# Detection of breast cancer by near infrared absorption and excitation

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## Introduction

Breast cancer is a world-wide and frequent disease whose fatal outcome can only be prevented by an early diagnosis. The near infrared (NIR) and Fourier transform (FT) Raman spectroscopies, respectively based on near infrared light absorption and excitation, have already been used as clinical subsidiary diagnosis tools for breast cancer.[1,2]

The purpose of this study is to confirm the possibility of using the NIR and Raman spectroscopies to detect the presence of cancer cells in breast tissue in correlation with the histo-pathological diagnosis.

## Material and methods

75 cases of breast carcinoma were used in this study. Among them 27 cases are invasive ductal carcinoma, 16 cases are invasive ductal carcinoma with a predominant intraductal component, seven cases are invasive lobular carcinoma *in situ* and two cases are mucinous carcinoma. The specimens were obtained from breast resection (lumpectomy and mastectomy). For each case at least one sample was taken in surrounding tissue corresponding to macroscopically normal fibroglandular area and one in the non-necrotic carcinomatous tissue. The size of the sample was about $1.2 \times 1.2 \times 0.2$ cm. From each sample approximately three cryostat sections of 50 mm thick were sliced and simply adhered to a coverslip by a classical method and then air-dried at room temperature for 24 hours.

The dried tissue sections and their supports were centred between a glass fibre filter, Millipore AP40047, as a background and a 50 mm diameter glass window, then were set in an usual reflectance sample cup. NIR spectra of the tissue were recorded every 2 nm from 1100 to 2500 nm by a Pacific Scientific model 6250 spectrometer. The reflectance $\log(1/R)$ spectra were recorded and processed with the NSAS software version 3.30 of NIR Systems on an IBM personal computer. Raman spectra were collected using a Perkin Elmer FT-IR 2000R.

## Results and discussion

A typical set of NIR and FT-Raman spectra of invasive ductal carcinoma is shown in Figures 1 and 2, which present one section of normal tissue and one section of carcinomatous tissue. In some parts of the spectral ranges, a relative similarity is observable among the spectra obtained from different sections of normal tissue while the corresponding spectra of carcinomatous tissue are variable, diverging from that of the normal tissue. The spectral profile of normal tissue is similar in these parts for all the studied samples.[3]

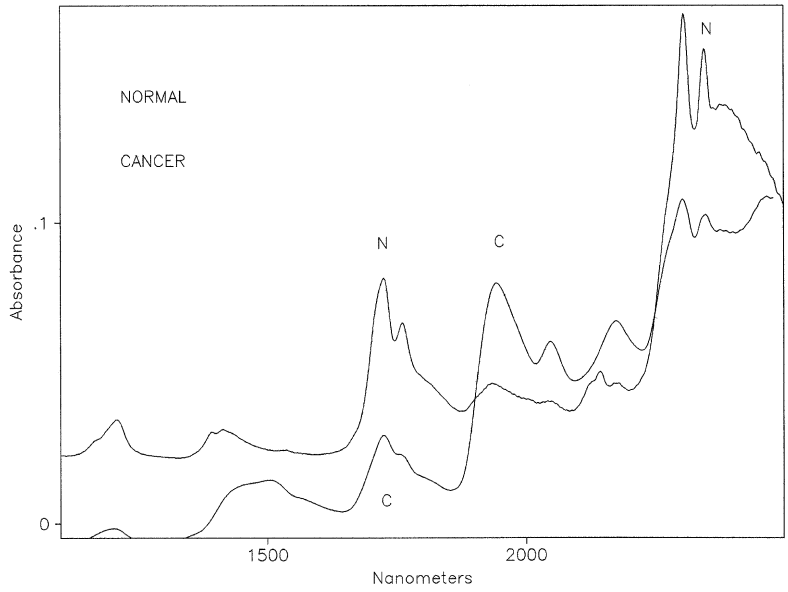


**Figure 1. NIR spectra of representative normal (N) and cancer (C) breast tissues.**

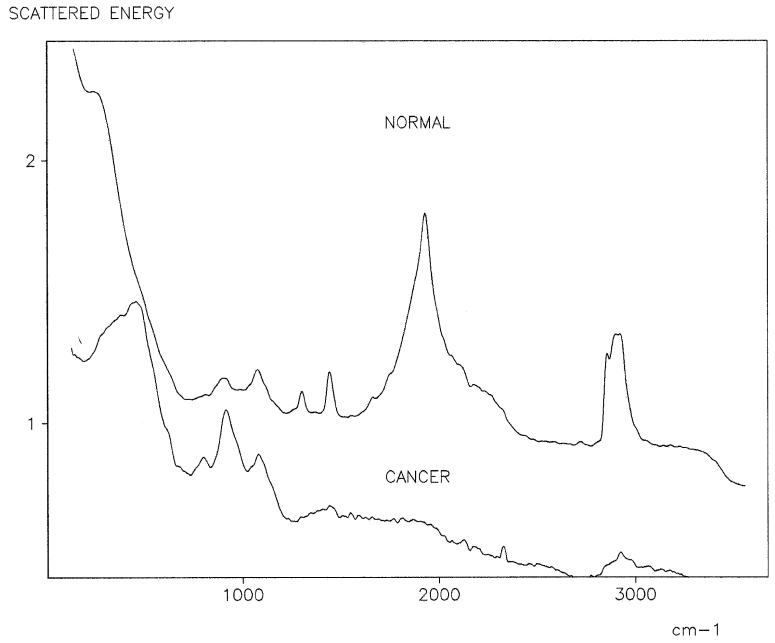


**Figure 2. FT-Raman spectra of normal and cancer breast tissues.**

A comparison of the mid infrared spectra obtained in another study of Meurens *et al.*,[4] on the same samples, has shown that the main differences of infrared spectra between cancerous and normal tissues are due to nucleic acids and proteins which are more abundant in cancerous tissues.

Correlation models between morphometrical data such as the volume density of malignant cells (VDMC) and the NIR data have been calculated. High correlation coefficients ($r > 0.9$) and acceptable standard deviations (%) were obtained in different multivariate approaches.

The need to dry the samples before NIR and Raman spectroscopy has been tested in comparing the wet and dry sample presentations. We have observed that a simple subtraction of water spectrum could advantageously replace the physical drying applied to all the samples since the beginning of our study. Now we have to confirm this important simplification in the application of NIR and Raman spectroscopy to breast cancer detection.

## Conclusion

This study clearly demonstrates the possibility of using NIR absorption and excitation spectroscopy as an accurate and rapid technique to distinguish between normal and cancer breast tissues. It seems that for NIR, as for Raman spectroscopy, it is possible to directly detect cancerous cells "*in situ*" and "*in vivo*" in breast tissues without any sample preparation.

## References

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