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ENERGY TRANSFER RODAMINE B-RESAZURIN DYE LASER

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ABSTRACT

Resazurin has shown to lase in Rhodamine B-Resazurin pair by energy transfer (ET) mode. The tuning range of 95 nm at a pump power of 50 Kw by N_2 laser is achieved.

INTRODUCTION

For many problems in the field of atomic and molecular physics, tunable dye lasers are desired. So the intention was to search for efficient and stable dyes in the uv-vis and IR [2] with solubility in handy solvents and with broad tuning ranges. Some selected dyes can not be pumped directly by N_2 laser since its absorption curves are not well overlapped. Thus, the only possible route for pumping is to use energy transfer from another lased dye (donor) which can easily pumped by N_2 laser, such case the

fluorecence curve of the donor should overlaps the absorption curve of the acceptor to some extent. These mode of pumping improves the dye laser efficiency [9], since it increases the gain and thus lower the acceptor laser threshold [1].

Moreover, it extends the band of tunability. Several pairs of dyes has been proved to lase efficiently by this mode of excitation [7].

Resazurin was tested to lase by previous works [8] using flashlamp as a pump source but was unsuccessful. In the previous work [5], Resazurin was shown to lase efficiently, by energy transfer from Rhodamine 6G, with wide band of wavelengths. In the present work, Rhodamine B is used to act as a donor of energy to Resazurin. This is because the absorption curve of Resazurin is well overlapped by the fluorescence curve of Rhodamine B. This means that energy transfer would be more efficient, where the critical separation of donor/acceptor molecules (R_o) is about four times than that with Rh 6G/Resazurin, It is worth to mention that (R_o) is just the strength of interaction between the donor/acceptor molecules, which can be expressed in terms of the overlapping integral of the emission spectrum of the donor and absorption spectrum of acceptor [4].

Delta J.Sci. 12 (2)1988
F.M. El-Mekawey and M.M.F. Sabry

The dye laser peak wavelength has been studied as a function of the donor/acceptor ratio at different donor concentration.

EXPERIMENTAL

Rhodamine B(BDH) and Resazurin from Aldrich; assay 85%, were used as supplied from manufactures. Absolute Ethanol (Merck) was used as a solvent. The dye solutions of RhB and Resazurin were transversely excited with a N_2 laser bulit in the lab [6], with out put peak power of 50 Kw. The superradiant laser output from the dye laser solution was monitored with Jobin-Yvon H 10 monochromator and detected with R 446 Hamamatsu photomultiplier tube and storage oscilloscope Tek, 466 to measure the relative lasing intensities. PYE UNICAM SP 8-100 uv/vis spectrophotometer was used to obtain the absorption spectrum of Resazurin and is given in Fig. (1), along with the emission spectrum of Rhodamine B. The laser peak wavelengths (λ_{max}) has been drown at different donor/acceptor ratios as a function of donor concentration are given in Fig. (2).

RESULTS AND DISCUSSION

Fig. (1), shows an overlap between the fluorescence emission spectrum of Rhodamine B and the absorption spectrum of Resazurin. Since the strength of interaction between the donor and acceptor molecules efficiently

increases with increasing the overlaping area between the emission spectrum of the donor and absorption spectrum of acceptor. Thus an efficient energy transfer Rh B-Resazurin dye laser would be expected.

The lasing maximum wavelength (λ_{max}) as a function of the donor concentration for different donor/acceptor ratios is shown in figure (2). It can be seen that λ_{max} is red shifted with increasing the donor concentration for aconstant donor/acceptor ratio. This is due to the increasing of the acceptor concentration since the lasing wavelength, λ_{max}, in such donor/acceptor pairs has been shown to depend on the concentration of the acceptor [3]. Moreover, as the donor/acceptor ratio increases, the lasing wavelength of the acceptor largely shifts towards a shorter wavelength, i.e. blue shifted. This indicates that the gain is enhanced as the donor concentration increases [10].

In addition to these characteristics, it can be seen from figure (3), that at acceptor concentration below 2.85×10^{-3} M/1. The λ_{max} increases with increasing the donor concentration from $6\text{-}14 \times 10^{-3}$ M/1, but over that value the λ_{max} decreases. This could be interpret by the gain enhancement at that acceptor concentration for different donor concentrations. More detailed invesigations are neccessary to clearify that behaviour: The widest tuning

range achieved by such pair is 95 nm with donor/acceptor ratio of 7 at donor concentration of $12x10^{-3}$ M/1.

In conclusion, from there properties the RhB/Resazurin convenient laser source in the Red region.

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Delta J.Sci. 12 (2)1988

F.M. El-Mekawey and M.M.F. Sabry

FIGURE CAPTIONS

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

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

Fig. 3: Dependence of λ_{max} on the acceptor concentrations.

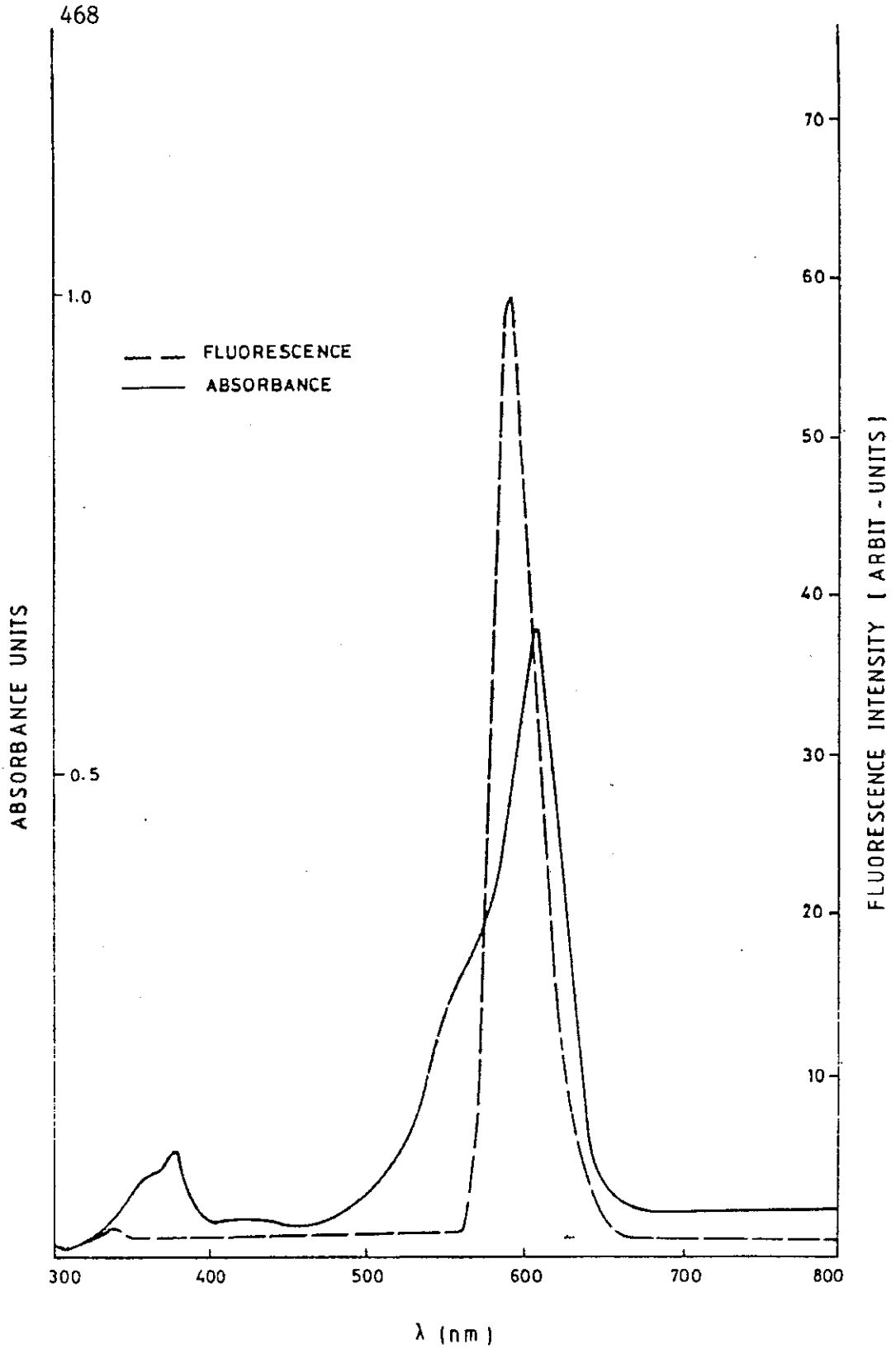
468
FLUORESCENCE
ABSORBANCE
ABSORBANCE UNITS
1.0
0.5
FLUORESCENCE INTENSITY (ARBIT - UNITS)
70
60
50
40
30
20
10
300
400
500
600
700
800
λ (nm)

Fig. 1

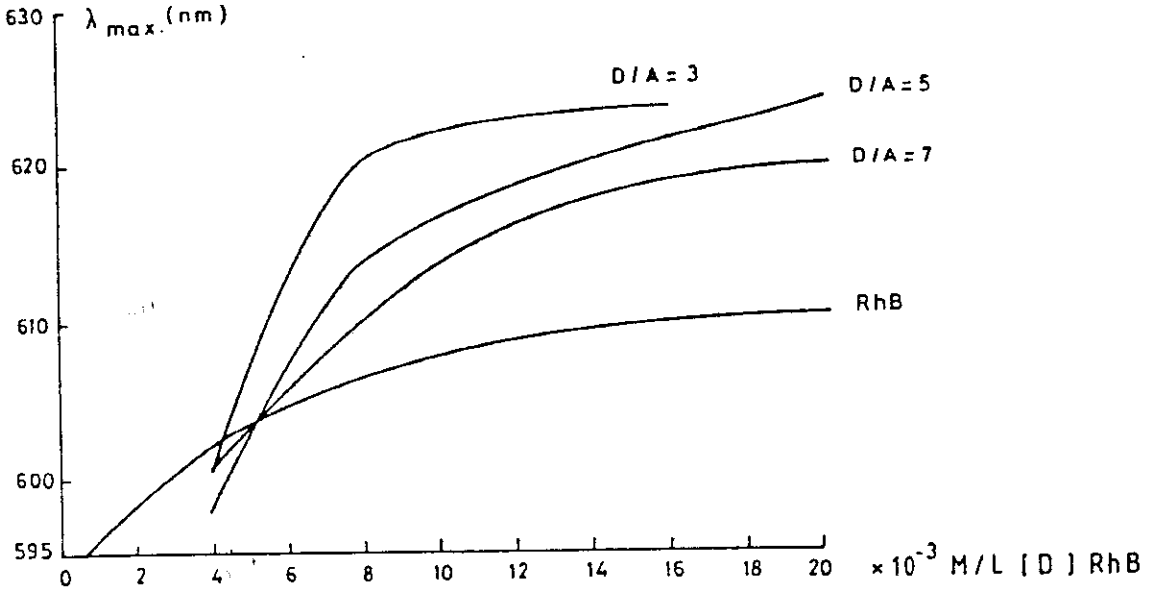
630
620
610
600
595
λ max. (nm)
D/A = 3
D/A = 5
D/A = 7
RhB
0
2
4
6
8
10
12
14
16
18
20
× 10⁻³ M/L [D] RhB

Fig. 2

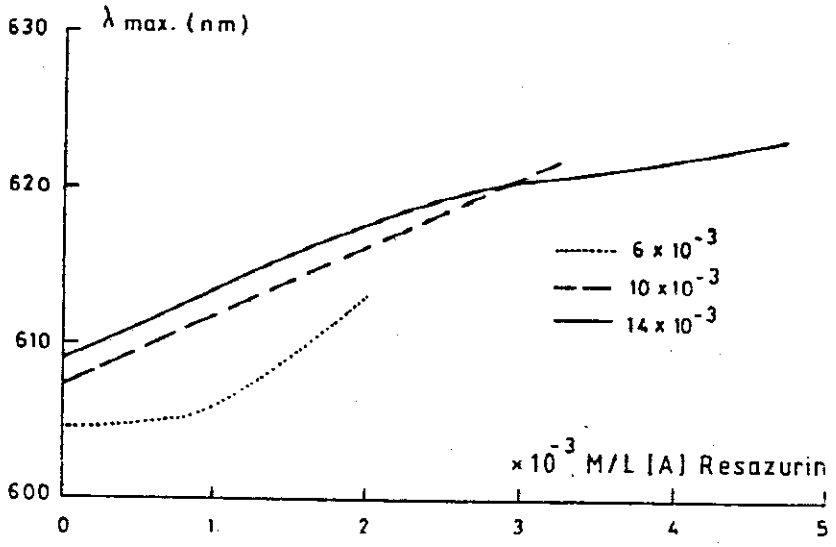
λ max. (nm)
630
620
610
600
0
1
2
3
4
5
6 x 10⁻³
10 x 10⁻³
14 x 10⁻³
x 10⁻³ M/L [A] Resazurin

Fig. 3

الاشعاع الليزرى من مخلوط أصباغ الروزازورين والرودامين B عن طريق انتقال الطاقة من الرودامين B الى الروزازورين

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لقد تم الحصول على أشعة الليزر عن خلط صبغه الروزازورين بصبغه الرودامين B عن طريق انتقال الطاقة اليها وتم دراسة الاشعاع الليزرى مع تركيز كل من الصبغتين وكذلك نسبة كل منهما ولقد وجد أن مدى الاشعاع الطيفى يصل الى ٩٥ نانومتر عندما تكون قدرة ليزر النتروجين المستخدم حوالى ٥٠ كيلووات.