

The objective of the project is analyses of phenomena related to embedding fibre optics with fibre Bragg grating (FBG) sensors into polymeric structures made by additive manufacturing method as well as the embedded fibre optics influences on element structure and durability.

Samples made out of two polymeric materials (different mechanical properties) will be manufactured using additive manufacturing method. During the manufacturing process inside the samples fibre optics with fibre Bragg grating (FBG) sensors will be embedded. Different alignment of FBG sensors according samples layers directions will be considered. Next, the durability of samples without/ with embedded sensors will be compared using static tensile test. Additionally environmental factors influence on material durability will be considered. Among many environmental factors moisture and temperature were chosen. Samples after tests in controllable environmental conditions will be also tested using static tensile test. It allows to analyse influence of such factors on durability of material with embedded sensors in comparison with samples without sensors. The internal structure of samples after manufacturing and environmental and mechanical tests will be inspected using THz spectroscopy. The method allows to evaluate internal structure as well as detect and localise potential hidden damage, especially in close area of embedded fibre optics with FBG sensors.

The reasons for choosing the research topic are increasing interests of additive manufacturing methods of elements in prototypic solutions and embedding sensors that are useful to monitor behaviour of elements during their manufacturing and then exploitation (tests). Information from such sensors are useful in designing (implemented modifications). Among a variety of sensors FBG sensors were chosen due to their advantages as small size (fibre optic diameter is slightly thicker than human hair) and weight, no calibration requirements and high chemical resistance. Additionally, structures with embedded FBG sensors are used in structural health monitoring systems in a purpose of increase structural reliability and safety level. The project aim is related to combination of these two matters and develop sensors embedding method that can be in future applied for prototypes for strain and temperature monitoring. Additionally, understanding the sensors embedding influence on material structure and durability is an important issue.