International Journal Of Advancement In Engineering Technology, Management and Applied Science (IJAETMAS)
ISSN: 2349-3224 || www.ijaetmas.com || Volume 03 - Issue 07 || July 2016 || PP. 79-82

Study of Cancer Diagnosis by Synchronous luminescence Spectroscopy

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ABSTRACT:

Cancer diagnosis is an important issue as far as its early treatment and cure are concerned. Biopsy is the conventional method of cancer diagnosis. In this method, the suspected tissue is medically removed, examined and analyzed under the microscope by the pathologist. But since it is a time consuming and tedious process, novel research in Optical techniques has come up in order to remove these drawbacks. In the present work we have considered two samples and we have recorded the Synchronous luminescence spectra. The respective spectra gives a lot of information about the sample, whether it is cancerous or not and also about its degree of malignancy.

Key Words: *Biopsy, luminescence, spectra, cancer*

I. INTRODUCTION:

The conventional method of cancer diagnosis is Biopsy. It is the medical removal of tissue from a living subject to determine the presence or extent of a disease. The tissue is generally examined under a microscope by a pathologist and can be analyzed chemically.[1,2] But this method has some disadvantages such as it is more complex and time consuming method due to which the patient has to suffer a lot. So there is a need to investigate more simple and less time consuming method. Tremendous research is being made in the field of cancer diagnosis and Optical Spectroscopy is one of them. Some of the Optical Spectroscopic techniques for cancer diagnosis are Light Induced Fluorescence Spectroscopy,synchronous luminescence, HPGLC (High precession Gas liquid Chromatography), Raman spectroscopy.

The Synchronous Luminescence Spectroscopy method can be used to analyse tissue in vivo or to investigate spectral differences in normal and neoplastic cells in vitro[3]. The first report on Synchronous Luminescence Spectroscopy was given by Lloyed and Vo-Dinh[4]who had provided the basic theory about it. In SLS, both the excitation and emission wavelength are changed simultaneously,with the help of monochromator while keeping a constant wavelength interval between them. . Since it takes the advantages of both the absorption as well as excitation properties of a given compound, it leads to considerable simplification in the fluorescence spectral profile. The SL spectra reveal a more resolved structure from a composite system in contrast to the generally featureless and broadband appearance of the conventional fluorescence spectra. The Synchronous Spectrum is considered to be the characteristic, “fingerprint”, because it is unique for a given system. By the comparison of synchronous spectra of two similar systems, it is possible to reveal and identify differences or anomalies in their composition. The synchronous fluorescence spectroscopy has been developed for multi-component analysis and used to obtain fingerprints of real life samples and for enhancing the selectivity in the assay of complex chemical and biological systems.[5, 6, 7]Diaggaradjaneet_al have performed synchronous fluorescence spectroscopy to characterize DMBA-TPA induced squamous sell carcinoma in misc in vivo. Thus results demonstrated high diagnostic accuracy in differentiating premalignant and malignant conditions from normal tissues when synchronous fluorescence spectroscopy was used in combination with a statically analysis method.[8]

S.Ganesan et_al[9] have reported that in SLS method as the tissues transform from normal to malignant, the concentration of the amino acid residues in the tissues decreases and that of the NADH increases.

Sample Preparation

We have collected a part of the malignant tissue as well as some part of the non malignant tissue from the neighboring portion of the malignant portion of different organs of human both. The samples were collected with the help of doctors. The collected samples are cleaned and blood was completely removed using distilled water. The samples were confirmed histopathologicaly. After performing surgical operation the samples were preserved in icebox immediately to carry to laboratory for recording synchronous luminescence spectra of these tissues.

Experimental set up

A block diagram of the experimental set up for recording polarized synchronous luminescence spectrum is shown in fig.3. Commercial spectra physics fluorometer (SPEX, USA, FLUOROLOG II) was used to record the SLs spectra.

The polarized spectra were recorded by scanning both the excitation and emission monochromator simultaneously at the same speed of 5 nm/s with fixed wavelength separated between them. For these studies wavelength difference between excitation and fluorescence emission was chosen to be 20nm since it led to the most resolved spectra. A xenon lamp of 45w is used as the excitation source. The light from the xenon lamp was incident perpendicular to the sample surface to a spot of size approximately 2mm x 4mm and the emitted light was collected at approximately 20^0 angle with respect to the excitation light. Excitation intensity varied with wavelength but was always less than $40w/mm^2$.

A bundle of seven optical fibers are used as light transporting system. A single central fiber carries light from the source to the sample and six fiber surrounding the central fiber collect the fluorescence signal given by the sample.

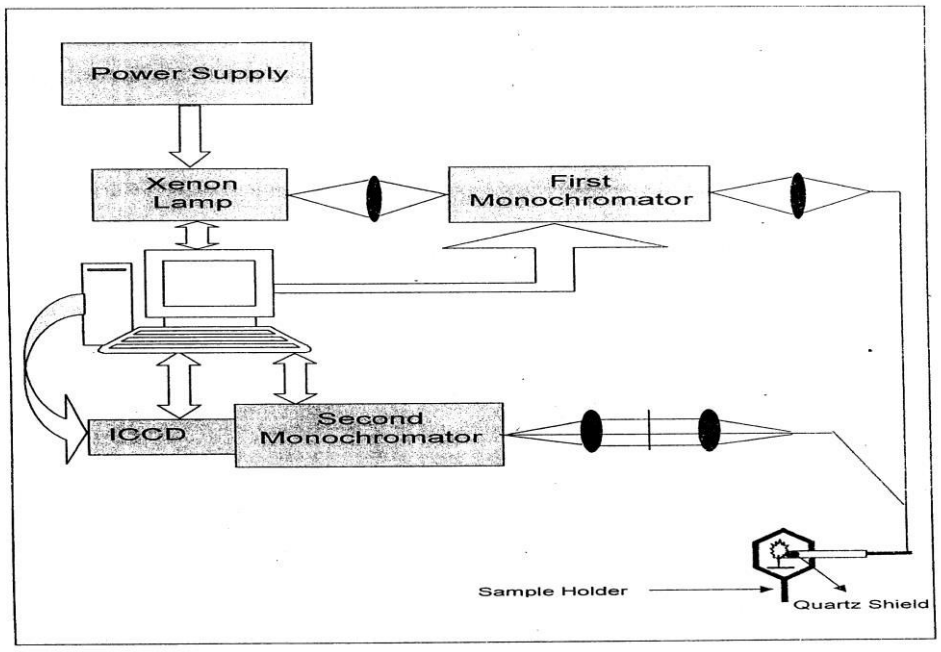

Fig 1: Experimental arrangementfor Synchronous Luminescence Spectroscopy

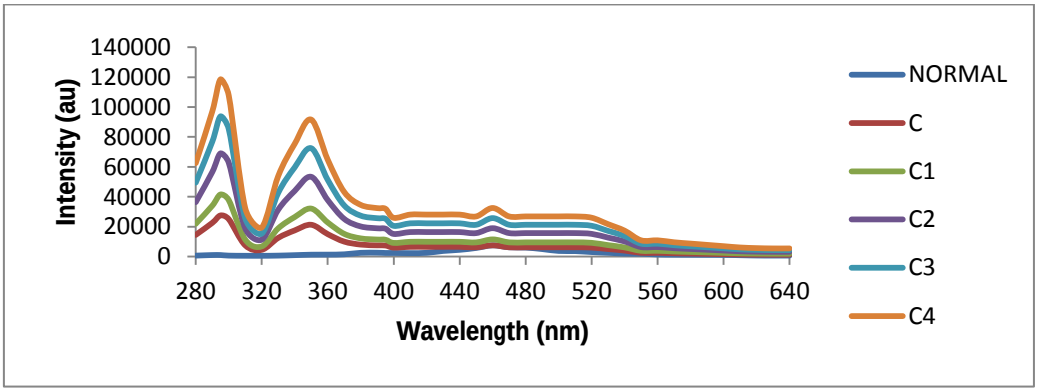

Fig 2(a): Spatial variation of intensity of synchronous luminescence(Sample 1)

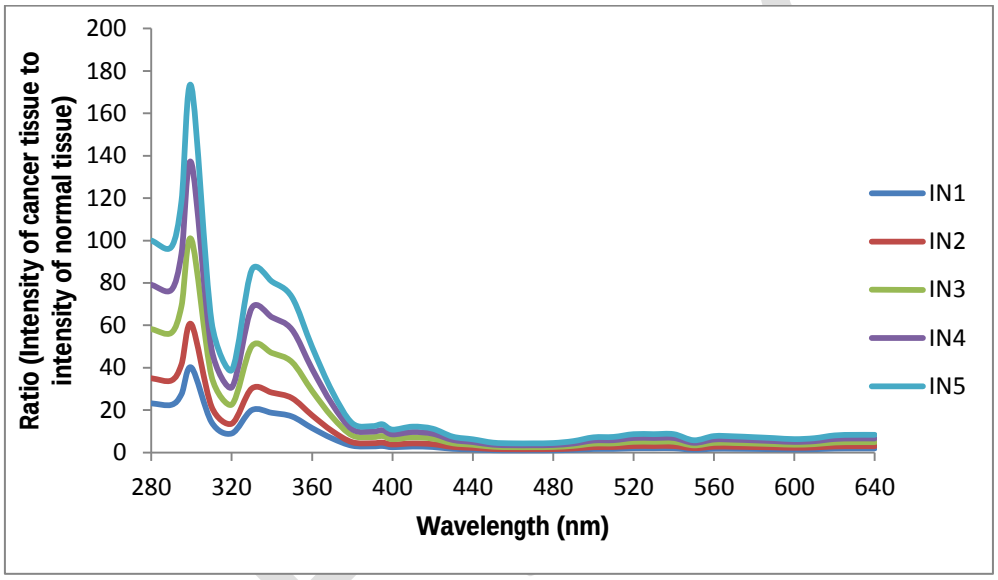

Fig 2(b): Ratio of the intensity of S L emitted by cancer tissue to normal tissue(Sample 1)

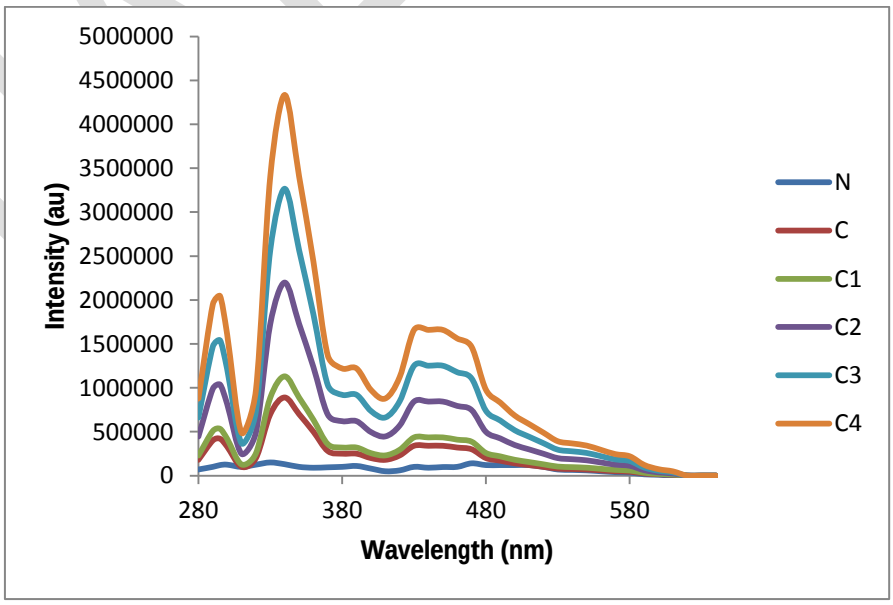

Fig3(a): Spatial variation of intensity of synchronous luminescence (Sample 2)

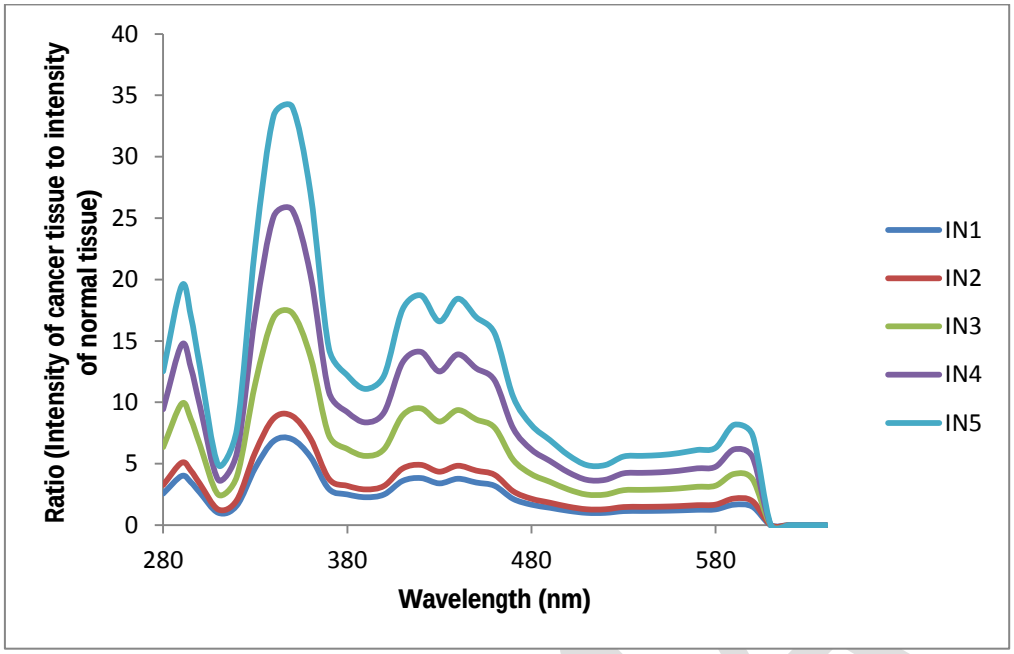

Fig 3(b):Ratio of the intensity of S L emitted by cancer tissue to normal tissue (sample 2)

Result and Conclusion:

Fig 2(a) shows the S.L. spectra of Breast. From the graph it is clear that as the sample shifts towards more malignant part, the luminescence intensity goes on increasing. Thepeaks at 290nm, 350nm and 460nm are more intense which may be attributed to tyrosine, elastin and NADH. We have also plotted a graph of intensity ratio of synchronous luminescence of cancer tissue to normal tissue which is given by Fig.2 (b). The intensity ratio was observed to be larger for the cancerous sample than the corresponding values of the normal tissue.

In Fig 3 (a), we get higher intensity peaks at 350nm, 440nm and 460nm. These are the emission peaks attributed toTrytophan, NADH and NADPH.The reason behind the higher intensity of emitted fluorescence of cancerous tissue is that, the cancerous cells may have more concentration of NADH , elastin, tryptophan, and NAD(P)H (Reduced Nicotinamide Dinucleotide Phosphate).Thus from the above discussion it is clear that, Synchronous Luminescence Spectroscopic technique may be useful in diagnosing the dreadful disease like cancer. Also more study and practical trials will help us to determine its degree of malignancy.

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