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Abstracts

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This book contains the materials on the fundamental and applied problems of pulsed lasers. It may be interesting for researches and engineers working in the sphere of quantum electronics, spectroscopy, plasma physics, medicine, remote sensing and laser technologies.

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emission different in spectral composition. As a rectifier, pure GaSe shown higher THz pulse power to that in ZnTe under pump fluences exceeding 5 mJ/cm^2 but the optimally S-doped GaSe from 2 mJ/cm^2 and did not show saturation until studied pump fluences of over 5 mJ/cm^2. Finally, S-doped GaSe is the one of the prospective materials for multiple nonlinear-optical applications.

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F-7

THE MODELLING OF GENERATION SUPERCONTINUUM IN PHOTONIC-CRYSTAL FIBRE IN THE SPECTRAL BROADENING UNIT OF HIGH-INTENSITY LASER SYSTEM

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At Institute of Laser Physics of SB RAS a high-intensive femtosecond diode-pumped system with 1 kHz pulse repetition rate based on Yb^{3+}-doped media is developed. We use hybrid (parametric + laser) method of the amplification of pulses [1].

Initially, pulses from master oscillator have spectral width of 1.7 nm (FWHM), but the system is designed to produce pulses shorter than 15 fs at the output, using a spectral broadening unit, based on a photonic crystal fibre. A numerical simulation of the generation of supercontinuum in SC-5.0-1040 (NKT Photonics) fibre was done.

The propagation through the fibre is described by generalised nonlinear Schroedinger equation [2], which was solved using split-step fourier algorithm. The result shows good agreement between simulation and experiment. The supercontinuum spanning from 650 to 1100 nm obtained can be used to further amplification in the OPCPA-channel. The results are for further discussion.

This work is supported in part by RAS Program "Extreme laser radiation: physics and fundamental applications" and Government program, registration No. 01201374306.

1. *Petrov V.V. et al.* // Quantum Electron. 2014. 44 (**5**). P. 452.
2. *Agrawal G.* // Nonlinear Fiber Optics 5th edition. 2013.

F-8

NEW NONLINEAR CRYSTAL GA_2S_3 FOR IR APPLICATIONS

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Highly nonlinear crystals with high resistance to laser radiation and suitable birefringence are of top interest in the field of efficient parametric phase-matched mid-IR and THz generation. Among the widely used chalcogenides the 2-d (layered structure) pure and doped GaSe crystals show a range of attractive physical properties however the mechanical properties are poor, which in turn limits the application of GaSe to indoor applications. In this work, we first report the results of detailed investigation on physical properties of 3-d (bulky) chalcogenide Ga_2S_3 crystals grown by melt and flux crystallization methods. As grown crystals have monoclinic Cc structure according to XRD patterns. The measurement of physical properties renders Ga_2S_3 crystal as a strong competitor to pure and doped GaSe in mid-IR and THz applications. Its transparency range lies within 0.48–25 μm (with multiphonon absorption peak at 24 μm) which is wider than that for pure and doped GaSe, while the short wavelength cut-off provides lower nonlinear loses of pump radiation. The

birefringence has a satisfactory level B = 0.0025. Another advantage is the absence of phonon absorption peaks in the long wavelength part of THz range (> 500 μm) known to be free of water vapor absorption. Besides, Ga_2S_3 crystal demonstrates 30 times higher optical damage threshold. Its high mechanical properties allow processing, out-of-lab and commerce applications after improvement of the growth technology.

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F-9

STUDY OF HOT CARRIER RELAXATION IN NARROW-GAP SEMICONDUCTORS WITH TIME-RESOLVED TERAHERTZ SPECTROSCOPY

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Ultrafast relaxation of hot charge carriers in semiconductors is the main process that determines functional properties and limiting capabilities of electronic and optoelectronic devices. This process is especially significant for operation of nanodevices when their size becomes compared to the free length of charge carriers.

We implemented the method of time-resolved terahertz spectroscopy based on Ti : Sapphire femtosecond laser (central wavelength – 800 nm, pulse duration – 35 fs, pulse power – 3 mJ). Preliminary excitation of narrow-gap semiconductors (InAs, InSb) was carried out with terahertz pulses and/or optical pulses converted from Ti:Sapphire laser radiation. The state of charge carriers was probed by measuring terahertz absorption spectrum of semiconductors with subpicosecond time resolution. The studies using terahertz pre-excitation showed that the rate of impact ionization in the electric field of < 20 kV/cm of half-period terahertz pulse was thrice as fast at 300 as at 80 K. This is caused by an increased ionization threshold at lower temperatures which is proportional to the width of bandgap at the Γ, L, and X points of Brillouin zone. Pre-excitation with optical photons with different energies showed that the time of momentum relaxation and thermalization of hot photocarriers was 150 fs for Γ-valley and > 1.5 ps for L-valley carriers. We also studied influence of kinetic energy of hot charge carriers on the rate of impact ionization with simultaneous excitation of semiconductors with terahertz and optical pulses.

F-10

MODEL STUDIES OF THz-RANGE GENERATION BY DOWN-CONVERSION IN GASE И GASES CRYSTALS

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Detailed model study of not phase matched and phase matched optical rectification or down-conversion of ultrashort Ti : Sapphire laser pulses at 950 nm into THz range in pure and S-doped GaSe single crystals is carried out. First, the ordinary and extraordinary wave dispersions of the GaSe refractive indices were measured by terahertz time-domain spectroscopy (THz-TDS). Measured data were approximated in the form of Sellmeier dispersion equations for 0.62–2000 βm range with using available shorter wave data. Different types of three-frequency interactions are considered. Dispersions, estimated phase-matching conditions and frequency conversion efficiencies will be presented in graphical forms.