

Claims

1. A method for analysing a sample obtained from a subject, comprising the steps of:

- a) ~~providing a spectrum or spectra produced by spectrally scanning the sample using a single element ATR infrared spectroscopy having a macroscopic spatial resolution technique, the spectrum being an average spectrum over a substantial part of 1 mm or more the sample;~~
- b) ~~identifying one or more target-tissue types in the sample in dependence on reference spectra produced by~~ according to the spectrum each such target-tissue type produces; wherein the identifying comprises a combination of steps of:
 - (i) assigning the spectrum to either a {non-dysplastic or high-grade-dysplastic or cancerous} classification or a {squamous} classification;
 - (ii) assigning a {non-dysplastic or high-grade-dysplastic or cancerous} spectrum to either an epithelial classification or a lamina propria classification;
 - (iii a) assigning an epithelial spectrum to either {a non-dysplastic} classification or {a high-grade-dysplastic or cancerous} classification;
 - (iii b) assigning a lamina propria spectrum to either a {non-dysplastic} classification or a {high-grade-dysplastic or cancerous} classification; and
- c) determining the presence or absence of a specified disease and/or disease state depending on whether ~~one or more target~~ high-grade-dysplastic or cancerous tissue types are identified in the sample.

2. A method according to claim 1, wherein ~~the spectrum or spectra is from an ATR-FTIR spectrometer~~ assigning the spectrum under step (i) to either the {non-dysplastic or high-grade-dysplastic or cancerous} classification or the {squamous} classification is on the basis of {1385-1235 and 1192-1130 cm⁻¹} spectral regions and/or the spectral region around 1153 cm⁻¹.

3. A method according to claim 1 or claim 2, wherein ~~the sample is a sample of epithelial tissue~~ assigning a {non-dysplastic or high-grade-dysplastic or cancerous} spectrum under step (ii) to either the epithelial classification or the lamina propria classification is on the basis of the spectral region around 1570 cm⁻¹ and/or a 1610-1465 cm⁻¹ spectral region.

4. A method according to claim 3, wherein ~~the epithelial tissue is from the esophagus~~ assigning an epithelial spectrum under step (iii a) to either the {non-dysplastic} classification or the {high-grade-dysplastic or cancerous} classification is on the basis of a 1200-900 cm^{-1} spectral region, preferably a 1100-900 cm^{-1} spectral region, further preferably the spectral regions around 1082, 1043, and 974 cm^{-1} .

5. A method according to any preceding claim, wherein ~~the method includes the step of obtaining the spectrum or spectra~~ assigning a lamina propria spectrum under step (iii b) to either the {non-dysplastic} classification or the {high-grade-dysplastic or cancerous} classification is on the basis of {1290-1210 and 1130-870 cm^{-1} } spectral regions, preferably the spectral regions around 1221 and 1047 cm^{-1} .

6. A method according to any preceding claim, wherein ~~the target tissue types include healthy and non-healthy tissue types, tissues with different cell types and/or tissues associated with a disease state~~ the identifying further comprises combining classification results from two spectra, one from each side of the sample.

7. A method according to any preceding claim, wherein the sample is epithelial tissue from the esophagus.

8. A method according to any preceding claim, wherein the method also comprises the step of shifting or calibrating the spectra to take into account the hydration of the sample ~~or any drug or other pharmaceutical agent or any other agent that may have been administered to the subject prior to sampling.~~

9. A method ~~for diagnosing a disease state in a subject, comprising analysing a sample from the subject using the method of any of claims 1 to 7, wherein the presence of non-healthy tissue types having a particular disease state is indicative of the subject having the disease state~~ according to any preceding claim, wherein step b) is performed by comparing the spectrum to a reference data set.

10. A method according to any preceding claim 9, wherein ~~the spectroscopy technique is single element ATR-FTIR spectroscopy~~ the reference data set are spectra of samples with a known specified disease and/or disease state produced using a spectroscopy technique

with microscopic resolution.

~~1011. A method according to any preceding claim, wherein the sample is a biopsy and the spectrum or spectra are from either side of the biopsy~~ the sample comprises two or more constituent tissue types, including a predominant tissue type and at least one minority tissue type.

~~11. A method according to any preceding claim, wherein the reference spectra are produced using infrared spectroscopy techniques having microscopic resolution.~~

~~12. A method according to any preceding claim, wherein the target tissue types include a precancerous tissue type.~~

~~13. A method according to any preceding claim, wherein the target tissue types include a dysplastic tissue type.~~

~~14. A method according to any preceding claim, wherein the target tissue types include an epithelial tissue type.~~