DEVELOPMENT OF NANOSTRUCTURED CORE OPTICAL FIBERS

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We present a new approach for development of graded-index optical fibres made of silica glasses. Core of the fibre is composed of multiple subwavelength rods of high and low refractive index ordered according to the design. Effective medium theory is applied to describe a performance of the structured fibres. We show that nanostructurization allow to develop optical fibres with an arbitrary refractive index distribution not limited to the circular symmetry, as it is for standard MCVD methods used for graded-index silica fibre fabrication.

We developed a proof-of-concept fibre with parabolic refractive index core. The fiber has a core with the diameter of 7 µm composed of 2107 rods of 190 nm of diameter made of either pure fused silica or Ge-doped fused silica with 8.5 % mol concentration. The attenuation of 0.05 dB/m was measured using the cut-back method and in the spectral range from 0.7 to 1.7 µm. Attenuation is only higher at the "water peak" located at a wavelength of around 1.4 µm. The obtained attenuation is low, if we take into account research grade of fiber drawing laboratory class and standard quality of glass rods used for fiber development. It also shows that assembling of a preform did not bring any severe pollutions into the preform.

We have measured dispersion and modal properties of developed fibre. The cut-off wavelength in fabricated fibers is 1.1 µm and its numerical aperture is equal to NA=0.11.

A perfect match between predicted, designed and measured optical properties is achieved. It proves that with this method the manufacturing process of nanostructured fibre is fully controlled and optical fibers with a free-form core shape and refractive index distribution can be developed with the proposed method.