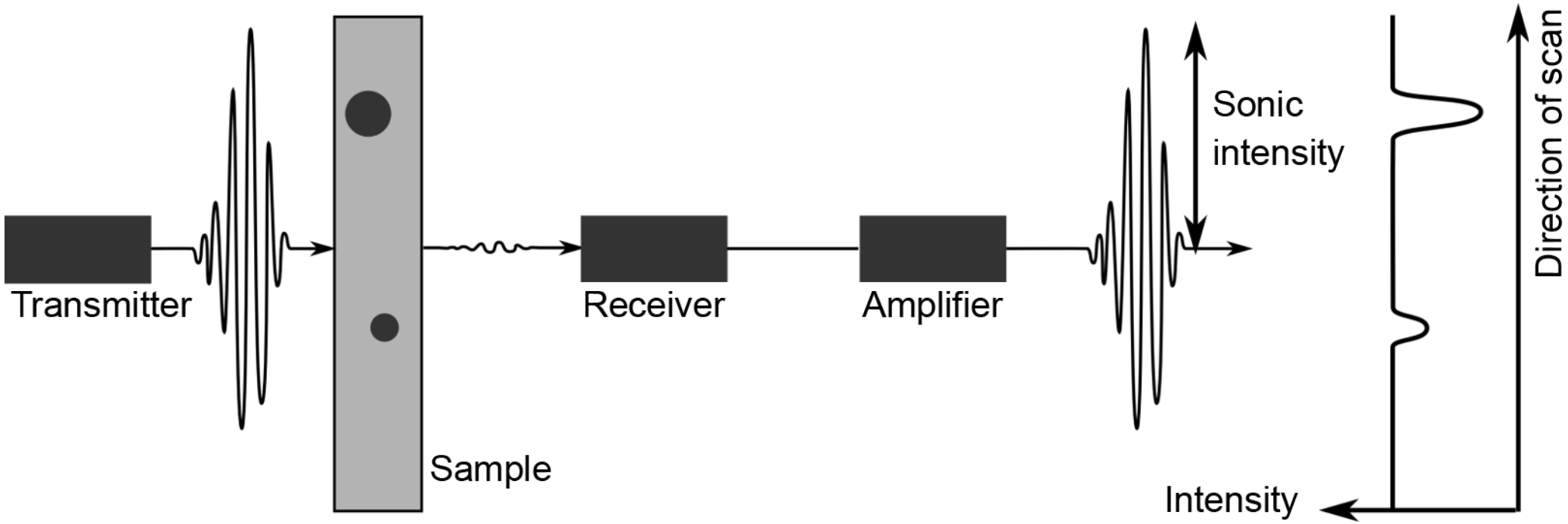
Contact-Free Inspection of modern Materials (CFRP, GFRP, Ceramics, Honey Comb Structures, Foams, etc.)

- → Interface Detection
- → Homogeneity Analysis
- → Bond Inspection
- → Delamination Testing





Signal Processing



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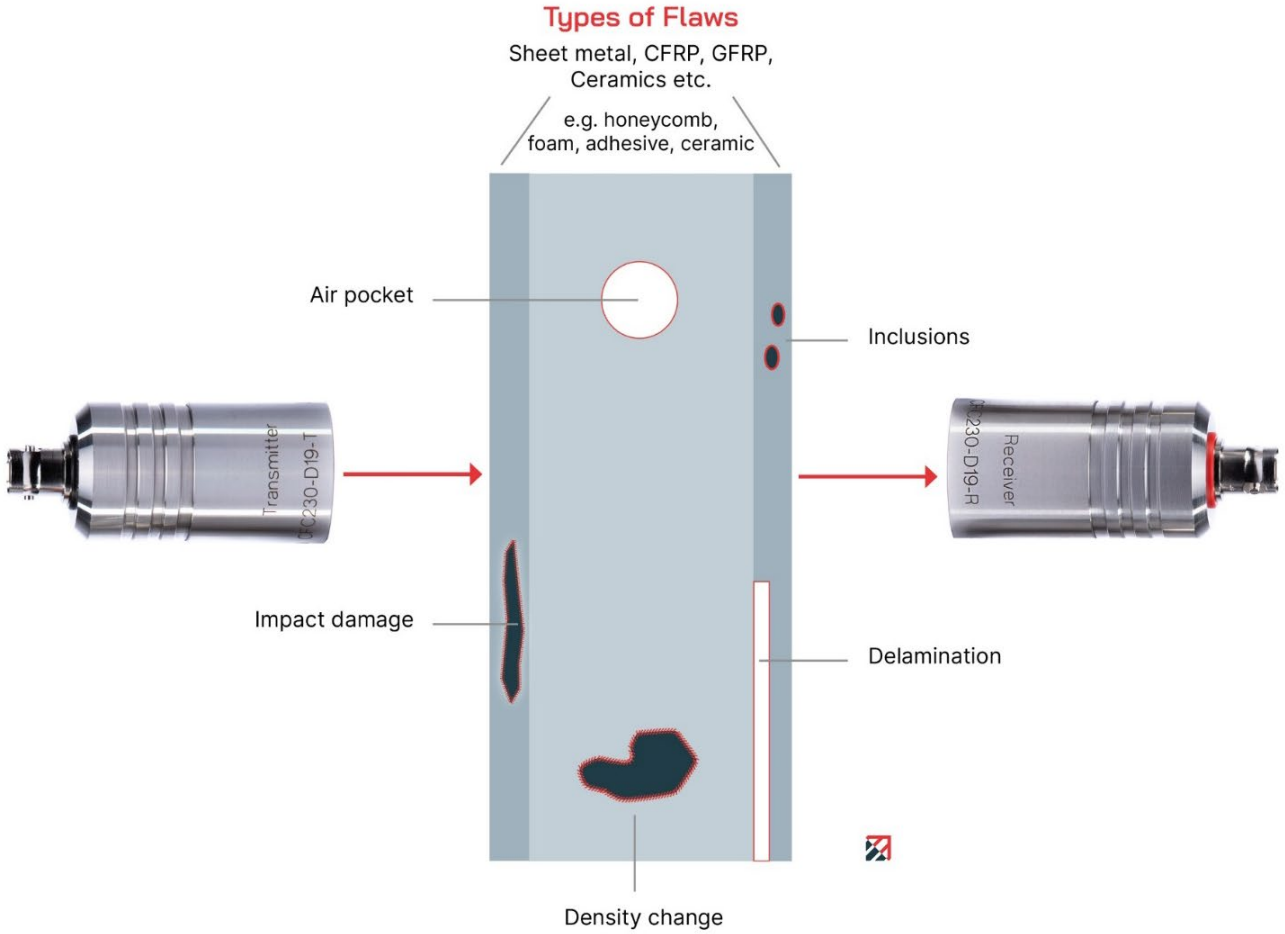
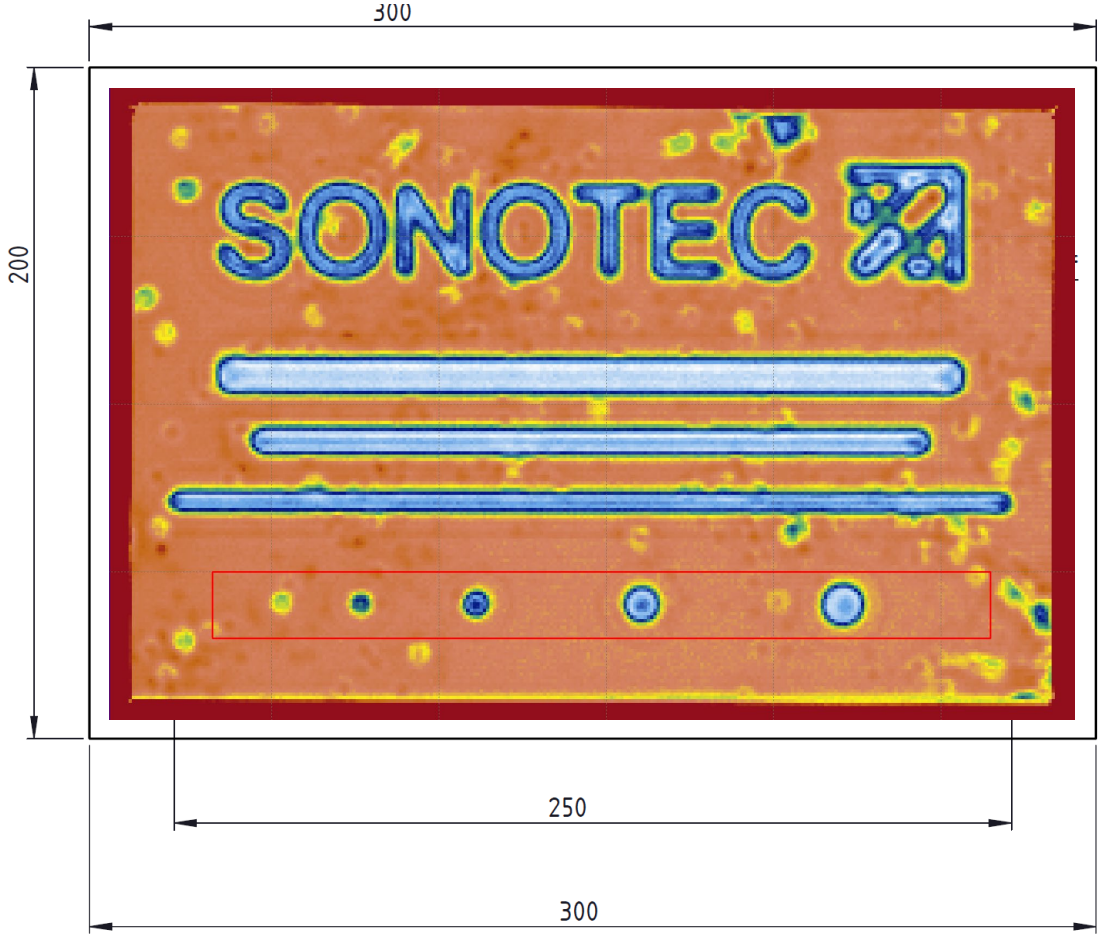
Air-Coupled Testing of Sandwich Sheets



Adhesively Bonded PMMA Sheets with Air Pockets



- → Focused 400 kHz transducers
- → 1 x 1 mm grid

- → Ø2 mm detectable
- → Adhesive flaws visible

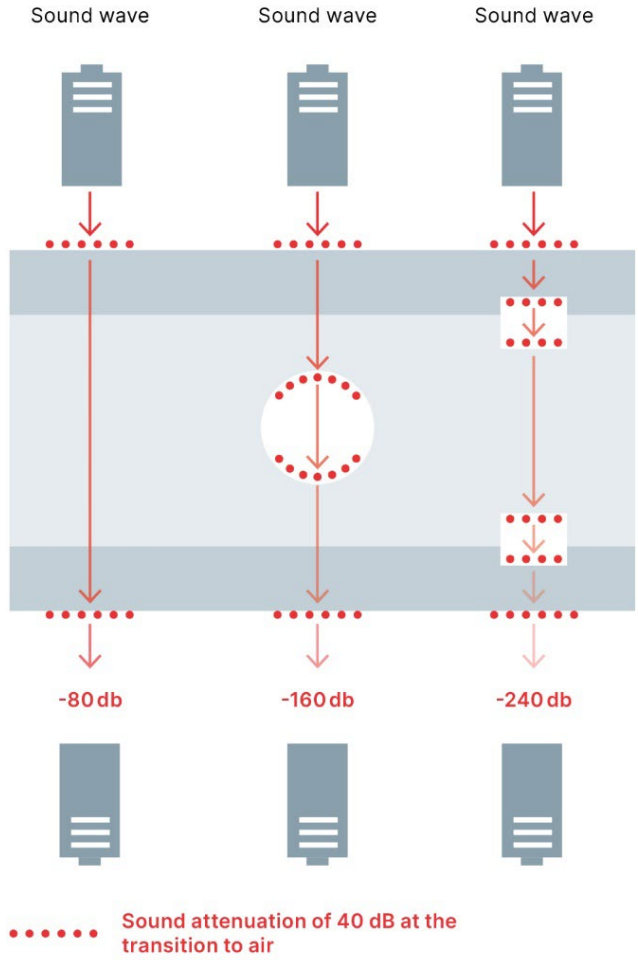
- → No depth information
- → The small FBH (Ø2 mm) are significantly oversized

Air-Coupled or “Couplant-Free” Transducers

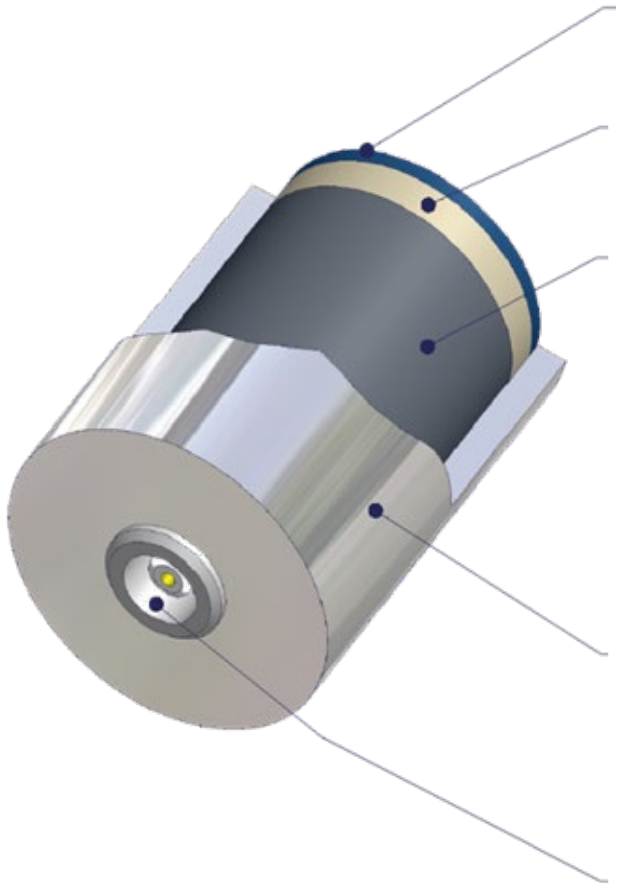
Challenges in air-borne ultrasound

- → Low accoustic impedance results in very low transmission coefficient of ultrasonic energy
- → Low speed of sound result in a high refraction index
- → High attenuation of ultrasound in air

Technology restricted to frequencies from 50 kHz to 400 kHz



Schematic composition of piezo based ultrasonic transducers

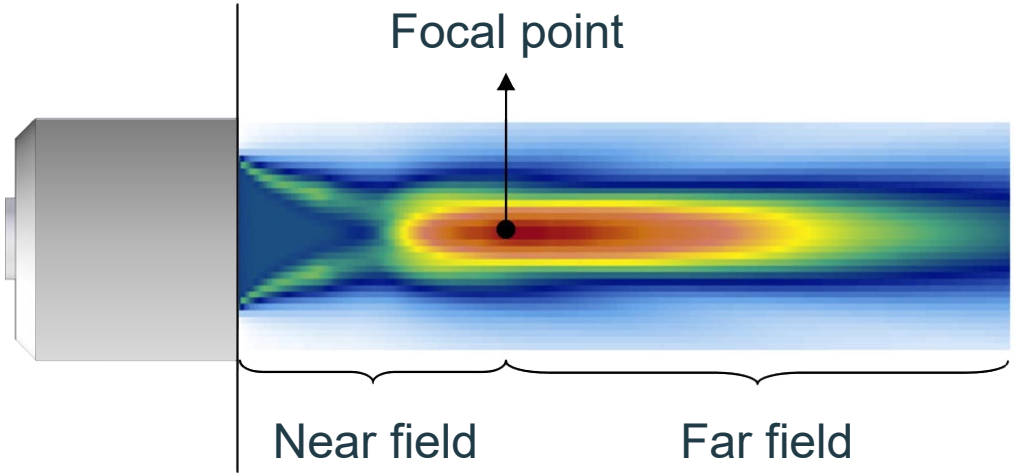


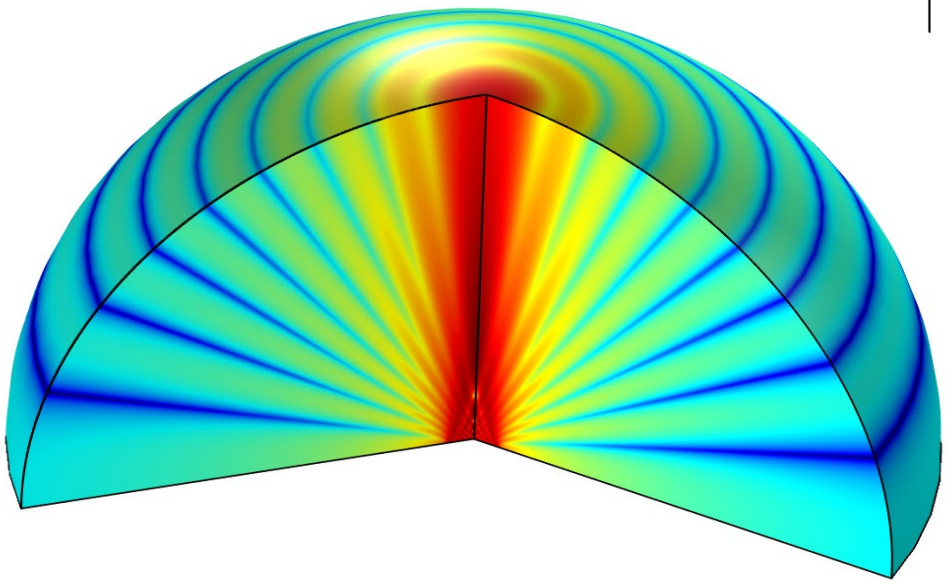
Functionalities

- → Matching layer: Effective transmission of sound wave to propagation medium
- → Backing: Suppress echoes from backside
- → Optional: Electrical matching network
- → Piezo: Convert electrical signal to mechanical movement and vice versa

Sound Field – Terms

- → Beam axis
- → Near field
- → Far filed
- → Focal zone
- → Side lobes





Improved Transfer of Ultrasonic Energy out of the Transmitter

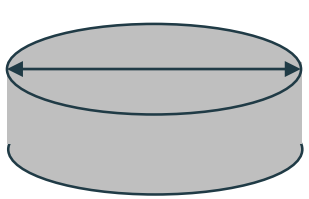
Requirements on piezo elements

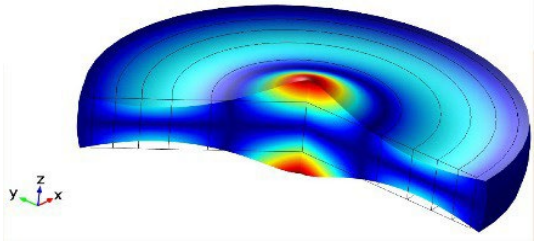
- → Low acoustic impedance to minimize impedance mismatch
- → Broad bandwidth
- → No radial oscillations of the piezo, which do not contribute to axial sound-field

- → Clear advantages of piezocomposite compared to piezoceramics

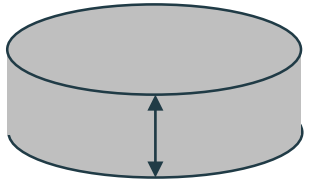
Piezoceramic vs. Piezocomposite Transducers

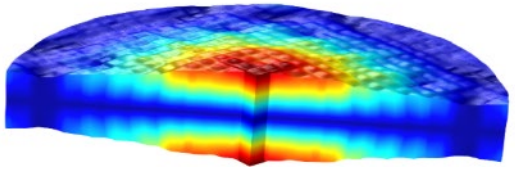
Piezo Ceramic





Piezo Composite





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From Ceramic to Composite-based Transducers

Piezo Ceramic

CF050, CF075, CF125, CF200, CF300

Piezo Composite

CF400, CF400 3E, CFC230-Series with optional built in preamplifier

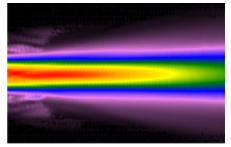
Flexibility of Transducer Apperture

Requirements for piezoelement

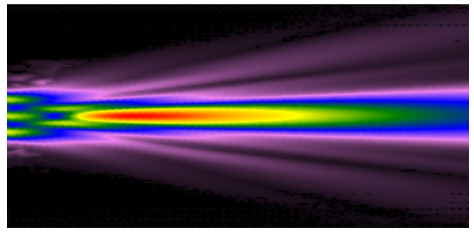
→ Working frequency independent on lateral dimensions

Same frequency, different apperture

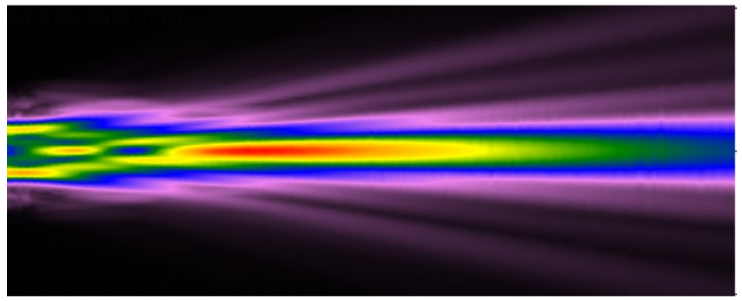
→ 12 mm



→ 19 mm



→ 25 mm



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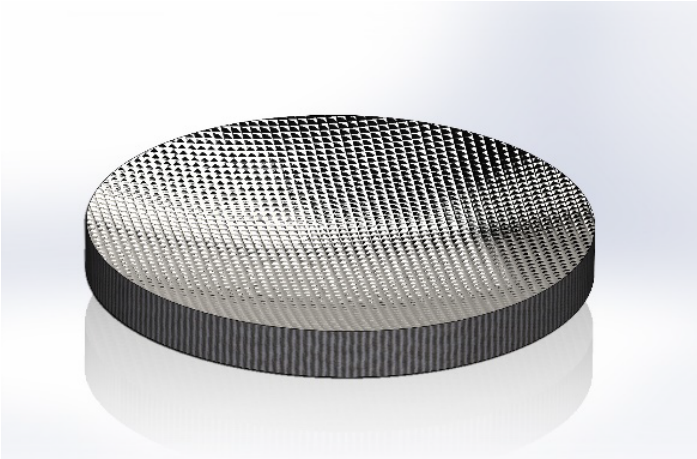
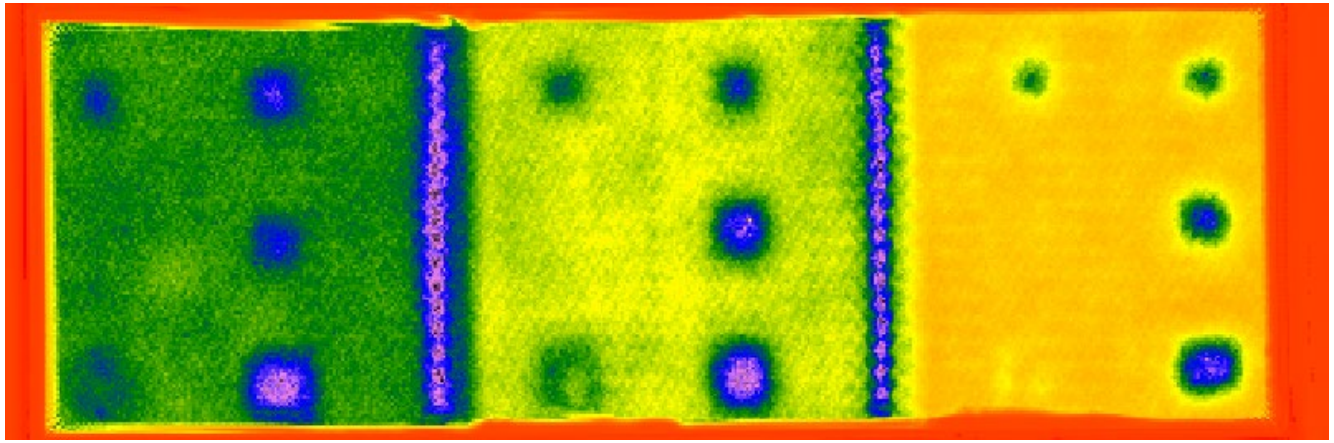
Mechanical Focus

Requirements for piezoelement

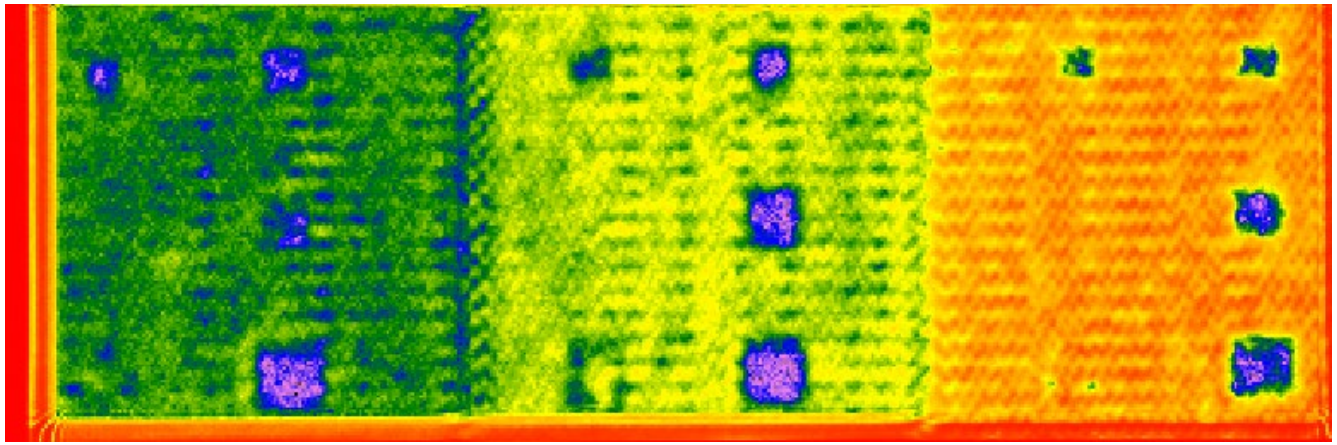
- → Material must be brought into concave shape
- → Difficult to fabricate with piezoceramic
- → SONOSCAN CF400



Flat Transducer



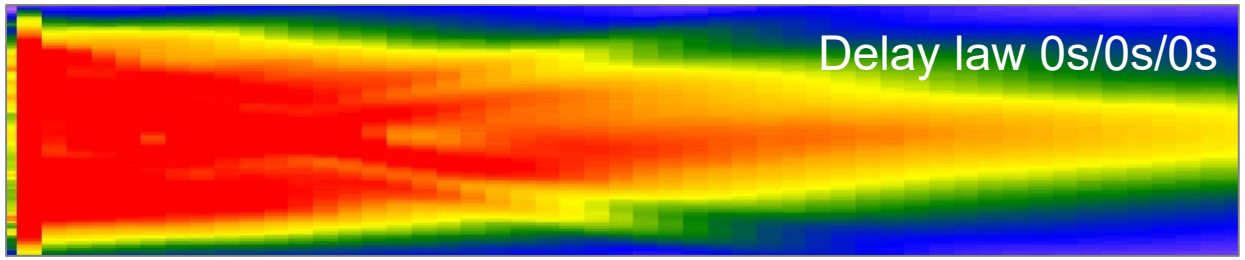
Focused Transducer

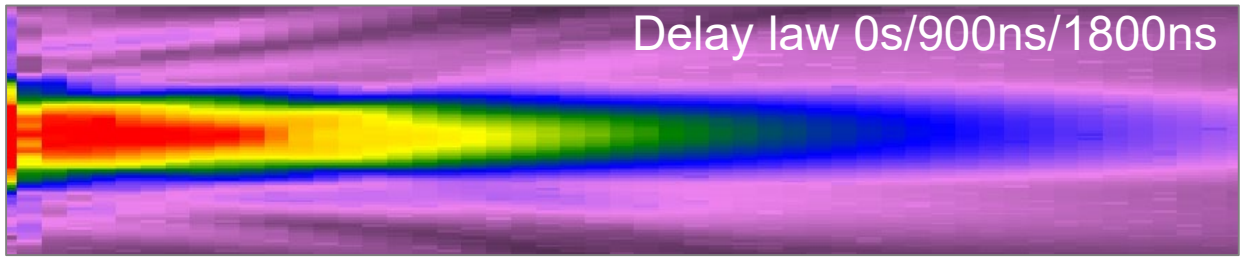


Electrical Focussing

Requirements for piezoelement

→ Multiple elelctrical independently drivable elements have to be arranged in close proximity





Scan field: 200 x 10 mm²

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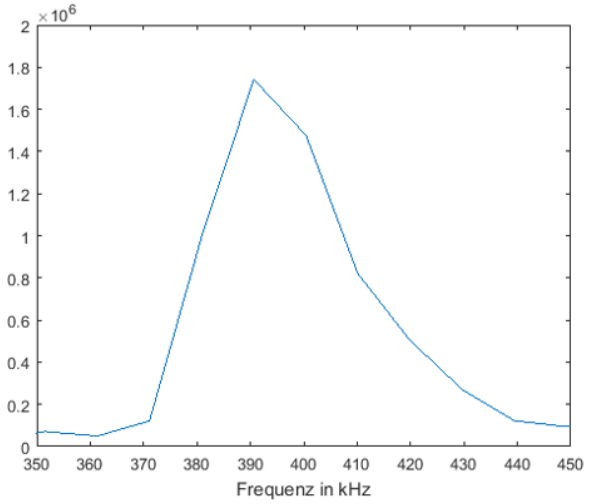
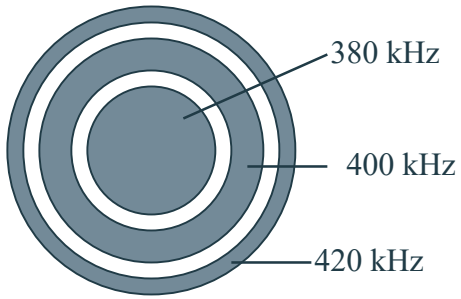
Control of Bandwidth

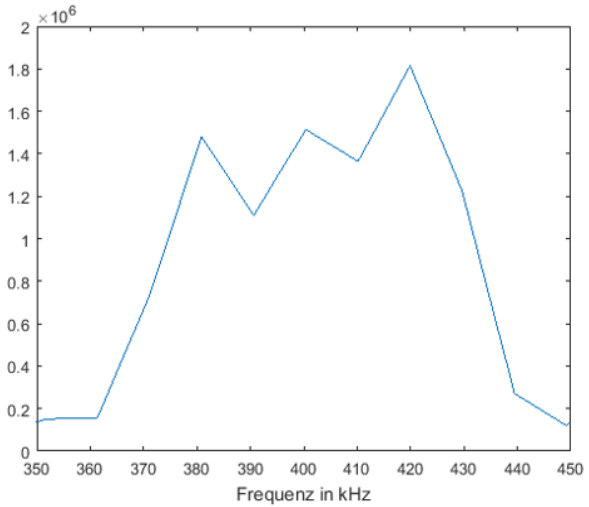
Difference in excitation

→ All elements driven with 400 kHz burst



→ Elements driven with different frequencies





Combination of Mechanical Focus and Multi-Element Design

CK050

- → 16 parallel elements (long side)
- → Mechanical focus (short side)

- → See speech of Dr. Steinhausen (Session 3, Sound field shaping with a 16-channel probe for coupling agent-free airborne ultrasonic testing)

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