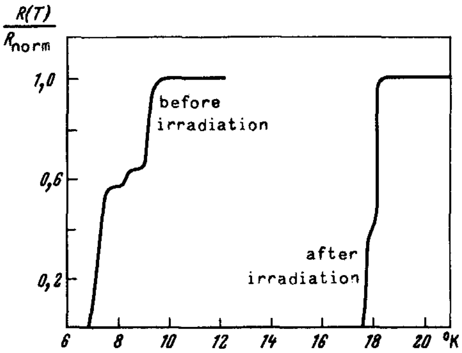
Different sections of the irradiated sample have different values of T_c with different critical fields.

The new state of matter obtained in the surface layer as a result of the action of the laser pulses on the sample surface is stable and is preserved at room temperature. The observe strong increase of T_c following laser irradiation cannot be attributed, within the framework of modern ideas concerning superconductors, solely to distortions of the crystal structure, to the appearance of point defects, etc. The nature of the observed phenomenon calls for further research.



Superconducting transition temperature of $Nb_{0.8}Sn_{0.2}$ before and after laser action

[1] Z. I. Mezokh, V. A. Yanushkevich, and L. I. Ivanov, Fizika i khimiya obrabotki materialov 4, 163 (1971).
[2] S. A. Metz and F. A. Smidt, Appl. Phys. Lett. 19, 207 (1971).
[3] G. G. Bondarenko, L. I. Ivanov, and V. A. Yanushkevich, Fizika i khimiya obrabotki materialov 4, 19 (1973).
[4] S. S. Avotin, E. P. Krivchikov, I. I. Papirov, M. I. Stoev, and V. I. Terenin, Zh. Eksp. Teor. Fiz. 62, 288 (1972) [Sov. Phys.-JETP 35, 155 (1972)].
[5] L. R. Testardi, Phys. Rev. B4, 2189 (1971).

EXPERIMENTAL STUDY OF GASDYNAMIC AMPLIFICATION OF N_2O-N_2-He LASER EMISSION

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Results are presented of gain measurements in a shock-heated ternary mixture (20% N_2O, 10% N_2, 70% He) escaping through a nozzle, at a distance 15 mm from the end face. The maximum gain is 1.15×10^{-2} cm^{-1} at a Mach number 2.75.

Amplification of infrared radiation in the 10.9 μ band was observed following adiabatic expansion, through a wedge-shaped nozzle, of a shock-heated mixture of nitrous oxide, nitrogen, and helium.

The feasibility of obtaining inverted population in vibrational levels having different relaxation times by adiabatic expansion of a gas mixture containing molecular gases, particularly CO_2-N_2 and N_2O-N_2, was suggested in [1 - 3].

The general ideas concerning the construction of gasdynamic lasers were formulated in [4, 5]. So far, a theoretical model of such a laser, using a CO_2-N_2 mixture, was developed in [2, 3, 6, 7]; experimental studies of this model were made in [8 - 12].

We have investigated experimentally the gain of laser radiation passing through a supersonic molecular stream of nitrous oxide. The gas escaped through a wedge-shaped nozzle into a receiver (nozzle aperture angle 30°, length of supersonic part 3.6 cm, critical-section dimensions 1.3×90 mm). The mixture (20% N_2O, 10% N_2, 70% He) was used. The mixture was heated in a shock tube behind a reflected shock wave, the incident wave having Mach numbers M from 2 to 3.5. The stagnation temperature was 1000 - 2200°K and the stagnation pressure 3 - 12 atm. The low-pressure chamber of the shock tube, of 98 mm diameter, was separated from the nozzle by an aluminum diaphragm. The pressure in the receiver was 10^{-2} Torr, and the initial pressure of the investigated mixture was 150 Torr, i.e., the gas escaped without back-pressure.

Figure 1 shows a two-pass system for measuring the gain (1 - flow-through electric-discharge N_2O cw laser, 2 - semitransparent silicon mirror, 3 - KCl window, 4 - flat rotary mirror, 5 - focusing lens, 6 - chopper modulating the laser beam, 7 - Ge-Au receiver). The receiver signal was fed to an S1-37 oscilloscope triggered by a synchronizing pickup P. The sounding eam of a single-mode N_2O laser was directed parallel to the larger dimension of the critical section and passed at a distance 15 cm from the nozzle end face.

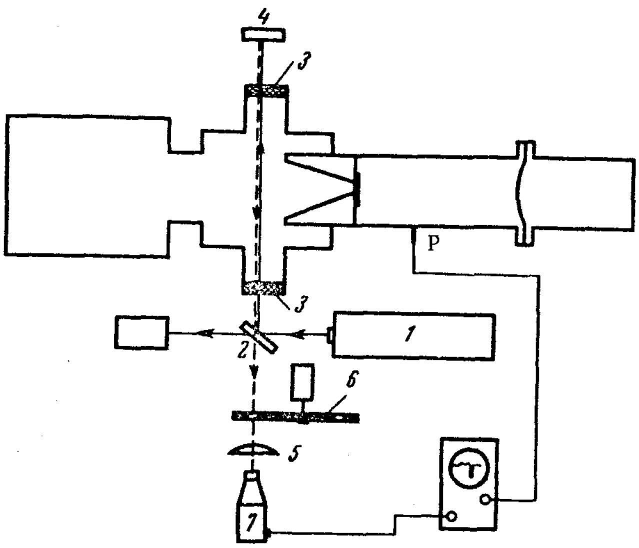

Fig. 1

Fig. 2

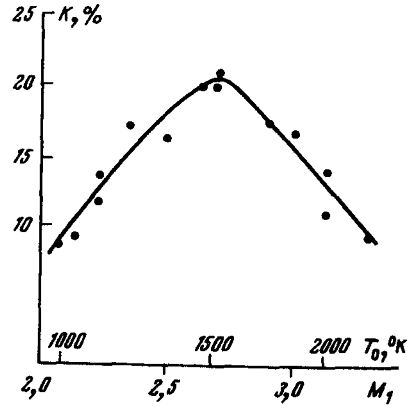

Fig. 3

Figure 2 shows a typical oscillogram (M = 2.7) of the signal obtained following the passage of laser radiation through a supersonic jet. The N_2O laser operated on the 00^01 - 10^00 transition. The upward and downward displacements of the beam relative to the initial sweep line correspond to amplification and absorption, respectively. Using a chopper (time interval Δt), the null position and the intensity I_0 of the incident radiation were determined with the laser beam blocked. The gain $k = \Delta T/I_0$ was determined from the measured increment of the transmitted-signal intensity.

Figure 3 shows a plot of the gain against the stagnation temperature. The maximum value is of the order of 21% (1.15×10^{-2} cm^{-1}) at $T_0 \sim 1500$°K. The gain measurement accuracy was 2.5%.

Raising the temperature from 1000 to 1500° increases the population difference of the asymmetric valence and deformation oscillations and increases the gain. With further increase of the temperature, a decrease of the gain is observed, probably because at these temperatures the lower laser level begins to become populated more rapidly than the upper one, and the degree of dissociation of the N_2O molecule increases.

The results of the investigations show that in the gasdynamic regime it is possible to obtain with N_2O molecules the same gain as with CO_2 molecules, amounting to $\sim1\times10^{-2}$ cm^{-1} according to theoretical [13] and experimental [10] estimates.

[1] V. K. Konyukhov and A. M. Prokhorov, Author's certificate (patent) No. 223954, priority 19 November 1966, Byull. izobr. No. 25, 1968.

[2] V. K. Konyukhov and A. M. Prokhorov, ZhETF Pis. Red. 3, 436 (1966) [JETP Lett. 3, 286 (1966)]

[3] N. G. Basov, A. N. Oraevskii, and V. A. Shcheglov, Zh. Tekh. Fiz. 37, 339 (1967) [Sov. Phys.- Tech. Phys. 12, 243 (1967)].

[4] N. G. Basov and A. N. Oraevskii, Zh. Eksp. Teor. Fiz. 44, 1742 (1963) [Sov. Phys.-JETP 17, 1171 (1963)].

[5] A. Hertzberg and I. R. Hurle, Bull. Am. Phys. Soc. 9, 582 (1964).

[6] N. G. Basov, V. Mikhailov, A. N. Oraevskii, and V. A. Shcheglov, Zh. Tekh. Fiz. 38, 2031 (1968) [Sov. Phys.-Tech. Phys. 13, 1630 (1969)].

[7] A. S. Biryukov, B. F. Gordiets, and L. A. Shelepin, Zh. Eksp. Teor. Fiz. 57, 585 (1969) [Sov. Phys.-JETP 30, 321 (1970)].

[8] V.K. Konyukhov, I.V. Matrosov, A.M. Prokhorov, D.T. Shalunov, and N.N. Shirokov, ZhETF Pis. Red. 10, 84 (1969) [JETP Lett. 10, 53 (1969)].

[9] D. M. Kuehn and D. J. Monson, Appl. Phys. Lett. 16, 48 (1970).
[10] A. P. Dronov, E. M. Kudryavtsev, N. N. Sobolev, and A. S. D'yakov, ZhETF Pis. Red. 11, 516 (1970) [JETP Lett. 11, 353 (1970)].
[11] V. K. Konyukhov, I. V. Matrosov, A. M. Prokhorov, D. T. Shalunov, and N. N. Shirokov, ibid. 12, 461 (1970) [12, 321 (1970)].
[12] G. V. Gembarzhevskii, N. A. Generalov, G. I. Kozlov, and D. I. Roitenburg, Zh. Eksp. Teor. Fiz. 62, 844 (1972) [Sov. Phys.-JETP 35, 447 (1972)].
[13] R. McLeary, IEEE J. QE 8, 716 (1972).

DETERMINATION OF TOTAL ηN INTERACTION CROSS SECTION IN η-MESON PHOTOPRODUCTION FROM COMPLEX NUCLEI

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The incoherent process $\gamma + A_i \rightarrow \eta + A_f$ from C, Cu, Ag, and Pb was investigated at a maximum bremsstrahlung beam energy $E_{\gamma\max} = 900$ MeV and at a c.m.s. η-meson emission angle $\theta^*_\eta = 90°$. The η mesons were detected by registering the two γ quanta from the $\eta \rightarrow 2\gamma$ decay. The total ηN-interaction cross section was determined by using the dependence of the η-meson yield from the nuclei on the mass number A and by using the optical model; it was found to be $\sigma^{tot}_{\eta N} = (66 \pm ^{29}_{20})$ mb.

We investigated the incoherent process

$$\gamma + A_i \rightarrow \eta + A_f, \tag{1}$$

where A_i and A_f are the initial and final nucleus, respectively. The measurements were made on the nuclei C, Cu, Ag, and Pb at a maximum bremstrahlung γ-quantum beam energy $E_{\gamma\max} = 900$ MeV and at an η-meson emission angle $\theta^*_\eta = 90°$ in the c.m.s. Under such kinematic conditions the contribution of the coherent η-meson production to the measured process (1) is negligibly small because of the large momentum transferred to the nucleus.

The η mesons were detected by their decay into two γ quanta with two total-absorption Cerenkov spectrometers [1]. The recoil nucleons were not detected. To separate process (1) with the subsequent $\eta \rightarrow 2\gamma$ decay from the background reaction, we used measurement procedure "outside the kinematics" [2]. The Monte Carlo method was used to calculate the registration efficiency and the angular and energy resolutions of the apparatus. Figure 1 shows the energy spectrum of the η mesons in comparison with the spectrum calculated by the Monte Carlo method.

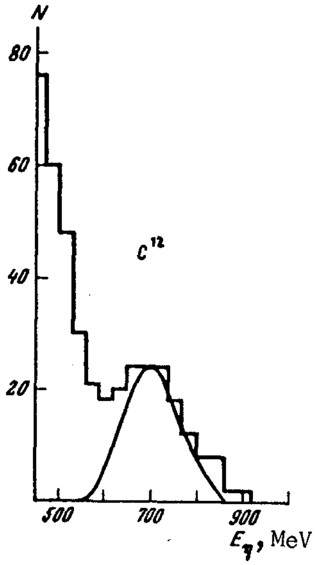

Fig. 1. Histogram - experimental spectrum obtained with C^{12}. Solid curve - η-meson energy distribution calculated by the Monte Carlo method with allowance for the energy resolution of the spectrometers.

In the quasifree approximation, the differential cross section for photoproduction of an η meson from a nucleus with mass number A can be expressed in the form [3]

$$d\sigma(A)/d\Omega_\eta = A(d\sigma/d\Omega_\eta)[1 - G(p)]\, f_A(\sigma^{tot}_{\eta N}). \tag{2}$$

Here $d\sigma/d\Omega_\eta$ is the differential cross section for photoproduction from a free nucleon, averaged over the momentum distribution of the nucleons in the nucleus, G(p) is the inelastic nuclear form factor, and $f_A(\sigma^{tot}_{\eta N})$ is a factor that takes into account the interaction between the η meson and the nucleons of the nucleus. According to the optical model, we can write for a uniform density distribution of the nucleons in the nucleus

$$f_A(\sigma^{tot}_{\eta N}) = (1/V)\int e^{-\ell(x)\rho\sigma^{tot}_{\eta N} k}\, d^3x, \tag{3}$$

where $\ell(x)$ is the length of the classical trajectory, V is the nuclear volume, $\sigma^{tot}_{\eta N}$ is