Spectral Broadening of mid-IR Femtosecond Pulses in Highly Germanium Doped Fiber

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Abstract: We demonstrate spectral broadening of high-powerfemtosecond mid-IR pulses in a single-mode highly Ge-doped fiber.

OCIS codes:060.2390 Fiber optics, infrared; 320.6629 Supercontinuum generation 140.3070 Infrared and far-infrared lasers

1. Introduction

2. Experimental setup

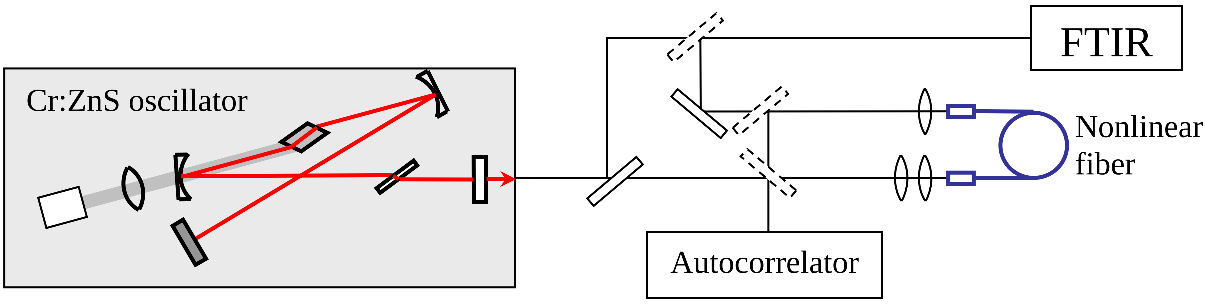

Figure 1: Schematic setup for characterization of mid-IR femtosecond pulse propagation in nonlinear fibers.

The experimental setup is schematically shown in Fig. 1.As a source of the femtosecond pulses in mid-IR spectral region WE USE the Kerr-lens mode-locked Cr:ZnS oscillator. The laser was built on the basis of X-folded four-mirror cavity. It was pumped by the diode-pumped 5-W 1.61 μm Er-fiber laser from IPG Photonics. The mode-locking was achieved by soft-aperture Kerr-Lens effect. The compensation of the group-delay dispersion was performed by sapphire plate inserted into the cavity and chirped HR mirror. The laser produced pulses of about 69fs at the central wavelength of 2.39 μm, repetition rate of 150 MHz and output power up to 550 mW, which corresponds to the pulse energy of 3.7 nJ. The spectral bandwidth of output emission reached 193 nm, which corresponded to the time-bandwidth product of 0.335 (Fig. 2). We assume the input pulse to be essentially chirp-free.

About 80% of the laser output were delivered to the input end of the nonlinear fiber, The oscillator emission was focused to the fiber input by a CaF2 lens. The fiber input facet was cut at the angle of 82° to exclude backreflection to oscillator. The emission from the fiber output was delivered either to spectrometer or autocorrelator.The launched energy was varied by a transverse translation of the fiber input facet against the excitation beam. The maximal coupling efficiency reached 5%, measured by the average power at the output end of the fiber.

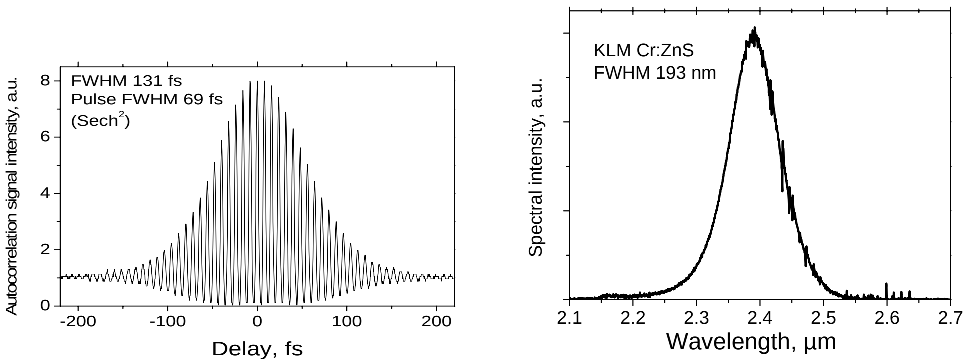

Figure 2. Autocorrelation trace and output spectrum of Cr:ZnS oscillator, used as a pulse source.

3. Results

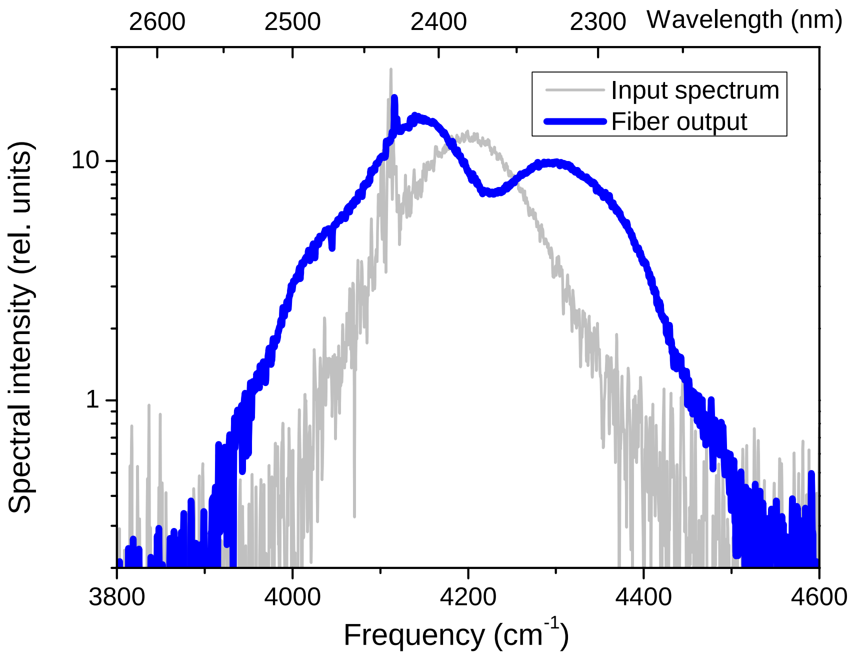

Figure 3.Spectra (log scale) of femtosecond pulses after propagation in 1.5 m highly Ge-doped fiber.

4. Modeling

5. Conclusion

We have successfully demonstrated femtosecond pulse broadening in highly Ge-doped fiber. Supercontinuum generation is prospective with increased pulse energy.

Acknowledgments

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References