Photophysical Investigation of Coumarin – A Study of the Effect of Substituents in Fluoresence

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Abstract- In the present work, coumarin has been subjected to photophysical analysis. Though the influence of the electron-donating groups such as amino, substituted amino, hydroxyl, alkoxy groups, etc. at position 7 of the coumarin ring system has been extensively studied, the luminescent properties of the coumarin moieties with an aliphatic amine substituent have not been explored. Here it is attempted to study the variation of fluorescent lifetime behaviour of coumarin with n-butyl anine (NBA).

Index Terms- Coumarin, n-butyl amine, Lifetime, Fluorescence.

I. Introduction

During the last few years there has been a remarkable growth in the use of fluorescence in biological sciences especially in biochemistry and biophysics. Fluorescence also finds application in environmental monitoring, clinical chemistry, DNA sequencing and analysis by fluorescence *in situ* hybridization (FISH). In molecular biology, fluorescence is used for cell identification and citing in flow cytometry, and in cellular imaging and movement of intracellular substances by means of fluorescence microscopy.

Coumarin derivatives are the subject of photophysical studies during the last few decades as they are highly fluorescent molecules. The nature and position of the substituent on coumarin ring has profound importance in deciding the phtophysical behavior of the substitute, coumarin compounds, coumarins substituted position with an electron-donating group are known to exhibit strong fluorescence (1).

Coumarins are used as non-linear optical chromophores and as an excellent probe to study salvation dynamics in homogenous solutions as well as organized media (2-8). It is found that the nature of solvents and substituents bring out changes in the vales of fluorescence wavelength maxima, quantum yield, lifetime, polarization and excited-state dipole moment of the coumrin (9).

II. Materials and Methods

Coumarin and n-butly amine were purchased from Sigma Aldrich Company, Bangalore, and were used without further purification.

UV/Vis absorption spectra were taken using 1650 PC SHIMADZU UV-Visible SPECTROMETER Fluorescence measurements were made by CARRY ECLIPSE VARIAN FLUORESCENCE SPECTRO PHOTOMETER.

III. Results and Discussion

Pico and nano second resolved photo are important spectroscopic techniques for characterizing quenching processes that are associated with the generation and the fate of photo excited state. The fine resolved spectra reveal as to how the acceptor is distributed in space around the donors (10). in addition to this, they give information on the quenching process, specifying whether it is due to diffusion or complex formation.

The lifetime spectra of Coumarin without and with n-butyl anine are shown in Fig.1. and the compiled data have been presented in Table 1. The occurrence of the shorter fluorescence decay times may be due to the distance between the pair (11).

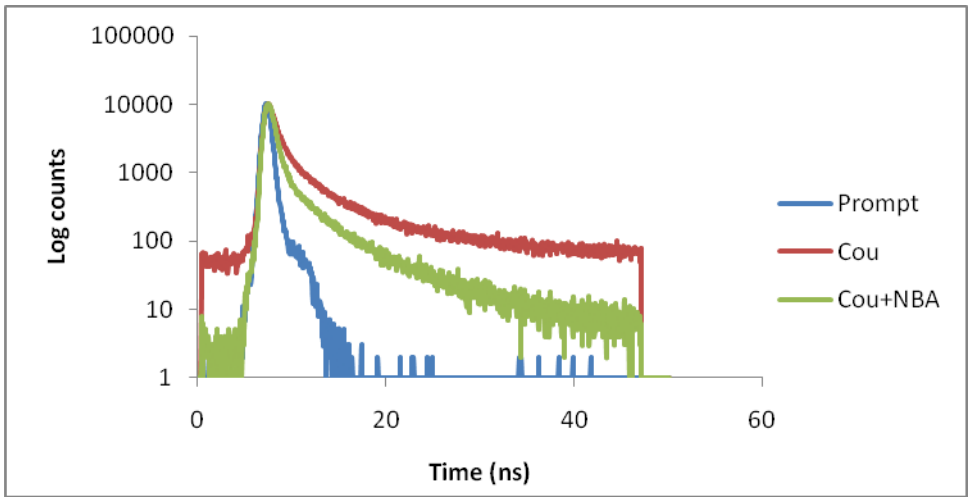

Fig.1. Fluorescence decay curves of Coumarin with and without NBA

Table 1: Fluorescence life time and amplitudes of Coumarin without and with different concentrations of NBA

Concentration of NBA (M)	Lifetime (ns)			Average life time 10^{-9} sec	Relative amplitude			χ^2	S.D 10^{-11} sec		
	τ_1	τ_2	τ_3		α_1	α_2	α_3		τ_1	τ_2	τ_3
COU	1.04	5.58	0.042	1.75	27.73	25.86	46.41	1.177	2.32 X10^{-4}	3.49 X10^{-5}	7.95 X10^{-3}
COU+NBA	0.78	0.21	5.21	1.32	28.79	52.3	18.91	1.172	4.109 X10^{-11}	0.820 X10^{-11}	6.217 X10^{-11}

The increase in lifetime indicates that the complexes may form in the solution such change in the lifetime occurs because quenching is an additional rate process that depopulates the excited state.

In the present investigation the lifetime of Coumarin in both conditions [(i) Coumarin & (ii) Coumarine + NBA], hence the merging of the kinetic traces is not observed (The plots not look like a single decay curve). This shows that the quenching of Coumarine might be dynamic in nature.

IV. Conclusion

From the fluorescent decay curves it is obvious that the compound follow a characteristic bi-exponential fluorescent decay, which revels the existence of two different emissive states for the molecules, which could be the locally excited state (LE, Frank condon state) and change transfer state (CT). the average lifetime has been calculated and presented in table.

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