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Laser Induced Fluorescence Spectra of Polluted Water of Brahmaputra River during December 2017

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Abstract: ***Laser induced fluorescence spectra of the polluted samples of water of Brahmaputra river exhibit distinct with peaks at 738, 762, 810, 826, 841, and 929 nm. These band systems exhibit similarity with the infra-red system of silicon fluoride (SiF). It may be inferred that the complexes of silicon contaminated the water samples of Brahmaputra River during the period of December 2017.***

Keywords: Laser induced fluorescence, river pollution.

I. INTRODUCTION

It was a matter of consideration interest and curiosity to everyone who live in North East India (Assam and Arunachal Pradesh in particular) to note that during the month of December 2017 the flowing water of Brahmaputra river became muddy due to the inflow of same turbid materials. Brahmaputra River is one of the great rivers of the world. Flowing eastwards to the north of Himalaya in China it turns sharply south and passes through Assam before entering Bangladesh. It was not possible to know exactly what caused the water pollution of the river that continued for more than a month. It was speculated from the unconfirmed information of news media that a big project was undertaken by the neighboring China which is concerned with the construction of a underground tunnel connecting the origin of Brahmaputra river to the Gobi dissert to the north of Chain. During the month of December (2017) dead fishes were occasionally seen to be floating at the surface close to the bank of the river at various places which was an unusual sight. It is worthwhile to note here that at the time of writing this communication the water of the river Brahmaputra has retained its original nature and thus it may be inferred that the process of dumping of construction materials at the origin of the river has stopped. Due to the general nature of the topic which concerns environment and people we wanted to examine the extend of pollution of the water samples using a well known technique of laser induced fluorescence (LIF). The excitation of fluorescence with the help of laser radiation has become a procedure that has attracted research workers in various domains and disciplines. As for example Laser Induced Fluorescence (LIF) of green plants detection of vegetation stress has been initially proposed by Chappelle et. at [1]. Later these studies have been used to explore the possibility of using laser as remotes means of measuring the various characteristics of vegetations such as plant vigour, plant type identification and natural mineral deficiency [2-5]. Fluorescence lidar is a potential new technique for terrestrial vegetation monitoring, biomass estimation and to supply canopy data [6,7]. The technique of LIF has been extensively used to study some medicinal plant leaves[8]. Laser induced fluorescence spectra of Namsai meteorite has been studied by our group [9]. Similarly Dergaon meteorite has been investigated using LIF technique [10].

We had collected few samples of polluted water from different locations during the period of pollution and in the present communication we report the LIF spectra of the samples along with the qualitative interpretation. The aim of the studies was to obtain an insight into the issue by independent study without being influenced by the hearsays.

II. EXPERIMENTAL

A diode pumped solid state green laser with power 30 mW and wavelength 532 nm was used to excite the fluorescence of the polluted water sample kept in a cuvette of suitable dimension (1 cm X 1 cm X 3 cm). The cuvette with the samples is held in front of the opening and of the optical fiber which is connected to a Mini USB Spectrophotometer, with spectral range 200-1200 nm. The spectrophotometer is connected to a lap-top where the necessary software is installed for recording the spectra. Fig 1(a,b,c) shows

the representative spectra of the samples and Fig 2 shows the spectrum of the source without any sample and cuvette being introduced in the path. It is worthwhile to remark here that we had also used a blue diode pumped solid state laser to observe any fluorescence in the green sector but no band systems were observed in the range.

III.RESULTS AND DISCUSSION

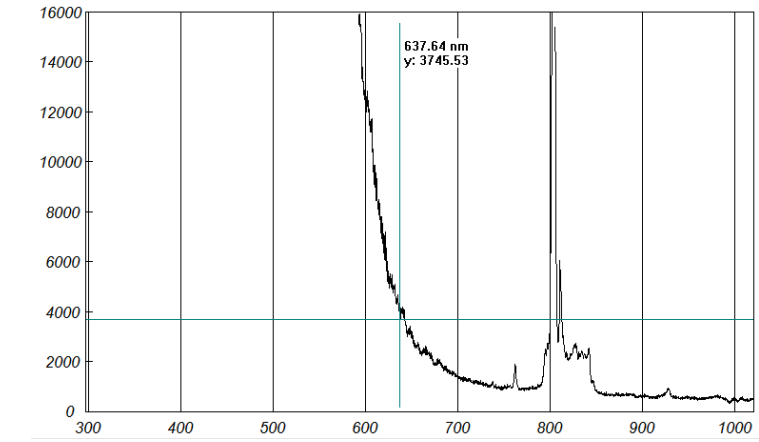
From the data exhibited graphically for LIF spectra of the samples in Fig 1 (a,b,c), Table 1 has been prepared to exhibit the salient wavelengths in the spectra which represent the source of the unknown impurities. It is worthy of remark here that the very strong fluorescence at 806 nm is present in the exciting laser source itself and hence may be eliminated from the spectra. As may be inferred from the spectra exhibited in Fig 1(a,b,c) most of the fluorescent peaks originated from the samples lie in the red sector of the spectrum. It is not possible to identify the emitter of these bands. It is reasonable to believe that some inorganic complexes are associated with the emission of the spectrum in the red sector. Survey of available literature particularly the classic by Pearse and Gaydon(11) is quite handy in identifying the LIF spectra in our present work.

TABLE I
FLUORESCENCE SPECTRUM OF THE POLLUTED SAMPLES

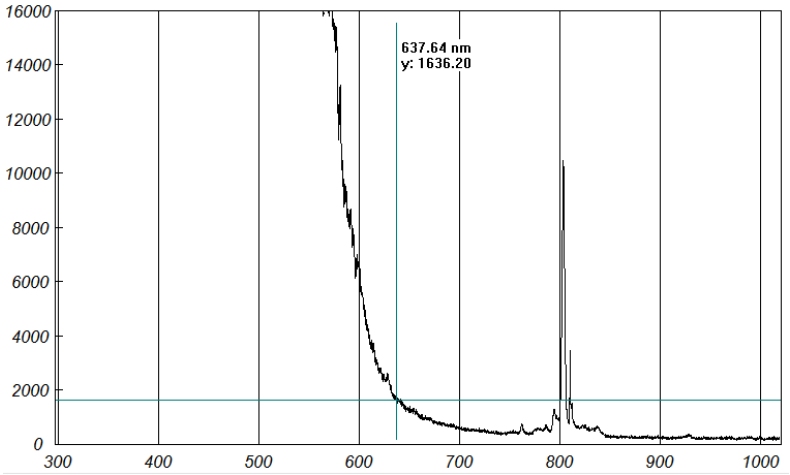
Sample No	Wavelength nm	Intensity	Analysis
1	738	vw	a
	762	s	b
	806	vvs	Present in the laser source
	810	s	c
	826	s	d
	841	s	e
	929	ms	f
2	762	ms	b
	773	s	b
	806	vvs	Present in the laser source
	812	s	c
	838	ms	e
	926	w	f
3	762	ms	b
	776	w	b
	806	vvs	Present in the laser source
	812	s	c
	823	w	d
	838	ms	e
	926	vw	f

S= strong, w= weak, vw= very weak, ms= medium strong, vvs= very very strong.
a,b,c,d,e,f represent LIF peaks from the polluted water (origin unidentified).

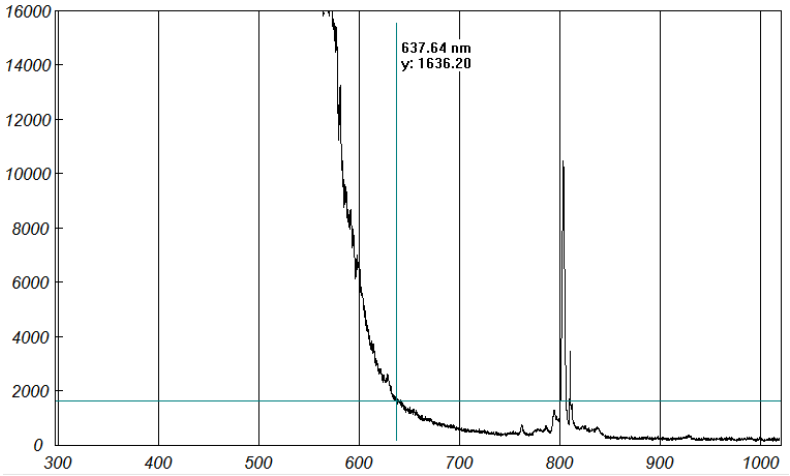
It is worthy of remark here that the LIF spectra is quite identical to the infra – red system of SiF. The infra –red system has been observed by Johns and Barrow [12] using powdered silicon and Potassium Fluorosilicate in a follow cathode containing helium. In Table 2 we indicate the band origins of the infrared system of SiF together with the LIF spectra of the polluted water samples for comparison only. One however may not be surprised to find few similarities of the LIF spectra with the infrared system of SiF. The polluted water samples of Brahmaputra River contained lot of silicate materials as floating objects during the period of above mentioned incidents.



(a)



(b)



(c)

Fig 1(a,b,c): LIF Spectra of three samples of polluted water.

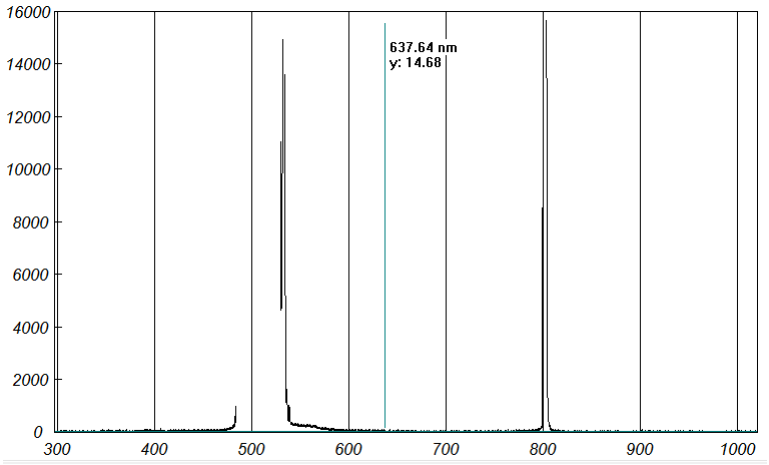


Fig 2: Spectrum of sources (diode laser 532nm) only

TABLE 2
INFRA – RED SYSTEM OF SIF AND THE LIF SPECTRA (A COMPARISON)

$\lambda_{(nm)}$ (υ^1, υ^{11}) (SiF)		$\lambda_{(nm)}$ (LIF Spectra)
896.45	0,1	929
843.59	0,0	841
777.85	1,0	810
760.50	2,1	762
722.12	2,0	738
707.62	3,1	-
706.81	4,2	-

IV. CONCLUSIONS

We now proceed to sum up the results which have emerged in this work. The laser induced fluorescence spectra of the polluted water sample of Brahmaputra river exhibit distinct band system in the wavelength range of 700 – 1000 nm with distinct peaks at 738, 762, 810, 826, 841 and 929 nm. These band systems exhibit similarity with the infrared system of silicon fluoride. It may be inferred that silicon complexes are associated as impurities in the water samples. These silicon complexs, present in the polluted water contaminated is leading to the death of some fishes during the period under consideration. However the exact cause of pollution that occurred at the origin of the river would still remain unexplained.

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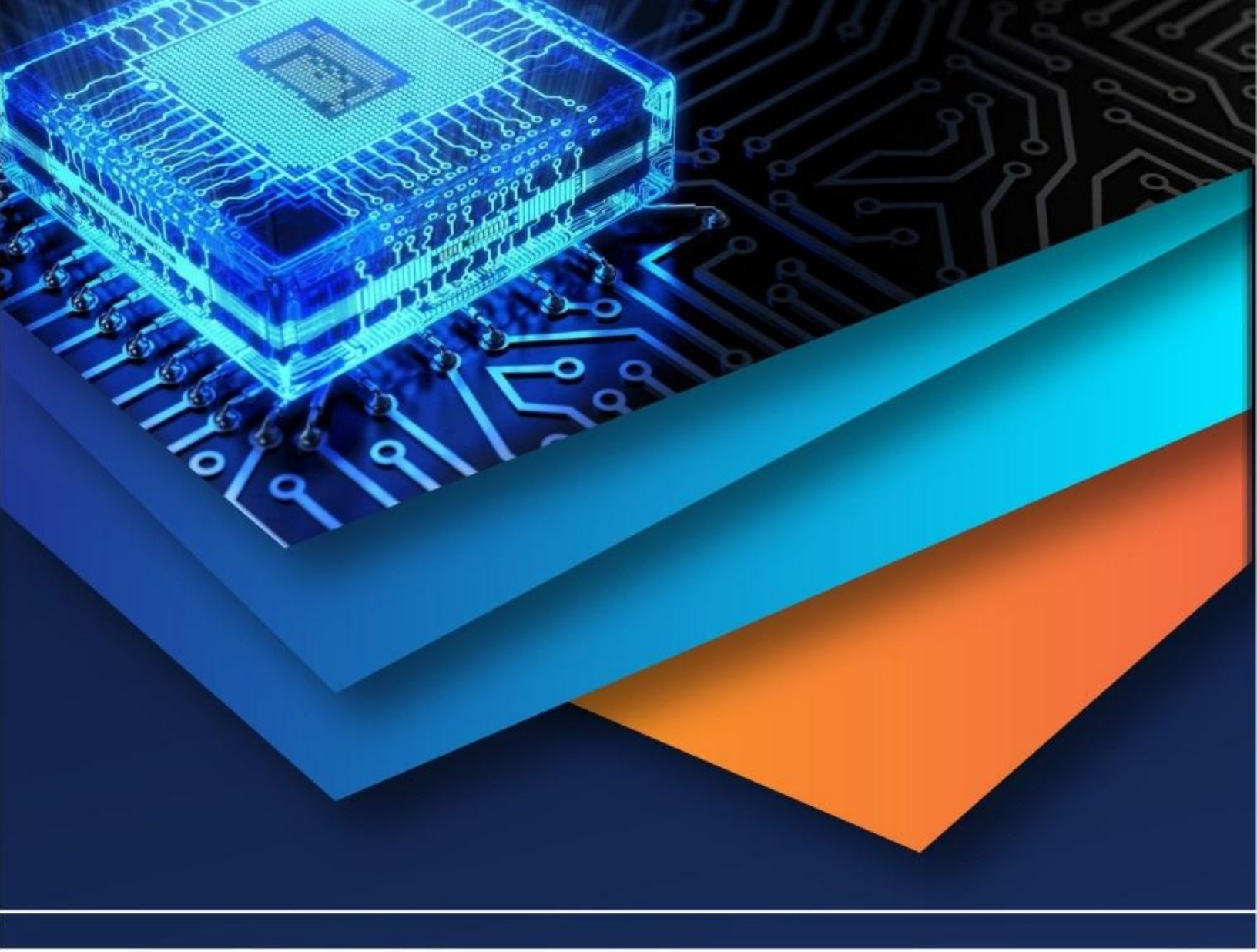

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