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ABSTRACTS

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A-11

INVESTIGATION OF THE LASER ON THE THALLIUM SELF TERMINATING TRANSITION PUMPED BY SUBNANOSECOND SWITCH

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The frequency energy characteristics of the laser on the self terminating 7s $^2S_{1/2}$–6p $^2P_{3/2}{}^0$ transition of a thallium atom (λ = 535 nm) were studied. Investigations were carried out with a gas-discharge tube described in [1]. It's improvement was the introduction of an additional electrode, which was used to ignite the discharge between it and the cathode, that made possible to accelerate the development of the discharge in comparison with the power supply circuit used in [1], in which the excitation was performed by a cold cathode thyratron TP13-10k/25. As switching devices were used: a kivotron in the regime of regular pulses up to a pulse repetition frequency of 2 kHz and up to 10 kHz in the burst mode operation an eptron (switch based on the combination of open and capillary discharges) in the burst mode operation with the pulse repetition frequency of up to 40 kHz.

As a result of comparative studies it was demonstrated that in both cases the energy parameters of the laser radiation and the optimal pulse repetition frequency are higher than those achieved in [1].

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A-12

AMPLIFICATION RADIATION ON SODIUM D LINES USING OPTICAL PUMPING

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In recent years, much attention of researchers is riveted to the creation of efficient and compact laser vapor of alkali metals diode pumped resonant transitions $n^2P_{3/2,1/2}$–$n^2S_{1/2}$ (D_2 and D_1 line) of these metals. Amplification characteristics were not studied these metals for possible creation of the amplifiers of brightness image. However, the gain of such media up to 2.5 cm^{-1} according to the calculated and experimental data. Amplification and efficient generation by resonant pumping of the $n^2P_{3/2}$ level is observed on the D_1 line, at high pressure (200–300 Torr) of buffer gas (usually helium). Possible non-resonant pumping at higher pressures of the buffer gas (600 Torr and more) with a large detuning of the pump from the n $^2P_{3/2}$ level in the short wavelength side. In this case, the lasing and amplification are possible at both D_2 and D_1 lines [1].

In this experimental work deals with the process of obtaining amplified spontaneous emission (ASE) in the cell with sodium vapor under longitudinal pumping by a dye laser at a detuning of pump radiation from the $3^2P_{3/2}$. We used the cell with sodium vapor, with a diameter of 1.6 cm and a length of heating zone of 10 cm. The temperature changes of the active medium from room to 350 °C, with an accuracy of ±1 °C. As the pump was used the radiation of a dye laser Pyrometer 597 excited solid-state Nd^{3+} : YAG laser (LQ-529B, Solar LS), with a wavelength of 532 nm. Pulse frequency was 1 Hz. Line width of the dye laser (FWHM) was 5 nm, and its maximum was varied in the range from 580 to 590 nm. The energy of the pump pulse is changed by using the filters in the range from 1 to 12 mJ. Experiments were carried out with single pass and double pass of radiation through the active medium.

Amplified spontaneous emission (ASE) was recorded on both lines of sodium at densities of pump power more than 1.5 MW/cm^2, at detuning pump from $3^2P_{3/2}$. Namely, when the maximum of the broadband pumping is in the range from 584.5 to 586.5 nm. The temperature of the external wall of the cell was 230–260 °C (working concentration of Na-atoms reaches 10^{14} cm^{-3}), the pressure of helium buffer gas was 600 Torr (initial 300 Torr) at operating temperature. ASE lost when changing the detuning of the pumping line from the specified range, despite the large increase in the density of pumping.

The work was supported by Russian Science Foundation, Project No. 14-19-00175.

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A-13

SIMULATION OF SPATIO-TEMPORAL CHARACTERISTICS OF METAL VAPOR BRIGHTNESS AMPLIFIERS

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One of the most promising applications of metal vapor active media on is use them as brightness amplifiers in active optical systems [1]. Active optical systems allow to visualize the processes and objects hidden from observation by power background illumination. The quality of the obtained images in such systems directly depends on the parameters of radiation and amplification (duration of inversion, radial profile, etc.) of the used active media. So, the task of a detailed study of the spatio-temporal characteristics of metal vapor active media is quite relevant.

An effective method for solving this problem is mathematical modeling of the kinetic processes taking place in the active medium plasma. In papers [2–4] a fairly detailed mathematical simulation of copper and copper bromide vapor lasers was carried out. However, in these papers, studies were carried out when the active medium was operating as the generator, without detailed study of the radial characteristics.

This work is devoted to the development of a spatio temporal kinetic model of the copper vapor active medium. As a result of the work, radial profiles of radiation and amplification of the copper vapor active medium in different operating modes were obtained. In particular, it was shown that during the pump pulse the gain first appears at the tube wall, then on the GDT axis. Theoretical studies of the process of image transmission through a brightness amplifier taking into account the radial unevenness of the gain were also carried out.

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