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SEMI-STATIC CRACK DETECTION IN COMPOSITE MATERIALS BY MAGNETOELASTIC ALLOY STRIPS

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ABSTRACT

Introduction
In Magnetoelastic materials the magnetization is stress dependent. Time dependent stresses such as those produced during crack formation induce corresponding changes to the magnetization of the material which can be detected non-destructively and wirelessly by and external pick-up coil [1]. The induced voltage on the coil is amplified and collected by a digital oscilloscope. The stored signal is filtered for unwanted noise and processed in order to get crack-specific information.

Materials & Experiental Procedures
A 2 mm thick glass fibre reinforced polyester plaque (GFRP) was cut in rectangular specimens of 4.5 x 20 cm by a diamond saw. These specimens were pre-cracked half way along their long side by two identical parallel notches on each edge making them Deeply-Double Edge Notch Tensile Specimens (DDEN-T). Thin 2.5 cm x 6.5 mm x 30 μm stripes of magnetoelastic alloy Metglass supplied by HITACHI METALS were attached in the vicinity of the cracks as cracking sensors by using a two component epoxy glue (BISON). In one of the specimens the sensor was placed along the crack and on the other specimen it was placed 2 cm away. An Instron Universal Testing Machine was used in order to perform semi-static tensile loading at 1 mm/min up to specimen rupture. The EMF signal for all specimens during tensile loading of the specimens was remotely collected (contact-free) by means of a detection coil located over the samples.

Results
We have used a magnetoelastic metglass strip to detect the crack propagation in a glass fibre reinforced composite with success. This measurement was performed in a non-contact, remote detection mode. This technique is very promising for the construction of new generation smart composites with self damage detection characteristics.

References:

[1] Kouzoudis D. and Mouzakis D.E., A 2826 Metglass Ribbon as A Strain Sensor for Remote and Dynamic Mechanical Measurements, Sensors and Actuators A, v. 127, pp. 355-359, 2006.