SMARTFIBER

Miniaturized structural monitoring system with autonomous readout micro-technology and fiber sensor network

Collaborative Project

ICT – Information and Communication Technologies

D3.2 Intermediary assessment of design and processing of FBG and embedding process

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List of abbreviations:

AFP	Automatic Fibre Placement
DTG®	Draw Tower Grating
FBG	Fibre Bragg Grating
OF	Optical Fibre
ORMOCER®	Organic Modified Ceramic
PIC	Photonic Integrated Circuit

1 Abstract and public summary

There are three main objectives in this deliverable.

The first objective is the aim to produce a smaller diameter FBG prototype. This design and processing of this first FBG sensor prototype for embedding has been discussed in detail in Deliverable 3.1. Assessment has been done on the level of standard optical and mechanical properties and additionally on the level of the sensor characteristics. Another objective will be to assess the automatic optical fibre embedding processes which are interesting and which are the most feasible in enhancing the embedding quality and integration of the optical fibre sensor in the host material reinforcement fibres. The last objective discussed in this deliverable is gather information on the in-situ quality of the embedded optical fibre, such as the position or location, but moreover on the quality or integrity of the coating, and on the optical fibre/ coating and the coating/host matrix interface.

Design and processing of the FBG (see Deliverable 3.1)

The goal in this project is to reduce the optical fibre diameter even further without deterioration of the sensors' characteristics (optical as well as mechanical) and to have an appropriate coating layer which only has the size of the typical thickness of a composite reinforcement layer. As such, the integration of the optical fibre sensors in the host material will be enhanced and its overall performance improved. A first prototype has been delivered and its dimensions and properties are assessed with regard to embedding in composite material.

Automatic embedding process

On the micro-level, repeatable and accurate placement of the optical fibres within the composite structure is crucial to the reliability of the information that can be obtained from the FBGs. Deformation or misalignment of the fibre can result in spurious strain measurements, and difficulty in interpreting the results that are obtained.

In terms of production, repeatability and accuracy translates to automated processes, and in particular automated fibre placement (AFP). AFP utilizes a machine that is able to place and steer a fibre tow or thin tape in predefined paths. In this report, an overview is made of different production techniques using AFP. The techniques are assessed in terms of feasibility and those that are most promising are highlighted.

Non-destructive quality check of embedded optical fibres

Whenever embedded optical fibres are envisaged, several questions comes in mind related to the location of the fibre and the different interfaces of fibre sensor and composite laminate. These are difficult to answer without having an appropriate non-destructive technique to check the quality of embedment of the optical fibre. Therefore, a relatively new technique called micro-tomography has been explored in the first stage of the 'SMARTFIBER'-project. The first results are discussed which look promising for further exploration in this project and certainly for future industrial application.