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Femtosecond Laser Micromachining of One-Dimensional Photonic Crystal Channel Waveguides

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Introduction

The use of a femtosecond laser to create integrated photonic crystal waveguides inside of a transparent polymer is discussed. In general, positive refractive index changes caused by femtosecond lasers can be used to build waveguides. Since this method can only produce minor changes in refractive index, their performance is constrained in transparent polymers. By designing hexagonal "photonic lattice-like" waveguides with negative refractive index modifications in the cladding, which enable light to be contained in the uneradicated core, these restrictions can be bypassed. The production of this brand-new kind of polymer waveguide is thoroughly examined, as well as its numerical aperture, mode field diameter, and attenuation. It is also possible to integrate Bragg gratings using the system's positive and negative refractive index modulations [1].

Description

Applications and basic research continue to show a lot of interest in integrated optics, which is a rapidly developing field. In particular, femtosecond laser inscription of optical elements within planar silica or crystal substrates is a mature technology that has applications in astronomy, quantum computing, optical sensing, and communications [2]. Nonlinear absorption of the laser pulse energy can cause a localized change in the refractive index within a transparent material. Because it allows for freedom in 3D design, curved waveguides, interferometers, 2D and 3D couplers, and Bragg gratings have all been demonstrated using the direct writing method. Important properties include the produced waveguides' geometric shape and the induced shift in refractive index. However, intense UV irradiation rather than femtosecond laser pulses are still used in established fabrication procedures for transparent polymers, an emerging material class for lab-on-a-chip applications [3]. Illumination masks and interference effects can be used to create integrated optical elements like waveguides and gratings, which are mostly used in sensor applications but not exclusively. The induced refractive index alteration's shape is difficult to control, and these procedures have a high level of performance, but they also have limited design freedom, are typically restricted to the surface of the substrate, and have limited design freedom [4]. Using ultrashort laser pulses instead of UV light to process polymethylmethacrylate has been the subject of numerous reports showing refractive index shifts in both the positive and negative directions [5]. These shifts depend on the processing conditions that were used, such as the repetition rate of the laser pulse and the wavelength of the laser. In the current state of the art, however, photonic structures created by femtosecond laser pulses on planar transparent polymer substrates are still restricted to simple topologies like internal waveguides and couplers.

Conclusion

The notion is based on a photonic lattice like structure that has been utilised to build optical waveguides in crystals. In this research, we present a novel method for producing internal waveguides in PMMA. A hexagonal pattern of modifications that impart a negative effective refractive shift to the waveguide's cladding makes it possible to route optical waves inside the pure core. Solid core photonic crystal fibres serve as the foundation for the waveguide's construction. Guidance is provided via total internal reflection, which avoids the photonic bandgap effect generally present in photonic crystal cladding and is achieved by an effective volume average refractive difference between a central core region and the surrounding photonic crystal cladding.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Wang, Fei, Wu Yuan, Ole Hansen and Ole Bang. "Selective filling of photonic crystal fibers using focused ion beam milled microchannels." *Opti Expr* 19 (2011): 17585-17590.
2. Surdo, Salvatore and Giuseppe Barillaro. "Impact of fabrication and bioassay surface roughness on the performance of label-free resonant biosensors based on one-dimensional photonic crystal microcavities." *ACS Sens* 5 (2020): 2894-2902.
3. Sohn, Ik Bu, Young Seop Kim, Young Chul Noh and Jin Chang Ryu. "Microstructuring of optical fibers using a femtosecond laser." *J Opti Soci Koer* 13 (2009): 33-36.
4. Lv, Jinman, Yazhou Cheng, Weihao Yuan and Xiaotao Hao. "Three-dimensional femtosecond laser fabrication of waveguide beam splitters in LiNbO 3 crystal." *Opti Mater Expr* 5 (2015): 1274-1280.
5. Li, Ming, Kiyotaka Mori, Makoto Ishizuka and Xinbing Liu, et al. "Photonic bandpass filter for 1550 nm fabricated by femtosecond direct laser ablation." *Appli Phys Lett* 83 (2003): 216-218.

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