Detection and localisation of water intrusion in glass fibre reinforced composite using THz spectroscopy

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ABSTRACT

Glass fibre reinforced composites are recently very popular in marine or wind energy industries. One of problems that can occur during manufacturing process is introducing of a contamination e.g. in a shape of a water drop. In such case the moisture is captured and cannot evaporate from the composite element during its exploitation. This discontinuity can be a damage origin (e.g. delamination, matrix cracking or fibre-matrix debonding) that significantly decreasing mechanical properties of composite element. It is important to have a method to inspect an internal structure of an element just after manufacturing process and also during its exploitation.

One of the non-destructive methods allow to observe and evaluate the internal structure of glass fibres reinforced composite is terahertz time-domain spectroscopy (THz-TDS). In the technique the properties of a material are probed with short pulses of THz radiation. The technique can be used for defects identifications like voids, delaminations, mechanical damage or burning \cite{1} in non-conductive materials. The THz method allows to determine material structural disintegration that results in changes of absorption and refraction index of examined material. The limitations of THz propagation through water (absorption) allowed to detect water layer between two thin elements made out of glass fibre reinforced composite \cite{2}.

The paper presents an application of THz spectroscopy for observation and evaluation of the internal structure of glass fibres reinforced composite samples with a water intrusion. The relatively high permittivity of water compared to other materials enables a contrast mechanism for the detection and imaging of moisture even in a form of a water drop. The experimental investigation is performed on four-layered rectangular samples manufactured using infusion method.

Keywords: THz spectroscopy, glass fibre composite, Structural Health Monitoring, moisture

REFERENCES
