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ABSTRACTS

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1. *Akhmanov S.A., Drabovich K.N., Sukhorukov A.P., and Chirkin A.S.* // ZhETF. 1970. V. 59. P. 485–499.
2. *Smetanin S.N.* Determination of the stimulated raman scattering threshold for a pump pulse of arbitrary width // Optics and Spectroscopy. 2016. V. 121. P. 395–404.

F-4

THE EFFICIENCY OF THz WAVE GENERATION IN b-BBO UNDER VISIBLE AND IR FS PULSE PUMP

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Potential efficiency of the THz wave generation by down conversion of the visible emission in nonlinear β-BBO crystal is estimated using well known Sellmeier equations [1] and measured absorption coefficients for o and e-waves. Eight types of interactions are found possible [2]:

$$d_{\text{eff}}^{e\text{-}o\to o} = d_{\text{eff}}^{e\text{-}e\to o} = d_{\text{eff}}^{o\text{-}e\to e} = d_{22}\cos^2\theta\cos 3\varphi;$$
$$d_{\text{eff}}^{o\text{-}e\to o} = d_{\text{eff}}^{e\text{-}o\to o} = d_{15}\sin\theta - d_{22}\cos\theta\sin 3\varphi;$$
$$d_{\text{eff}}^{o\text{-}o\to e} = d_{31}\sin\theta - d_{22}\cos\theta\sin 3\varphi;$$
$$d_{\text{eff}}^{o\text{-}o\to o} = -d_{22}\cos 3\varphi;$$
$$d_{\text{eff}}^{e\text{-}e\to e} = d_{15}\sin 2\theta\cos\theta + d_{22}\cos^3\theta\sin 3\varphi + d_{31}\cos^2\theta\sin\theta + d_{33}\sin^3\theta.$$

Four interaction types were realized in the carried-out experiments using 1.2 mm crystal cut at $\theta = 5°$, $\varphi = 0°$ orientation. Obtained results are well in coincidence with the estimated results.

Optical damage threshold under fs pumping (≥ 5 TW/cm^2 at 60 fs at 950 nm) was measured for the first time. So high damage threshold overcompensates low nonlinear coefficients. Thus, β-BBO crystal appears promising for generation of high powerful frequency tunable THz wave generation suitable for the atmosphere monitoring.

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1. *Nikolaev N.A. et al.* Optical properties of beta-BBO and potential for THz applications // J. Phys.: Conf. Ser. 2018. 951. 012003.
2. *Zernike F. et al.* Appl. Nonlin. Opt. NY: Wiley, 1973.

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CONTROL OF TERAHERTZ POLARIZATION SENSITIVE FILTERS BASED ON THE FORMATION BY A MAGNETIC FIELD OF STRUCTURES OF MICROPARTICLES OF THE 5BDSR ALLOY IN A LIQUID MEDIUM

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This study is devoted to the creation of magnetic fluids based on magnetic particles of the 5BDSR alloy up to 32 μm in size, which can be used to control terahertz radiation in the range from 0.3 to 1.5 THz. As a rule, diffraction gratings are used as filters for THz radiation, by varying the parameters of which it is possible to create band pass filters [1]. By controlling the behavior of microparticles in a magnetic fluid using an external magnetic field, one can create an analogue of the

corresponding diffraction gratings [2]. In this work, the parameters of magnetic fields for creating filters in the THz range are obtained.

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1. *Ezhov D.M., Kochnev Z.S., Fakhrutdinova E.D., Cherepanov V.N., Mamrashev A.A., Nikolaev N.A., and Svetlichnyi V.A.* Fe and 5BDSR based composite fluoropolymer films for THz photonics applications // Proc. SPIE. The International Society for Optical Engineering. 2020. 11582.
1. *Zyatkov D., Balashov V., Yurchenko V., Svetlichnyi V., Kochnev Z., Knyazkova A., Kistenev Y., and Borisov A.* Creation of a Magnetic Driven Gate for THz Rays // Progress in Electromagnetics Research M. 2019. V. 80. P. 103–109.

F-6

DETECTION OF THz WAVES IN GASE:S CRYSTALS BY FEMTOSECOND RADIATION WITH A WAVELENGTH OF 1.5 MICRONS

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In the nearest years, the modulation frequencies in optical communication lines (λ = 1.5 microns) are expected to increase to 0.1—0.3 THz. At these frequencies, silicon electronics devices become inefficient, and therefore nonlinear optical methods of signal processing are proposed. Thus, the search for suitable materials appropriate for solving this problem is relevant.

GaSe can be a promising material, since it has a high nonlinear coefficient d_{22} = 54 pm/V, high thermal conductivity, sufficient transparency at λ = 1.5 mkm and in the sub terahertz (sub THz) range. It is also suitable for creating planar structures by molecular beam epitaxy, which is promising for integrated optical devices. The disadvantages of the crystal are almost zero hardness on the Mohs scale and a large number of structural defects. The disadvantages can be compensated by doping the crystal with sulfur elements, which, on the one hand, increases the hardness, reduces the number of defects, but at the same time leads to a decrease in the nonlinear coefficients of the crystal.

In this regard, the aim of this work is to find the optimal degree of doping of a GaSe crystal with S elements for the detection of sub THz radiation using femtosecond laser pulses with a wavelength of 1.5 mkm.

For the study, several samples of the composition $Ga_{50\%}Se_{50-x\%}S_{x\%}$ were made at the IG&M SB RAS, where x takes the values: 0, 1, 5, 6, 8, 11. The atomic occurrence of sulfur was determined by the EDRS SEM method. A pulsed THz spectrometer based on a femtosecond fiber erbium laser has been assembled at the IA&E SB RAS. The generator of THz radiation is an InAs semiconductor in a magnetic field of 0.8 T. Detection of THz radiation is based on the Pokkels effect in a GaAs crystal of orientation (110).

Beforehand the optical and THz refractive indices for each GaSe:S sample were measured, the coherence length l_c was calculated for detecting a band up to 1.5 THz, which was ~ 0.3 mm, and samples of the specified thickness were cut.

It is experimentally shown that the most sensitive THz detector is a sample with a 6% atomic content of sulfur. At the same time, it is 2.2 times less sensitive than the GaAs crystal. In accordance with the obtained data, the electro optical coefficient of the samples is GaSe:S was r_{33} ~ 1 pm/V.

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