Effect of Concentration on Absorption and Fluorescence for Eosin y in Methanol

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Abstract

In the present work, Studying effect of concentration on the absorption and fluorescence spectra of eosin y in methanol in different concentration like $1x10^{-2}$, $0.5\ x10^{-2}$,…. , $1x10^{-5}$ mol/liter, and afterward measure the absorptions spectra to this concentration like ($\lambda_{abs.}$=521nm) for concentration ($1x10^{-5}$ M) and (513 nm) for concentration ($1x10^{-4}$ M) and also measure the fluorescence spectra like (582 nm) , (573 nm) (560 nm) (550nm), and also measure some photophysical parameters such as molar coefficient and oscillator strength and fluorescence coefficient , after that obtain increasing to the $\lambda_{fluo.}$ for different concentration and measure the $\lambda_{abs.}$, by uv –vis Absorption and $\lambda_{fluo.}$ measure by using fluorometer spectropoto.

1-1.Introduction

A dye laser is a laser which uses an organic laser dye active medium, visually as a liquid solution. An organic dyes can usually be used because of wide band width of fluorescence spectrum that is suitable for tunable lasers [1].

Organic dyes of xanthenes family have been extensively used as medium for tunable dye lasers with tunability over arange of wavelength.

One of this xanthenes dye is eosin y that is emitting in the visible region of electro magnetic spectrum. It is an anionic fluorescent dye it is tetra bromo fluorescein in sodium salt [2, 3]. This dye is used Medicine, Biological, Cosmetics, Drugs, Paper, Varnish and other application on [4, 5]. A variety of experimental technique have been employed for under standing the lasing and potophysical properties of the dye. Potophysical properties of xanthene dyes include absorption and fluorescence affected by many effects such as concentration of dye solution , solvent effects and temperature, [6-9].

Gangulyetal [3] showed that eosin y in a gaseous solution exhibit a maximum absorption at 520 nm and maximum emission at 560 nm , and the $\lambda_{max.}$ shifts to the red and the intensitiy of absorbance and Fluorescence increases when added ProH to an aqueous solution. And the absorption spectrum of fluorescence in methanol at room temperature we calculated (518 nm) and in water (490 nm) and compared it with eosin y in methanol at same temperature and there is a good similarity between them[10].

In this present work effect of concentration on the absorption and fluorescence spectra was investigated.

2.Experimental Work

a.Materials

In this work using eosin y, it is a fluorescent red dye laser and it is form of eosin which consider as fluorescein derivatives . Also it is known as eosin y ellowish oracid red 87 tetra bromo [2,3].

The chemical form eosin y is $C_{20}H_6Br_4O_5Na_2$ and its molecular weight is 691.9gm/mol [2,4].The chemical Structure of eosin y dye is shown in Fig (1)[2,4].

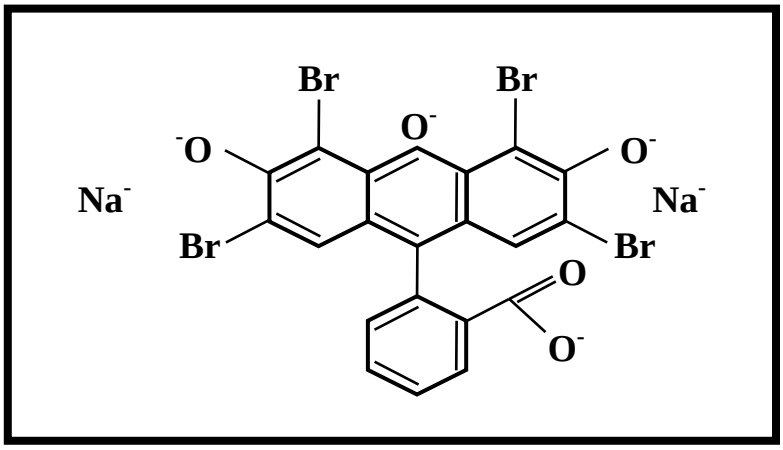


Fig (1): The chemical structure of eosin y dye [2, 4].

The solvent was used Methanol. It is chemical form CH3-OH molecular weight 32.04 gm/ mole an it is a colorlessly gyroscopic liquid usually containing 0.01-0.04% water. It is highly in flammable and toxic [5].

b.Preparation of Dye Solution

To prepare the dye solution of ascertain concentration was dissolved the proper amount of dye power in a certain volume of solvent used in accordance with this relation ship.

$$W = C * V * M_w$$

Where m: is the weight to the dye needed to obtain the desired concentration in (gm).

C: is the concentration needed to prepare in mol/ litter.

V: is the Volume of solvent in litter necessary to add to dye.

M_w: is the molecular weight of dye used the concentration of eosin y in Methanol

C.Equipment Work

The fluorescence spectrum emitted from eosin y in methanol were recorded by fluorescence spectrophotometer type:

J A Sco Model FP- 770 SHIMADZU
Spectrofluorometer

Also absorption spectrum for these solution were measured by UV- visible Absorption spectrophoto meter type: **CARY 100 conc,** UV –visible Spectrophotometer VARIAN

EL 04113001

3. Theoretical Part

In this work using some equation like it is stokes shift $\Delta\upsilon = \upsilon_{flv} - \upsilon_{abs} \geq 0$ it is the wavelength difference between absorption (excitation) and fluorescence (emission) maximum. And also used bandwidth:

$$\Delta\upsilon_{1/2} = \frac{1}{\lambda_{1/2}} \quad [9] \quad (\text{nm}^{-1})$$

was calculated by measuring abs. spectral at half maximum of absorbance where λ it is wavelength of absorption and also used the molcr extinction coefficient .

$$\varepsilon(\lambda) = \frac{A}{Lc} \; in(M^{-1}cm^{-1}) \; [9]$$

Where *A*: is the absorption at the peak wave length of the absorption spectra.

L: is the path length of the dye solution medium in (cm)

C: is the molar concentration of dye in (mol/liter) and also used oscillator strengthen in liter/mol.

It is mean the intensity of an electronic or veronica absorptions transition is defined as:

$$f = 4.33\times10^{-33}\times\varepsilon(\lambda)\times\Delta\upsilon_{1/2} \quad [9]$$

4.Results and Discussion

In this work measured the absorption spectrum and obtain, and compare this results with other results like eosin y in methanol (518nm) and in water (490 nm), and this measurement as shown in the fig (2).

Concentration (Mol)	Peak of Wavelength to (nm) Absorption Spectrum
$1x10^{-5}$	521
$1x10^{-4}$	504
$0.5x10^{-4}$	518

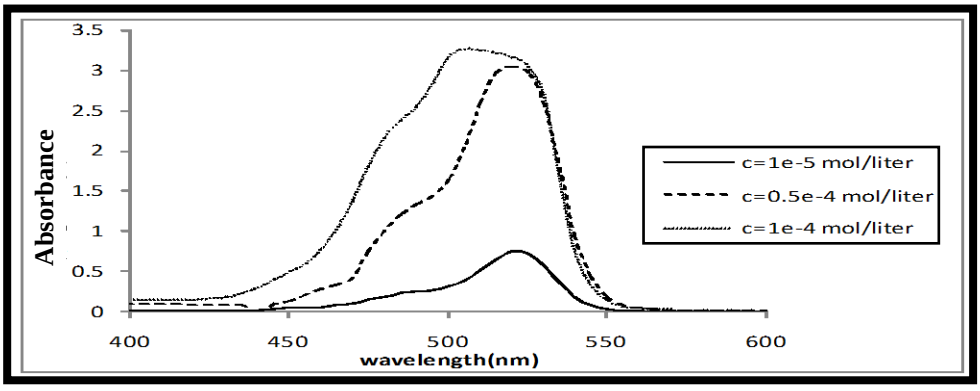


Fig. (2): Absorption spectrum for eosin y in Methanol in different concentration.

The eosin y was supplied sigmachemicals this was crystamized twice from methanol and ethanol this dyes was checked by absorption and fluorescen spectra, the effect of concentration of focus where the abs option spectrum is subject to Beer-Lambert law:

After that the absorption spectrum does not depend on the concentration where the in concentration lead to make aggregation and thus making the cross-sections for absorption is depending on concentration and thus deviate from the Beer-Lambert law. And the methanol solvent is a polar, and portico solvent and it is an ideal solvent for visible pumped dye laser like eosin y .

Concentration mol/liter	**Stokes shift $cm^{-1}x10^{-7}$**	**$\varepsilon(\lambda)$ $mol^{-1}cm^{-1}$**	**$\Delta\upsilon_{1/2}$ nm^{-1}**	**f $L/mol.cm^2$**
$0.5x10^{-5}$	0.000128	$5.0x10^{4}$	0.025	$2.2x10^{-45}$
$1x10^{-4}$	0.000164	$7.5x10^{4}$	0.061	$1.981x10^{-44}$
$1x10^{-5}$	0.000101	$3.2x10^{4}$	0.061	$6.5x10^{-45}$

Table (1) photophysical parameter of the dye in methanol solution.

From table (1) showing that stokes shift increase with increase of concentration mean that $\lambda_{fluo.}$ as shown in figs.(3,4,5) increase with concentration and this increasing in λ useful for tuning dye laser without using any tools.

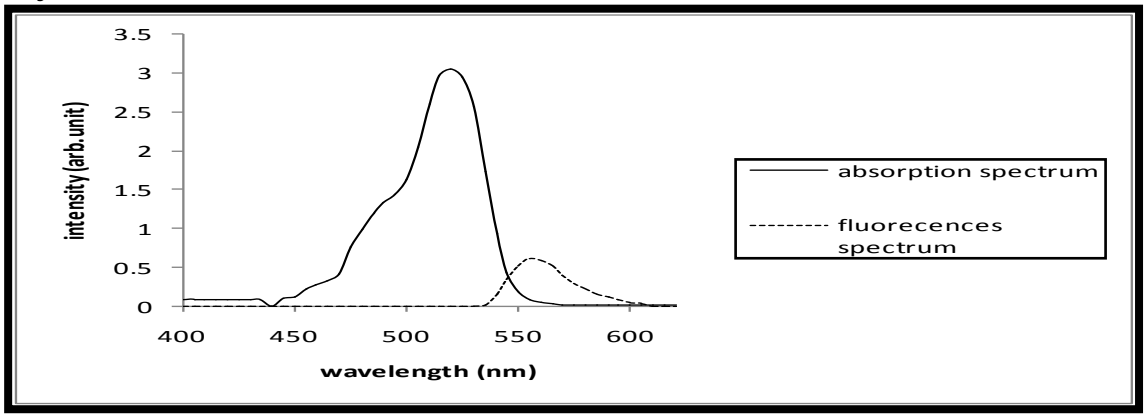


Fig.(3): Absorption and fluorescence spectra for $C=0.5x10^{-5}$mol/liter for eosin y solution in Methanol.

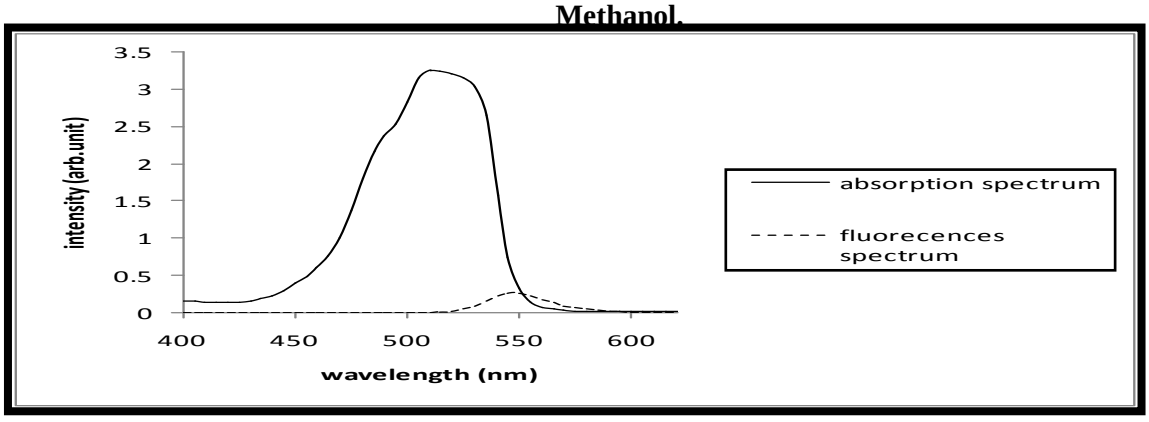


Fig.(4): Absorption and fluorescence spectra for $C=1x10^{-4}$mol/liter for eosin y solution in Methanol.

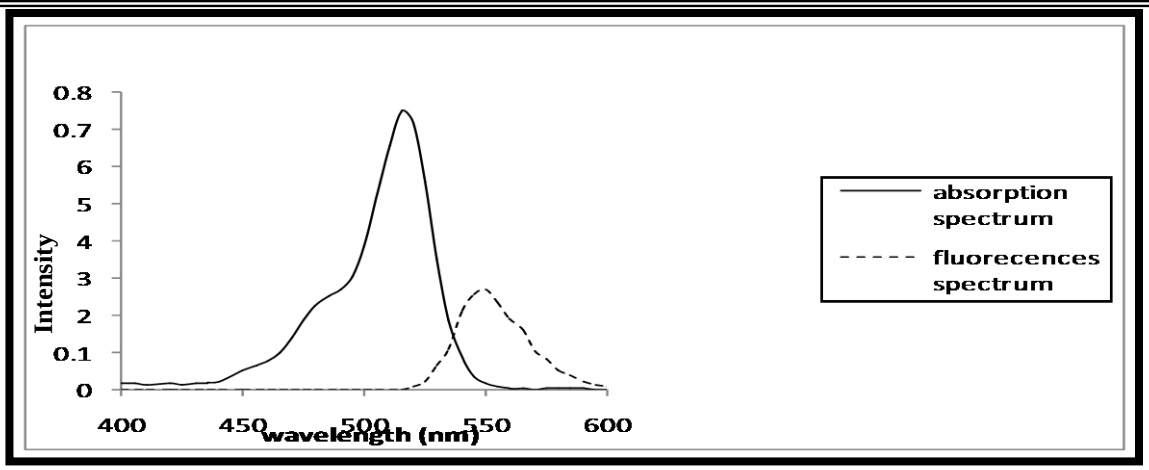


Fig. (5): Absorption and fluorescence spectra for C=1x10^{-5}mol/liter for eosin y solution in Methanol.

a. Resultant Fluorescence's Spectra

About fluorescence spectrum for eosin y in Methanol it is show in table (2), it is clear

Table (2) Fluorescence's spectrum parameter for eosin y in methanol .

Concentration Mol	$\lambda_{fluo.}$(nm)	$kf = \frac{I_f}{c} mol^{-1}$
1×10^{-2}	582	5.26
1×10^{-3}	573	19.3
1×10^{-4}	560	2640
1×10^{-5}	550	26300
0.5×10^{-2}	580	56.4
0.5×10^{-3}	570	92.6
0.5×10^{-4}	560	12340

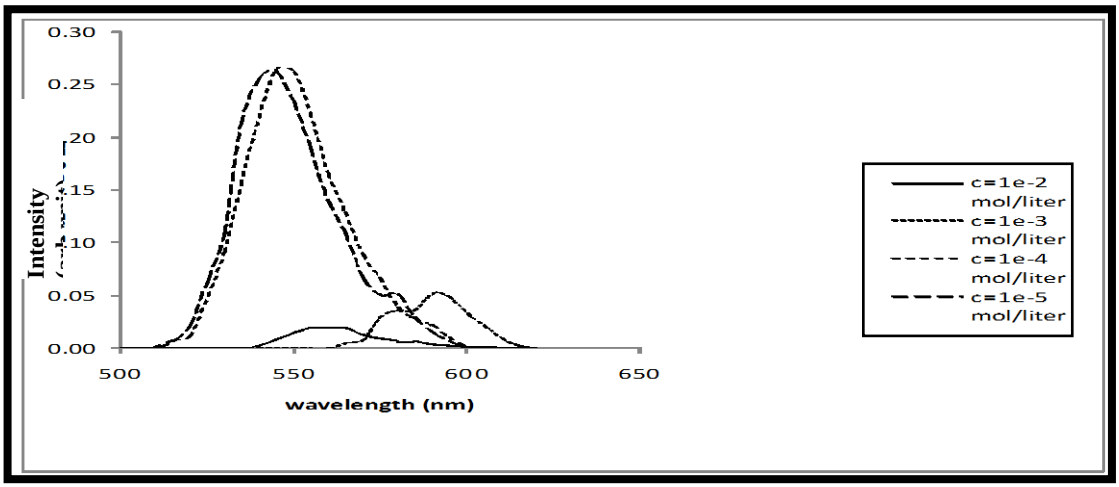
that $\lambda_{fluo.}$ increase with increase of concentration and it is shown in the fig. (6a,b) ,and the fluorescence parameters are calculated as follows and shown in table(2).

$$k_f = \frac{I_f}{c}$$

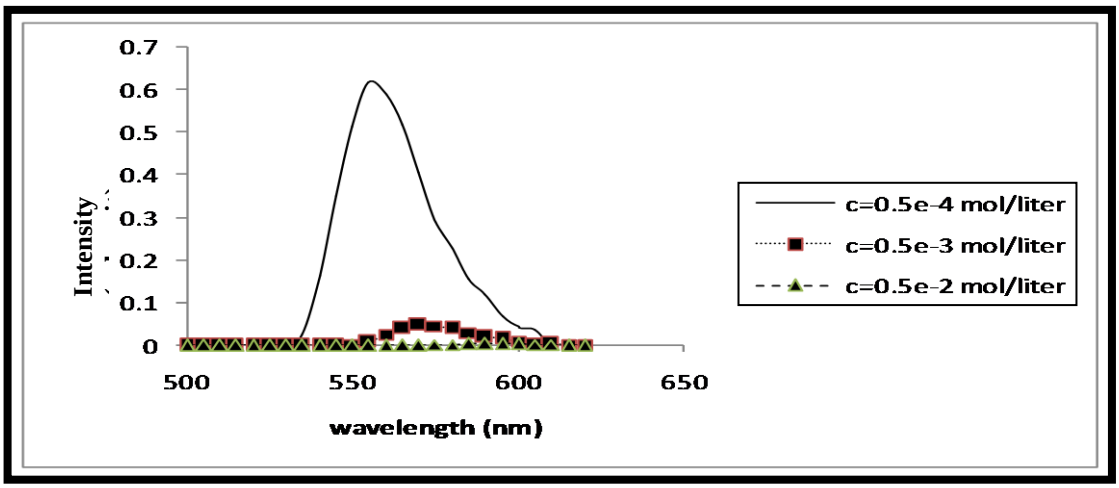
where k_f : it is the empirical fluorescence coefficient [4] .

I_f: Fluorescence intensity (arb.unint).

c: concentration in mol/litter.



(a)



(b)

Fig. (6 a,b): Fluorescence spectrum for Eosin y in Methanol in different concentration.

b. Discussion of Fluorescence Spectra

The effect of concentration on the florescence spectrum for eosin y solution in methanol were studied for different concentration C = (10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 0.5×10^{-2} , 0.5×10^{-3} , 0.5×10^{-4}) as shown in the fig (2). We find that the peat of wave length of florescence spectrum increase with increasing of concentration.

This fluorescence spectrum is subject to substantial changes with concentration changes the small increase in concentration produces a little decrease in intensity in dilute solution while at high concentration where the dimmer will be sensitive , the peak wavlength for eosin y increase with concentration and in very high concentrated solution as shown in fig.(7), the increase in peak wavelength with concentration will be very small and these changes are attributed to the increase of quenching arising from the monomer in dilute solution . The increase of peak wavelength of fluorescence spectrum cause by separation of dimmer. The stability of trimmerrespect to dimmer explains the little increase of peak wavelength of fluorescence spectrum with concentration.

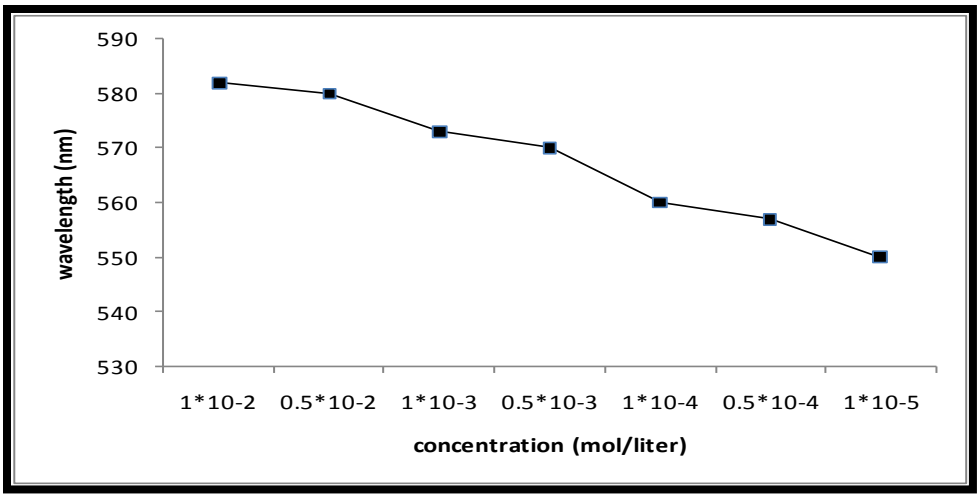


Fig. (7): The relation between concentration of Eosin y solution in Methanol and wavelength of fluorescence.

5. Conclusion

In this work we show that increasing of $\lambda_{fluo.}$ with increasing of concentration for eosin y in methanol and after this measurements that increasing useful in tuning for dye laser without using any other tools, because the shift in wavelength for UV. wavelength useful in tuning for dye laser .

6-1 References

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تأثير التركيز eosin y في الميثانول
على الامتصاص والفلورة

الخلاصة :

في البحث الحالي تم دراسة تأثير التركيز على الامتصاصية والفلورة eosin y في الميثانول لتراكيز مختلفة ١*١٠^-٢ ، $0.5*10^{-2}$ ، $1*10^{-3}$ ، $1*10^{-4}$ ، $0.51*10^{-4}$ ، $1*10^{-5}$ مول /لتر ، وفي ما بعد قياس اطياف الامتصاص لتلك التراكيز مثل الطول الموجي للمتصاص 521 نانو متر لتركيز 10*1 مولاري والطول الموجي للامتصاص 513 نانو متر لتركيز 10*1 مولاري وايضا قياس العديد من المعلمات البصرية مثل معامل المولرية وقوة المهتز ومعمل الفلورة بعد احراز الزيادة بالطو الموجي للفلورة لتراكيز مختلفة وقياس الطول الموجي للامتصاص بالمنطقة فوق البنفسجية والمرئية حيث ان الامتصاصية والطول الموجي للفلورة قيست لاستخدام مقياس الطيف.