

CONDITION ASSESSMENT OF CARBON FIBER COMPOSITES USING RAMAN SPECTROSCOPY

Frank Blum, Jr.

Dr. Glenn Washer, Graduate Advisor

ABSTRACT

The goal of this research is to examine the potential of Raman spectroscopy as a method of condition assessment for carbon fiber composite materials. Carbon fiber composites are used in high performance situations such as overwrapping of composite over-wrapped pressure vessels (COPVs) in aerospace applications and hydrogen and natural-gas transportation systems. The composites will play a larger role in the future due to the materials high strength to mass ratio. There are currently limited nondestructive evaluation (NDE) technologies to evaluate these composite materials in-situ. NDE technologies will be critical for analyzing environmentally caused degradation that can reduce strength and service life of the materials. Variations in elastic strain in the composite material can manifest from degradation or damage, and can be analyzed using Raman spectroscopy. The characterization of active Raman bands and the strain sensitivity of these bands for commercially available carbon fibers are reported. Additionally carbon fiber/epoxy matrix strands and burst COPV samples are investigated. These results indicate that Raman spectroscopy has some ability to make strain measurements in commercially available carbon fibers. Such measurements have the potential to be used as a tool for NDE in inspections and reliability assessment of carbon fiber composite materials.