Optimized magneto-optical isolator based on bismuth-substituted YIG fiber

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In this paper, a numerical analysis of magnetic photonic crystal fibers (MPCFs) based on bismuth-substituted yttrium iron garnet (Bi: YIG) is performed. In order to enhance the magneto-optical (MO) properties of the design, the physical parameters characterized by lattice constant, diameter of the holes and thickness are optimised. The MO behavior of the design is investigated by studying the effect of the gyrotropy on the design's performance.

Keywords: Bi: YIG; magnetic fluid; isolator; magnetic photonic crystal fiber

1. Introduction

MO isolators are considered to be the main elements for the next generation of optical signal processing. These components are incorporated to allow a high- speed data transmission and protect devices from damaging reflections [1]. MO isolators can be realized by using the unique non-reciprocal properties of MO materials such as garnets, because of their large Faraday rotation, low optical losses and their transparency at the communication wavelengths [2]. One of the most used material for the realization of NR devices is bismuth substituted yttrium iron garnet (Bi: YIG) [3], due to its attractive MO properties, especially Faraday rotation. In addition, various theoretical and experimental studies have been carried out using magnetic fluids (MFs) with garnets [4], [5].

2. Simulation results and discussion

Due to the flexibility of MPCF and the tunable refractive index property of MF, an MPCF using Bi:YIG film (n = 2.6) has been proposed. The air holes are filled with 0.25% MF concentration (n = 1.4102) [5]. The influence of the geometrical parameters defined by a lattice constant, (a), a diameter of the holes, (d) on the mode conversion efficiency (R_m) is investigated.

As shown in Fig. 1, the increase of the parameter a induces an increase of R_m. In order to enhance the characteristic of the design, the optimum value of 90.4% is chosen. Thus, the optimized MPCF is formed with $d = 0.9 \times a$, placed periodically in triangular fashion with a lattice constant of a = 2.6 µm.

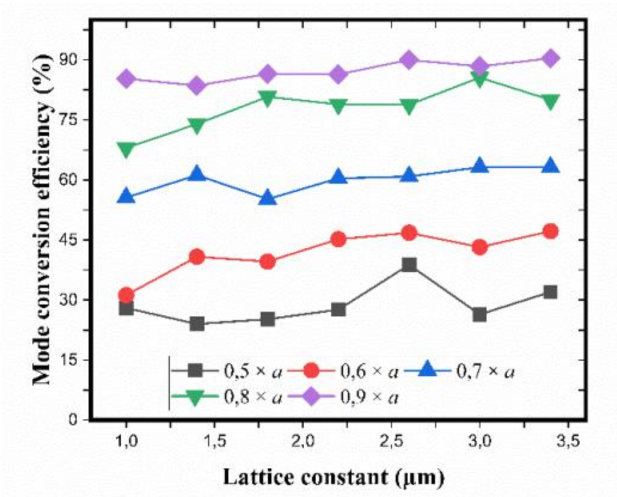

Figure 1: Effect of lattice constant and diameter of the holes on mode conversion efficiency.

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