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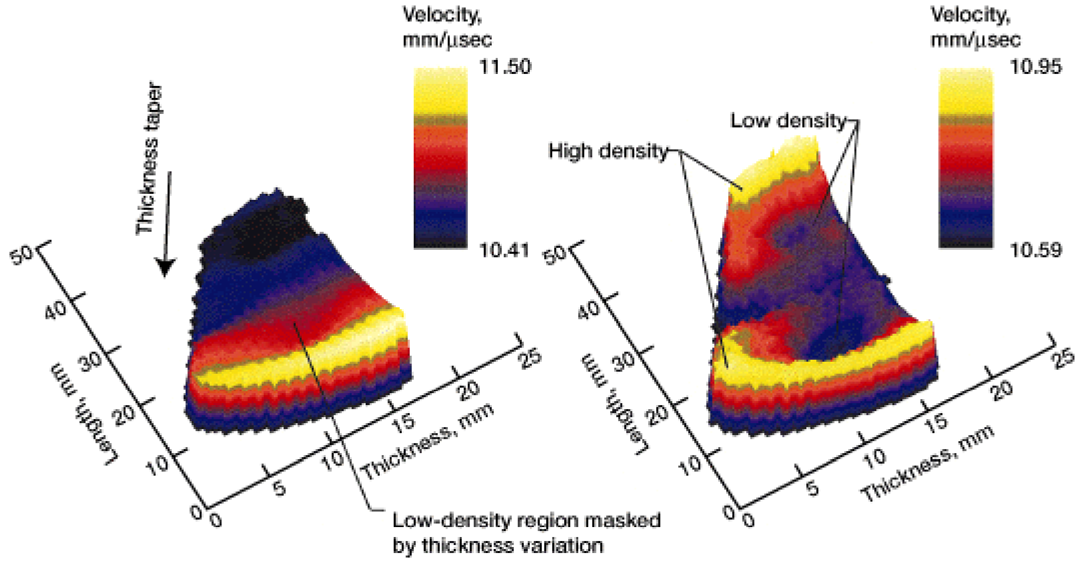
Single-Transducer, Ultrasonic Imaging Method for High-Temperature Structural Materials Eliminates the Effect of Thickness Variation in the Image

NASA Lewis Research Center's Life Prediction Branch, in partnership with Sonix, Inc., and Cleveland State University, recently advanced the development of, refined, and commercialized an advanced nondestructive evaluation (NDE) inspection method entitled the *Single Transducer Thickness-Independent Ultrasonic Imaging Method* (refs. 1 to 4). Selected by *R&D Magazine* as one of the 100 most technologically significant new products of 1996, the method uses a single transducer to eliminate the superimposing effects of thickness variation in the ultrasonic images of materials. As a result, any variation seen in the image is due solely to microstructural variation. This nondestructive method precisely and accurately characterizes material gradients (pore fraction, density, or chemical) that affect the uniformity of a material's physical performance (mechanical, thermal, or electrical). Advantages of the method over conventional ultrasonic imaging include (1) elimination of machining costs (for precision thickness control) during the quality control stages of material processing and development and (2) elimination of labor costs and subjectivity involved in further image processing and image interpretation.



Conventional ultrasonic imaging versus thickness-independent ultrasonic imaging for silicon nitride monolithic ceramic with pore fraction variations and 10-percent thickness variation. Left: Conventional ultrasonic image. Thickness effect not eliminated; defects not revealed. Right: New thickness-independent ultrasonic imaging. Thickness eliminated; defects revealed.

At NASA Lewis, the method has been used primarily for accurate inspections of high-temperature structural materials including monolithic ceramics, metal matrix composites, and polymer matrix composites. Data were published this year for platelike samples, and current research is focusing on applying the method to tubular components.

The initial publicity regarding the development of the method generated 150 requests for further information from a wide variety of institutions and individuals including the Federal Bureau of Investigation (FBI), Lockheed Martin Corporation, Rockwell International, Hewlett Packard Company, and Procter & Gamble Company. In addition, NASA has been solicited by the 3M Company and Allison Abrasives to use this method to inspect composite materials that are manufactured by these companies.

References

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