Diploma thesis abstract.

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Frequency shifting and short pulse generation with microstructure fibers for nonlinear spectroscopy.

In this work the propagation and nonlinear interactions of femtosecond laser pulses in microstructure fibers are studied. Experiments presented in this paper demonstrate the capability of microstructure fibers to provide short light pulses with a tunable frequency shift for nonlinear spectroscopy.

The laser systems used in experiments consisted of a Ti: sapphire master oscillator and also of a Cr^{4+}: forsterite master oscillator. The optical scheme of prism compressor was calculated and mounted for obtaining chirped femtosecond pulses. The pulse duration measurement and chirp evaluation were made by means of autocorrelator and fiber-optic spectrometer. The efficient generation of new spectral components in area of short wavelengths was observed as the femtosecond pulse propagates in microstructure fibers. The frequency shift according to initial pulse parameters (energy, chirp, polarization) was studied. Spectrum transformation pattern depends on initial pulse properties and fiber dispersion. The pulse spectral shape variation and the generation of new spectral components is explained in terms of soliton propagation theory.

New features in the area of coherent nonlinear spectroscopy concerned with using of ultrashort laser pulses with controlled chirp were studied. It was demonstrated that chirp tuning of short probe pulse open the ways toward smoothly varying of sensitivity in coherent anti-Stokes Raman scattering (CARS) in wide range. The spectral sensitivity dependence in CARS spectroscopy due to chirp parameter was studied.

The opportunity of complex shape pulse generation in microstructure fibers was shown. The cross-correlation frequency-resolved optically gated laser-induced grating technique was applied for the characterization of the microstructure fiber output. This emission was employed to probe the nonlinear response of a polyvinyl pyrrolidone film by means of coherent anti-Stokes Raman scattering.