

# Optical Properties of a Chalcone in Solution

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**Abstract:** In this report we had studied the optical properties of chalcone in different solvent environments. The results showed that the chalcone has a good photochemical stability and high intense light compared with other dyes. Moreover the absorption and fluorescence spectra were varied from solvent to another under same operational conditions.

**Keywords:** Absorption; Fluorescence; chalcone

## 1. Introduction

The materials, which give color to your clothes and add luster to the face creams are organic compounds, called dyes. When these are dissolved in organic liquids (like, ethanol, chloroform, etc.) the solution becomes highly fluorescent (Recall the fluorescent paints used for warning signals). These dye solution have proved to be excellent media for laser action [1-5].

Laser dyes are large organic molecules with molecular weights of a few hundred. When these organic molecules are dissolved in a suitable solvent such as benzene, methanol, or acetone, can be used as lasing media in a dye laser. Laser dye solutions absorb at shorter wavelengths and emit at longer wavelengths. Many different dyes are nowadays available, and in total they can cover huge wavelength regions like exalite, coumarin, rhodamine, pyromethene, pyridine, fluorescein, pyridine or crystal can characterize a whole family of dyes with slightly different chemical structures, having somewhat different ranges of emission wavelengths and being distinguished with additional numbers. For example, one may use coumarin 2, 47, 102 or 153 for lasers in the blue to green spectral region [6-8].

Note that many laser dyes and some of the used solvents are poisonous and partly also carcinogenic. One should therefore carefully avoid to expose the skin to such a dye solution, or even to spill the dye by operating a not properly assembled dye circulating system. A particularly hazardous solvent, sometimes used for cyanide dyes, is dimethylsulfoxide (DMSO), which greatly accelerates the diffusion of dyes into the skin [6, 9]

## 2. Experimental

Chalcone (C<sub>6</sub>H<sub>5</sub>CH=CHCOC<sub>6</sub>H<sub>5</sub>) was dissolve in a different type of organic solvent, they will produce a different absorption and fluorescence spectra peaks; this is what distinguishes liquid as an active lasing medium compared by gas and solid-state lasing. Third harmonic of Nd: YAG laser, ( $\lambda=355\text{nm}$ ) with the pulse width 7 ns, was used as the excitation source. The UV laser was focused into a quartz cylindrical lens with focal length of 5cm. This was collected by 0.1 mm entrance slit of an EG&G optical multi-channel analyzer (OMA).

## 3. Results and Discussions

The absorption spectra in the acetone of the chalcone were recorded for a wide range of concentrations from 0.1mM to 1mM. It was found that the shape of the absorption showed a single band at 410 nm and the spectral profile remained the same irrespective of concentration, though the intensity increased with increasing concentration of dye, without any new band as seen in Fig.1. This indicates the absence of any dimer formation. The absorption spectra were recorded of the chalcone for different solvents; the concentration was fixed at 1 mM. It can be seen that when the polarity of the solvent increases the red shift of the absorption increased (see Fig.2).

Similarly the fluorescence spectra of the chalcone were recorded for the same concentrations which mentioned above. It was found that the shape of the fluorescence spectra remained the same irrespective of concentration and there was only one band at 530 nm, though the intensity of the band at 530 nm increased with increasing concentration of dye, without any new band as seen in Fig.3. This indicates the absence of any excimer or exciplex formation.

The fluorescence spectra were recorded of the chalcone for different solvents; the concentration was fixed at 1 mM. It can be seen that when the polarity of the solvent increases the red shift of the fluorescence increased (see Fig.4). Therefore, the solvent plays an important role for the absorption and fluorescence spectra in their positions.

In cases where the polarization interaction is the major contribution factor, Mataga et al[10, 11] have shown that the Stokes shift has a linear variation with the dipole factor, given within square brackets in the expression

$$\nu_a - \nu_f (\text{Stokes' shift}) \approx \left[ \frac{(\epsilon - 1)}{(\epsilon + 1)} - \frac{(n^2 - 1)}{(n^2 + 1)} \right] \times \text{Constant} \quad (1)$$

$$\text{Dipole factor } \Delta f = \left[ \frac{(\epsilon - 1)}{(\epsilon + 1)} - \frac{(n^2 - 1)}{(n^2 + 1)} \right] \quad (2)$$

Here,  $\nu_a$  and  $\nu_f$  are absorption and fluorescence peaks in wave numbers,  $\epsilon$  the dielectric constant and  $n$  the refractive

index of the solvents,  $\mu_e$  and  $\mu_g$  represent the dipole moment of the solute in the excited state and the ground state respectively, and  $a$  is the radius of the solvent cage around the solute. Fig.5 shows a plot of Stokes shift as a function of dipole factor for representative solvents. This dipole factor is a measure of dipole-dipole interaction between the solvents and the solute.[11, 12]. From Fig.5 early see that the chalcone is more in excited state, the influence of this fact could be seen subsequently.

#### 4. Conclusion

In this paper we had shown the spectral properties of the chalcone dye were investigated in different concentrations and solvents. The results revealed that the polarity of the chalcone is very high according to Mataga plots. Moreover, the solvent polarity makes a significant red shift when the polarity of the solvent increased.

#### References

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#### Figure Captions:

|       |  |
|-------|--|
| Fig.1 | Absorption spectra of chalcone in acetone for different concentrations.                          |
| Fig.2 | Absorption spectra of chalcone in acetone for different solvents.                                |
| Fig.3 | Fluorescence spectra of chalcone in acetone for different concentrations.                        |
| Fig.4 | Fluorescence spectra of chalcone in acetone for different solvents.                              |
| Fig.5 | Variation in the Stokes' shift chalcone in solution with a dipole factor for different solvents. |

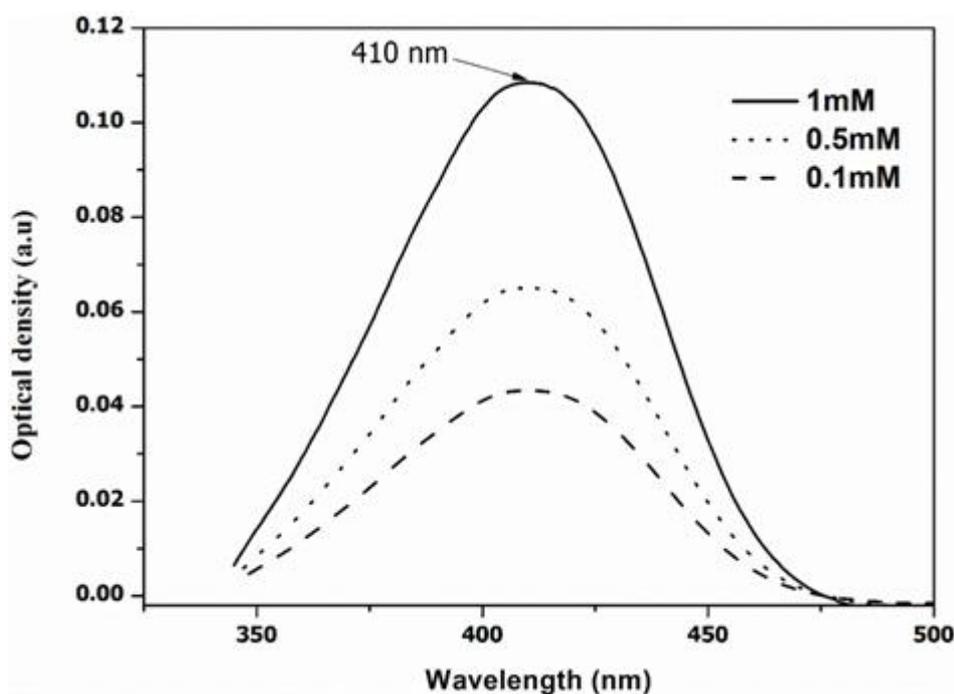


Figure 1

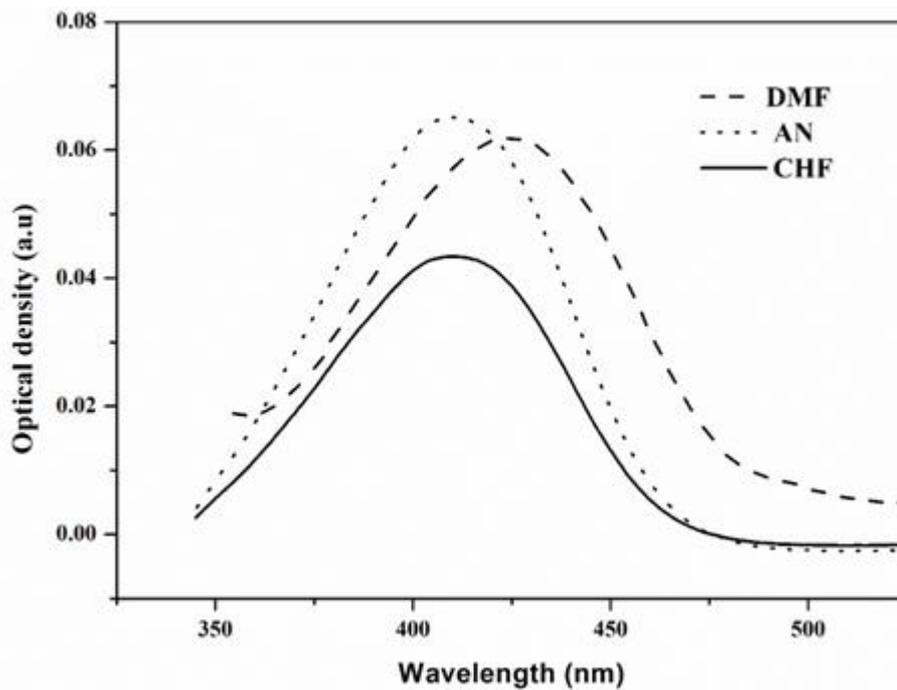


Figure 2

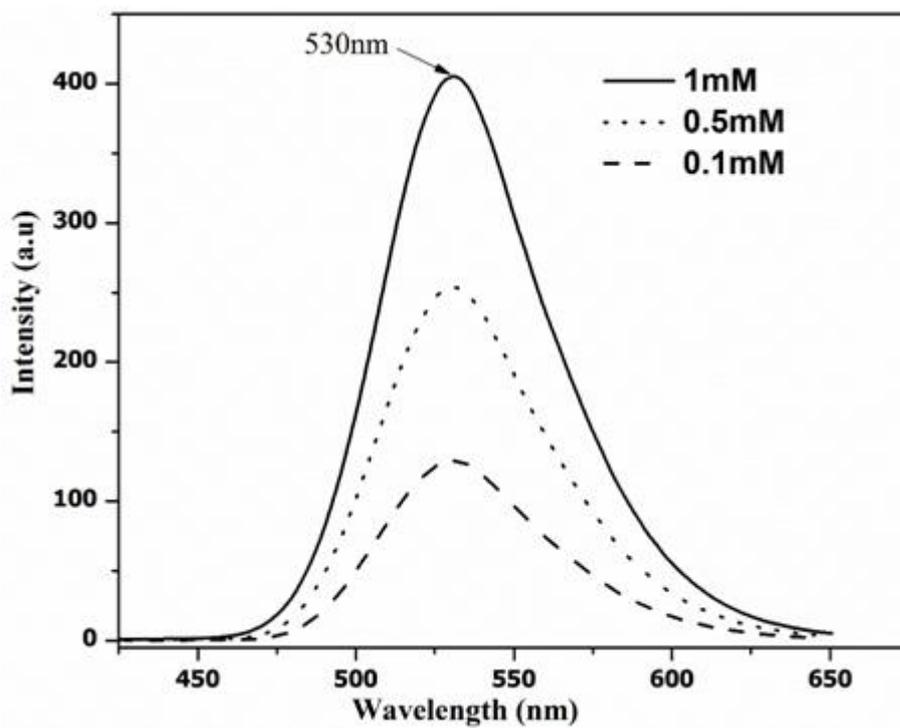


Figure 3

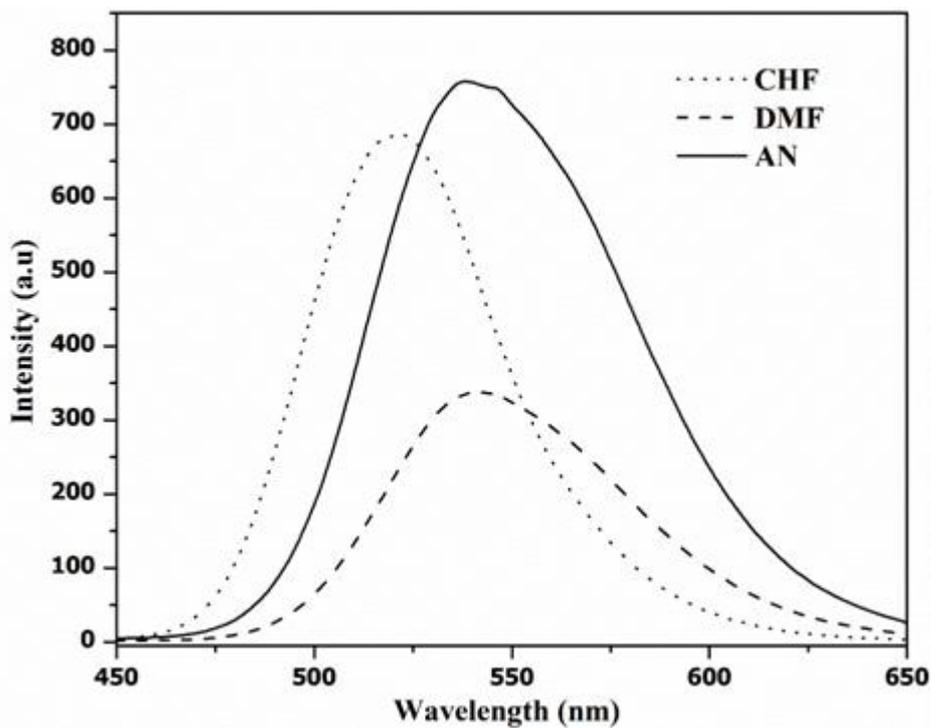


Figure 4

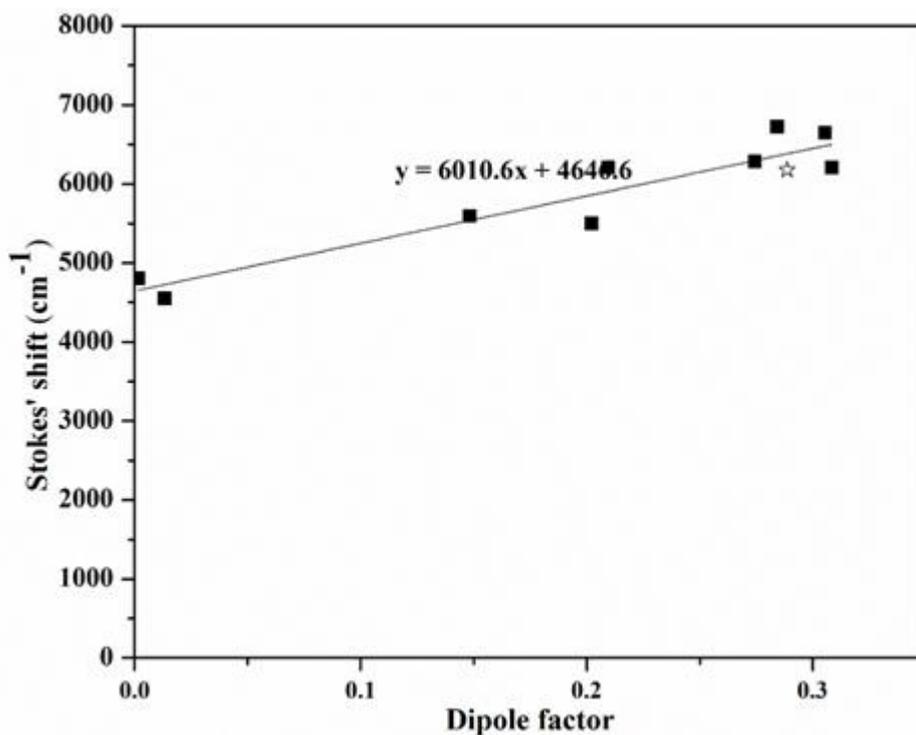


Figure 5