Bragg gratings inscription in polypropylene light pipes using different laser sources

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Polypropylene (PP) a polyolefin material, constitutes a significant polymer with a vast number of everyday applications. Its importance in the field of optics and photonics has increased substantially during the last decade, since PP exhibits interesting properties such as high chemical resistance, biocompatibility, transmission at the THz wavelength band, and high tensibility. Therefore, the use of PP optical fibers and guided wave structures appears promising in the fields of biomedical, chemical and structural sensing, offering a new alternative in the broader domain of sensing using polymer optical fibers [1]. Herein, we are presenting the inscription of Bragg grating reflectors in PP large diameter (150μm) light-guides using a variety of laser sources including 193nm and 248nm ultraviolet, nanosecond excimer pulse and 514nm, 290fs laser beams, while using phase mask interferometry. An important aspect of this work is the introduction of toluene treatment of PP for reducing its bandgap and simultaneously increasing its photosensitivity at the exposure wavelengths [2], corresponding to different orders of photon-absorption. The Bragg grating inscription process using different wavelengths is characterized versus the exposure conditions applied. Additional material characterization methods are used for illustrating the underlying photosensitivity mechanism of PP at these wavelengths and intensities/photon densities, while considering the presence of toluene in the soft matrix acting as a plasticizer. Finally, results on the use of the inscribed Bragg grating reflectors in the PP light-guides as strain gauges or temperature probes are exemplified.

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