

ANALYSIS OF RESONANT ULTRASOUND SPECTROSCOPY AS A TECHNIQUE TO EVALUATE MATERIAL PROPERTY CHANGES

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ABSTRACT

The objective of this thesis is to validate Resonant Ultrasound Spectroscopy (RUS) as a non-destructive evaluation tool that can be used to study effects of radiation on the mechanical properties of a material, mainly its elastic constants. RUS involves experimentally measuring the resonant frequencies of a sample and calculating the elastic constants based on these measurements. Finite Element Method (FEM) is used to get the frequencies of the modes of free vibration for the sample model. This result depends on the elastic constant values used in the FEM simulation. Studies were conducted to confirm the accuracy of the FEM model, and determine the right configuration and parameters to use for the simulation. Assuming uniform and isotropic elastic property changes, the effects of radiation damage can be quantified by obtaining a set of matching resonant frequencies between the experimental and FEM simulation results, before and after irradiating the sample. This is done by adjusting the elastic constant values used in the simulation so that the results match with the experimentally obtained resonant frequencies. With powerful enough equipment, even real time monitoring is possible in harsh environments, thus pointing out imminent failure.