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Interaction of Coumarin dyes with PMMA

Amit Sharma
Department of Applied Sciences
Bharati Vidyapeeth's College of Engg.
New Delhi.

ABSTRACT

We report Flourescence spectra of Coumarin dyes in methanol. Spectra are also reported in different dye doped PMMA samples. Position of fluorescence peak changes in case of dye doped PMMA compared to their position in methanol. The fluorescence wavelength in all the dyes is red shifted which confirms the interaction between coumarin dyes and PMMA.

Keywords-coumarin; PMMA; fluorescence spectra.

1. INTRODUCTION

Dye lasers are considered to be a source of coherent radiation which can be tuned. The operational flexibility is an additional advantage alongwith emission from near ultraviolet to near infrared. Dyes can lase in solid, liquid and gas phase but liquid solutions of dyes in organic solvents have been the most frequently used laser media. But with the use of liquid solutions there arise a number of inconveniences like requirement of large volume of dye solutions which is toxic as well as expensive. Further each dye has a limited range of tunability so that the dye has to be changed for different wavelength regions.

From the early days of development of dye lasers, attempts were made to overcome the problems posed by dye solutions. The solution to overcome the above said problems was to incorporate the dye molecules in to the solid matrices.A solid state dye laser avoids the problems of toxicity and flammability and they are compact, versatile and easy to operate. The initial solid state dye lasers were reported in 1967 and 1968 [1-2]. In recent years the synthesis of high performance dyes and the implementation of new ways of incorporating the organic molecules in to the solid matrix fhave resulted in significant advances towards the development of practical tunable solid state lasers{3-12}.The polymers provide an opportunity for the production of active elements that can effectively control the characterstics of laser radiation. Hence adequate knowledge of thermal and optical properties of dye doped polymers is important in identifying suitable laser media.

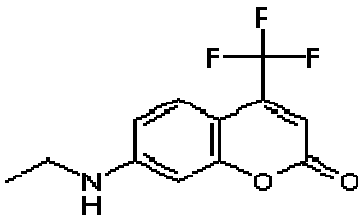
Coumarin class of dyes has high quantum yield of fluorescence and is quite stable to light. Therefore it is used as active medium in tunable dye lasers. Flourescence and photophysics of the dyes and therefore the lasing properties are influenced by structural changes. The structural changes in the dye when doped in solid host can be studied by studying the fluorescence spectra of the dye in the solid host.In the present work we report fluorescence spectra of different coumarin dyes in polymethylmeta acrylate (PMMA).

2. EXPERIMENTAL

Coumarin dyes were purchased from Exciton (USA) and used as it is without further purification.The Spectroscopic grade solvents methanol, from Qualigens Fine Chemicals, India was used without further purification. Coumarin dyes, coumarin 500, Coumarin 522B and coumarin 6 were doped in PMMA. To prepare samples 0.25 mg. of dye was dissolved in chloroform. Commercially available PMMA (0.25gm) was added to the above solution. The resultant solution was transferred to Teflon molds of desired shape. The fluorescence spectra were recorded at Edinburgh instrument F900, version 6.84 at INMAS, DRDO , New Delhi .

3. RESULTS AND DISCUSSION

The structure of different coumarin dyes are shown in figure 1-3. Figure 4 shows the structure of PMMA. The fluorescence spectra of different dyes under different experimental conditions are shown in figure 5-7 and the corresponding fluorescence wavelengths are listed in table1.



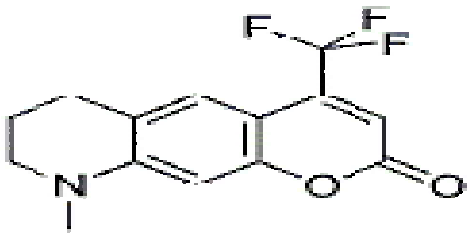


Figure 1. *Structure of Coumarin*

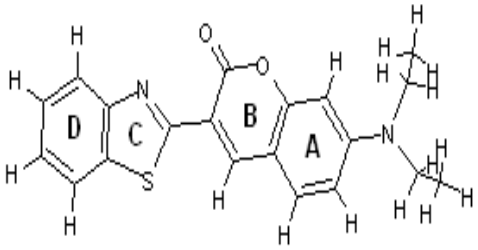


Figure 3. *Structure of Coumarin 540*

Figure 2. *Structure of Coumarin 522B*

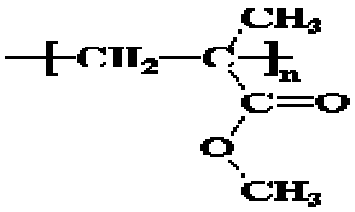


Figure 4. *Structure of PMMA*

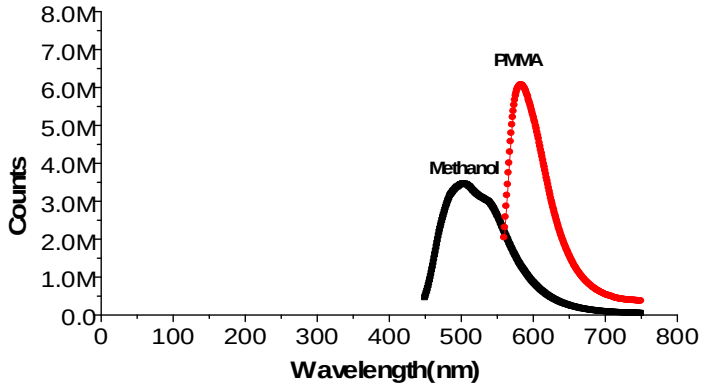


Figure 5. *Fluorescence spectra of C500 in methanol and PMMA*

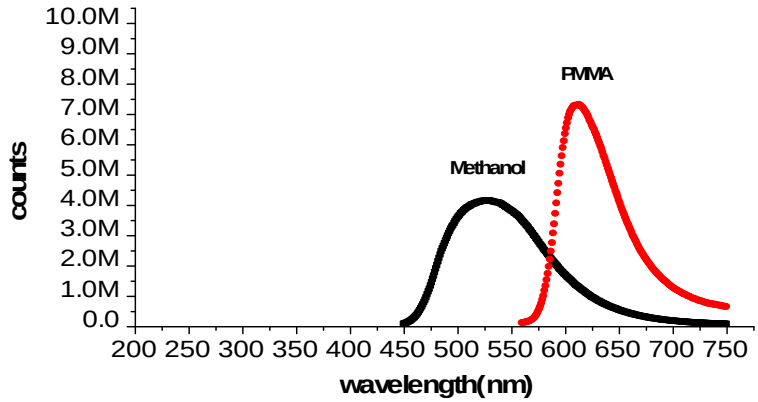


Figure 6. *Fluorescence spectra of C522B in methanol and PMMA*

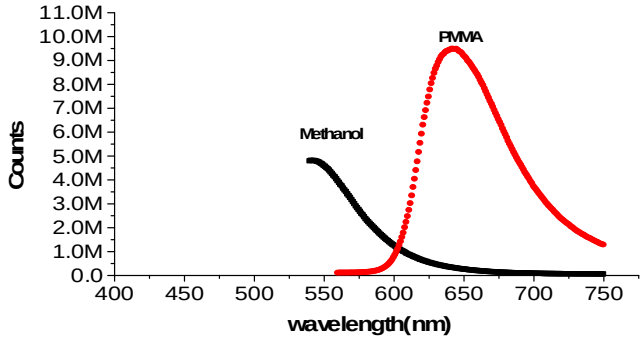


Figure 6. *Fluorescence spectra of C540 in methanol and PMMA*

Table 1. *Flourescence wavelength (in nm) of different coumarin dyes under different experimental conditions*

.	Flourescence wavelength in nm in	
Dye	Methanol	PMMA
Coumarin 500	**504**	**583**
Coumarin 522B	**527**	**611**
Coumarin 540	**542**	**644**

When coumarin 500 is dissolved in methanol the fluorescence wavelength is observed at 504 nm. The fluorescence wavelength shifts to 583 nm when the dye is doped in PMMA In case of coumarin 522B, the fluorescence maximum is observed at 527 nm. The fluorescence wavelength is shifted to 611 nm when the dye is doped in PMMA. In case of coumarin 540, the fluorescence wavelength of the dye in methanol is observed at 542 nm but with PMMA a red shift of 102 nm is produced and fluorescence wavelength is observed as 644nm.

From the results it is clear that all the coumarin dyes show a red shift in their fluorescence wavelengths, as compared to their fluorescence wavelength in methanol, when doped in PMMA. This shift in fluorescence wavelength indicates that some type of interaction exists between the dyes and PMMA. Greater is the extent of interaction greater is the shift in fluorescence wavelength. The interaction between the dyes and PMMA changes the gap between the energy levels of the dye. This gap can be changed if either the ground state or the excited state of the dye gets shifted. In all the coumarin dyes the red shift in fluorescence wavelength indicates that the spacing between the energy levels of the dye is decreased due to the interaction of the dye and PMMA.

4. CONCLUSIONS

The fluorescence wavelength of coumarin dyes is red shifted when the dyes are doped in PMMA. This red shift in fluorescence wavelength confirms the interaction between the dyes and PMMA. This interaction between the dyes and PMMA decreases the spacing between the energy levels involved in the transitions.

5.REFERENCES

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