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RHODAMINE 6G-RESAZURIN ENERGY TRANSFER DYE LASER

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ABSTRACT

Efficiently operation of mixed dye system of Rh 6G-Resazurin of various concentrations with different ratios is shown. The tuning range of 90 nm at a pump power of N_2 laser of 50 Kw is achieved.

INTRODUCTION

Energy transfer in a proper mixture of dyes pumped by a N_2 laser is very efficient way for the improvement of dye laser efficiency and the extension of their tuning range. This is because of the high gain, which is the result of an enhancement life time of the sensitized acceptor [3], and the threshold pump intensity needed for direct excitation of the laser dye acceptor is lowered [2].

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This technique is especially suited to those dyes with absorption curves that are not well overlapped by the emission wavelengths of the pump laser.

In that case a dye (donor) is selected that absorbs at the pump wavelengths and emits near the (longer) absorption wavelength peak of the dye (acceptor) to be consequently pumped. By that way, in some cases, new laser materials which can only be excited by energy transfer were found. These new dyes are not easy to pump above threshold with the nitrogen laser either bacause their absorption coefficient at 337.1 nm is too low, or because the fluorescence quantum efficiency for the desired visible fluorescence when pumped by 337.1 nm radiation is too small. Rhodamine 6G-safranine-T paris has been shown [5] to lase using N_2 laser, which without energy transfer route lasing was unsuccessful.

Resazurin was tested to lase by previous workes [6] using flashlamp as a pump source, but was unsuccesful. Up to the authers available informations no reprots shows that Resazurin has been lased by direct or indirect way of pumping. In the present investigations, we have obtained laser action in Resazunin by the energy transfer techniques with Rhodamine 6G using a pulsed N_2 laser of 50 Kw peak power. The dye laser peak wavelengths has been studied as

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a function of the donor and acceptor ratios for different donor concentrations.

EXPERIMENTAL

The dye solutions were transversely excited and lased in superradiant mode by 337.1 nm radiation from a homemade [4] N_2 laser. The superradiant radiation output from the dye solutions was monitored with Jobin-Yvon H10 monochromator and detected by storage oscilloscope Tek. 466, through R446 Hemamatsu photomultiplier tube. The intensity of the dye laser as a function of the wavelengths was delineated for three fixed donor/acceptor ratios at different donor concentrations and fixed N_2 laser output power. Absorption spectra were measured using a Unicam SP8000 spectrophotometer and steady-state emission spectra were measured using a Shimadzu RF 510 spectrofluorometer. All dyes were used as supplied, without further purification. The Resazurin was purchased from Aldrich; assay 85%, Rhodamine 6G from Merck and absolute Ethanol from Merck.

RESULTS AND DISCUSSION

Fig. (1) shows the spectral distribution of the fluorescence emission spectrum of Rhodamine 6G which overlap the absorption spectrum of Resazurin. The use of Rhodamine 6G as energy donor enables a high lasing effici-

ency to be obtained in Resazurin. As stated before, a 50 Kw N_2 laser pump was sufficient to obtain this lasing. The concentrations effect of the donor (Rh 6G) on the lasing wavelength (λ_{max}) for different donor/acceptor ratios (D/A) is shown in Fig. (2). It can be shown from Fig. (2), that as the donor concentration, increases, (D/A = 3 → D/A = 7), the lasing wavelength (λ_{max}) of the acceptor largely shifts towards a shorter wavelength, i.e., blue shifted. This indicates that the gain enhancement of Resazurin due to the energy transfer occurs efficiently [1]. The extension to high concentration of the acceptor shows that efficient energy transfer excitation overcomes the losses arises in the high concentration region. Also, energy transfer dye laser system operates at low concentration of the acceptor. These effects practically extend the spectra region of operation. The dependence of λ_{max} on the concentration of the acceptor could be delineated from Fig. (2) and is given by Fig. (3). It could be seen that as the concentration of the acceptor increases the λ_{max} is red shifted. Moreover, within the experimental errors, the acceptor lasing wavelength λ_{max} is almostly independent of the donor concentration. Thus, most of the excitation energy absorbed by Rh 6G is transfered to Resazurin as a useful pump power making excitation transfer quite efficient.

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The maximum laser wavelength (λ_{max}) of Rh 6G-Rasazurin in the ETDL sustem of 672 nm is achieved at D/A = 3 and donor concentration of 12 x 10^{-3} M/L. Beside that a wide tuning band extends from 580 - 670 nm is realized at D/A = 7 and donor concentration of 2 x 10^{-2} M/L. During a period of continous excitation of some three houres, no perceptible degradation of laser activity occurred.

In conclusion, it is shown that Rh 6G-Resazurin pair is found suitable for energy transfer dye laser with wide tunability over the red band.

REFERENCES

1- Berlman I., Rokni M. and Goldschmidt C.R. Chem. Phys. Letters 2(1973) 458.

2- Burlamacchi P. and Gutter, opt. Commun. 22 (1977) 283. E. Weiss and S. Speiser Chemical Physics Letters 40 (1976) 220.

3- Lu P.Y., Xu Z.X., Alfano R.R. and Gerster J.I. Physical Review A 26 (1982) 3610.

4- Sabry M.M.F., Hassan A. and Ewaida M. J. Phys. E 17 (1984) 3.

5- Sebastian P.J. and Sathianandan opt. Commun. 32 (1980) 422.

6- Sorokin P.P., Lankard J.R., Moruzzi V.L. and Hammond E.C. J. Chem. Phys. 48 (1968) 1726.

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FIGURE CAPTIONS

Fig. 1: Absorption spectrum of Resazurin and fluorescence spectrum of Rh 6G. Resazurin concentration is 1×10^{-5}(m/1). Rh.6G.concentration is 1×10^{-5}(m/1).

Fig. 2: Dependence of λ_{max} on the donor concentrations for different donor/acceptor ratio of 3,5 and 7.

Fig. 3: Dependence of λ_{max} on the acceptor concentrations at 8,10 and 12×10^{-3} M/L donor concentration.

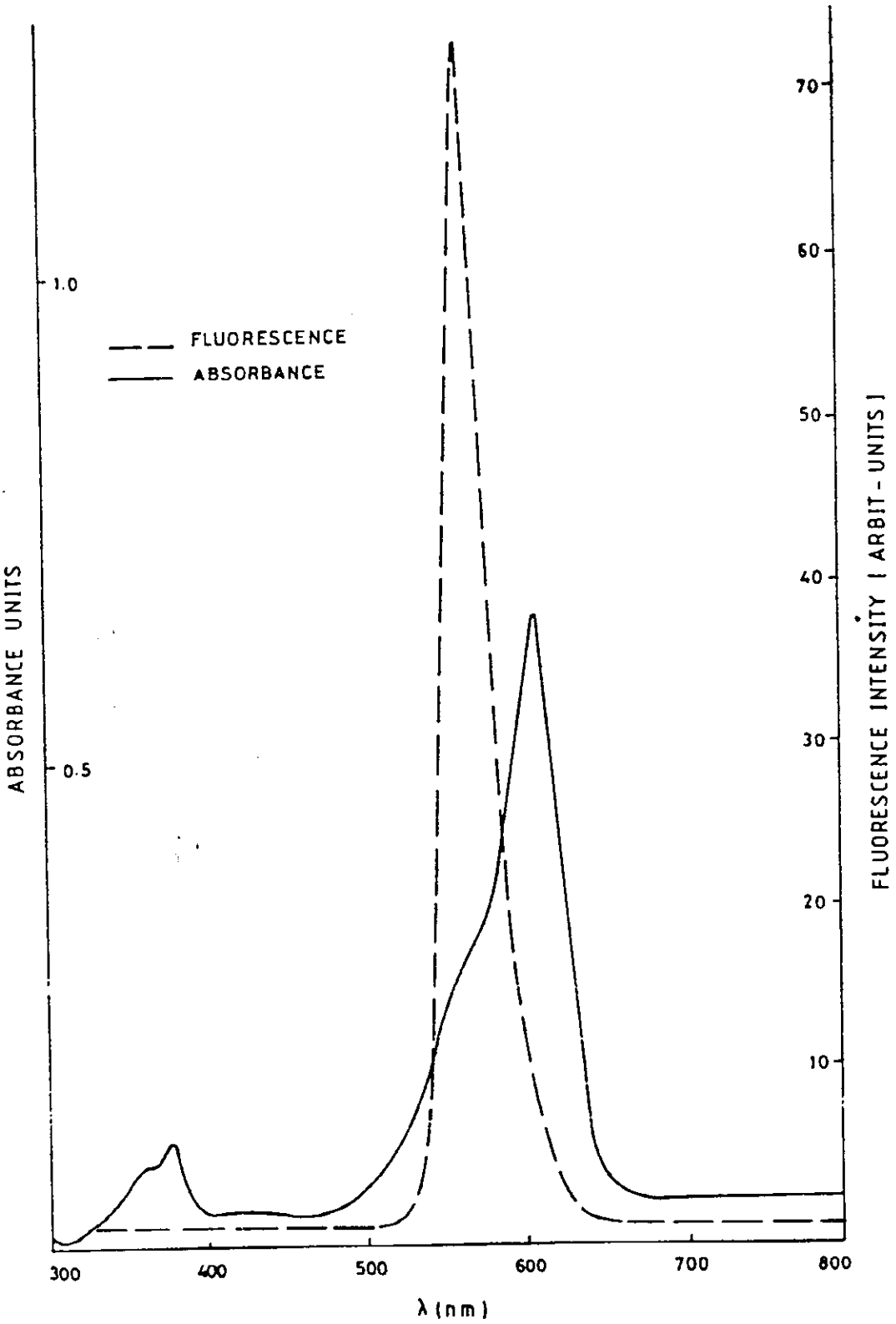
FLUORESCENCE
ABSORBANCE
ABSORBANCE UNITS
1.0
0.5
FLUORESCENCE INTENSITY (ARBIT - UNITS)
70
60
50
40
30
20
10
300
400
500
600
700
800
λ (nm)

Fig. 1

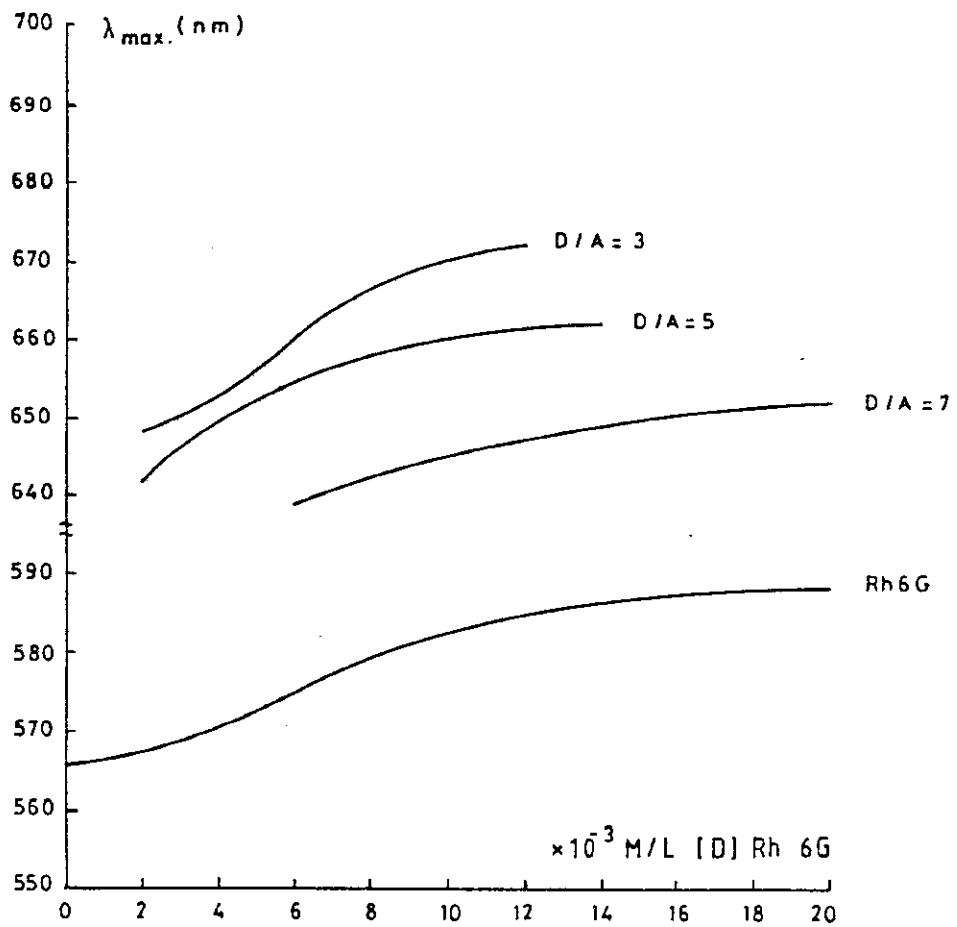
700
690
680
670
660
650
640
590
580
570
560
550
λmax. (nm)
D/A = 3
D/A = 5
D/A = 7
Rh6G
×10⁻³ M/L [D] Rh 6G
0
2
4
6
8
10
12
14
16
18
20

Fig. 2

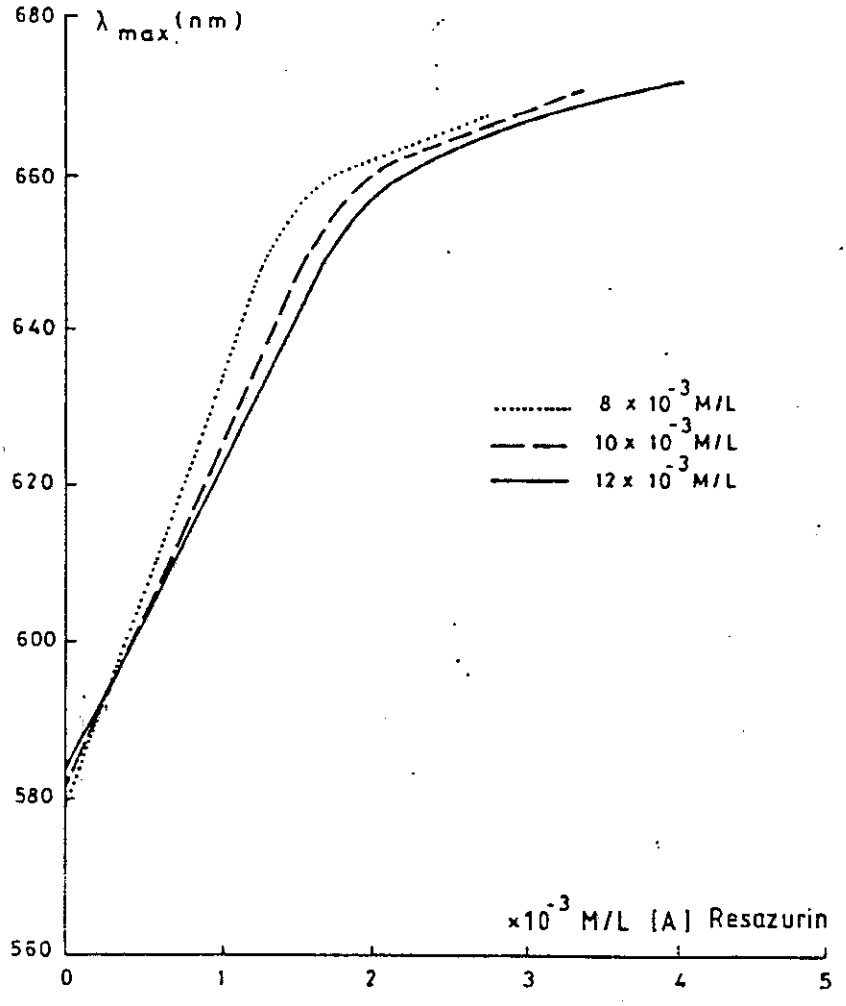
680
660
640
620
600
580
560
λ max (nm)
8 x 10⁻³ M/L
10 x 10⁻³ M/L
12 x 10⁻³ M/L
×10⁻³ M/L [A] Resazurin
0
1
2
3
4
5

Fig. 3

ليزر الأصباغ الناتج من مخلوط من رودامين ٦ج والروزازرين عن طريق انتقال الطاقة

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فى هذا البحث تم الحصول على أشعة الليزر فى مدى واسع عند خلط رودامين ٦ج الى صبغه الروزازرين وتم دراسة كفائة الاشعاع الليزرى عند تركيزات مختلفة لكل من الصبغتين وتم الحصول على مدى مقداره ٩٠ نانومتر عند استخدام ليزر النتروجين بقدره مقدارها حوالى ٥٠ كيلو وات ٠