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Experimental Ultrasonic Sub-Surface Consolidation of Fiber Bragg Grating for Sensorial Materials

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Abstract

The paper investigates the ultrasonic consolidation process of fiber optics inside metals. It allows surface embedding of fiber Bragg grating to protect them from exposure to open environment. This particular process requests small amount of heat created at the contact interface to embed the fibers. FEM modeling and simulation of the process has been carried out prior to experiments to evaluate initial process parameters to trigger the experiments. The simulation matched the experimental results. Extensive experiments were carried out to understand the process of ultrasonic consolidation and the effect of its related parameters such as waves amplitude and welding time on the process with a selected host material e.g. aluminum. The ultrasonic frequency was kept constant throughout the tests. Coated fibers are easily embedded and more importantly protecting the fiber optics from an easy breakage while we observe a wavelength shift that should be updated when used for real measurements.

Keywords: ultrasonic consolidation; FBG; nervous materials; sensorial materials; fiber optic Ultrasonic welding

1. Introduction

Embedding fiber optics in materials is a novel technique to protect sensors in multi arrays fiber Bragg gratings (FBG). Materials can have both sensors and actuators to form new nervous materials as described by (Mekid et.al, 2009). Embedding techniques of fibers have