Ultrasonic
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UST = Ultimate Smart Tools

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CRACK DETECTION in ZrO_2 CERAMICS

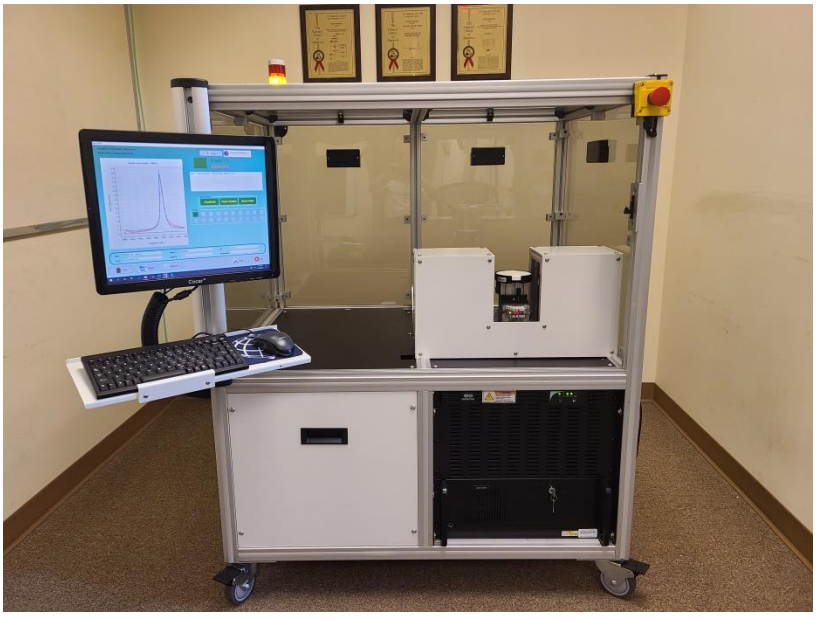
Resonance Ultrasonic Vibrations (RUV) Technology

High accuracy: 91 – 99 percent

High throughput: <5 seconds/cycle

Non destructive

In-line & Off-line configuration



RUV system for ZrO_2 discs

RUV TECHNOLOGY

The Resonance Ultrasonic Vibrations (RUV) technique was developed for off-line and in-line non-destructive crack and stress detection in ceramic materials such as pre-sintered dental ZrO_2. The RUV method relies on deviation of the resonance frequency response curve measured on a sample with millimeter length crack compared to identical non-cracked samples.

The RUV technology allows to (1) reject mechanically unstable ceramic objects before they are introduced into further processing, (2) identify objects with cracks and high stress in real time to avoid parts breakage during milling or final sintering, and (3) to save production expenses by eliminating labor cost on cracked ceramic discs. RUV system also serves as a process control tool to increase yield by eliminating production flaws caused by mechanical defects.

FREQUENCY CURVE

Through a resonance frequency curve selected from a broad range (20 - 250 kHz) the RUV method enables screen out materials with hidden invisible cracks. A crack introduced into ceramics alters the RUV peak parameters: amplitude, bandwidth and peak position. This is illustrated in Figure 1 for a set of ZrO_2 ceramic discs. Specifically, the crack in the disc shows the following RUV features: (1) a frequency shift of the peak position; (2) an increase of the bandwidth, and (3) a reduction of the amplitude. Therefore, the RUV approach is based on a fast measurement and analyses (below 5 seconds per scan) of a specific resonance peak and rejection of the object if peak characteristics deviate from the normal non-cracked samples. Additional RUV feature is stress inspection caused by voids and components delamination.

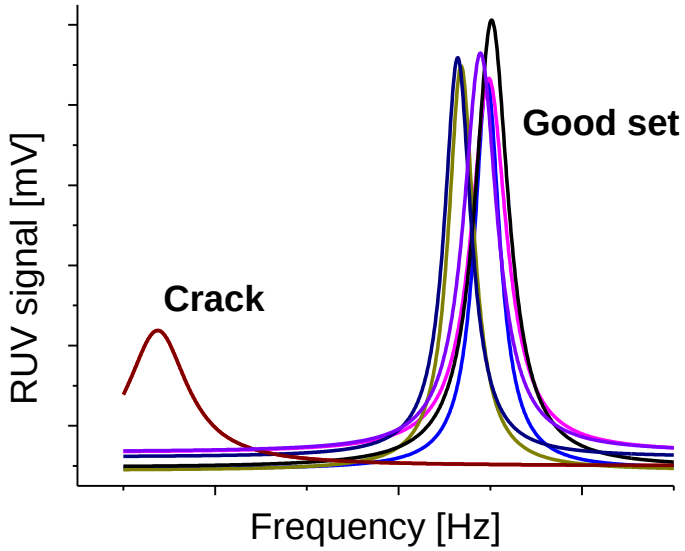


Figure 1: Deviations of RUV peak parameters caused by a crack

The sensitivity of the system, which refers to the length of the cracks, is adjustable to the needs of the user. The rejecting method is based on a statistical approach. In production the accuracy of this method approaches 99%. RUV system is used in production of ZrO_2 dental discs, Zr-based solid oxide fuel cells and metallized ceramic rings.

IN LINE & OFFLINE CONFIGURATIONS

Fully automatic In-line, Off-line and Quality Control RUV Tools are currently available for ceramic products. For technical information and RUV system availability, please contact Ultrasonic Technologies at support@ultrasonictech.com

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