Assessing Interface Layer Characteristics of Functionally Graded Material And Biological Tissue Through Acoustic Mapping

Rais Ahmad\textsuperscript{1} and Steve James\textsuperscript{2}

1. Department of Civil Engineering & Construction Management, California State University, Northridge, CA.

Abstract:

Functionally Graded Materials (FGMs) are a new generation of engineered material that is gaining widespread interest in recent years due to their versatility of behavior. FGMs are increasingly used in biomedical applications. FGM implants are commonly used for bridging fractured bones or even critical hip replacements surgeries, these days. It is very important to assess, how the biological system interacts with the FGM implants at their interface. This research outlines a novel approach for interface characterization between Functionally Graded Materials and biological system, used for biomedical applications, using acoustic mapping of the gradient layers. Assessing the interaction action between the FGM implants and the biological tissue at their interface is critical, as it reveals the condition whether the implant would be accepted or rejected by the tissue. Conventional Magnetic Resonance Imaging (MRI) can not be performed on these metallic implants when they are in use inside a human body. The only possible way to assess the integrity of the implants is ultrasonic procedure. In this research we developed an ultrasonic inspection technique to assess the condition of the FGM implants. In our laboratory, Titanium (Ti-64) and Inconel 625 are combined together and hipped in high pressure and temperature to produce FGM implants. Acoustic surface contour maps are generated at different layers of the gradient material using high frequency acoustic C-Scanner. Through the mapping of the FGM layers, we investigated the behavior of FGM due to acoustic pressure, especially wave scattering at the gradient material interfaces. This research also tried to ascertain mechanical properties of the FGM layers using the information received from the reflective acoustic signals from the gradient layers.

Keywords:

Functionally Graded Material, Acoustic Mapping, Interface, Ultrasonic Wave, Ultrasonic Inspection