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RESEARCH ARTICLE

A DETAILED SPECTROSCOPIC STUDY ON THE INTERACTION OF RHODAMINE 6G WITH TWO AMINES

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ABSTRACT

Fluorescence, Fourier Transform Infrared (FTIR) and Scanning Electron Microscope(SEM) Spectroscopic investigations have been made to reveal the native of the interactions between xanthene dye Rhodamine 6G (R6G) and the well known amines (i) n-butyl anine (BTA) and (ii) triethyl amine (TEA). From the analysis of the steady – state fluorescence quenching of Rhodamine 6G in aqueous solution in the presence of BTA and TEA, it is revealed that the quenching is dynamic in nature. FTIR and SEM studies confirm this quenching. The stern-volmer constant, Molar extinction coefficient, stoke's shift have been computed. The tentative frequency assignments for the FTIR spectra have been tabulated.

INTRODUCTION

Xanthene dyes are the most widely investigated class of luminescent dyes because of the special characteristics and wide range of applications as biological stains, sensitizers, tracing agents, photochromic and thermochromic agents and laser dyes. As tracing agents rhodamine dyes are used in water purification and in aerial pesticide spraying studies. These dyes are used in drugs, cosmetics, textiles, and inks as colors (Brown *et al.,* 1978; IARC, 1978). Also due to their high luminescence, some of these dyes were used as luminescent standards, and other were applied as fluorescent probe indicators of microscopic environments, especially in enzyme and membrane studies (Magde *et al.,* 1999). Rhodamine dyes had been found to be carcinogenic (Umeda, 1956). For all these reasons we have selected rhodamine 6G (R6G) to observe the interaction of this dye with amines. In the present investigation complex formation between amine and the dye (R6G) is hinted by a strong quenching of dye fluorescence. In this paper we have discussed in detail the results obtained from the bimolecular interaction of a famous xanthene dye, Rhodamine 6G (Fig.1) with amines in aqueous solution medium. Steady state fluorescence intensities of the dye were measured as a function of amines concentrations. The FTIR

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spectra of dye without and with the two quenchers were also recorded.

MATERIALS AND METHODS

Materials

The samples Rhodamine 6G (Aldrich) and the amines, n-butyl amine and (ii) triethyl amine (S.D. fine chemicals) were tested before use for the presence of any impurity emission in wavelength region studied.

Spectroscopic apparatus

At the room temperature, steady state fluorescence emission spectra of dilute solutions (8 x 10^{-5} mol dm^{-3}) of the samples were recorded using VARIAN CARY ECLIPSE fluorescence spectrophotometer. FTIR spectra were recorded by using AVATAR – 360 series FTIR spectrometer. SEM photographs were taken using JEOL JSM 5610 LV Scanning electron microscope (SEM).

RESULTS AND DISCUSSION

Steady state fluorescence spectra

When the amines, BTA and TEA interact with the fluorescent dyes R6G, a decrease in the fluorescence of the dye generally takes place. The steady-state fluorescence emission studies had been done on the R6G by exciting it at 527 nm in the presence of n-butyl amine and triethyl amine. The fluorescence emission of the R6G (with fixed concentration) was quenched regularly with the gradual addition of n-butyl amine as shown in Fig. 2. The similar quenching phenomenon was observed for Rh6G with triethyl amine as shown in Fig.3. For dynamic quenching, the fluorescence data at room temperature was analyzed by the well-known Stern-volmer equation (Bevington, 1999).

$$\frac{f_o}{f} = 1 + K_{SV}\,[Q]$$

Where f_o and f denote the steady – state fluorescence intensity in the absence and in the presence of quencher respectively. K_{SV} is the stern-volmer quenching constant and (Q) is the concentration of dye.

Table 1. λ_{abs}, λ_{flu}, Molar Extinction Co-efficient and stoke's shift values of R6G

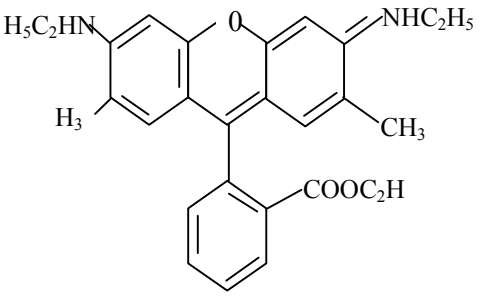
Quenchers	λ_{ab}	λ_{flu}	*Molar Extinction co-efficient log Σx 10^5*	*Stoke's shift*
BTA	527	551	7.818	827
TEA	527	553	7.818	892

Table 2. Stern-Volmer constants and regression coefficients of R6G

Quenchers	K_{SV}		*r*	
	Calculated 10^5	Graph 10^5	Calculated	Graph
BTA	30.52	30	0.988	0.98
TEA	21.44	22.66	0.988	0.9

Table 3. Tentative frequency assignments of R6G without and with BTA and TEA

FTIR frequency (cm^{-1})			*Intensity*	*Tentative assignment*
R6G	R6G with BTA	R6G with TEA		
2693	2771	2784	W	Hydroxyl Stretching
2592	2592	2594	S	H bonded OH Stretch
2502	2503	2503	S	H bonded OH Stretch
2326	2325	2324		NH Stretching
2272	2273	2273	M	C=N Stretching
2251	2251	2251	V	C=N Stretching
2181	2182	2182	M	C=N Stretching
2116	2116	2116	M	C=N Stretching
2044	2045	2046	M	C=N Stretching
1707	1750	1744	(S)	C = O Stretching
731	707	727	(S)	CH out of plane deformation
698	694	695	S	CH of plane
657	683	676	S	-C ≡ CH bend
509	513	513	S	C – C = O band



Rodamine 6G (R6G)

Fig.1. Molecular Structures of R6G

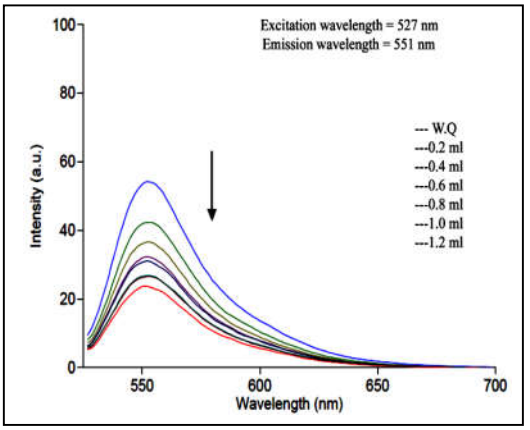


Fig. 2. Fluorescence emission spectra of R6G with different concentration of BTA

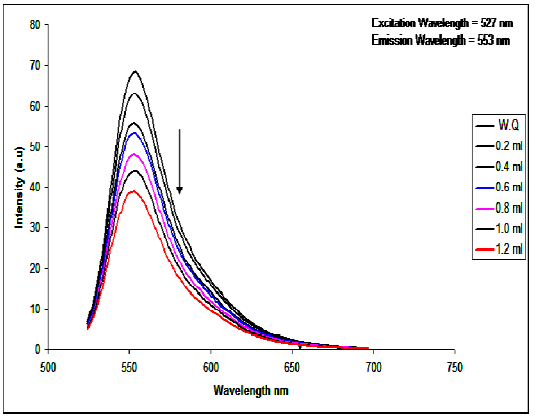


Fig. 3. Fluorescence emission spectra of R6G with different concentration of TEA

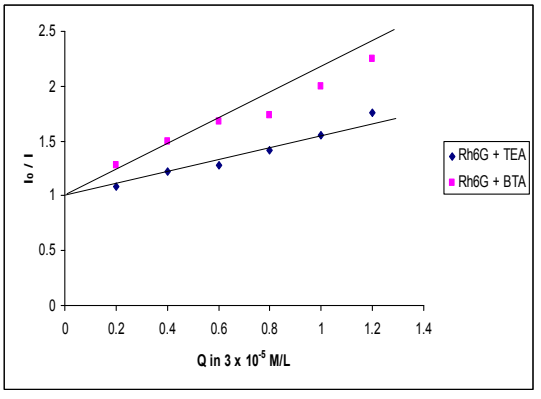


Fig. 4. Stern-volmer plot of R6G with BTA and TEA

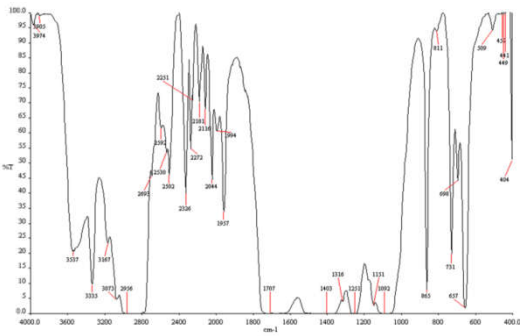


Fig.5. FTIR spectrum of Rhodamine 6G

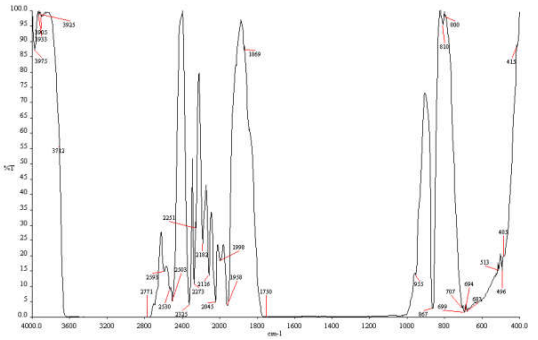


Fig.6. FTIR spectrum of R6G with BTA

The stern-volmer plots (Fig. 4) were linear in nature which indicates that only dynamic or static type of quenching is involved in these quenching processes. As, there was no change in absorption spectra, it is known that the quenching is dynamic in both cases. (Quenching of R6G by BTA and TEA). Table 1 gives the data of λ_{abs} & λ_{flu}. The calculated values of molar extinction coefficient and stoke's shift were presented in Table 1. The calculated and graphical values of stern-volmer constants and regression coefficients of Rh6G with BTA and TEA were compiled in Table 2. The maximum change in the fluorescence intensity of Rh6G in the presence of n-butyl amine (32 A.U) was observed than triethyl amine (29 A.U).

Fourier transforms Infrared Spectra

The recorded FTIR spectra of Rhodamine 6G without and with n-butyl amine and triethyl amine

are shown in figs. 5, 6 and 7 respectively. The tentative assignments were tabulated in Table 3. The complex formation was conformed.

Scanning electrons Microscope Photograph

The powdered form of R6G was subjected to scanning electron Microscope. This photograph is shown in Fig.8. The SEM photographs of the mixture of R6G with BTA and the mixture of R6G with TEA are shown in figs. 9 and 10 respectively. These are the proofs of complex formation.

Conclusion

The interactions of Rhodamine 6G with n-butyl amine and triethyl amine have been investigated by several spectroscopic methods. This detail study reveals that the quenching mechanism involved here is of dynamic type and due to the formation of excited state complex. The observed FTIR spectra and SEM photographs support the view regarding the nature of the complex formed. It is also concluded that Rhodamine 6G was more quenched by n-butylamine than triethyl amine.

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REFERENCES

Brown, J.P., Roehm, G.W. and Brown, R.J. 1978. Mutagenicity testing of certified food colors and related azo xanthene and triphenylenethene dyes with the sa/mone//a/microsome system. *Mut. Ã¢t. Res.,* 56: 249-271.

International Agency for Research on Cancer, 1978. Rhodamine B, IARC Monogr. 16: 221-231.

Magde, D., Rojas, G.E. and Seybold, P.G.1999. Solvent dependence of the fluorescence lifetimes of xanthene dyes. *Photochem. Photobiol.,* 70 (5): 737-744.

Umeda, M. 1956. Experimental study of xanthene dyes as carcinogenic agents. *Gann*, 47: 51-78.

Bevington, R.P. 1999. Data Reduction Error Analysis for the physical sciences, McGraw – Hill, New York.

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