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Absorption characterization of a dye and two amines

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ABSTRACT

In this study, we report the absorption characterization of a dye, Rhodamine 6G and two amines in water. Two amines used were, (1) n- Butyl amine (NBA) and (2) Triethyl amine (TEA). For this study water was used as solvent.

Key words: Absorption, Rh6G; n-Butyl amine, Triethyl amine.

INTRODUCTION

Organic dyes of xanthene family have been extensively used as medium for tunable lasers with tunability over a range of wavelengths. One of the most commonly used xanthenes dye is rhodamine 6G (Rh6G) emitting in the red region of visible spectrum. This dye is also used as sensor [1], non-linear optical material [2], photosensitizer [3] and malarial protease labels [4]. There is much current interest in the area of laser dyes encapsulated in solid matrices for making practical tunable solid-state dye lasers [5, 6], as an alternate to conventional liquid dye lasers. The use of solid matrix as host for laser dyes presents a number of advantages such as compactness, free from solvent evaporation problems, reduced toxicity and manageability.

MATERIALS AND METHODS

Experimental

Rhodamine 6G was purchased from Sigma Aldica Company, Bangalore and was used without further purification. n-Butyl amine and triethyl amine were purchased from S.d fine chemicals (India). UV/Vis absorption spectra were taken using 1650 PC SHIMADZU UV-VISIBLE SPECTROMETER.

RESULTS AND DISCUSSION

The main absorption band of Rh6G in visible region corresponds to a transition moment largely parallel to the long axis of the molecule due to $\pi \rightarrow \pi^*$ transition. Corresponding absorption maximum at 526 nm is observed in water.

Table 1 presents the absorption spectral data of Rh6G in water. It has been observed that absorption intensities increase with increasing concentrations of the two quenchers, n-butyl amine and triethylamine.

These are shown in figs. 1 and 2 respectively. From the figures it can be noted that the absorption intensities increase when the concentration of n-Butyl amine and triethyl amine increase. The absorption maxima occur at 526 nm.

The formation constants for the Rh6G: nBA and Rh6G : TEA complex formation have been determined by analyzing changes in the intensity of absorption with quencher concentration.

The plot of $\left(\frac{1}{A - A_0}\right)$ versus [Q] will result in a straight line as shown in Fig.3. From the slope values of this plot, K has been evaluated and tabulated (Table 2). This is the ground state formation constant K_g. From this K_g value the free energy change, ΔG_g, has been calculates and tabulated (Table 2).

SEM Analyses

Rh6G, n-Butylamine and firiethyl amine were powdered separately and the structure of their particles in these powders were observed first, in the Scanning Electron Microscope (SEM), and then the particles of the powdered form of the mixtures (1) Rh6G + n-Butyl amine and (2) Rh6G + Triethyl amine were also studied. These are shown in Figs. 4-8. The structures of the mixtures are different from that of the pure chemicals (i.e., Rh6G, n-BA and TEA). It can be assumed as a proof or the formation complex of Rh6G with n-BA and TEA.

Table-1: Absorption spectral data for Rh6G with different Quenchers

Chemicals	Intensity	Wavelength (nm)
Rh6G	0.0511, 0.782	331, 526
Rh6G + NBA	0.067, 1.037	331, 526
Rh6G + TEA	0.065, 0.998	330.9, 526

Table-2:Absorption, Energy, Ionization potential, Electron affinities of charge transfer complexes, Molar restriction co-efficient (log □), and solvent parameter of Rh6G with NBA, TEA

λ_{abs}	$h\upsilon_{CT}$ (ev)	ID (ev)	EA (ev)	log □ (M^{-1} cm^{-1})	Z (nm)
526	2.3619	8.2024	1.7890	7.8178	54.356

Table-3: Formation constant (K_g) and free energy (ΔG_g) of Rh6G with NBA and TEA

Quenchers	$K_g(M^{-1})$	$\Delta G_g(kJmol^{-1})$
NBA	20.280	-7581.77
TEA	22.650	-7860.19

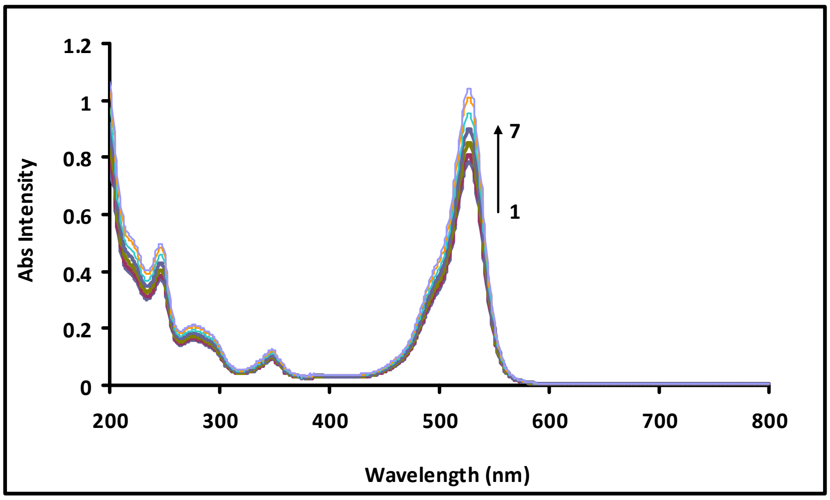

Fig. 1: Absorption spectra of Rh6G in different concentration of NBA (mol dm^{-1}) (1) 0, (2) 0.002, (3) 0.004, (4) 0.006, (5) 0.008, (6) 0.010, (7) 0.012

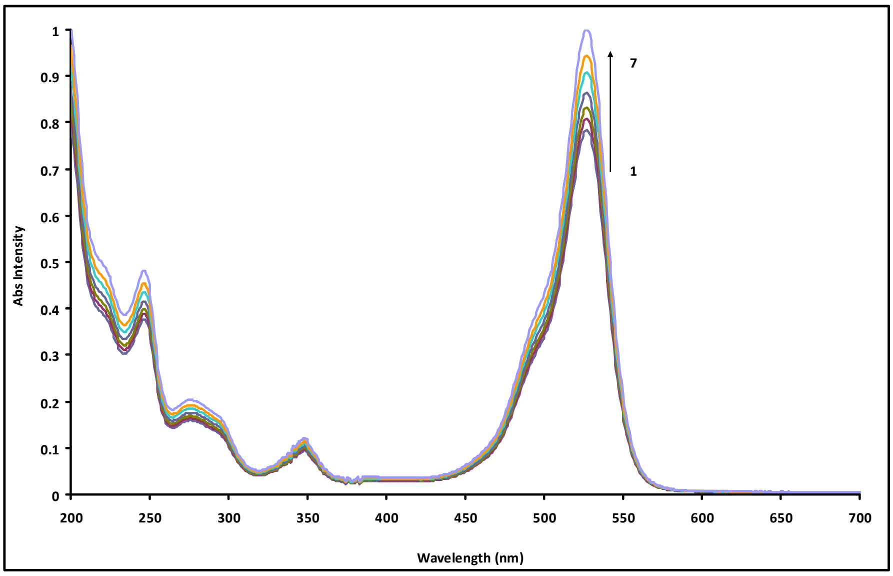

Fig. 2: Absorption spectra of Rh6G in different concentration of TEA (mol dm^{-1}) (1) 0, (2) 0.002, (3) 0.004, (4) 0.006, (5) 0.008, (6) 0.010, (7) 0.012

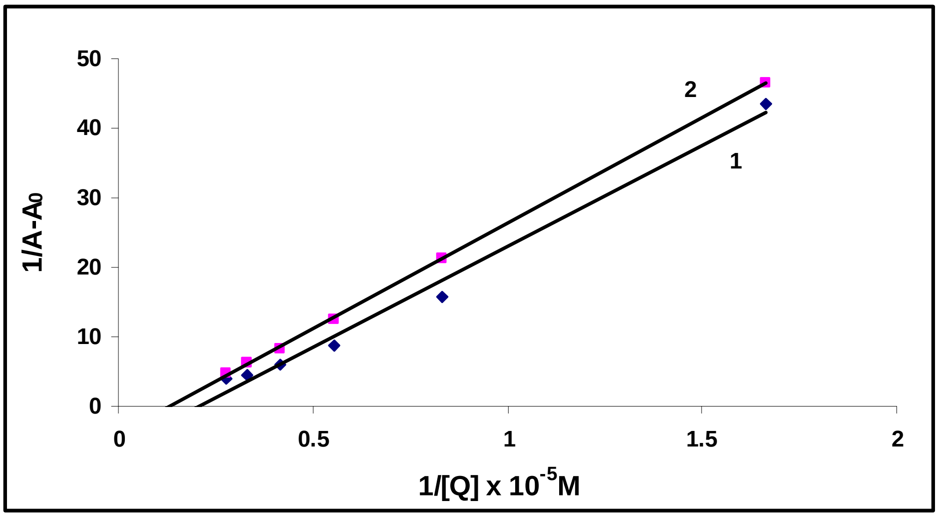

Fig. 3: Plot of 1/A-A$_0$ and 1/[Q] for Rhodamine 6G for 1. NBA, 2. TEA

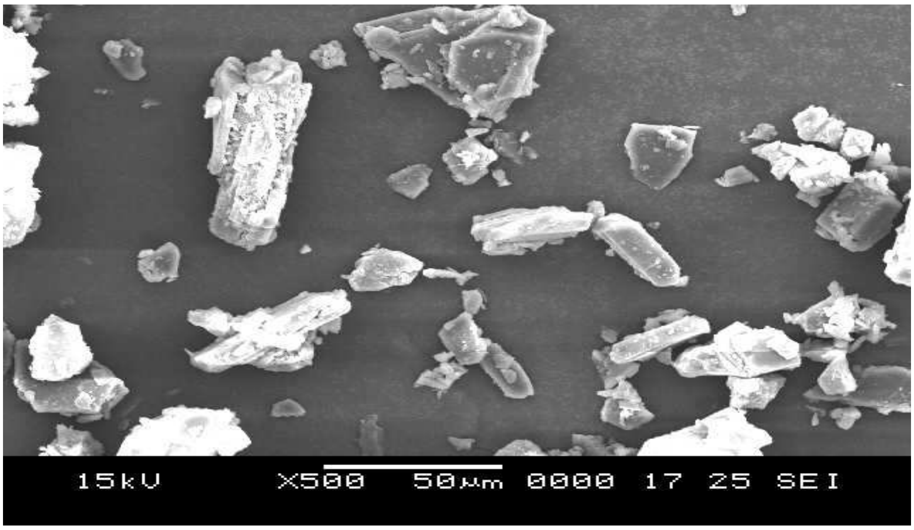

Fig. 4: Scanning electron microscope photograph of Rh6G

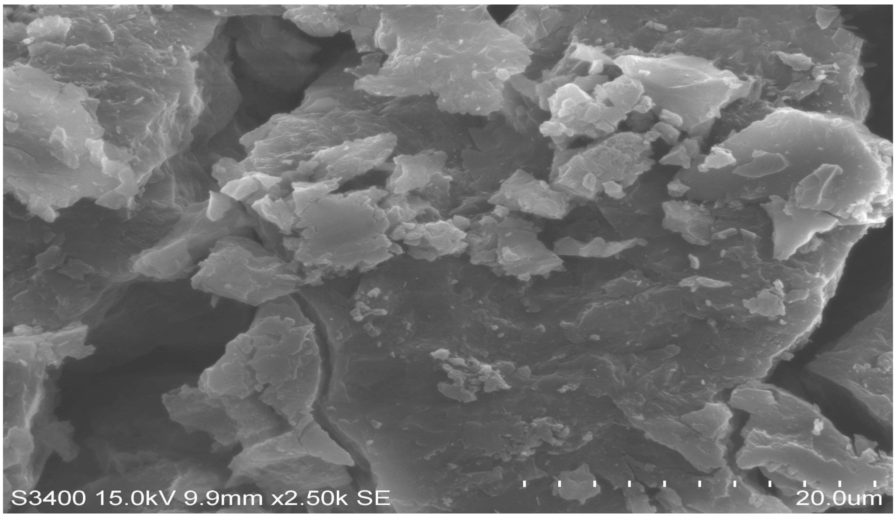

Fig. 5: Scanning electron microscope photograph of (Rh6G + NBA)

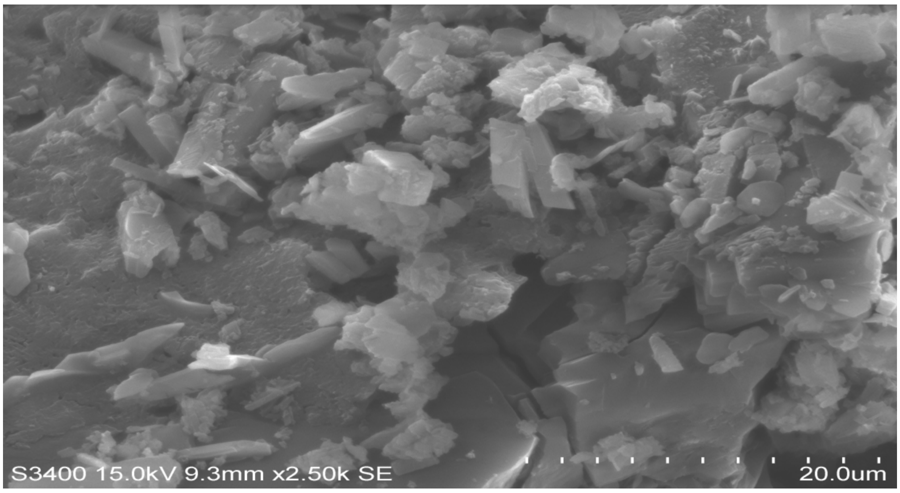

Fig. 5: Scanning electron microscope photograph of (Rh6G + TEA)

CONCLUSION

Absorption characterization of Rh6G with n-Butyl amine and triethyl amine have been studied. The ground state formation constant and the free energy change have been calculated SEM photographs can be assumed as a proof of the formation of the complexes.

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