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INVESTIGATION OF SUPERCONTINUUM GENERATION IN PHOTONIC CRYSTAL FIBERS WITH DIFFERENT CHARACTERISTICS USING FEMTOSECOND PUMP PULSES

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Phenomenon of supercontinuum generation is interesting and very useful in applications such like spectroscopy, telecommunications, and metrology [1]. Supercontinuum is a phenomenon when a sufficiently intense ultrafast pump pulse propagating though nonlinear media induces intensity-dependent refractive index, which results in nonlinear effects such like self-phase modulation (SPM), cross-phase modulation (XPM), four-wave mixing (FWM), stimulated Raman scattering (SRS) and soliton generation and fission [2]. A full information of such distorted pulse (temporal shape, phase, intensity, duration) can be retrieved by implementing cross-correlation frequency-resolved optical gating (XFROG) method, which requires two different pulses (well defined reference and unknown) [3]. Photonic crystal fibers are especially suitable for supercontinuum generation due to unique properties like tight light confinement, low effective mode area (increment of intensity of propagating light), flexibility to choose pump wavelength [1]. As nonlinear response is sufficiently increased by decreasing effective mode area, tapered photonic crystal fibers were invented and implemented to obtain higher spectral broadening [4].

The main objective of this work was to measure supercontinuum spectrum, characterize temporal profile of SC pulse in conventional or tapered PCFs and compare experimental results to determine quality of tapered fibers performed in FTMC, Department of Laser Technologies, Fiber Laser laboratory. SC was generated by directly pumping PCF by “FLINT” femtosecond laser oscillator with central wavelength of 1028 nm and repetition rate of 75.2 MHz.

After performing measurements of evolution of supercontinuum by increasing pump power and measurements of XFROG trace, spectral and temporal results of tapered or conventional PCFs were compared. To compare conventional PCFs, spectral and temporal characteristics differs remarkably due to different ZDW properties and fiber core size. Therefore, supercontinuum of respective tapered PCFs differs only quantitatively – spectral broadening was less efficient. Contrary to what was expected, tapered PCFs did not show any enhanced nonlinear response. Temporal characterization of tapered PCFs showed that light was probably leaking into other PCF core or cladding modes, resulting in intensity losses. Such results showed that manufacturing technique was insufficient in which tapering was conducted without applying air pressure to microstructure holes. This might have caused them to collapse and distort the geometry of microstructure region resulting in loss of intensity of propagating light.

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