Fiber Bragg gratings in graded-index multimode CYTOP and silica optical fibers

By Ying-Gang NAN

Supervisor: Prof. Patrice MEGRET

Co-supervisor: Prof. Marc WUILPART

Due to significant advantages such as low Young's modulus, biocompatibility and high flexibility, polymer optical fibers (POFs) attract more and more attention in the fields of communication and sensing devices. Among POFs, cyclic transparent fluoropolymer (CYTOP) graded-index multimode polymer optical fiber is a good candidate for such applications due to its low attenuation in telecom transparency windows and specific material properties.

In this Ph.D. thesis, we report a new technique method using a femtosecond laser system operating at 400 nm and a phase mask to produce high quality FBGs in CYTOP fiber without over-clad. In contrast to previously reported results, the gratings are obtained in a few seconds with a writing power as low as 80 µW. With this setup, 2 mm-long gratings with reflectivity up to 92 % and full width at half maximum bandwidth around 0.5 nm were obtained in less than 10 s. To avoid the removal of the overclad and therefore keep the fiber integrity, we report the inscription of fiber Bragg grating through the over-clad using a phase mask technique and a 400 nm femtosecond pulsed laser. 8 mm-long grating were obtained in less than 20 s with 500 µW average beam power. Moreover, a three-variable two-level factorial experimental method has been used to investigate the FBG response to temperature, humidity, and strain in CYTOP fiber.

We then describe a simulation method to analyze the spectral properties of fiber Bragg gratings written in silica-based multimode graded-index fiber and compare the simulation results with experimental spectra measured in Bragg gratings made in a commercially available graded-index silica fiber. Comparing the experimental spectra with the simulation ones, we found that the cross-mode peaks are highly related to the fabrication parameters. To go deeper, we focus on the FBG inscription in graded-index few-mode fibers with different methods and demonstrate that the cross-mode effects in the grating spectra are suppressed by using a phase mask inscription setup based on a 400 nm femtosecond pulsed laser.