Dispersion Decreasing Fibers Based Supercontinuum Sources in the Spectral Range of 0.9-2.3 μm

I V Zhluktova[1], A D Zverev[2], V A Kamynin[1], A I Trikshev[1], A A Sysoliatin[3], and V B Tsvetkov[2]

[1] *Oscillation department, Prokhorov General Physics Institute of RAS, Moscow, Russia*
[2] *Laser Materials and Technology Research Center, Prokhorov General Physics Institute of RAS, Moscow, Russia*
[3] *Coherent and Nonlinear Optics, Prokhorov General Physics Institute of RAS, Moscow, Russia*
Contact Email: iv.zhluktova@gmail.com

Supercontinuum (SC) generators, emitting in the spectral range 1–3 μm, are used both in scientific researches [1] and in practice, for example, coherence tomography [2], optical communication [3]. One of the methods for obtaining SC generation is the use of all-fibre sources of ultrashort pulses with a subsequent amplification of radiation (to ensure a high power density), which is introduced into a highly nonlinear medium, where spectrum broadening occurs due to nonlinear effects (stimulated Raman scattering, self-phase modulation, four-wave mixing, etc.). This paper presents the results on the generation of SC in the spectral range of 0.9–2.3 μm using dispersion decreasing fibres (DDF).

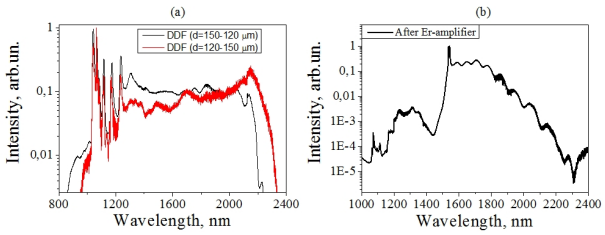

Figure 1: The optical spectra of SC (a) and radiation obtained after Er-doped fiber amplifier (b)

The experimental setup included the passive mode-locked ytterbium fiber laser (master oscillator) [4], the ytterbium fiber amplifier, and nonlinear media. The pulse duration of the master oscillator (MO) was 260 ps with a repetition rate of 1 MHz. After the fiber amplifier, the average output power reached 800 mW that corresponded to a peak power of 1.3 kW with a pulse duration of 600 ps. To obtain SC irradiation DDFs were used as nonlinear media, in which the cladding diameter was changed from 120 μm on one side to 150 μm on another. Both the radiation's temporal and spectral characteristics after amplification and of SC generation were obtained. Fig.1a shows the optical spectra during SC generation obtained when radiation was forward (from small to large cladding diameter) and backward (from large to small cladding diameter) inputted to the DDF. During SC generation, the maximum width was reached about 1500 nm at –30 dB level, with the largest temporal divergence of various spectral components. The maximum pulse envelope duration was about 1 ns. An Er-doped fiber amplifier was used to increase the power density in the spectral region 1.5–1.6 μm of SC (Fig.1a.(black curve)). Fig.1b shows the optical spectrum obtained using an Er-doped fiber amplifier. It was also noted that with an increase in the pump power of this amplifier, the optical spectrum broadens. The power contribution in the 1500-1650 nm range was about 70% and in the 1650–2300 nm range was about 28%. In general, the pulse envelope duration varied here in the range of 300–440 ps. The maximum output power was 220 mW. Thus, an all-fibre supercontinuum generator was assembled with a subsequent amplification of the spectral component in the 1.6 μm region using an Er-doped fiber amplifier.

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