The 15th International Conference

# AMPL-2021

# PULSED LASERS AND LASER APPLICATIONS

## September 12–17, 2021
## Tomsk, Russia

## ABSTRACTS

### GENERAL SPONSOR

*Special Systems. Photonics, St. Petersburg, Russia*

### CONFERENCE ORGANIZERS

*Institute of Atmospheric Optics SB RAS*
*Institute of High Current Electronics SB RAS*
*Tomsk State University*
*Tomsk Polytechnic University*

### CONFERENCE SPONSORS

*Ministry of Education and Science of Russian Federation, Russia*
*Russian Academy of Sciences, Russia*
*Siberian Branch of Russian Academy of Science, Russia*
*Laser Association, Russia*

### CONFERENCE SPONSORS

*TOPAZ Research and Inculcation Enterprise, Tomsk, Russia*
*Young Scientists Counsil IAO SB RAS, Tomsk, Russia*
*SP Equipment, Novosibirsk, Russia*
*Azimut Photonics, Moscow, Russia*
*LOTIS TII, Minsk, Belarus*
*Special Systems. Photonics, St.-Petersburg, Russia*
*CLZ Ltd, Moscow, Russia*
*Leningrad Laser Systems, St.-Petersburg, Russia*

### MEDIA SPONSORS

*Atmospheric and Oceanic Optics Journal, Tomsk, Russia*
*Photonics Journal, Moscow, Russia*

Scientific & Technical Translations
STT
PUBLISHING
Tomsk, 2021

the transparency windows of the Earth's atmosphere of 3–5 (MWIR) and 8–12 (LWIR) μm. We fabricated MWIR and LWIR *nBn* structures with different diameters (from 20 to 500 μm), which made it possible to study the role of various current components (volumetric and surface leakage). The side walls of the walls of the mesa structures were passivated with $Al_2O_3$ films formed by plasma atomic layer deposition at a temperature of 120 °C; for comparison, structures were fabricated without passivation.

Studies of MWIR *nBn* structures with a composition of 0.84 in the barrier layer showed that dark currents in such structures in a wide temperature range (180–300 K) are limited by hole diffusion from the absorbing layer. At a lower composition in the barrier layer (0.64–0.67) of MWIR *nBn* structures, the role of the surface leakage component increases. The dark current in LWIR *nBn* structures at a temperature of 300 K and a bias of −2 V is 0.241–0.247 A/cm when the side walls are passivated with an $Al_2O_3$ film. In LWIR *nBn* structures without sidewall passivation, the role of surface leakage increases, the density of which is in the range of 0.423–0.432 A/cm. Dark currents in MWIR *nBn* structures are in good agreement with the empirical Rule07 model, which indicates the possibility of creating efficient unipolar barrier detectors based on MBE HgCdTe. For LWIR *nBn* structures, dark currents at small reverse biases are limited by the bulk component, and the activation energy of this current is in good agreement with the band gap of the absorbing layer. Studying the admittance of test MIS devices based on *nBn* structures in a wide range of temperatures showed that with high-quality passivation of the side walls of mesa structures, it is possible to create efficient LWIR *nBn* detectors based on MBE HgCdTe.

The research was carried out with the financial support of the Russian Science Foundation within the framework of the Project No. 19-12-00135.

**F-22**

## THRESHOLD OF LASER DESTRUCTION OF NONLINEAR GaSe AND GaSe:In CRYSTALS WHEN EXPOSED TO PULSED RADIATION AT A WAVELENGTH OF 2.1 MICRONS

**N.N. Yudin[1,2,3], O.L. Antipov[4], V.V. Demin[2], A.I. Gribenyukov[5], M.M. Zinoviev[1,2,3], S.N. Podzivalov[2,3], E.A. Slyunko[2,3], E.V. Zhuravlev[1], and A.A. Pfeif[2]**

[1]*Institute of Atmospheric Optics SB RAS, 1 Zuev Sq., 634055 Tomsk, Russia, muxa9229@gmail.com;*
[2]*Tomsk State University, 36 Lenin Ave., 634050, Tomsk, Russia, rach3@yandex.ru;*
[3]*LLC "Laboratory of Optical Crystals", 7, 28 Vysotsky St., 634040 Tomsk, Russia, cginen@yandex.ru;*
[4]*Institute of Applied Physics RAS, 46 Ul'yanov St., 603950, Nizhny Novgorod, Russia, antipov@ipfran.ru;*
[5]*Institute of Monitoring of Climatic and Ecological Systems SB RAS, 10/3 Akademichesky Ave., 634021, Tomsk, Russia, alexander.gribenyukov@yandex.ru*

The aim of this work is to determine the optical breakdown threshold of a single crystal GaSe and GaSe:In when exposed to nanosecond radiation of the two micron range and determining the influence of the energy parameters of the testing radiation on the breakdown threshold. The $Ho^{3+}$:YAG laser was used as the laser radiation source in this work. Pumping was carried out by a Thule fiber laser. Two GaSe and GaSe:In crystals were used as the studied samples. According to the results of the holographic experiment, no inclusions and volume defects were found in the GaSe sample, except for microcracks. In GaSe:In samples, volume inclusions with a size of ~ 300 microns were detected. The optical breakdown threshold is determined by the energy density and power density of the GaSe crystal and the GaSe crystal: In when the parameters of the test radiation are close to the parameters of the pump radiation of promising dual frequency OPO (which are effective sources of pumping THz generators of difference frequency): the wavelength is 2.091 microns, the pulse repetition frequency is 12 and 20 kHz, the pulse duration is 18–22 ns. In a sample doped with In, with an increase in the pulse repetition frequency, a more significant decrease in the optical breakdown threshold is observed than in a non-doped sample. These results indicate a significant influence of the bulk defects found in the GaSe:In sample indicates accumulation effects that increase with increasing frequency, which leads to a drop in the breakdown threshold with increasing pulse repetition frequency.