FLAW DETECTION AND CHARACTERIZATION IN CERAMICS WITH THE SCANNING LASER ACOUSTIC MICROSCOPE (SLAM)*

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ABSTRACT

The high resolving power coupled with the real time capability of the SLAM make it a useful technique for characterization of materials including ceramics. The elastic structure of ceramics is often dependent upon the details of the fabrication process, e.g., sintering, hot pressing, amount of binder, etc. Accordingly, acoustic micrographs and acoustic interferograms which reveal characteristic sonic transmission patterns and sonic velocity variations, respectively, can be used to nondestructively evaluate ceramics to ensure material uniformity. In addition, the ability to nondestructively detect flaws and inclusions is important in fracture toughness studies and in the evaluation of finished components.

This presentation will survey a series of acoustic micrographs obtained at 100 MHz. Micrographs illustrating the characteristic acoustic signatures of a variety of hot pressed and reaction sintered components will be presented. In addition to this characterization data, micrographs showing specific defects in silicon nitride and silicon carbide will be presented. The "library" of flaws includes implanted inclusions and induced surface flaws, as well as buried inclusions and surface flaws which occur as the result of the normal processing cycle. Work was done on fabricated test samples as well as molded parts, e.g., turbine blades. The ultrasonic detectability of defects is dependent upon many factors including acoustic frequency, acoustic energy mode, elastic properties of the flaw, and the background structure of the material under investigation. Because of the large acoustic impedance difference between some flaws and the host material, defects an order of magnitude smaller than the 25 micron resolution element at 100 MHz are easily detected. For example, the presence of micron-sized pores in reaction sintered turbine blades is readily discernable although individual pores are not resolved. The importance of SLAM real time capability, the influence of acoustic background structure, and the use of different acoustic energy modes, e.g., bulk waves vs. surface waves on defect detectability and characterization will be discussed.

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