FURTHER STUDY OF SPECTRUM FROM STOMACH CANCER SERUM EMISSION

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***ABSTRACT*-By using laser-induced Raman spectrum technology, we researched the spectrum characteristic of normal human, atrophic gastritis and stomach cancer. Three sharp peaks (A, B and C) can intensity of peak C excited by 488.0nm is higher than excited by 514.5nm in spectrum of stomach cancer, whereas lower in other cases. We utilized it as a criterion and got an accuracy of 80.77% in stomach cancer detection. Results showed that it is available of detection of stomach cancer and pre-stomach cancer.**

***Keywords*: spectrum, stomach cancer, serum**

I. INTRODUCTION

Optical spectroscopy provides a means to characterize various physical and chemical changes occurring in cells and tissues thereby offers exciting possibilities for developing novel noninvasive diagnostic instruments and approaches [1]. Recently, the intrinsic photo-physical properties of bio-molecules and bio-structures have been considered as a possible parameter which may be related to the morpho-functional state of the biological substrate[2~4]. And there has been considerable interest in native fluorescence spectrum of serum for early cancer detection, especially laser-induced spectrum [5-8]. With different wavelength excitation and experimental setup, they investigated serum and presented much instructive information for cancer diagnosis according to spectral features. A point of view, which has been generally accepted is that porphyrin derivatives can be concentrated in serum of cancerous patients. Then it is possible for us to diagnose early cancer by means of detecting the characteristic peaks of porphyrin derivatives.

However, the precise detection of early cancer in clinic continues to be a challenge. A lot of questions (such as the spectral distinctions between different cancer, the origin of serum fluorescence, and the influence of circumstance and laser power on serum spectrum etc.) have to be solved in order to improve the diagnosis accuracy of laser induced fluorescence spectroscopy (LIF).

In our previous researches on spectrum of cancerous serum, we found that the spectrum of stomach cancer had three slight sharp peaks, whereas other cancer cases (such as lung cancer, liver cancer, rectum cancer, esophagus cancer and pancreas cancer) hadn't. This difference may account for the metabolic specialities during stomach cancer evolution and have valuable information for detection of stomach cancer. For this reason, further researches were performed. In this paper, we recorded and investigated a number of spectra from different specimens emission in an attempt to find a applicable method for stomach cancer diagnosis, characterize all spectra except esophagus cancer. The intensity of each peak was different in different spectrum. And we differentiated the spectrum of these three cases. A notable difference is that the relative

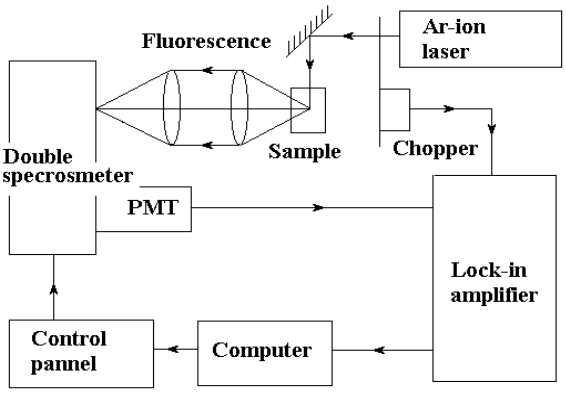

Fig.1: instrument

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Abstract

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II. MATERIAL AND METHODS

A. *Samples and Instrument*

Forty-five selected samples were studied, and were composed of seven normal cases, eight stomach cancers (before operation), six stomach cancers (after operation), fifteen atrophic gastritis and nine esophagus cancers. All specimens were obtained from Hospital of Dalian University of Technology and Tumor Hospital of Liaoning Province and have been exactly diagnosed in clinic.

The experimental setup is shown in Fig.1. An Ar-ion laser is used as the source of excitation light (488.0nm and 514.5nm). After modulation by a chopper (modulation frequency is 700HZ), the laser beam is reflected into the sample (pass through cuvette lengthways from the mouth of cuvette to the bottom). In the vertical direction of beam, fluorescence and Raman spectrum was focused by a lens into a double spectrometer (it can be precisely controlled by computer) equipped with a PMT. And after amplified by a lock-in amplifier, spectral data were input into a computer and transacted.

B. . *Data Acquisition*

The fluorescence and Raman spectra cover the range of 520nm~640nm or 500nm~620nm with a resolution of $2cm^{-1}$. Three spectra were recorded for each sample. The first is excited by 514.5nm ranging from 520nm to 640nm; the second, excited by 488.nm ranging from 500nm to 620nm; and the third is excited by 514.5nm ranging from 520nm to 640nm after samples are radiated by laser. Due to the tardy of lock-in amplifier, computer should wait for a moment before input spectral data when step motor of spectrometer comes to the accurate position. And at a position, several data are sampled, and then average value is recorded.

III. RESULTS AND DISCUSSION

Of seven normal cases, six exhibit three relatively strong sharp peaks (A, B and C). A typical one is shown in Fig. 2. And the residual one has not, we thought, accounting for the bad quality of serum. Additionally, there is a broad, featureless fluorescence band centered at 547nm. After laser radiated samples, the intensity of fluorescence decreased along with red shift of its band center and increase of relative intensity

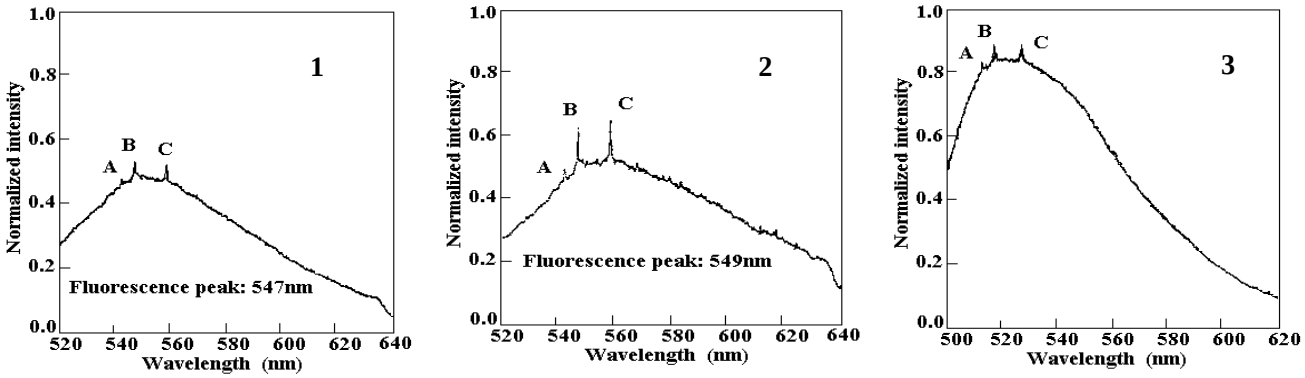

Fig. 2 normalized spectra of normal case (In Fig.4.1~3.5, **1**: excited by 514.5nm; **2**: excited by 514.5nm after samples radiated by laser; **3**: excited by 488.0nm)

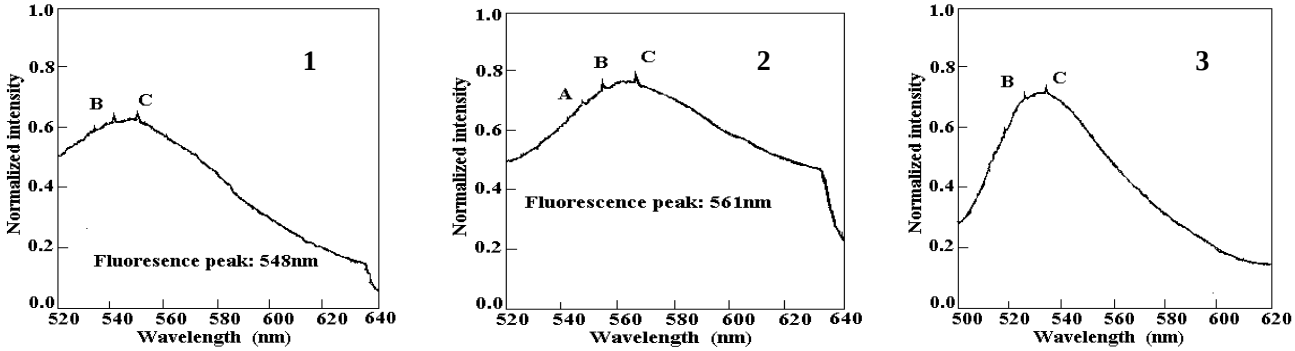

Fig.3. Normalized spectra of stomach cancer (after operation)

at wavelength 634nm nearby in spectrum excited by 514.5nm. Such features we described above also appear in spectrum of stomach cancer (after operation) except its broad fluorescence peak centers at 548nm (see Fig. 3). It indicated that two kinds of samples had similar components and the abnormal metabolism of tumor cells was refrained after operation. Latter examinations in clinic proved that the operation was very successful.

Fig. 4 and Fig.5, three sharp peaks were observed, and the intensity of them is lower in contrast to normal cases. But the spectrum of esophagus cancer only has a broad fluorescence band centered at 545nm, without any sharp peaks (see Fig.6). Just as normal cases, spectra **2** of stomach cancer (before operation), atrophic gastritis and esophagus cancer all change remarkably, both spectral shape and intensity distribution compared with spectra **1**. However, a notable difference is that the red shift of fluorescence peak (Äë) is often bigger than 12nm in them whereas less than 12nm in normal cases I and stomach cancer(after operation). Table 1 lists the statistical results. Another distinction is the ratio (á) between relative intensity at 520nm and at 634nm in spectrum **2**

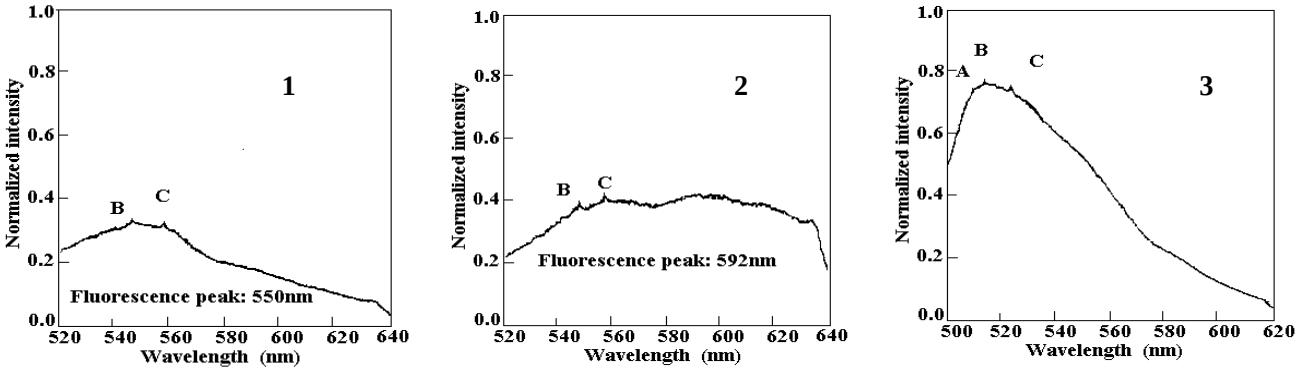

Fig.4. Normalized spectra of stomach cancer (before operation)

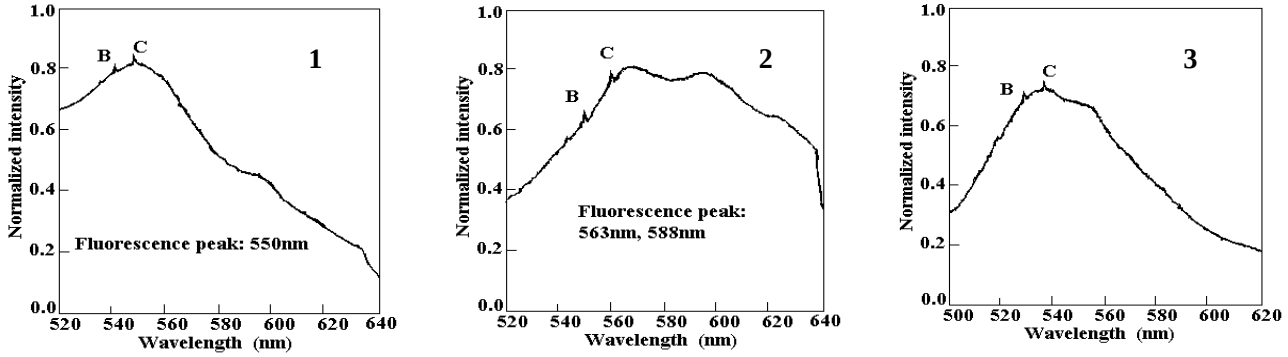

Fig.5. Normalized spectra of atrophic gastritis

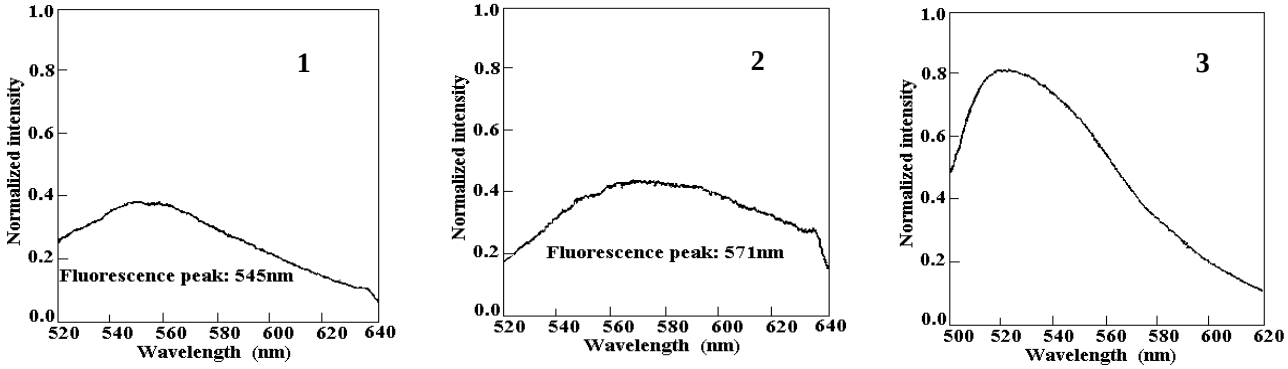

Fig..6. normalized spectra of esophagus cancer

Table 1: statistical results of samples' spectra

		normal cases	Stomach cancer (after operation)	stomach cancer (before operation)	atrophic gastritis	esophagus cancer
Äë	>12nm	0	1	8	14	9
	<12nm	7	5	0	1	0
á	>0.8	6	6	1	2	0
	<0.8	1	0	7	13	9
â	>1.0	7	5	0	14	

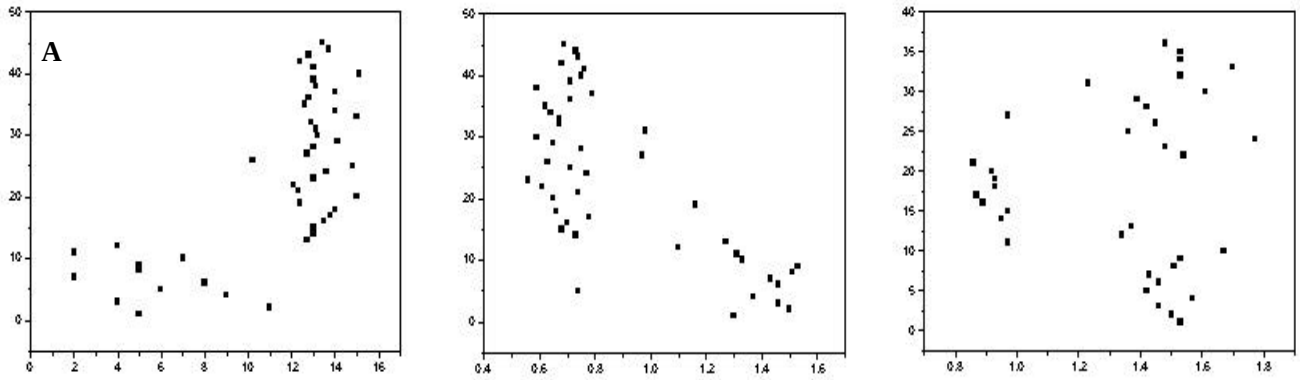

Fig.7. distributions of red shift Äë (**A**), ratio á (**B**) and ratio â (**C**)

X coordinate axis – the number of samples

Y coordinate axis -- red shift Äë (**A,** unit: nm), ratio á (**B**) and ratio â (**C**) respectively

(see Table 1). For normal cases and stomach cancer (after operation), á usually bigger than 0.8, and in others, less than 0.8. Using Äë or á, we can only differentiate stomach cancer from normal cases and stomach cancer (after operation), but with exceptions. Other features should be found to distinguish stomach cancer from atrophic gastritis.

Therefore, basing on the analysis of spectra, we introduced another parameter â, ratio between the relative intensity of Raman peak C using 514.5nm and 488.0nm excitation. Experimental data showed that â was an applicable parameter for demarcation between stomach cancer and atrophic gastritis. In the course of this study, several critical values of three parameters Äë, á and â were chosen for statistic. Comparison showed the best values were 12nm, 0.8 and 1.0 respectively. Fig.7 shows the distributions of these parameters. We utilized â<1.0 as a criterion and got an accuracy of 80.77% in stomach cancer detection. In clinical medicine, atrophic gastritis is viewed as a kind of pathological change before stomach cancer. And the similarities of them in spectrum after samples are radiated by laser, to some extent, indicate that there are many identical components in their serum.

Though it is observed that the serum native fluorescence spectra of stomach cancer cases are distinctly different from that of atrophic gastritis cases, it should be noted that the fluorescence spectra of other types of stomach diseases had not been investigated, and whether â is the real distinction between stomach cancer and other stomach diseases should be testified by more researches on the serum native fluorescence spectra of other stomach diseases.

IV. CONCLUSION

We investigated spectra of normal, stomach cancer (both before and after operation), esophagus cancer and atrophic gastritis sera for stomach cancer detection. Results demonstrate several points. First, spectra of different samples exhibit different features, but we can not differentiate them from each other at once; Second, of three parameters we have introduced, â is the best one that can differentiate stomach cancer from other cases, especially from atrophic gastritis. Therefore, we suggest that native fluorescence spectroscopy of blood

plasma may be used as a potential method to discriminate stomach cancer subjects from normal and other stomach diseases group. However, spectra of other stomach diseases have not been measured, and extensive studies with more number of cases have to be carried out to examine the repetition of such difference features between different samples.

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