Fabrication Holographic of Photonic crystals for telecommunications

Luis Fernando de Avila (PQ), Rony da Silva Albano (IC)

Abstract
In this project, we recorded two-dimensional Hexagonal Photonic Crystals (2D-HPC) layers, with a linear waveguide, in erbium doped GeO2-Bi2O3-PbO-TiO2 glassy films, by combining the techniques of holographic recording and femtosecond (fs) laser micromachining

Key words Photonic Crystals, holographic Lithography, femtosecond laser micromachining.

Introduction

The rapid growth of data traffic on the internet offers a great challenge to be overcome in optical systems of communication. Today's networks need the transduction of optical signals in electronic and this process limits the speed of data transmission and generates an increase in energy consumption. The use of fully optical devices can help to overcome these limitations, eliminating the need for signal transduction in optoelectronic systems. Combining several techniques of manufacture of high resolution with deposition of materials, it is possible to create a wide range of structures with different sizes, shapes and compositions, defined according to the desired application. In particular, periodic structures serve well for this purpose, because it can be used to manipulate the macroscopic optical properties, electrical and magnetic when electromagnetic waves interact with these structures. When these periodic structures are made purely of dielectric materials, it is possible to produce materials with frequency bands of propagation prohibited of light that can control the transmission and the location of the light within these materials. These types of materials are called photonic crystals and has been intensively studied since the end of the 80 [1] [2].

Results and Discussion

The two-dimensional Hexagonal Photonic Crystals is recorded holographically in a photoresist film coated on a glass substrate (Figure (a)) by exposing the sample to the same interference pattern twice and rotating the sample of 60° between the exposures. After the development a two dimensional hexagonal array of photoresist columns remain on the glass substrate (Figure (b)). The recording of the waveguide is made by a fs laser micromachining system focused at sample surface (Figure (c)). The laser spot produces the ablation of the photoresist columns generating a defect line in the periodic hexagonal array. The Figure (d) shows the deposition of glass doped with erbium and the Figure (e) waveguide photonic crystal after remove the photoresist.

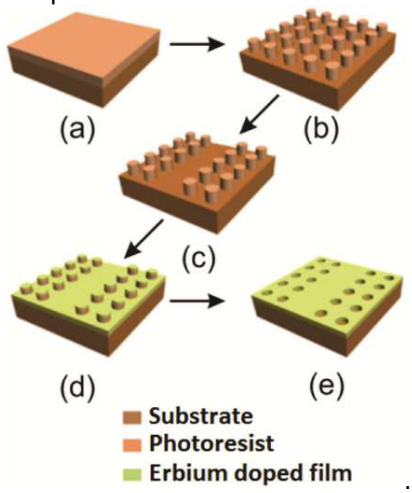

Figure 1. Scheme of the fabrication process .

Conclusions

In this work, we designed and fabricated 2D-HPC layers, with a linear waveguide, in erbium doped GeO2-Bi2O3-PbOTiO2 glassy films, by combining the techniques of holographic recording and femtosecond (fs) laser micromachining. The results demonstrate the possibility to use these techniques as a low cost alternative to fabricate photonic devices instead of FIB or e-Beam lithography. The next step of the work involves the measurement of the luminescence of the Er3+ doped through the waveguide.

Acknowledgement

The authors thanks to the Conselho Nacional de Desenvolvimento Científico e tecnológico (CNPq) for the financial support.

---

[1] Materiais Avançados 2010-2022, Centro de Gestão e Estudos Estratégicos (CGEE), Ciência, Tecnologia e Inovação, Brasília, DF, 2010.
[2] J. D. Joannopoulos, R. D. Meade and J. N. Winn, "Photonic Crystals", Princeton University Press, New Jersey, (1995).