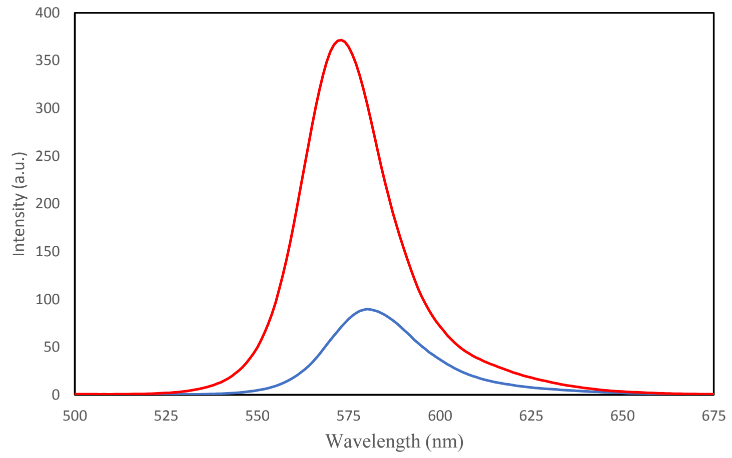

Fig. (8) The comparison between fluorescence spectra for Rhodamine dye dissolved in water and ethanol at 350nm excitation wavelength

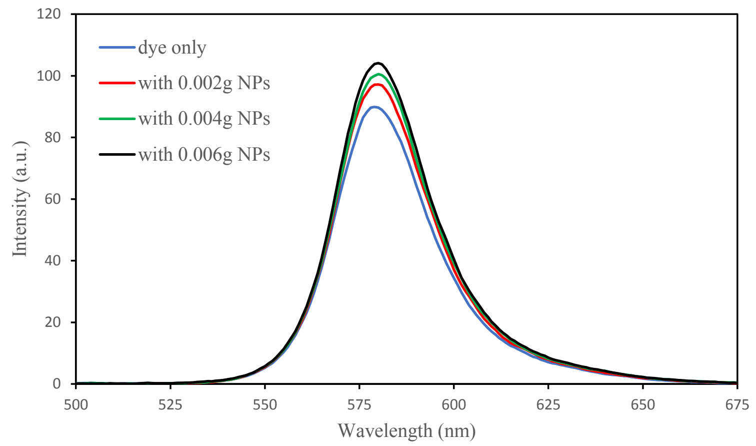

Fig. (9) Fluorescence spectra of Rhodamine B dye dissolved in water at 10^{-5} M concentration (with SiO_2 NPs)

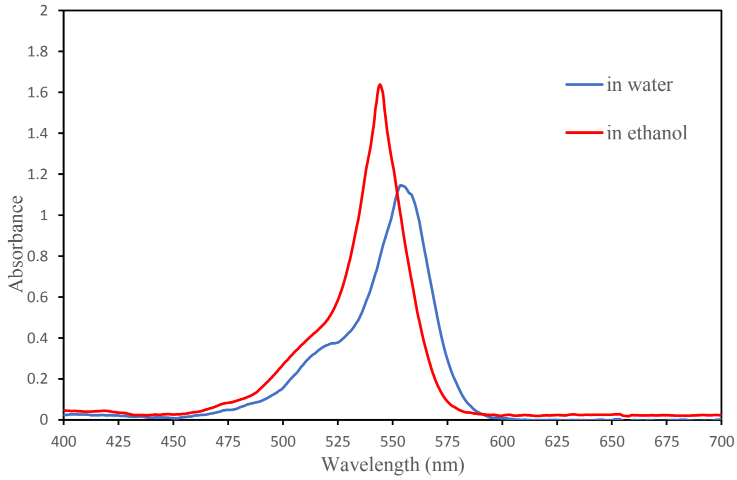

Fig. (5) The comparison the absorption spectra for Rhodamine B between water and ethanol at 10^{-5} concentration of both

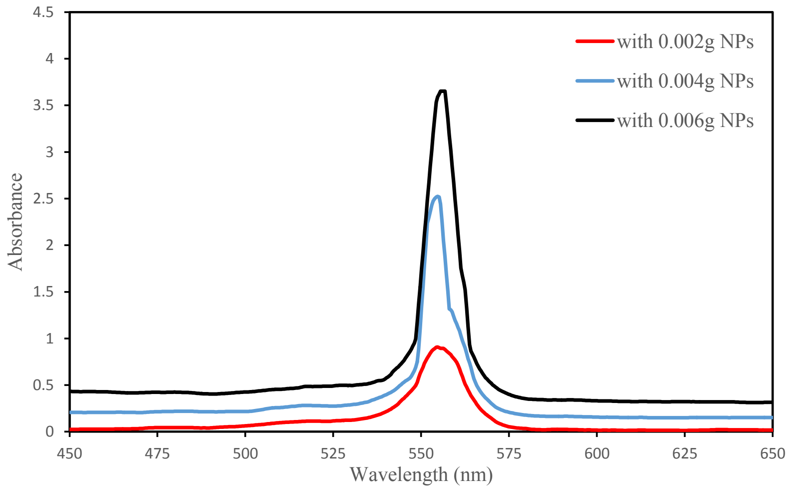

Fig. (6) The absorption spectra of 10^{-5} M Rhodamine B dye solution with different amounts of SiO_2 nanoparticles

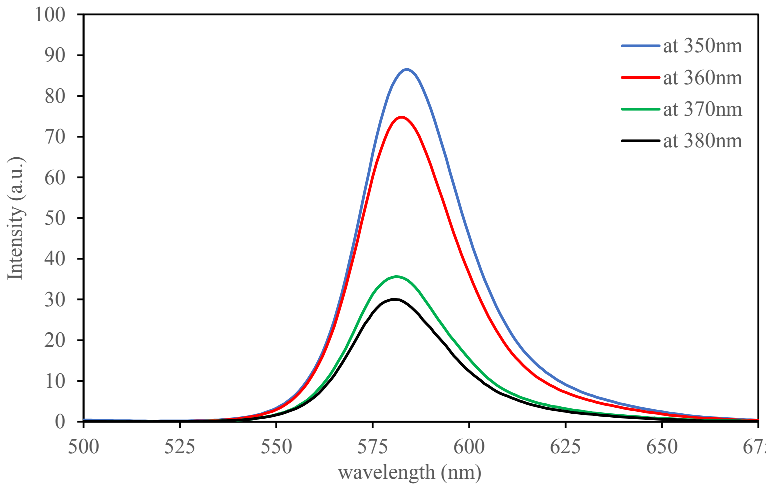

Fig. (7) Effect of excitation wavelength on fluorescence spectra of Rhodamine dye at 10^{-5} M concentration dissolved in water

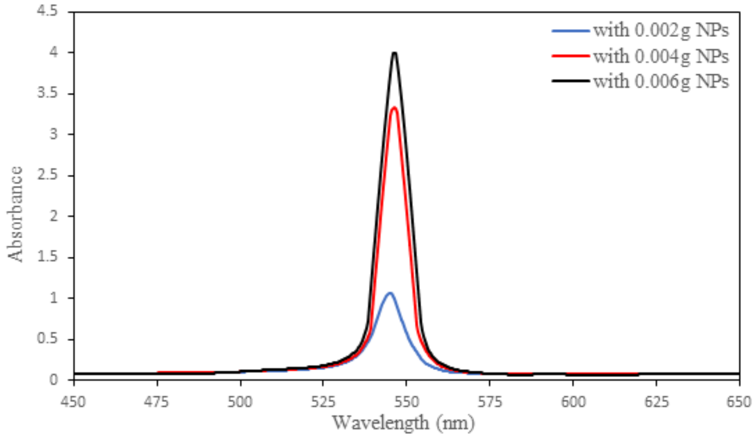

Fig. (2) The absorption spectra of 10^{-5} M Rhodamine B dye solution with different amounts of SiO_2 nanoparticles

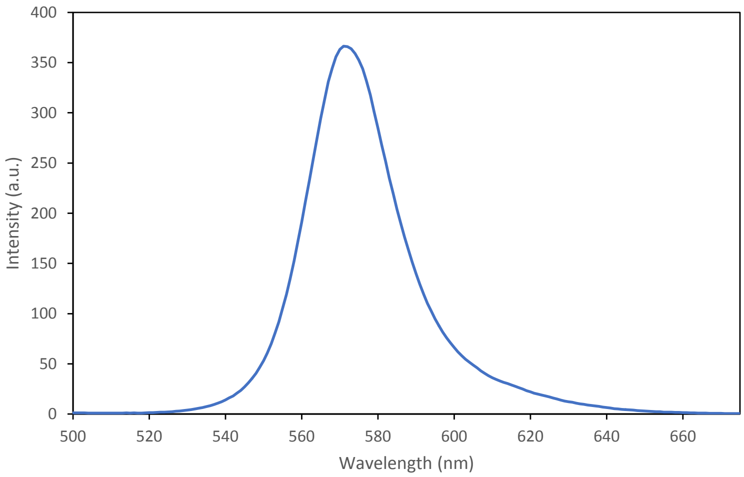

Fig. (3) The fluorescence spectrum of RB dye without nanoparticles

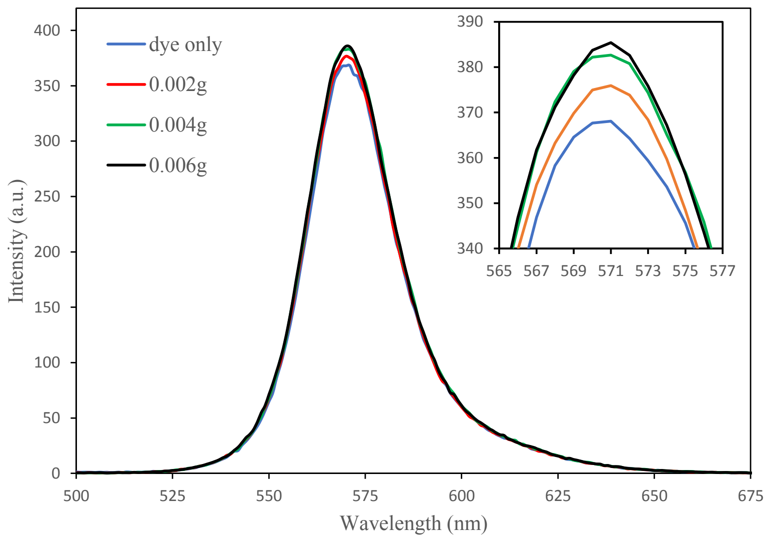

Fig. (4) The fluorescence spectra of RB dye with the amount of SiO_2 nanoparticles

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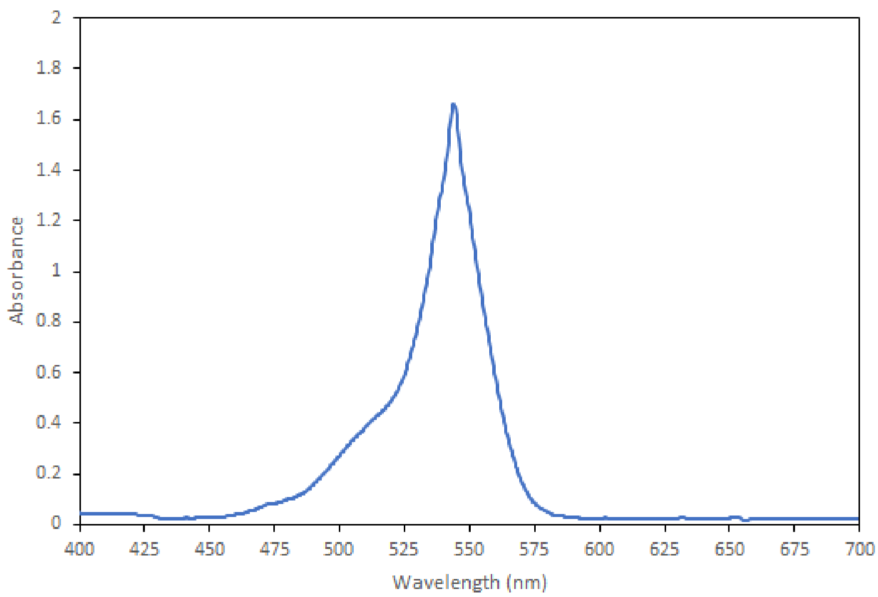

Fig. (1) The absorption spectrum of the Rhodamine B dye with 10^{-5}M concentration damine B dissolved in water and ethanol within nanoparticles and without nanoparticles. Observed from this results for quantum yield, it has value, where increasing with increase amount of SiO2 nanoparticles, this mean that the best lasing sample is Rhodamine dye dissolved in ethanol with 0.006g nanoparticles, where has highest quantum yield 90 % and good lasing properties.

Table (1) Quantum yield of RB without and within nanoparticles

Dye	Solvent	Concentrations (mol/l)	Dye and amount of SiO_2 (g)	Quantum yield %
RB	Water	10^{-5}	Dye only	33
			0.002	40
			0.004	59
			0.006	60
	Ethanol	10^{-5}	Dye only	62
			0.002	79
			0.004	84
			0.006	90

Conclusion

In concluding remarks, silicon dioxide nanoparticles were employed in Rhodamine B dye solution dissolved in water and ethanol with 10-5 M concentration to act as a gain medium. The highest increase in fluorescence intensity was reasonably measured as an amount of 0.006 g of the SiO2 nanoparticles were added to the dye solution. These results can effectively be used to design and fabricate gain media with low production cost, high spectral quality and good reliability for wavelength narrowing and tuning.

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nanoparticles that can be added to the dye solution.

Fig. (3) shown the fluorescence spectrum of RB dye without nanoparticles, but the assessment of nanoparticles in dye solution can be determined by measuring the fluorescence spectra as the contributions of nanoparticles is observed by further increase in fluorescence intensity when compared to the fluorescence of laser dye.

Figure (4) shows that the fluorescence intensity increases with increasing the amount of SiO2 nanoparticles added to the laser dye solution. The fluorescence peak is centered at 570 nm, which is 24 nm away from the absorption peak. As the amount of nanoparticles reaches 6 mg, the fluorescence intensity is increased by more than 25% than that of laser dye without nanoparticles. Inset figure apparently shows the variation of fluorescence intensity with amount of SiO2 nanoparticles in the dye solution.

In other time a same weight of Rhodamine B dye had been dissolved in 10ml of water. By using the same method of dilution, at dye concentration 10-5 M. The absorption spectra of this concentrations had been taken using the same UV spectral analyzer. Figure (5) illustrates the absorption spectra for Rhodamine B in water and ethanol at 10-5M concentration.

It was observed that the water polarity is larger than ethanol, so absorption spectrum shifts to the short wavelength in ethanol solvent (Blue shift), This indicates that the increase in the polarity of the solvent displacement occurs towards the longer wavelength. Fig (6) shows the absorption spectra of Rhodamine B solution dissolved in water with different amount of masses of SiO2 nanoparticles.

Figure (7) shown effect of excitation wavelength on fluorescence spectra at different Rhodamine dye concentrations dissolved in water.

Where from this figure, it is clear that increasing the wavelength excitation led to decreasing the fluorescence intensity.

Generally, Kasha's rule indicates that fluorescence normally occurs on the lowest vibrational level of the first excited electronic state, so fluorescence emission of molecules should be independent of the excitation wavelength. When the excitation wavelength was gradually changed from 350 nm to 380 nm, the emission maxima of RB solution showed a concomitant red shift. The maximum wavelength of emission spectrum, which depended on the excitation wavelength, showed the red-edge effect (REE). It indicated that these molecules formed different conformational isomer due to the C-N rotating of dialkylamine group of RB. Figure (8) The comparison between fluorescence spectra for Rhodamine dye dissolved in water and ethanol at 350nm excitation wavelengths.

Figure (9) Fluorescence spectra of Rhodamine B dye dissolved in water at 10-5 M concentration (with SiO2 NPs)

Table (1) shown quantum yield of Rhothe gain medium (Rhodamine B dye) to enhance the lasing properties, because of the strong dependence of lasing threshold on the nanoparticles size.

Experimental

The Rhodamine B (RB) laser dye solution was prepared by dissolving the required amount of the dye in the solvents (water and ethanol). This amount of the dye (W) was weighed using a precise digital balance of 10-3g sensitivity and can be calculated using the following equation:

W=(MW.V.C)/1000 (1)

Where MW is the molecular weight of the dye (g/mol), V is the volume of the solvent (ml) and C is the molar concentration (mol/liter).

Then, different amounts of SiO2 nanoparticles was dispersed in 10 m1 of ethanol containing 10-5M of Rhodamine B dye.

The spectroscopic characteristics (absorption spectra) of the dye solution were measured by a UV-visible spectrophotometer (K-MAC Spectra Academy SV-2100) in the range 200-900 nm with an optical resolution of about 0.2 nm, while the fluorescence was measured by a fluorescence spectrophotometer (F96 instrument from Shanghai LengGuang Tech.) in the emission wavelength range of 250-900 nm with a xenon CW lamp as an excitation source.

Results and Discussion

The absorption spectrum of the Rhodamine B dye with 10-5M concentration dissolved in ethanol, was recorded in the spectral range 200-900 nm, as shown in Fig. (1). In general, the dye solution has low absorbance at wavelength range below 475 nm. The absorbance at 544 nm. The spectroscopic measurements to introduce the effect of adding SiO2 nanoparticles to the dye solution sample was carried out using this concentration.

Fig. (2) Shows the absorption spectra of 10-5 M Rhodamine B dye solution with different amounts of SiO2 nanoparticles (0.002, 0.004 and 0.006 mg). The highest absorbance was measured when 6 mg of SiO2 nanoparticles added to the dye solution. This is attributed to the decrease in scattering mean free path and hence traverse mean free path of SiO2 nanoparticles in the dye solution. Also, the absorption spectra were noticeably narrowed with consequent increase in the intensity, which is attributed to the contribution of SiO2 nanoparticles to trap the emitted photon and hence to increase the photon flux (amplification) within narrow spectral range 537-560 nm. A shift towards longer wavelengths (~4 nm) was observed as the amount of SiO2 nanoparticles was increased from 0.002 to 0.006 g in the dye solution. Accordingly, the peak of absorption spectrum was shifted from 544 to 548 nm.

Theoretically, increasing the amount of nanoparticles would lead to increase the absorbance; however, the effect of saturation makes a limitation on the amount of

Introduction

Of particular interest in interface analysis is the optical characteristics of molecules affected by their physical and chemical environment [1].

During the past few years, photophysical properties of laser dyes in various solid matrices are attracting great attention because of their optical applications [2]. Rhodamine dyes are one of the most widely studied family of synthetic dyes, characterized in most cases by fluorescent quantum yields close to unity. These dyes belong to the xanthene family. This family are known by their excellent photo-stability and photophysical properties that, in diluted alcoholic solutions, make them suitable as a gain media in tunable dye lasers [3]. Many studies focused on Xanthenes family which Rhodamine B belong to them because of there higher gain, and the lasing emission of it is dependent on the many parameters such as different solvents, different concentrations [4,5]. Generally, the visible radiation emitted by most organic dyes has helped to be used as an effective medium in dye lasers. These fluorescent dyes contain a high concentration of active atoms of the volume unit when compared to the invasive medium [6].

Lasing compounds are classified according to their chemical structure and the region that emit in them spectrum into the different classes: polymethane where the emission range about 700-1000 nm, Xanthene with emission range around 500-700 nm, and other classes [7]. Rhodamin B with an absorption peak centered at 554 nm and an emission peak at 576nm [8], has small stoks shift (typically less than 35 nm) that cause systematic errors due to excitation back scattering effect [9]. Fluorescence quantum yield is one of the key photophysical quantities that are amenable to direct experimental determination [10]. In order to evaluate absolute quantum yield, we have to consider both the radiative and the non-radiative processes occurring in the medium [11].

The knowledge of fluorescence quantum yield of organic dyes and its concentration dependence are essential for selecting efficient laser media. Conventional measurements require the use of accurate luminescence standard sample and comparison of the give sample with a standard for which the fluorescence yield is known [10].

Silica nanoparticles are widely used in high technology applications owing to their many attractive properties such as excellent physicochemical and optical properties. They are extensively studied for their potential as photonic crystals, chemical sencers and bio sencers. Generally, optical absorption and emission properties, concentration of silanol groups, specific surface area and density are some of key parameters that govern the utilization of silica nanoparticle in the contemporary research works [12,13].

In this work, we employed silicon dioxide nanoparticles with an optimal size into

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Spectral properties of Rhodamine B and Enhanced lasing by SiO2 nanoparticles

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Abstract

In this work, spectral properties of Rhodamine B laser dye were studied on different conditions, such as different kinds of solvents, addition SiO2 nanoparticles amounts. varied excitation wavelengths, Observed by varying amount of SiO2, the intensity of absorption and fluorescence are increasing with increasing this amount, the absorption and fluorescence intensities in ethanol solvent is stronger than that in water, and fluorescence emission is decreased with increasing excitation wavelengths. Quantum yield is so increased with increasing amount of SiO¬2 nanoparticles, where increased from 33% for dye only dissolved in water to 90% for dye dissolved in ethanol with 0.006g NPs. These results can effectively be used to design and fabricate laser gain medium.

Keywords: Nanoparticles; Rhodamine B dye; quantum yield

دراسة الخواص الطيفية لصبغة الرودامين B وتحسين عملية انبعاث الليزر باستخدام جسيمات SiO٢ النانوية

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في هذا البحث: درست الخواص الطيفية لصبغة الرودامين B الليزرية عند ظروف مختلفة مثل: تغيير نوع المذيب، اضافة كميات مختلفة من جسيمات SiO٢ النانوية، أطوال موجة تهيج مختلفة.

أوضحت النتائج أنه عند اضافة كمية من الجسيمات النانوية للصبغة فان كل من شدة الامتصاص والفلورة تزداد بزيادة هذه الكمية، وهذه الشدات كانت أعلى عند اذابة الصبغة في الايثانول منها عند الاذابة في الماء، وانبعاث الفلورة يقل مع زيادة طول موجة التهيج.

الكفاءة الكمية للفلورة ازدادت بزيادة كمية الجسيمات النانوية المضافة حيث ازدادت من ٣٣ ٪ في حالة الصبغة فقط مذابة في الماء الى ٩٠ ٪ في حالة الصبغة مذابة في الايثانول مضافاً اليها g٠,٠٠٦ من المادة النانوية.

هذه النتائج يمكن استخدامها في تصميم وتصنيع وسط ليزري فعال.

الكلمات المفتاحية: الجسيمات النانوية، صبغة الرودامين B ، انبعاث الليزر