

Ultrasonic Inspection of PZT Ceramics

Application

Ultrasonic inspection of unfired (green) ceramic materials to detect internal cracks and voids. During the manufacturing process of PZT ceramic crystals, fine ceramic powders are first highly compressed, wetted and allowed to cure. After drying, the resulting solid ceramic blocks are then fired at extremely high temperatures. Following this firing process, the block can then be machined down to the final product size and shape.

Current Condition

During the pressing and drying processes, internal cracks and/or voids can develop. These voids are impossible to detect by visual inspection, since they normally emanate from inside the block. Void and cracked areas cannot be machined into final product, which reduces the yield. If the cracks can be detected prior to the machining process, yields can be increased and dollars can be saved by machining around defects and/or discarding blocks in advance that would produce a low yield..

Test

The test is a straight-forward, Ultrasonic time-of-flight and amplitude scan. Sensor selection is a spot focused 5-10 MHz sensor with a focus length of 1.5-2". The longer focus results in a more consistent spot resolution throughout the thick block (1-2") during a TOF scan.

Performance

The attached CSCAN images show the results of scanning a 1.3" thick unfired ceramic block. The color palette at the left of the screen depicts the thickness levels present throughout the sample. Green correlates to 100% thickness and blue represents 0% thickness. If the block was free of cracks, the Ultrasonic signal would travel through the block and bounce (echo) off the bottom of the sample. Since the velocity in the material is known (220k"/sec), it is a simple matter to calculate the thickness. Therefore, a good sample would produce a pure green scan. Blue areas represent near surface imperfections. Notice on the lower scan that many areas are red and orange in color. This depicts premature echoes due to cracks and voids 50-60% into the part.

Conclusions

As the results show, inspecting unfired blocks with a PAC CSCAN system can save costly machining dollars and increase the yield and quality of precise ceramic PZT components. PAC's bond analysis and clustering programs can also be used to quickly locate and size a batch of blocks that can be scanned at once (bond analysis shown on top scan shows the left part has 26.7% void area, and the right part has 11.9% unusable)..

For a demonstration or additional information, please contact our Princeton Junction headquarters at 609-716-4000.

