SONOTEC

A New Approach to Air-Coupled Broadband Measurement:

Effective Testing of Composite Laminates by Using A New Multi-Element Transducer

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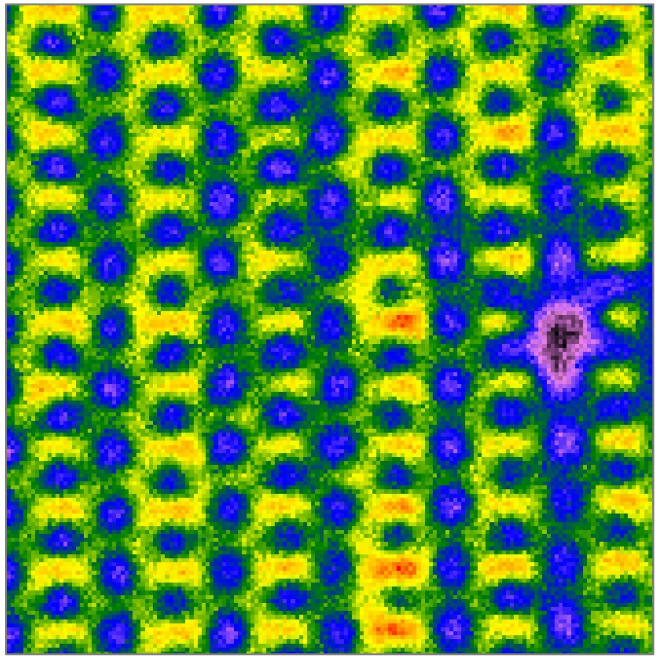
OUTLINE

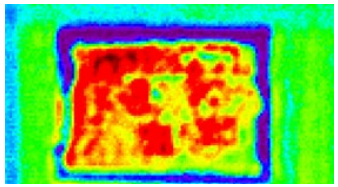
- Introduction
- Motivation
- Phased-Array ACUT Probe
- Broadband Multi-Element ACUT Probe
- Application
- Test Results
- Conclusion

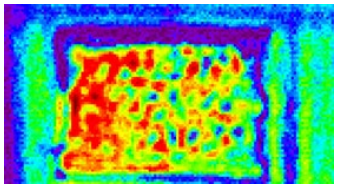
Introduction

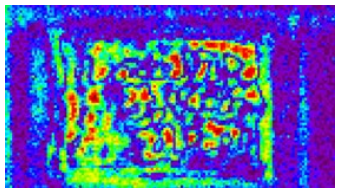


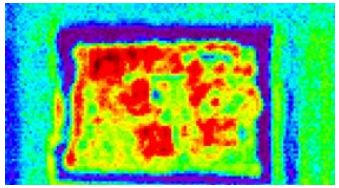
Motivation – Frequency Dependent Flaw Detection

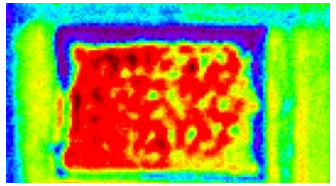
- Test object: Composite with delamination


365 – 390 kHz


390 – 403 kHz

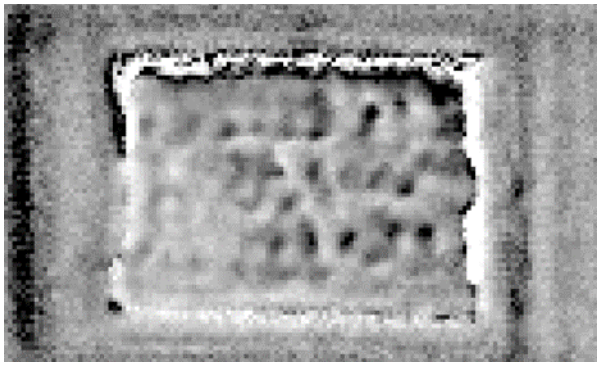

403 - 415 kHz


415 - 428 kHz


428 - 440 kHz

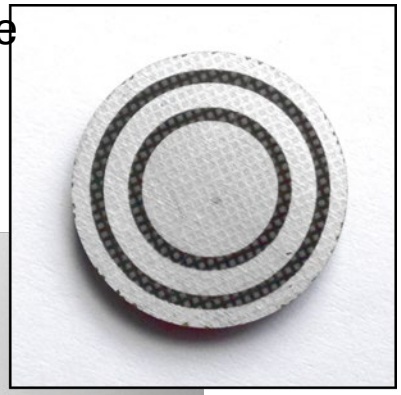
- 5 Scans
- Equal Setup
- 5 different center frequencies

→The detectability of delaminations and the outline of the flaw is frequency dependent
→High Bandwidth Transducers could lead to a better detection and sizing of delaminations


Spectral Analysis

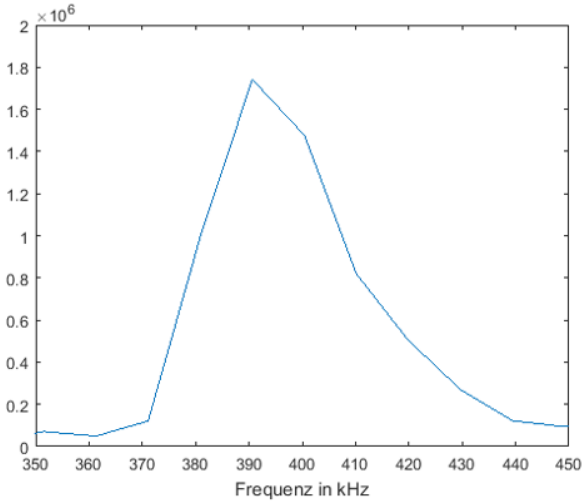
Phased-Array ACUT Probe

- Piezocomposite Transducer
- Dice and Fill

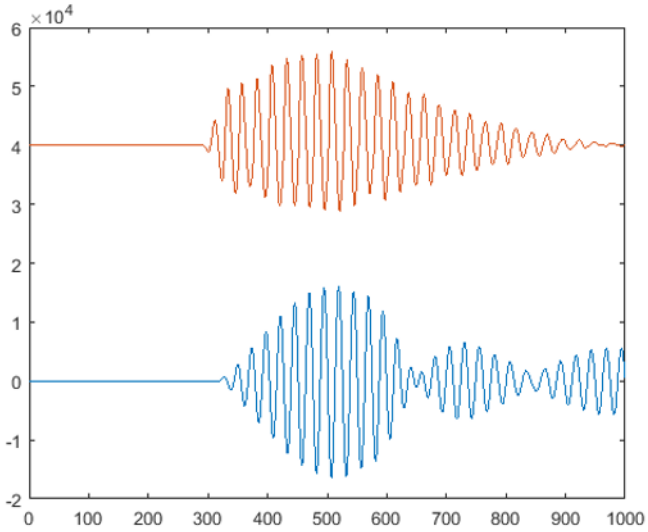


- 3 Elements
- Equally sized
- Structured Electrode
- Annular Array

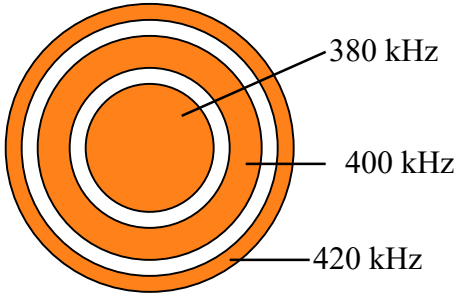
- 400 kHz
- Small Bandwidth
- Single Peak Spectrum



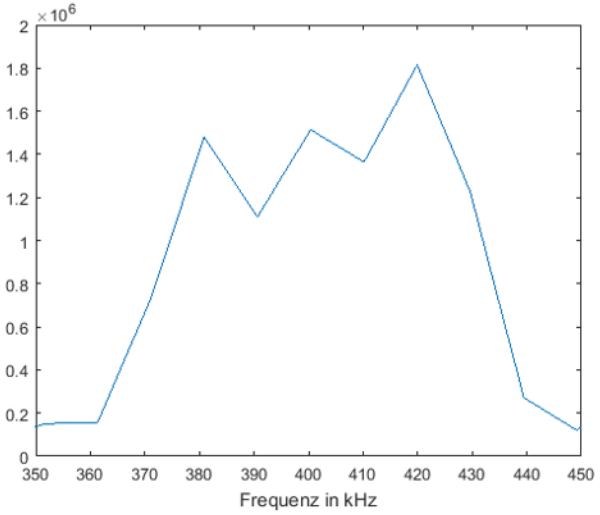
Broadband Multi-Element ACUT Probe



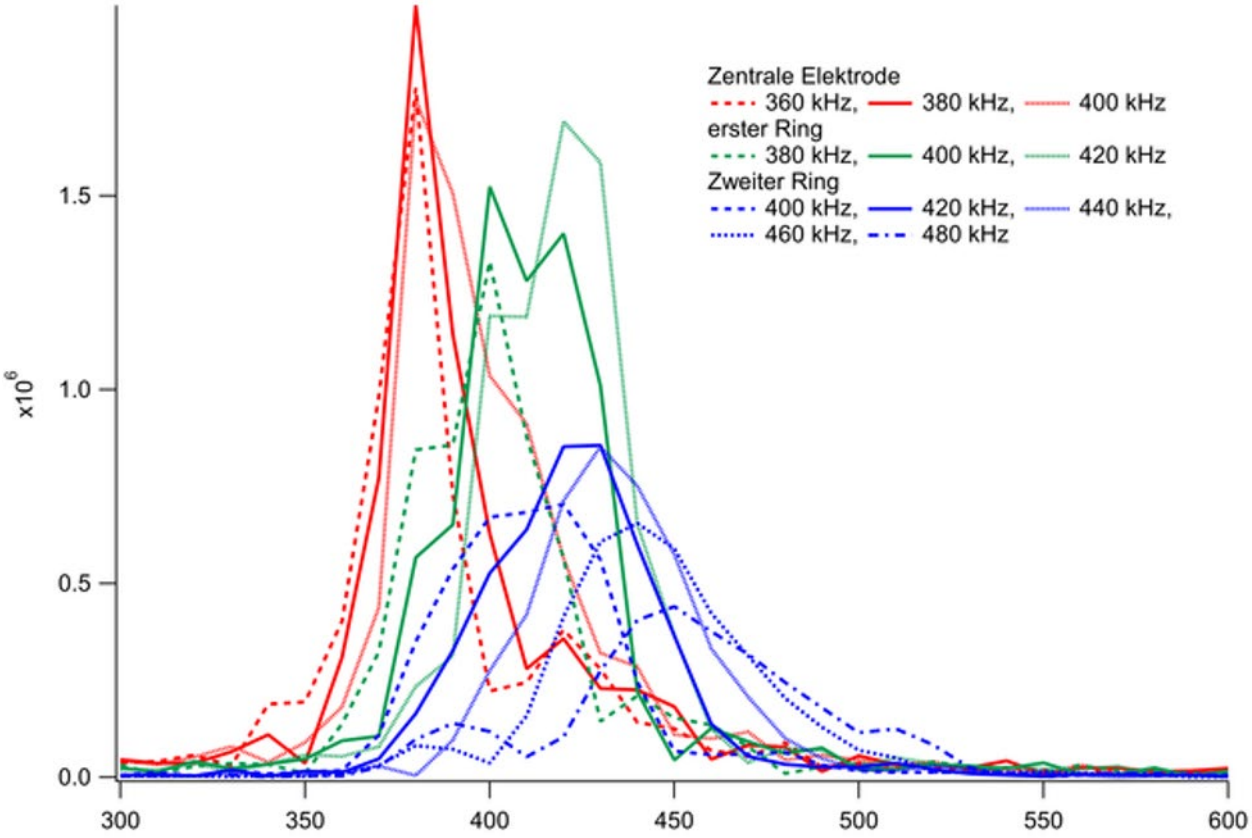
- 3 Elements
- Equally sized area
- Structured Electrode
- Annular Array



- 380, 400 and 420 kHz Elements
- Wider Bandwidth
- Three Peak Spectrum
- Shorter A-Scan Burst

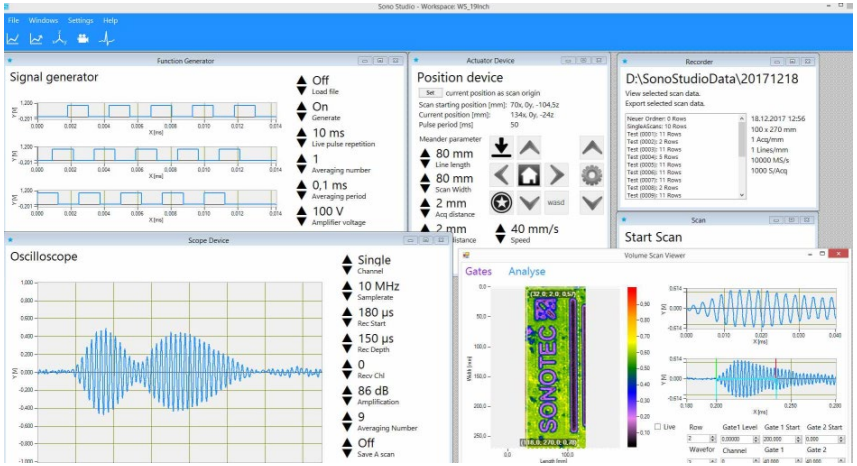


Broadband Multi-Element ACUT Probe Test Results

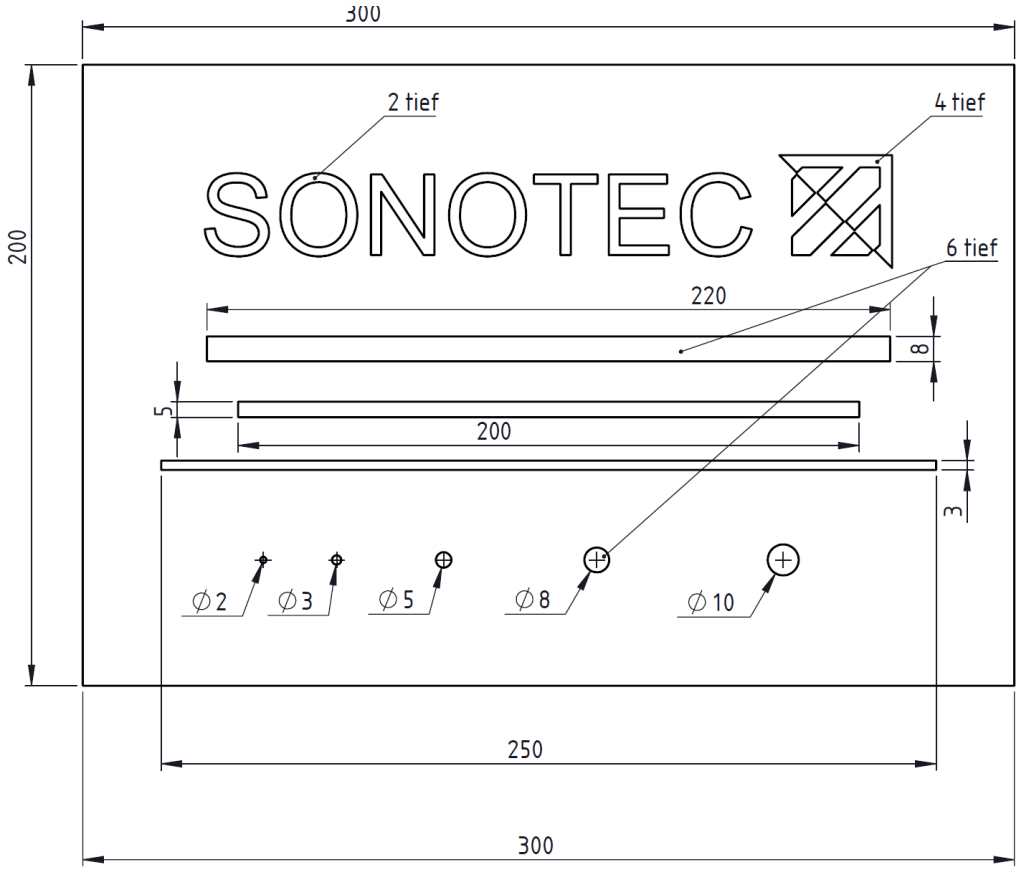


Equipment

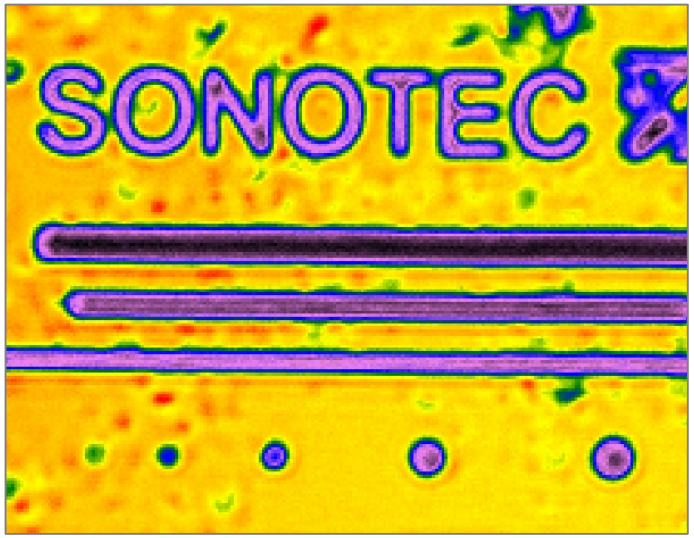
- High End 4-Channel ACUT Electronics
  - Powerful transmitter up to 800 V (4 kW)
  - Freely programmable signal generator (50 – 750 kHz)
  - High dynamic low-noise amplifier up to 120 dB at 1 nV / √Hz
  - Customizable Software SONOSTUDIO
  - Full Data Access



Application

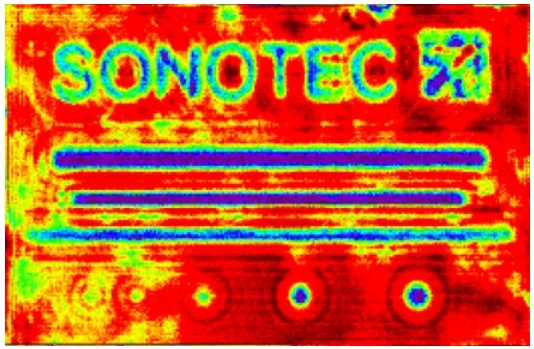


- Reference scan

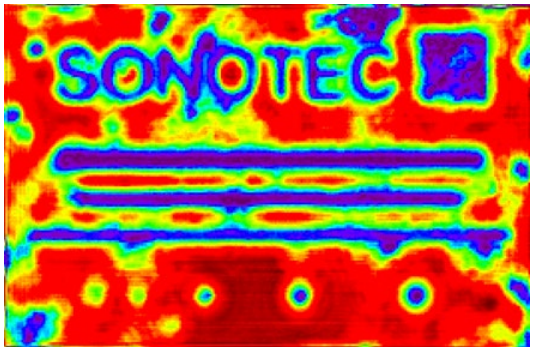


- 400 kHz through transmission
- Phased-Array transducer
- Ø2 mm detectable

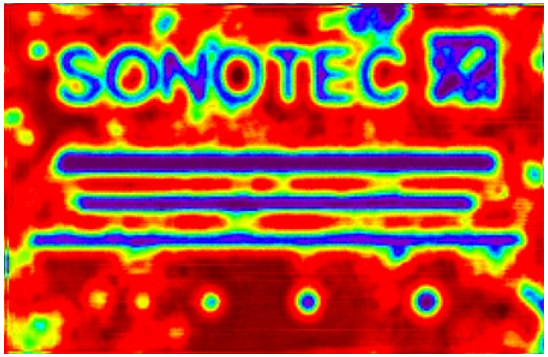
Test Results - Scans



380 kHz



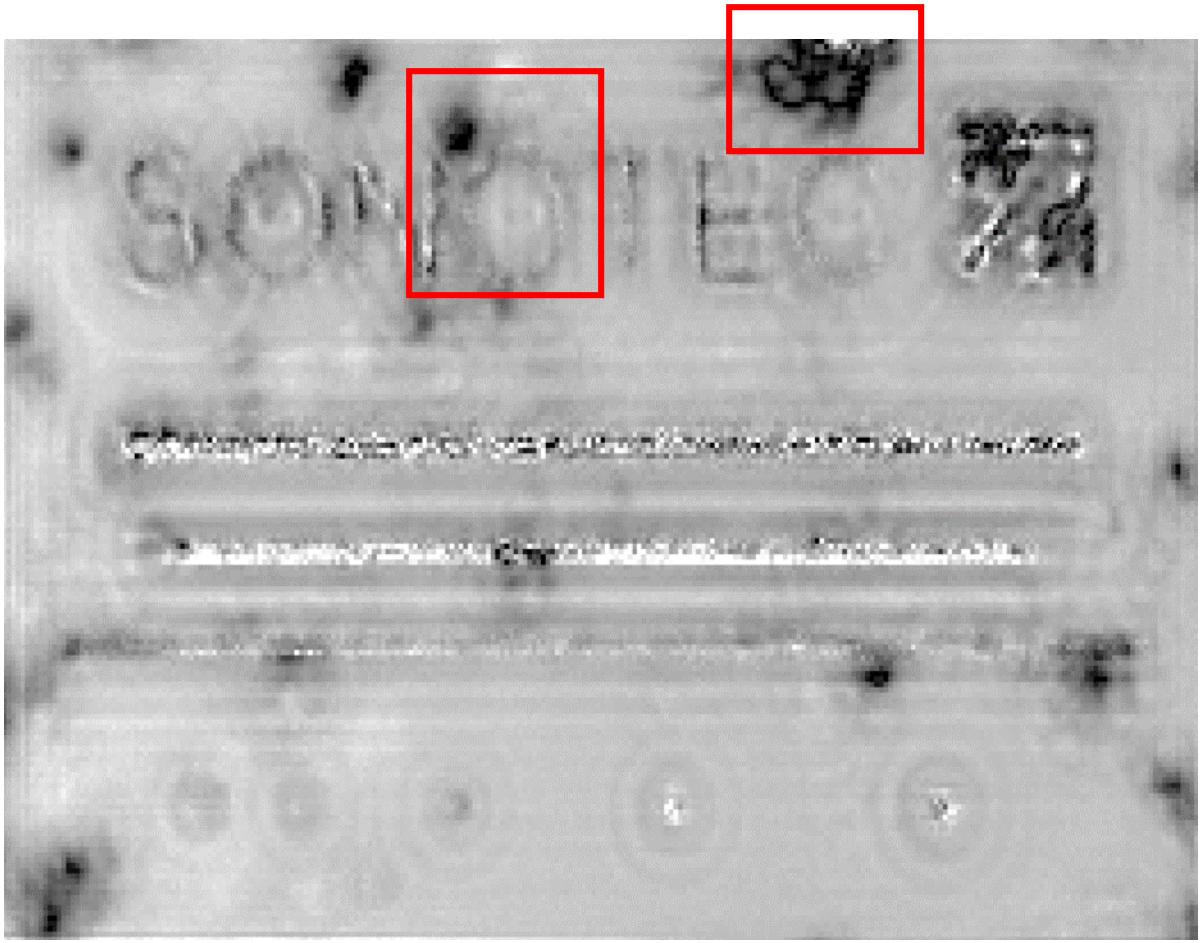
400 kHz



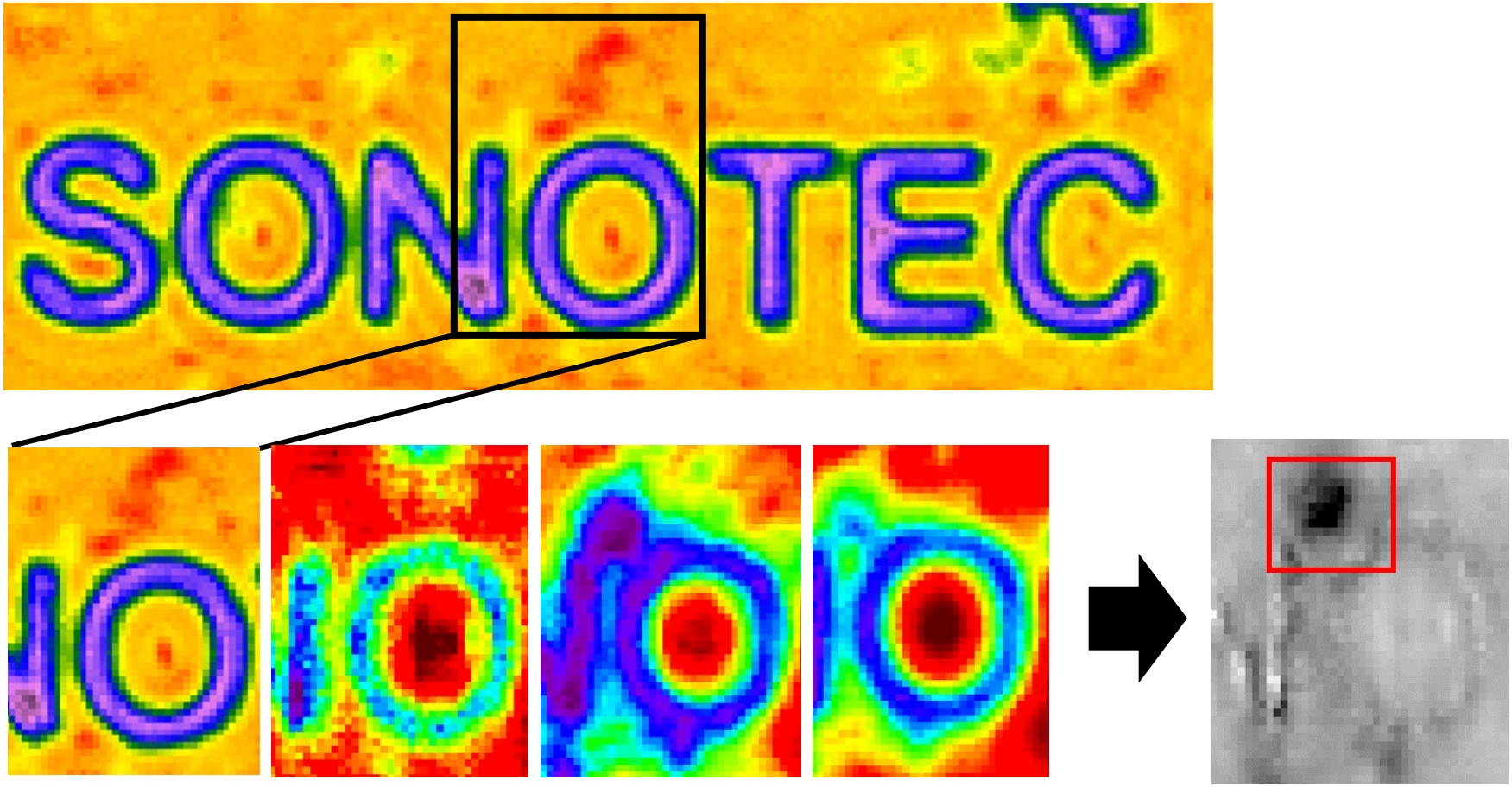
420 kHz

- Differences in Amplitude drop
- Differences in interference pattern
- Less focused than the reference scan

Test Results – Spectral Analysis



Test Results – Exemplary Analysis



Conclusion

- A wider bandwidth can be achieved with dice and fill composites
- Spectral analysis can be used as a contrast mechanism with high bandwidth probes
- The detection and sizing of delamination and flaws in composites can be improved with this contrast mechanism

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