COPPER BROMIDE VAPOR LASER WITH AIR COOLING AND MEAN GENERATION POWER OF 10–15 W

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Received October 15, 1997

Design of the copper bromide vapor laser with air cooling having a mean generation power of 10–15 W *and a pulse repetition frequency of* 27 kHz *is described. For stable operation of a thyratron with these pumping parameters, additional self-bias is applied to the anode.*

From lasers on self-terminated transitions in metal vapor, a copper vapor laser is one of the best studied ones. Investigation of active media on metal salts is a logical continuation of the development of lasers of this type due to some positive distinguishing factors compared with lasers on pure metal vapor. Metal salt vapor lasers, in particular, a copper bromide vapor laser, can enter the working regime faster and can operate with higher pulse repetition frequencies than pure copper vapor lasers. This is of interest in a number of practical applications of metal vapor lasers used, for example, in light graphics.

In the present paper, a copper bromide vapor laser is described developed on the basis of laboratory investigations. An external view of the laser is shown in Fig. 1.

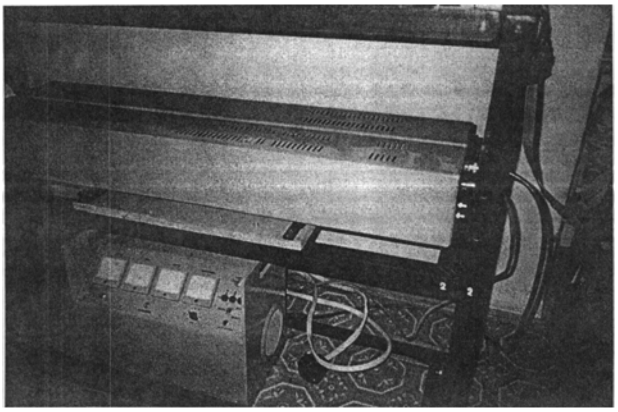

FIG. 1. External view of the copper bromide vapor laser.

To investigate and to develop the copper bromide vapor laser, a gas-discharge tube (GDT) was used made from optical quartz with an active zone 700 mm long and 26 mm in diameter. On the ends of the active zone, electrodes were placed in the form of quartz valves filled with copper powder. Input current terminals of electrodes from pulsed photoilluminating lamps sealed in the valves were used as input current terminals of the electrodes. Copper bromide was uniformly distributed in the three branch-pipes sealed in along the discharge gap of the GDT. Copper bromide in the branch-pipes was heated with furnaces placed at each branch pipe.

Our investigations of operating regimes of the GDT showed that when it was inserted in an inverse current-carrying element and connected to a power supply unit through the RK–50–9 cable 3–3.5 m long, the average power of generation was 12–15 W with a pulse repetition frequency of 27 kHz, a voltage on a rectifier of 5.8 kV, a buffer gas (neon) pressure of 200 Torr, and a storage capacitance of 750 pF. The TGI1–1000/25 thyratron was used as a commutator. This operating regime was chosen as a basic one for the development of the copper bromide vapor laser.

In design, the laser has two blocks. In the first block, the high-voltage rectifier with units of control over the laser parameters is located. The high-voltage rectifier is built around a three-phase transformer protected against overloading with automatic output in operating regime. To increase the reliability of laser operation, a step-voltage regulator was inserted that ensured the supply voltage stability of the hydrogen generator and of the thyratron heating on a level of 3% when the power supply voltage changed by about 10%. The second block comprises the GDT inserted in a cavity and a commutation block with circuits for charging of the storage capacitance. The TGI1–1000/25 thyratron with resonance charging of the storage capacity inserted in the thyratron anode is used as a commutator.

Arrangement of the GDT and thyratron in one block makes the connection of these elements through the cable difficult. Joining of these laser elements without cable leads to unstable operation of the thyratron. Analysis of reasons for thyratron unstable operation showed that it was due to the lack of inverse voltage on the thyratron anode. To provide the stable thyratron operation, additional circuit for application of the additional anode negative self-bias on the thyratron was inserted in the laser supply scheme. This provided the stable operation of the thyratron and the stable laser energy characteristics.

0235-6880/98/02-03 164-01 $02.00