Incorporation of fiber Bragg sensors for shape memory polyurethanes characterization

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Shape memory polymers (SMPs) are a class of smart materials which, in recent years, have been receiving special attention, due to their tremendous technological potential as actuators for biomedical applications, as well as in morphing structures, to be used in aerospace, aeronautic, and marine structural fields. SMPs can be shaped reconfigured and maintained in a transitory shape until receiving a special stimulus, for instance temperature.

The experimental characterization of the shape memory effect is usually performed using methods which are not sufficiently accurate. The development of improved measurement techniques, towards enhanced levels of accuracy and repeatability is crucial for an efficient and reliable material characterization. Due to their unique characteristics, including immunity to electromagnetic interference, compact size, high sensitivity, integration ability into other materials, multiplexing capability and real-time measurement, fiber Bragg grating (FBG)-based systems became one of the most attractive technologies for sensing applications.

FBGs sensors were embedded into shape memory polyurethanes (SMPUs), during the SMP injection process, aiming to characterize its shape memory effect. Therefore, a dedicated mold with v-shaped grooves to accommodate the optical fibers was specially designed to allow the simultaneous injection of the SMPU and embedding of the FBG sensors into the samples. With this methodology it was expected to obtain instrumented samples with an improved strain transfer between the material and the sensor, and, consequently, incrementing the measurement accuracy. The experimental setup also allowed the in situ monitoring of the injection process.

This work has shown the ability to incorporate FBGs in polymers during the injection process, which can be used not only to characterize smart materials, but also to access further details on other engineering polymers.

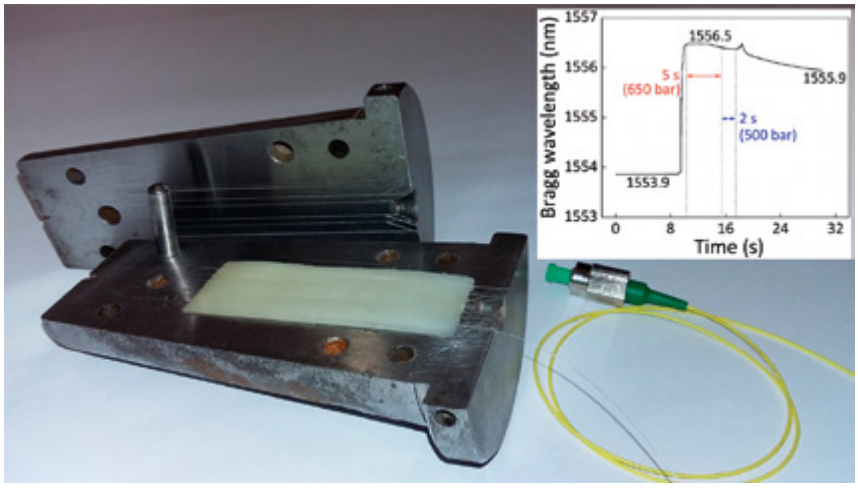

FIGURE 1
Mold cavity containing the SMPU with the embedded FBG and evolution of the Bragg wavelength along with the injection time.