NOVEL LONG PERIOD GRATINGS IN CHANNELED OPTICAL FIBERS

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In this work we report about the fabrication and sensing properties of Long Period Gratings inscribed in specialty optical fibers with side holes by means of electric arc discharge technique.
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1. Introduction

Long Period Gratings (LPGs) are wavelength selective filters inscribed into the optical fiber. The working principle of an LPG is based on the light coupling between the core mode and co-propagating cladding modes. Consequently, the fiber transmission spectrum exhibits several resonance peaks located at those wavelengths where the coupling occurs. LPGs are widely employed for the measurement of physical, chemical and biological parameters, since the spectral position and depth of the rejection bands are dependent on several parameters, as for example temperature, strain, bending and surrounding refractive index (SRI) [1,2].
In addition, the properties of the optical fiber hosting the grating affect the sensing features of the latter and can be properly selected for specialty applications. On this line of argument, side hole fibers (SHFs) have recently attracted attention for the development of different devices, as for example liquid level, directional bending and voltage sensors [3].

2. Results

Here we report about the fabrication of LPGs in a single mode side hole fiber. The cross-section view of the fiber is reported in Fig. 1(a). The core and cladding have a diameter of 8.3 µm and 125 µm, respectively. Moreover, the fiber has two holes with a diameter of 28 µm, whereas the distance between each hole center and fiber center is around 34 µm.
For the purpose of the work, we have identified the arc discharge fabrication parameters (arc power, arc time, fiber tension and electrodes gap) in order to realize long period gratings with deep and narrow attenuation bands [4]. Fig. 1(b) reports the transmission spectra of two representative gratings in SHF with periods Λ of 550 µm and 400 µm. The spectral position of most attenuation bands agrees with the results of LPG in standard fiber whereas some new bands, probably due to asymmetric cladding modes, are visible. The effect of grating parameters has also been studied, which influences the device sensitivity to external stimuli. In particular, the SRI sensitivity of these gratings is also comparable with that of standard fiber [4].

3. Conclusions

The availability of long period grating devices in specialty optical fibers like side hole types can further improve the application of fiber sensors to single and multi-parametric detection. In particular, we believe that LPGs in SHFs are particularly appealing for the integration with a microfluidic system for the development of chemical sensors.

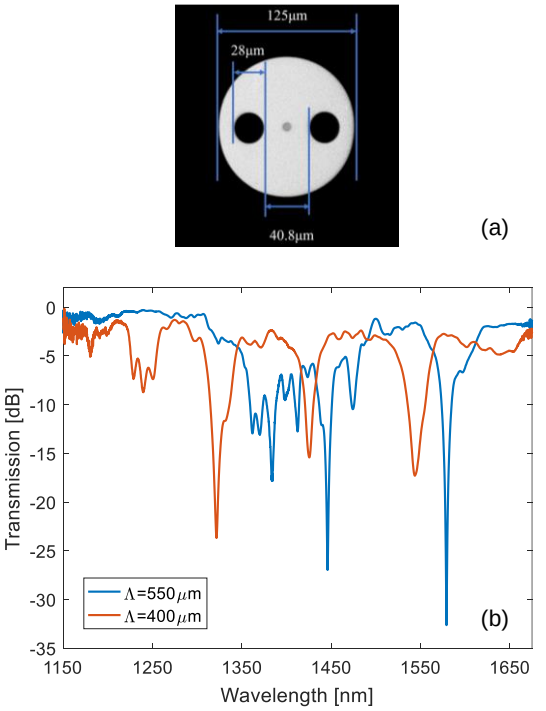

Fig. 1 (a) View of SHF cross section. (b) Transmission spectra of LPGs in SHF with different periods.

References

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