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GREEN LIGHT ORGANIC DYE LASER EXCITED BY FLASH LAMPS,(U)

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by

M. I. Dzyubenko, A. M. Korobov, I. G. Naumenko

FOREIGN TECHNOLOGY DIVISION

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	sinh^{-1}
cos	cos	ch	cosh	arc ch	cosh^{-1}
tg	tan	th	tanh	arc th	tanh^{-1}
ctg	cot	cth	coth	arc cth	coth^{-1}
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

GREEN LIGHT ORGANIC DYE LASER EXCITED BY FLASH LAMPS

Dzyubenko, M. I., Korobov, A. M., Naumenko, I. G.

Solutions of organic dyes, which have been studied extensively recently, make it possible to obtain intensive, easily tunable on frequency, narrow-beam coherent radiation.

However, there are certain difficulties connected with the use of these substances for lasers. The main difficulty is that the lifetime of organic molecules in an excited state is very short, therefore the duration, or if only the build-up front, of the pumping pulse should be of the same order [1].

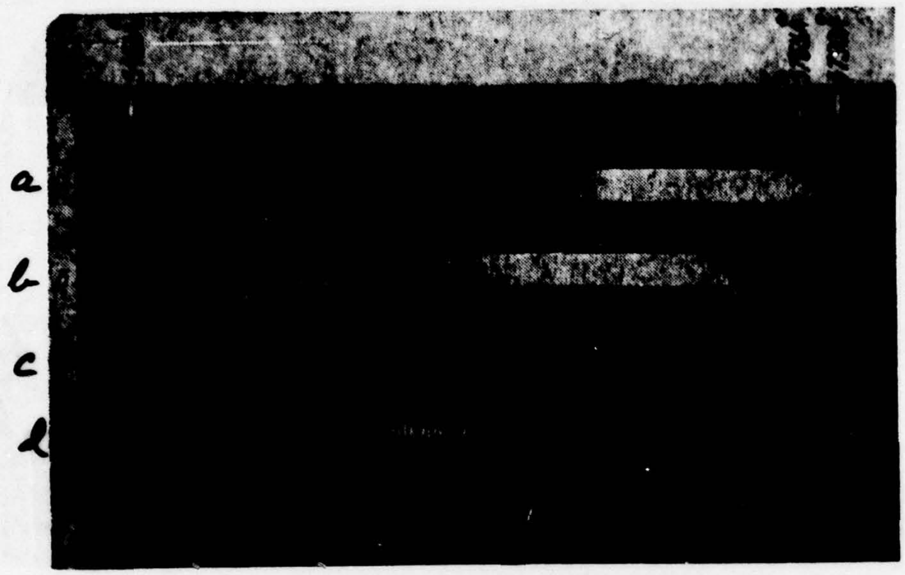
The first sources of pumping were solid-state ruby and neodymium lasers with modulated Q-factor [1, 2], and also their harmonics [3].

Later the pumping of organic dye lasers was done by a simpler and more effective method - by the non-monochromatic radiation of gas-discharge tubes [4-6]. However, in this case the radiation which was obtained was in the red and yellow ranges of the spectrum. For obtaining generation in the green and blue ranges it is necessary to use more powerful pumping pulses.

For this we used an arrangement of the discharge of a low-inductance capacitor through a vacuum discharger on two direct xenon tubes of the IFP-2000 type. In this case particular attention was given to lowering the inductance of the discharge circuit.

The overall duration of the light flash, as is known, is determined, first of all, by the duration of liberation of electrical energy in the discharge gap; secondly, by the duration of the afterglow of the heated plasma. Therefore main attention was given to shortening the duration of liberation of energy in the discharge gap.

As a result of the experiments which were conducted it was established that with an increase of voltage from 6 to 24 kV the period of the discharge is reduced from 3.8 to 2.1 μs, and the duration of the light pulse is increased from 1.15 to 1.4 μs, while the build-up front is reduced from 0.7 to 0.4 μs.



Spectra of generation of fluorescein solutions: a - $C=4\cdot10^{-4}$, b - $C=2\cdot10^{-4}$, c - $C=1\cdot10^{-4}$, d - $C=5\cdot10^{-5}$ moles/l.

Light pulses with such parameters were used to excite aqueous and alcohol solutions of sodium fluorescein, 9-aminoacridine, 4-methylumbelliferone, and certain other derivatives of coumarin which yield stimulated radiation following pumping of the second harmonics of a ruby laser. The solutions were poured into a cylindrical quartz cuvette (length - 160 mm, inner diameter - 5 mm) with precision-finished ends. Small glass windows were attached to the ends mechanically. Two outlets for the replacement of the solution were adhered to the side surface. The cuvette with the solution was placed between the lamps. For the more effective utilization of the radiation of the lamps a system with the so-called "dense" filling was used. The resonator of the generator was formed by flat extension mirrors which had dielectric coatings with a reflection coefficient in the band of luminescence of the investigated substance R_1=99.5% and R_2=99.5-30%.

Under these conditions it was possible to obtain generation on alcohol and aqueous solutions of fluorescein with a concentration of active molecules of $1.25 \cdot 10^{-5} - 6 \cdot 10^{-4}$ moles/l. The wavelength of generation in this case varied in the range of 5420-5810 Å (on the boundary of the radiation bands). The spectrum of radiation of a solution of fluorescein at different concentrations is shown in the figure. The energy of excitation was constant and comprised ~345 J. As can be seen from the figure, a wide band is radiated (width ~150-200 Å), and its position depends on concentration, Q-factor of the resonator, and the level of excitation [1, 2]. However, in all cases the band of generation of the solution in the case of excitation by flash lamps was found in the longer wavelength area of the spectrum than in the case of pumping by a giant laser pulse (average length of generation band equal to ~5200 Å, concentration - 5.10^{-4} moles/l). Apparently this can be explained by the difference in the power of excitation [7]. The threshold of generation comprised ~195 J for the optimal concentration (~10^{-4} moles/l), and the energy of radiation ~30 mJ (energy of excitation ~540 J). The divergence of radiation comprised ~10^{-3} rad.

We did not succeed in obtaining radiation in the blue area of the spectrum. Apparently more intensive pulses of excitation and with a higher rate of build-up are required for providing conditions of generation on solutions of substances which luminesce in the blue area. Possibly this requires the use of some new systems, or the further improvement of the arrangement described.

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