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Detection of Malignancy by The Analysis of Energy Band Structure Using Synchronous Luminescence Spectroscopy

KEYWORDS: SL, NADH, Flavin, Tyrosine, Colllagen.

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ABSTRACT *In the present work we have collected statistical data related to cancer and analyzed it. The statistical analysis and data collection shows that in some cases the blood flow may get infected and become foreign material for the body and may cause the cancer. The investigation of Synchronous Luminescence (SL) Spectroscopy becomes the powerful tool in the medical and agriculture field. In this technique, the discrimination potential depends on the various emission and excitation spectra, which could change the tissue morphology and composition due to the repeated exposure during the spectral measurements. The recorded spectra show that their structures are different from each other and from the difference the development of cancer may be clearly identified. From the study of energy band structure it is clear that there is increase in the emission of NADH and Flavin as the tissue progresses from normal to malignant. On the other hand, the emission of tryptophan, tyrosine, collagen and elastin decreases as the normal tissues are transformed into benign and malignant.*

Introduction:

Cancer is an abnormal growth of cells. Cancer cells rapidly reproduce despite restriction of space, nutrients shared by other cells, or signals sent from the body to stop reproduction. Cancer cells are often shaped differently from healthy cells, they do not function properly, and they can spread to many areas of the body. Tumors, abnormal growth of tissue, are clusters of cells that are capable of growing and dividing uncontrollably; their growth is not regulated. Oncology is the study of cancer and tumors. The term "cancer" is used when a tumor is malignant, which is to say it has the potential to cause harm, including death. Generally the cancer is widely diagnosed by the method of biopsy A general method to diagnose a cancer is Biopsy, FNAC, Pop smear etc but all these traditional methods are painful and required more time. Therefore, non invasive, painless and fast diagnostic methods are sought. The diagnosis of cancer by using electromagnetic radiation is non invasive, in vivo and quick. The spectroscopic method of diagnosis may be more accurate and reliable.

In medical field the The Synchronous Luminescence Spectroscopy is successfully employed for the study of the cancer cells in the human tissues. This system is widely used for the analysis of multi-component system. In this system the fluorescence signal is recorded by simultaneously scanning both excitation and emission wavelength. 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 fluorescence spectra emitted by the normal tissues and cancerous tissues differ from each other in many respects. The cancerous tissues in different stages might show different features and therefore we are sure that the different stages of cancer may be detected by the analysis of band structure

EXPERIMENTAL SET UP:

A block diagram of the experimental setup for recording synchronous luminescence spectrum is shown in figure A. Commercial spectra physics fluorometer (SPEX, USA, FLUOROLOG II), which is available in the Raja Ramanna Centre for Advanced Technology, Indore was used to record the SL spectra.

The spectra were recorded by scanning both the excitation and emission monochromator simultaneously at the same speed of 5 nm/s with a fixed wavelength separated between them. For these studies wavelength difference between excitation and fluorescence emission was chosen to be 20 nm since it led to the most resolved spectra. The band pass of both the excitation and emission monochromator was kept 2 nm wide. A xenon lamp of 45 W 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 2 mm x 4 mm 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 40 W/mm^{2}

Results and Discussion:

We have collected some samples of cancerous and normal tissues from different organs of human beings. Then we record the SL spectra of the given samples. Here we are discussing about only one sample of Brest cancer. The SL spectra of normal and malignant tissues are shown in figure (1). The spectra show that the relative intensity of malignant tissue is more than that of normal tissue. The intensity ratio was observed to be larger for the entire cancerous sample than the corresponding values for the normal tissues as shown in figure. (2)

For comparison and reliable diagnosis, we take certain measurements from the recordings of the SL spectra. While measuring the height of the peak, we consider the left hand deep as the base point. The width of the peak is measured at a point where the height of the peak becomes half.

The figures (3) show the band structure of cancer tissue and normal tissue. The cancerous tissues in different stages might show different features and therefore we are sure that the different stages of cancer may be detected by the analysis of band structure.

From the study of band structure, it is observed that there

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is an increase in the emission of NADH, FAD and also increase in haemoglobin, re-absorption as the tissue progresses from normal into benign and malignant. On the other hand, the emission of tryptophan, tyrosine, collagen and elastin decreases as the normal tissues are transformed into benign and malignant.

If more samples are considered and plotted on the graphs, the stage of the cancer may be studied in detail with more reliability and the stages of cancer may be identified.

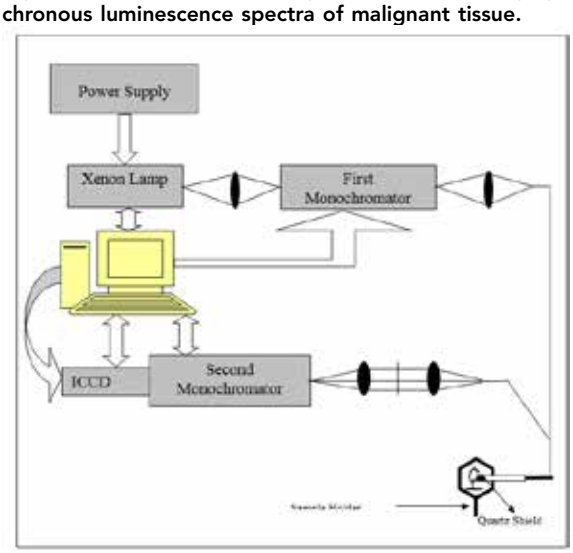
Conclusions:

It is observed that the SL spectra provide a more efficient tool for the characterizing a highly heterogeneous media like tissues. All the SL spectra show that the intensity of cancerous tissues is more than the normal tissue.

From the study of energy band structure, it is clear that there is increasing in the emission of NADH and Flavin as the tissue progresses from normal to malignant on the other hand the emission of tryptophan, tyrosine, collagen and elastin decreases as the normal tissues are transformed in to malignant. The information with regard to all the key fluorophores present in the tissues can be analyzed in a single SL spectrum.

From the statistical analysis it is observed that by using energy band structure, we can achieve better classification accuracy.

Figure A: Experimental arrangement for recording synchronous luminescence spectra of malignant tissue.



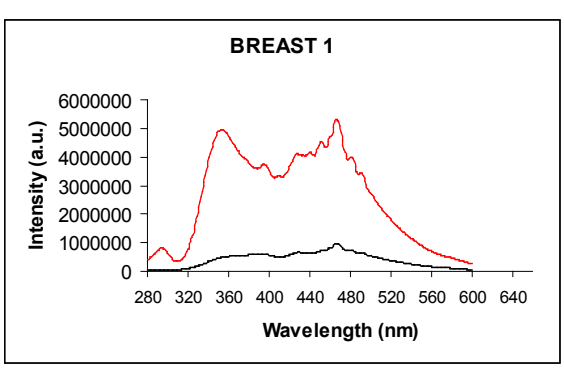


Figure 1: SL spectra of cancer and normal tissue of Breast 1 cancer

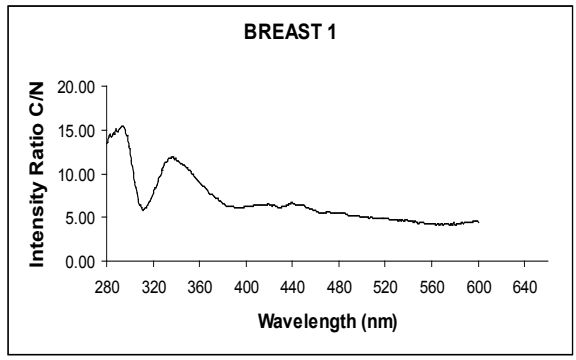


Figure 2: Intensity ratios of C/N of Breast1 cancer in SL spectra

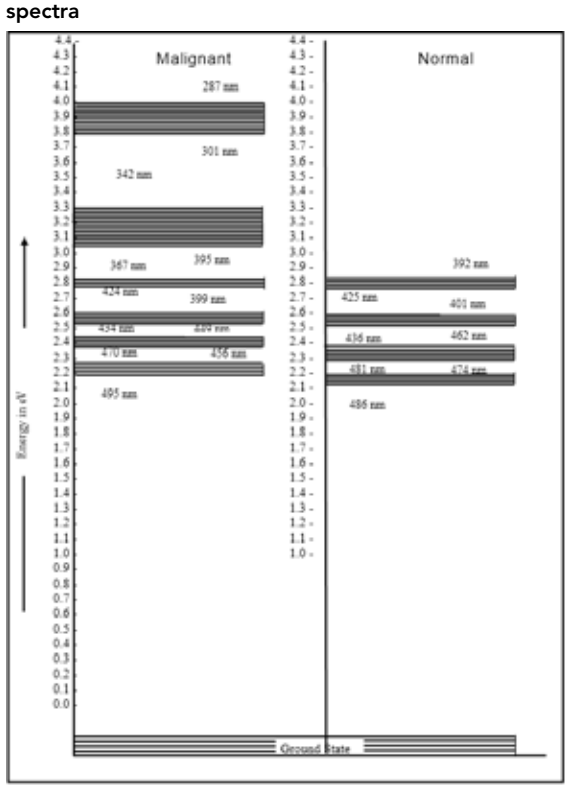


Figure 3: Energy band structure of Breast 1 cancer (SL Spectra)

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