Post-processing Microstructured Polymer Optical Fiber

Gildo S. Rodrigues, Luiz E. Silva, Thiago H. R. Marques, Cristiano M. B. Cordeiro

Abstract

Optical fibers, usually made by glass materials, use light pulses for data transmission. Polymer fibers, however, present high loss and are intended to short distance communication or optical devices. Microstructured polymer optical fibers present an air hole pattern that has fundamental role on the fiber optical (and mechanical) properties. Playing with the holes size, shape and position can impact directly its characteristics. Here we applied a few bars pressure inside the holes while some fiber section was heated around 100 °C for several minutes. We showed the possibility to change locally the fiber microstructure.

Key words:

Polymer Fibre, mPOF, Fiber processing.

Introduction

New fiber designs are possible with the use of microstructured optical fibers (mPOF). As the fiber properties are strongly dependent of the geometry the air hole pattern modification offers an interesting way of tuning its core characteristics.

Due the low glass transition temperature of polymers the post-processing of its geometry can be realized with mild temperatures around 100 °C. Here we put together a setup to internally pressurize the air holes of a mPOF (total length~20cm) with few bars while a specific fiber longitudinal position (~1cm) is heated. This procedure allow us to modify the fiber point to point.

To characterize the fiber modification we follow the structure external diameter (D.ext) and the ration between the hole diameter (d) and the hole-to-hole spacing (pitch).

Results and Discussion

Both fibers present an air hole hexagonal lattice with a missing hole on its center. This is the core region of the waveguide. While the HiBi fiber (figure 1a) have two bigger holes around the core the singlemode fiber (figure 1b) have all holes with similar diameter. The processing enhances the overall fiber diameter as well as the air holes.

Figure 1. A) Hi-Bi fiber before (1st picture) and after processing of 2 minutes (2nd photo) and 8 minutes (3rd picture).

B) Singlemode fiber before (1st picture) and after processing 90°C (2nd picture) and 105°C (3rd picture).

The Hi-Bi fiber was heated until 110°C and pressurized at 5 bars during 2 minutes producing an external diameter variation of 17% (from 286 to 337 μm) and a d/pitch variation of 12% (from 0.59 to 0.66). After 8 minutes the external diameter and the d/pitch increased 33%. This massive change on the fiber geometry induced an optical loss of just 1.1 dB.

The singlemode, on the other hand, fiber was pressurized at 5 bars at 90 °C for 5 minutes making the external diameter to increase 3% (from 187 to 193 μm) and the d/pitch to change 14% (from 0.71 to 0.81). Increasing the temperature to 105°C makes the external diameter to increase 41% and the d/pitch 21%.

Conclusions

We have shown the possibility to locally post-process microstructured polymer optical fibre changing the fiber cross section geometry. Next steps include numerical simulation of the fiber optical properties, the recording of Fiber Bragg Gratings and the optical characterization of the fundamental mode effective refractive index and birefringence.

Acknowledgement

We would like to thank SAE / Unicamp for the support.

XXIV Congresso de Iniciação Científica da UNICAMP