Carbon disulfide gasdynamic laser

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Lasing was produced on CS_2 molecules by supersonic expansion of $CS_2+CO+He$ mixtures in vacuum. The content of the carbon disulfide in the mixture was varied from 1 to 10%, and the ratio of He to CS_2 from 5 to 25. Tl lasing was observed in the region impact temperatures 600–1800°K and stagnation pressures 2–10 atm.

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The possibility of producing a CS_2 gasdynamic laser (GDL) was suggested in[1]. It was shown in[2] that in a mixture of diatomic and triatomic molecules it is possible to observe heating of the ν_3 mode of the triatomic molecules on account of the near-resonant V-V interaction of the diatomic molecule with ımbination levels of the triatomic molecules. The same article contains ;timates of this effect, particularly for the mixture $CS_2 + CO + He$. It follows om these estimates that the maximum heating takes place in a mixture con- ining 2.86% CS_2 at a helium to carbon disulfide ratio equal to 15. It follows om the same estimates that it is possible to develop on the basis of this ixture a GDL with relatively high gain at low stagnation temperatures.

To verify the conclusions of[2], we investigated $CS_2 + CO + He$ mixtures ex- .nding supersonically in vacuum through a flat profiled nozzle having at the ›int x (the distance to the critical cross section in centimeters) a ratio of the 'oss section to the critical cross section area (the height of the critical cross :ction is 0.8 mm) equal to $1 + 25(1 - e^{-x})$. The width of the nozzle is 70 mm, e height at the end face 20 mm, the length of the transcritical part is 40 mm. ixture with the required impact parameters (pressure p_0, temperature T_0) ıead of the nozzle was obtained behind a shock wave in a shock tube. The axis the resonator, made up of two spherical mirrors (diameter 40 mm, curva- re radius 2 m) was located at the point $x = 60$ mm. The duration and energy the lasing pulse were registered with a Ge–Au photoresistor (cooled with quid nitrogen) and with a calorimeter, respectively.

The experiments with the $CS_2 + CO + He$ mixtures revealed lasing in the range T_0 from 600 to 1800 °K and of p_0 from 2 to 20 atm. The CS_2 content in the ixture ranged from 1 to 10%, and the ratio of He to CS_2 from 5 to 25. Under milar conditions, there was no lasing in $CS_2 + N_2 + He$ mixtures. The duration of the lasing pulse varied, depending on T_0, in the range 0.3—0.4 msec. At $_{\textrm{,}} > 1400$ °K we observed decomposition of the carbon disulfide. For the mixture ; CS_2 + 30% CO + 65% He at $p_0 = 17 \pm 2$ atm we have $\tau \approx 3$ msec ($T_0 = 1420$ °K), ≈ 0.8 msec (1530 °K), or $\tau \approx 0.3$ msec (1800 °K). The maximum lasing power, W, was obtained with the mixtures 3% CS_2 + 57% CO + 40% He and 2% CS_2 ;8% CO + 30% He at $T_0 = 900 \pm 50$ °K and $p_0 = 9 \pm 0.5$ atm.

Lasing at a wavelength 11.5 μ was observed with the mixture 2% CS_2 + 68% CO 30% He ($T_0 \approx 600$ °K, $p \approx 5$ atm) with the reflectivity of each mirror not ex- ·eding 0.95. The gain of the medium in this case is therefore not less than $< 10^{-3}$ cm^{-1}.

Thus, the experimental investigations have confirmed the theoretical con- usions of[2].

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