NARROW BAND N_2 LASER SYSTEM WITH VARIABLE WAVELENGTH IN THE VICINITY 337.1 NM

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A nitrogen laser-amplifier arrangement emitting narrow band (001—0.02 nm) light pulses with variable wavelengths are described. The divergence of the beam was nearly diffraction limited.

N_2 lasers as high-power ultraviolet light sources have a comprehensive application. But some applications, such as interferometry and DFB dye laser pumping, would be more advantageous a N_2 laser having narrower bandwidth than the present one ($\Delta\lambda \sim 0.1$ nm).

This paper describes an oscillator — amplifier arrangement emitting only narrow band (0.01—0.02 nm) light pulses with variable wavelengths.

Previously, oscillator-amplifier systems were employed to improve the following parameters of the N_2 laser beam: power [1, 2], divergence [1, 3] and stability [4]. As it had been demonstrated [4, 5], it was advantageous to use a transversely excited atmospheric pressure (TEA) nitrogen laser as oscillator, and a transversely excited low pressure (TE) laser tube as amplifier. This system combined the good properties of the two components: short pulse duration (1—1.5 ns), high power (1.5 MW), small instability (2%), low divergence (0.1 mrad $\times$0.5 mrad) [6].

Fig. 1. shows our experimental arrangement. In the first case, the divergence of the TEA laser beam was reduced by a quartz lens with a 1 m focal length at a distance of 1 m from the laser mirror. The holographic grating ($d^{-1}=3050$ lines/mm) worked in nearly auto-collimation arrangement with a grazing incidence ($\Theta=78°$). The direction of the dispersion was vertical, perpendicular to the plane of electrodes. If the wavelength of two spectrum lines differs from each other by $\Delta\lambda$, the amplifier will amplify only the one, if the following inequality exists:

$$\frac{D}{2l} < \frac{2\cdot\Delta\lambda}{d\cos\Theta} > \delta,$$

where D(5 mm) is the entrance aperture of the amplifier in the direction of dispersion, l(3.4 m) is the distance between the grating and the amplifier, and δ(0.5 mrad) is the divergence of the TEA laser beam emerging from the lens. In our arrangement, this inequality exists for the wavelength distance ($\sim$0.03 nm) of the neighbouring

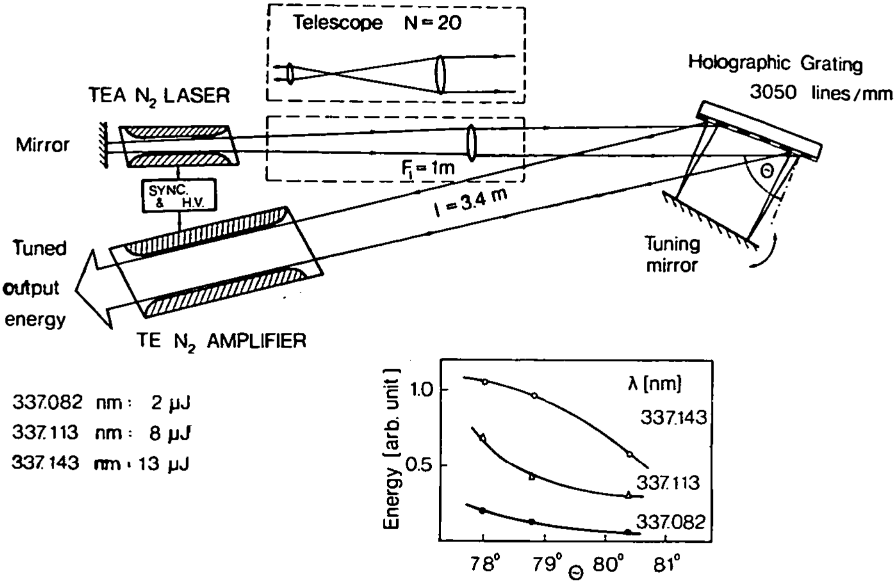

Fig. 1. Experimental arrangement with output energy, using lens (F_1), and output energy dependence on the incidence angle, using telescope (in the inset)

P_i branches. Fig. 2 shows the spectrum of N_2 laser at ~ 1 bar pressure [7] and the spectral bandwidth which was amplified. As only one of the P_1, P_2 or P_3 branches was amplified the spectral width of the output light was about 0.01 nm. The output energy for the different branches is displayed in Fig. 1.

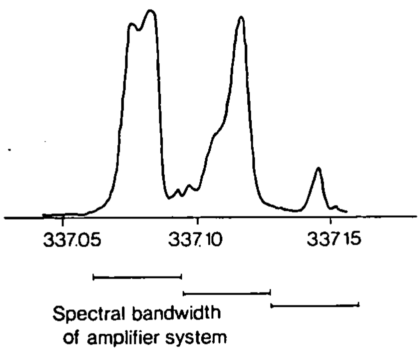

Fig. 2. Nitrogen laser spectrum, and the spectral bandwidth of the amplifier

In the second case, F_1 was replaced by a telescope with a magnification of $N=20$, so the divergence of the output beam was less than 0.1 mrad, nearly diffraction limited. Although the angle of incidence was increased, the fine structure of the branches could not be separated; on the other hand, the energy decreased fast (see the inset of Fig. 1.).

In conclusion, the separation and amplification of the main spectral lines of the nitrogen laser was brought about.

The use of the first arrangement was more favourable, because its spectral selectivity was high enough, and gave higher energy than the second one. The increase in output energy is allowed by the use of a second amplifying stage.

References

[1] *Nakamura, S., H. Mara, K. Umezu, H. Takuma:* Japan J. Appl. Phys. **15**, 2491 (1976).
[2] *Jitsuno, T.:* J. Phys. **D13** 1405 (1980).
[3] *Bergmann, E. E.:* Appl. Phys. Lett. **31**, 661 (1977).
[4] *Sánta, I., L. Kozma, S. Szatmári, B. Német and J. Hebling:* 4th Int. Conf. on Lasers and their Applications Leipzig, G.D.R. Oct. 19—23, p. 239 (1981).
[5] *Sánta, I., S. Szatmári, B. Német, J. Hebling:* Opt. Commun. **41** 59 (1982).
[6] *Kozma, L., I. Sánta, S. Szatmári:* XI. Natl. Conf. on Coherent and Nonlinear Optics, Yerevan, USSR, Nov. 22—25. p. 53 (1982).
[7] *Knyazev, I. N., V. S. Letokhov, V. G. Movshev:* Opt. Commun. **6**, 250 (1972).

УЗКОПОЛОСНАЯ ЛАЗЕРНАЯ СИСТЕМА НА АЗОТЕ С ПЕРЕСТРАИВАЕМОЙ ДЛИНОЙ ВОЛНЫ

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Описана лазерная система генератор-усилитель на молекулярном азоте, излучающая импульсы с узким перестраиваемым по длине волны спектром. Расходимость излучения была практически ограничена дифракционным пределом.