CLAIMS

1. A probe head for a diagnostic instrument, the probe head comprising;

a transmission optical fiber having an end face configured to output light;

a plurality of collection optical fibers, each of which has a bevelled end; and

a lens spaced a distance d apart from the end face of the transmission optical fiber and configured to transmit light from the transmission optical fiber into epithelial tissue and stroma tissue at a test site, wherein the distance d is less than 1000µm,

wherein the end faces of the collection optical fibers are bevelled such that the bevelled end faces of each collection optical fiber ~~comprises an end face~~are disposed at an angle β relative to a plane perpendicular to a longitudinal axis of the ~~colleciton~~ collection optical fiber, wherein the angle β is in the range of 10° to 25° and the end faces of the collection optical fibers are angled in a direction toward the transmission optical fiber, and

~~wherein the distance d and the angle β are selected such that the plurality of collection optical fibers selectively collects Raman photons from epithelial tissue layers while excluding photons from other tissue layers and while excluding autofluorescence photons~~

wherein the lens includes a central band-pass filter and a long-pass filter being on the lens, wherein the long-pass filter surrounds the central band-pass filter.

~~2. The probe head according to claim 1 wherein a number of collected Raman photons originating in epithelial tissue layers rather than stroma tissue layers increases as the angle β increases and the spacing d increases.~~

~~3. The probe head according to claim 1 wherein the end face of each of the plurality of collection optical fibers is angled in one of a direction away from the transmission optical fiber and a direction toward the transmission optical fiber.~~

~~4. The probe head according to claim 3 wherein the angle of the end face of each collection optical fiber is in the range 0° to 25°.~~

~~5. The probe head according to claim 4 wherein the angle of the end face of each collection optical fiber is in the range 0° to 20°.~~

Formatted: Normal

Formatted: Normal

~~6~~2. The probe head according to claim 5 wherein the angle of the end face of each collection optical fiber is in the range 10° to 15°.

~~7. The probe head according to claim 1 wherein the distance d from the lens to an end face of the transmission optical fiber is less than 1000µm.~~

~~8~~3. The probe head according to any one of the preceding claims wherein the collection optical fibers are arranged in a ring around the transmission optical fiber.

~~9~~4. The probe head according to any one of the preceding claims wherein the lens comprises one of a ball lens, a convex lens, a biconvex lens, an axicon lens and a gradient index lens.

~~10. The probe head according to any one of the preceding claims, further comprising a narrowband filter associated with the transmission optical fiber.~~

~~11. The probe head according to claim 12 wherein the narrowband filter comprises a filter disposed on one of the distal end of the transmission optical fiber, the lens, and a plate located between the transmission optical fiber and the lens.~~

~~12. The probe head according to any one of the preceding claims further comprising a long-pass filter associated with the collection optical fibers.~~

~~13. The probe head according to claim 12 wherein the long-pass filter is disposed on one of; the distal ends of the collection optical fibers, the lens, and a plate located between the collection optical fibers and the lens.~~

~~14~~5. A diagnostic instrument comprising;

a monochromatic light source,

a probe head comprising:

a transmission optical fiber having an end face configured to output light received from the monochromatic light source;

a plurality of collection optical fibers;

a lens spaced a distance d apart from the end face of the transmission optical fiber and configured to transmit light from the transmission optical fiber into epithelial tissue and stroma tissue at a test site, wherein the distance d is less than 1000µm,

wherein the end faces of the collection optical fibers are bevelled such that the bevelled end faces of each collection optical fiber ~~comprises an end face~~are disposed at an angle β relative to a plane perpendicular to a longitudinal axis of the collection optical fiber, wherein the angle β is in the range of 10° to 25° and the end faces of the collection optical fibers are angled in a direction toward the transmission optical fiber, ~~and~~

~~wherein the distance d and the angle β are selected such that the plurality of collection optical fibers selectively collect Raman photons from epithelial tissue layers while excluding photons from other tissue layers and while excluding autofluorescence photons; and~~

wherein the lens includes a central band-pass filter and a long-pass filter being on the lens, wherein the long-pass filter surrounds the central band-pass filter;

a spectral analysis apparatus to receive light from the collection optical fibers,

wherein the spectral analysis apparatus further comprises a grating element and a light-sensing apparatus, wherein the grating element is arranged to diffract light onto an area of the light-sensing apparatus.

~~15~~6. The diagnostic instrument according to claim ~~14~~ 5 further comprising an instrument head to receive the probe head, wherein the probe head extends beyond an end of the instrument head to permit the lens to be placed in direct contact with tissue.

~~16~~7. The diagnostic instrument according to claim ~~15~~ 6 wherein the grating element comprises one of a transmission grating and a reflection grating.

~~17~~8. The diagnostic instrument according to any one of claims ~~14~~ 5 to ~~16~~ 7 further comprising a processing apparatus, the processing apparatus being operable to receive data from the light- sensing apparatus and generate an output comprising a spectrum.

~~18~~9. The diagnostic instrument according to claim ~~17~~ 8 wherein~~, where~~ the light-sensing apparatus comprises a sensor array and the data comprises pixel values.

~~19~~10. The diagnostic instrument according to claim ~~18~~ 9 wherein the processing apparatus is configured to check the received data for saturation and reject the received data if saturation is found.

~~20~~11. The diagnostic instrument according to claim ~~18~~ 9 or claim 10~~19~~ wherein the processing apparatus is configured to generate the spectrum by way of binning corresponding pixels of the received data, subtracting a background signal from the received data, and smoothing the received data from which the background signal was subtracted.

~~21~~12. The diagnostic instrument according to claim ~~20~~11, wherein the processing ~~unit~~ apparatus is further configured to generate the spectrum by way of fitting a polynomial curve to the smoothed received data and subtracting the fitted curve from the smoothed received data.

~~22. The diagnostic instrument according to any one of claims 17 to 21, wherein the processing unit is operable to check the spectrum for contamination and determine if the spectrum is valid, and in the event the spectrum is valid classify the spectrum as corresponding to healthy or abnormal tissue and generate an output accordingly.~~