S4-P-004701

IMPROVING THE GENERATION CHARACTERISTICS OF A N2 LASER PUMPED BY A LONGITUDINAL DISCHARGE*

YU. N. PANCHENKO[1], I. N. KONOVALOV[1], A.V. PUCHIKIN[1], M.V. ANDREEV[1], E.V. GORLOV[2], V.I. ZHARKOV[2]

1 Institute of High Current Electronics SB RAS, Tomsk, Russia
2 V. E. Zuev Institute of Atmospheric Optics SB RAS, Tomsk*, Russia*

Many applications of UV laser radiation require high pulsed power, a narrow spectral line, and a high pulse repetition rate. In a number of cases, widely used semiconductor lasers do not meet the presented requirements. The most effective and simple solution in this case may be a nitrogen laser [1,2].

Thus, we present the results of a study of an N_2 laser with longitudinal pumping by a pulsed anomalous glow discharge. The possibility of bulk plasma formation at a maximum specific current density of 2.75 ± 0.25 kA/cm^2 and a specific pump power of more than 1 MW/cm^3 is shown. Preservation of a stable discharge structure was ensured by the automatic inclusion of preliminary ionization of the gas volume, due to the introduction of sharply inhomogeneous distortions in the electric field of the discharge gap. An LC inverter was used as a pump generator with storage capacitances of 11 nF and 5.6 nF and a discharge capacitance of 3.8 nF.

It is demonstrated that at a nitrogen pressure (purity 99.6%) P = 10 mbar, the pulse duration of the generated radiation corresponds to the duration of the pump pulse. At the charging voltage U_0 = 24 kV, the energy in the radiation pulse reached 1.3 ± 0.1 mJ with a duration at the half-intensity level up to 14 ± 2 ns, Fig.1.

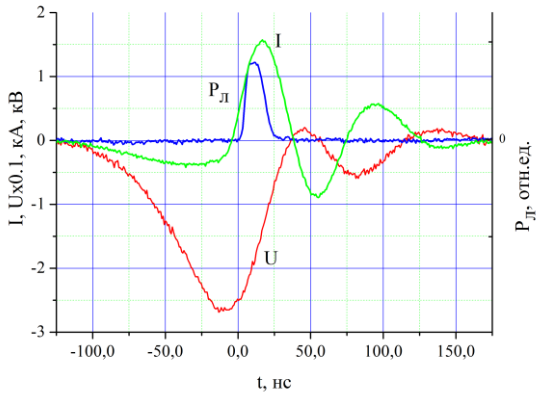

Fig.1. Oscillograms of the current I, voltage U on the discharge capacitance, and the time shape of the radiation pulse P_l.

The maximum peak power of the output beam was 80 kW. The generation of radiation developed near the inner wall of the discharge tube with an inner diameter of 9–12 mm, in a ring ~2.5 mm wide, and the cross section of the laser beam was 0.6 cm^2. The internal efficiency (relative to the energy stored in the discharge capacitance) was 0.11%. It is noted that when nitrogen was replaced in the discharge tube with atmospheric air (~78% N_2, ~21% O_2) at a pressure of 8 mbar and charging voltage U_0 = 24 kV, the energy in the radiation pulse was 0.6 mJ at a pulse duration t = 12 ns. Without a system for pumping a gaseous medium, in a repetitively pulsed mode of laser operation up to 10 Hz, a stable repeatability of the discharge and generation characteristics of the laser was maintained.

REFERENCES

[1] I. N. Konovalov, Yu. N. Panchenko, A. V. Puchikin, V. F. Losev, and S. M. Bobrovnikov, Izv. Physics. 2019. T. 62. № 9. C. 139.

[2] Yu. N. Panchenko, I. N. Konovalov, V. F. Losev, A. V. Puchikin. Nitrogen laser excited by a longitudinal electric discharge; Pat. No. 2664780; publ. 08/22/2018. - Bull. No. 24

* The work was supported by the Russian Science Foundation under grant No. 17-19-01229.