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PULSED LASERS AND LASER APPLICATIONS

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ABSTRACTS

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repetition rate (more than 100 kHz), high pulse energies (more than 100 uJ), operation in several spectral ranges, high beam quality, high gain, and short pulse duration (20–100 ns). These features make it possible to use them as illumination sources [1] and optical signal converters (brightness amplifiers) for monostatic and bistatic laser monitors [2]. When operating as an illumination source, the active element must provide a high pulse energy and pulse repetition rate. When operating as a brightness amplifier, additional requirements are imposed on the active element: minimal input signal distortion, high gain and diameter.

The features of the construction of imaging systems based on active media based on the copper and manganese atom transitions are considered. The imaging results obtained in monostatic and bistatic laser monitors are presented. For registration of images, modern cameras of the visible and SWIR spectrum ranges are used. Some results of visualization of fast processes are presented – processes of combustion of Ni–Al, evaporation of ytrium oxide, etc. Amplifying, frequency energy and spectral characteristics of these media when operating in a wide frequency range (up to 100 kHz) are presented in this work.

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2. *Evtushenko G.S., Torgaev S.N., Trigub M.V., Shiyanov D.V., Evtushenko T.G., Beloplotov D.V., Lomaev M.I., Sorokin D.A., and Tarasenko V.F.* Methods and Instruments for Visual and Optical Diagnostics of Objects and Fast Processes // Ed.: Gennadiy Evtushenko. Nova Publishers, 2018 236 p. ISBN:978-1-53613-568-8.

D-7

LASER SYSTEMS OF HIGH SPEED IMAGING FOR STUDYING THE COMBUSTION OF METAL NANOPOWDERS AND THEIR MIXTURES

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A promising direction in the development of powder technologies is the production, research and use of energetic materials, in particular, containing aluminum and iron nanopowders. The combustion of metal nanopowders and their mixtures with micropowders occurs at high temperatures, and in some cases is accompanied by the scattering of combustion products. The distance of scattering can reach tens of centimeters. In this regard, an urgent task is the development of methods and devices for non-contact remote study of the parameters of high-temperature combustion of nano and micro metal powders in real time.

The report presents the developed methods of high-speed optical imaging using laser radiation and brightness amplification. Laser monitors with a traditional visualization scheme, as well as schemes with an increased observation range are considered. In addition to laser monitoring, laser illumination imaging techniques are also being considered. The proposed experimental technique makes it possible to study the surface of samples of powder materials during high temperature combustion, accompanied by intense glowing and scattering of combustion products.

D-8

ASSESSMENT OF FATIGUE DAMAGE TO AIRCRAFT GLASS USING DIGITAL HOLOGRAPHY METHODS

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The purpose of this work is to test the digital holography method for determining the depth of fatigue surface defects of the "silver" type of aviation organic glass caused by cyclic mechanical overloads, as well as the impact of aggressive substances. To study the fatigue defects of aviation organic glass, a digital holographic camera was used, the configuration of which is an axial scheme for recording digital Gabor holograms. During the experiment, the possibility of using the digital holography method to determine the characteristic transverse dimensions of surface defects in aircraft glazing parts and longitudinal dimensions was shown. The work carried out and the created model of the digital holographic camera show the potential possibility of creating a method for checking with a given accuracy the elements of the aircraft glazing for the presence of surface damage and assessing their impact on flight safety.

D-9

PUMP INDUCED WAVEFRONT DISTORTIONS AND GAIN IN HIGH POWER LASER AMPLIFIER

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Currently, significant efforts are directed to the creation and development of laser radiation sources with high intensity, high energy and high pulse repetition rate. In the Institute of Laser physics of the Siberian Branch of the RAS a high intensity laser radiation source operating with a high repetition rate and stabilization of the carrier-envelope phase shift is developed. The source includes a Ti:Sa based system [1] and a Yb^{3+} based scalable subjoule laser system [2]. The main block of the scalable system is a high power multipass laser amplifier with closed loop cryogenic cooling.

The dynamics of phase distortions in cryogenically cooled active elements of the amplifier during the process of laser amplification is analyzed. A numerical simulation of the dependencies of the gain and aberrations of the wavefront of amplified radiation on the pulse duration and diameter of the pump beam is carried out. It is shown that it is possible to reduce the magnitude of the radiation wavefront aberrations while maintaining a high gain by choosing the optimal pump parameters. The results are aimed at optimization of the parameters of cryogenically cooled amplifiers with high diode pumping power.

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