Recent advances in microstructured optical fibers

Sergey L. Semjonov
Fiber Optics Research Center RAS
Moscow, Russia
sls@fo.gpi.ru

Abstract—Recent results obtained in Fiber Optics Research Center RAS in the field of microstructured optical fibers are reviewed.

Keywords—microstructured optical fiber; photonic crystal fiber

I. INTRODUCTION

Microstructured optical fibers are a comparatively new class of optical fibers. Their artificial crystal-like structure results in a number of unusual properties. They can guide light not only through a well-known total internal reflection mechanism but using also photonic bandgap effect. In this presentation recent results related with microstructured optical fibers obtained in Fiber Optics Research Center RAS are reviewed.

II. RESULTS

Some of obtained results are below:

Microstructured fibers optimized for supercontinuum generation in 400-2500 nm wavelength range were developed. High resistance to photodarkening under UV irradiation was obtained (Fig.1a).

A new design of microstructured fibers with high birefringence and low mode asymmetry was developed (Fig.1b). In this case all the holes have the same size, but in the first ring around the core holes have equal spacing \( \Lambda \) between the centers, except one or two pairs of holes with increased spacing \( \Lambda_1 \). Thus, the fibers have one or two wider bridges between the holes in the first ring. Numerical and experimental investigations of such fibers were performed. We fabricated the fibers with approximately equal mode field sizes along the two orthogonal axes and birefringence up to \( 2.7 \times 10^{-3} \) [1].

We demonstrated the light transmission in a spectral range of 2.5 to 7.9 \( \mu m \) through a silica negative curvature hollow core fiber (Fig.2a) with a cladding consisting of eight capillaries. A separation between the cladding capillaries was introduced to remove the additional resonances in the transmission bands. The measured optical loss at 3.39 \( \mu m \) was about 50 dB/km under a few modes waveguide regime [2].

An all-silica (without holes) photonic bandgap fibers (active and passive) with a cladding index difference of approximately 2 % and diameter-to-pitch ratio (d/\( \Lambda \)) of 0.12 were fabricated and studied (Fig.2b). To our knowledge, this was the first work on photonic bandgap fibers with such a small d/\( \Lambda \). The fibers were single-mode in the fundamental bandgap. The mode field diameter in the 1000-1200 nm wavelength range was 18-20 \( \mu m \). The minimum loss in the same range was 20 dB/km for a 30-cm bending diameter. In our opinion, all-silica photonic bandgap fiber can serve as a potential candidate for achieving single-mode propagation with a large mode area [3,4].

REFERENCES