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A comparison between CN red system of bands and laser induced fluorescence bands of *mesua ferrea L* plant leaves

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Abstract

The present work reports the *in vivo* fluorescence spectra of *mesua ferrea L* plant leaves in the visible region excited with the help of 500mW Ar^+ laser (5145Å). The fluorescence spectrum consists of thirteen discrete bands in the region 5300Å to 6700Å which are similar to CN red system of bands. We have also compared these bands with the bands of *mesua ferrea L* seed oil, excited by transformer discharge. *In vivo* excitation of CN red system in the LIF plant leaves is a first report of this kind.

Keyword: Laser induced fluorescence, CN red system.

INTRODUCTION

Mesua ferrea L is a pre eminently over green middle-sized glabrous tree and grows abundantly in Assam [1]. The seeds are still used by many to burn and produce light like candle. The seed contains a pale yellow coloured oil which is non edible and consists of glycerides of mainly linoleic, oleic, palmitic and steric acids[2]. The use of biomass as an alternative source of fuel and chemical feedstocks is attracting increasing interest [3-8]. The possibility of using vegetable oils as fuels for diesel engines has also been the subject of recent work [9-11].

The present work is concerned with the *in vivo* LIF of the *Mesua ferrea L* plant leaves. It may be noted that the results obtained in the present work is quite surprising and unexpected because leaves of other plants leaves do not exhibit discrete bands in the fluorescence spectra. The bands have been measured and identified and found to be identical with the CN red system of bands [12].

MATERIALS AND METHODS

To perform the experiment of LIF we have used an Ar⁺ laser (500mW, 5145Å, air cooled). A mature leaf of *Mesua ferrea L* is held in front of a Glass Spectrograph. The salient feature of the experiment is that the laser radiation is allowed to fall on the leaf and fluorescence is observed in the same direction. This arrangement is similar to the arrangement of Stimulated Raman scattering. The fluorescence spectrum is shown in Fig.I. For comparison we have recorded the emission spectrum of *Mesua ferrea L* seed oil in transformer discharge. The emission spectrum is shown in Fig.II. To record the fluorescence spectrum we have used commercially available colour film.

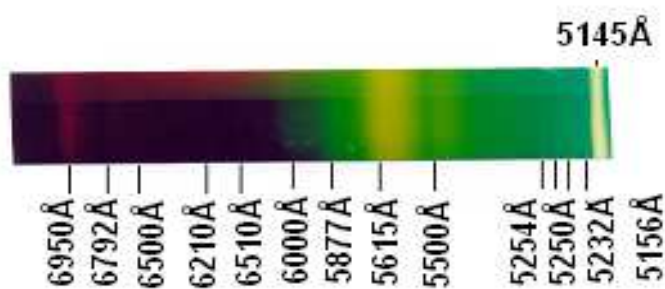


Figure I: Laser induced fluorescence spectrum of a leaf of *Mesua ferrea-L* plants

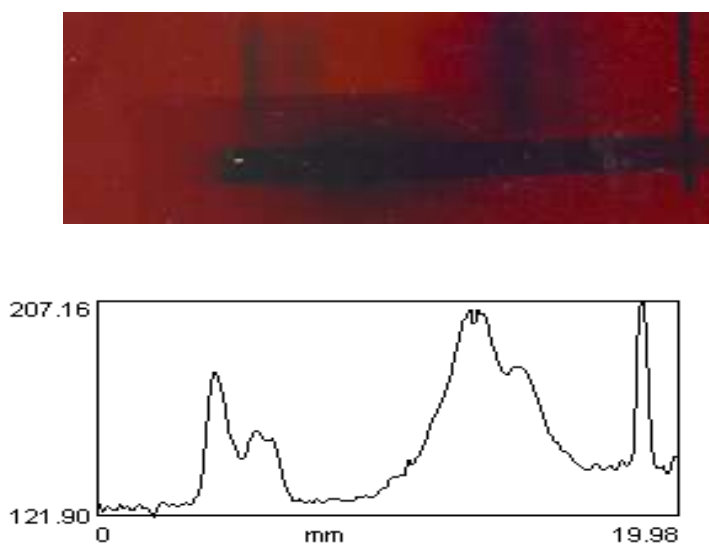


Figure II:(a). Emission spectra of *Mesua ferrea-L* seed oil excited in transformer discharge
(b). Intensity distribution pattern workout with a computer software

RESULTS AND DISCUSSION

As may be inferred from Fig.I. There are a number of discrete band observed towards the longer wavelength side of the exciting radiation at 5145Å. It is surprising and as well as unexpected that discrete fluorescence bands are observed in a plant leaf. We have also used the experiment to excite the fluorescence with discrete bands for plant leaves belonging to other species but similar discrete vibrational bands could not be observed. Therefore, the present observation is termed as surprising. Pending further investigation it is not possible to conclude directly about the origin of these bands but from a comparison of a standard literature [12] it appears that these bands are quite similar to CN red system of bands. It may be noted that the CN red system of bands appears usually in carbon arc in air, in the flame of burning cyanogens, in discharge tubes containing nitrogen and carbon compounds and especially strongly when vapors such as C₂H₂ and HCCl₃ are introduced into active nitrogen. Table I shows the measured bands of the LIF spectrum.

Table I: Fluorescence bands observed in the LIF spectrum of *Mesua ferrea L* plant leaf and comparison with CN red system of bands (vs= very strong, s= strong, m=medium, w=weak)

<i>Mesua ferrea -L</i> leaf		CN red			
Wave length	Intensit y	Wave length	(V ⁱ , V ^h)	Band heads	Intensity
5156	w	5155.7	(11,4)	R ₂	
5232	w	5232.1		R ₂	
5245	(w)	5240.0		R ₂	
5254	(w)	5254.9	(7,1)	Q ₁	
5500	(w)	5490	(9,7)	Q ₁	5
5615	(vs)	5615.7	(10,4)	Q ₁	3
5877	(m)	5877.6	(7,2)	Q ₁	9
6000	(m)	6012.5	(8,3)	Q ₁	6
6150	(w)	6153.3	(9,4)	Q ₁	3
6210	(w)	6213.8	(4,0)	Q ₁	4
6500	(w)	6502.3	(6,2)	Q ₁	10
6792	(m)	6792.5	(8,4)	R ₂	
6950	(s)	6954.0	(3,0)	-	2

There is a closed resemblance between the spectra belonging to the LIF of *Mesua ferrea-L* leaf and CN red system of band [12]. It should be borne in mind that the most satisfactory comparison of the two spectra is made by bringing films and prints together side by side. It is preferable that the spectra should be taken with the same instrument in the same state of adjustment, but if this not possible enlargements from the plates may be made to the same scale by means of the iron arc comparison spectra. Following this procedure we have observed that the LIF spectrum and the CN red system of spectrum are quite identical. As regards the origin of this fluorescence system of bands it must be indicated that the excitation condition involved in the CN red system is not present in the Laser induced fluorescence. The fluorescence system also

does not belong to the well-known chlorophyll fluorescence. The fluorescence due to chlorophyll a and b exhibit a broad maximum near the red end of the spectrum only. It is also worthwhile to compare the LIF spectrum with the emission spectrum of *Mesua ferrea-L* seed oil excited with the help of a transformer discharge. The emission spectrum shows broad and diffuse bands in the visible that region 4000-7000Å. It is believed that different emitters are involved. But the diffuse bands in the regions of wavelengths 4800-7000Å are somewhat similar to the CN bands observed in the LIF spectrum the band at 5615Å is the strongest.

CONCLUSION

In conclusion we may say that the LIF spectrum of the *Mesua ferrea-L* leaf indicates for the first time the use of this technique to characterize a plant leaf. This is due to the fact that the experimental observation of the LIF is not a general one. The plant leaf of a particular plant exhibited the fluorescence spectrum as shown in Fig.1. However the experimental observations could not be repeated for the same leaf belonging to other regions. Pending further work we reasonably conclude that the LIF red the present work exhibiting the CN red system is a result of environmental pollution.

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