Specialty optical fibers for dispersion management in the spectral ranges of normal and anomalous material dispersion

S.S. Aleshkina [a], K.K. Bobkov [a], M.Yu. Salgansky[b], M.V. Yashkov[b], M.E. Likhachev [a]

[a] *Prokhorov General Physics Institute of the Russian Academy of Sciences, Dianov Fiber Optics Research Center, Moscow 119333, Russia.*

[b] *Institute of Chemistry of High Purity Substances of the Russian Academy of Science, Nizhny Novgorod 603950, Russia.*

Abstract: The report discusses novel all-glass optical fibers designs for dispersion management and its applications.

The modern progress in fiber optics is inherently connected with the development of new fiber designs, which make it possible to expand possibilities for intrafiber light control. One of the tasks is to overcome the limitations associated with the decisive influence of material dispersion on the total dispersion of standard optical fibers. The present report covers several types of all-glass optical fiber designs, which could be used both for dispersion management in the spectral range of normal material dispersion of silica glass and in the spectral range where glass material dispersion is anomalous. The first fiber type, considered in the work, is so-called hybrid fiber. Such fibers consist of low-index core surrounded by one or two high-index thin ring layers. Operating mode in this case is one of high order modes with zero azimuthal index and radial index equal to quantity of high-index ring layers plus one. The operating mode can have anomalous dispersion in the spectral range of normal material dispersion and so, can be applied for dispersion control of Yb-doped laser schemes. The next fiber type is the fiber with high-index rods embedded into silica cladding. Due to mechanism of mode confinement in the fiber core, mode anti-crossing effect takes place and, as result, at wavelengths before the resonance the core mode has strong anomalous waveguide dispersion, that can significantly exceed the material one, and at wavelengths after the resonance it is strongly normal. By controlling of high-index rods position the resonance bandwidth can be appropriately adjusted on the modelling stage. Additionally, fiber bending allows to change the dispersion value and “tune” it for solution of the current task. One more interesting approach is a multi-layers fiber. One of such approaches is utilization of W-type fiber, which might have fundamental mode’s cutoff. Just near the cutoff the fundamental mode in such fibers exhibits strong normal waveguide dispersion those slope could be varied in a wide range (both positive and negative) that, opens a great opportunities for pulse propagation control, for example, for building fiber pulse stretcher with dispersion perfectly matched to compressor based on diffraction gratings.

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Biography: Dr. Svetlana Aleshkina is Senior Researcher of Specialty Optical Fiber Lab in FORC RAS, Russia. She received B.S. and M.S. degrees in physics from Mordovian State University, Russia, in 2006 and in 2008, respectively. In 2008 she joined the FORC RAS, and in 2012 defended Ph.D. thesis. She is an author of more than 60 scientific articles. Her research focuses on the design, development and investigation of specialty optical fibers and fiber lasers.