Claims

1. A method of identifying a structure in a sample comprising:

providing a sample holder having an upper surface face and a lower surface, the upper surface having a plasmonic layer associated therewith, the plasmonic layer including a periodic array of sub-micron structures;

applying the sample to the upper surface of the sample holder;

illuminating the sample with light so that said light interacts with the sample and sample holder;

forming an image using said light, after interaction of said light with said sample and sample holder, wherein at least one localised structural property of the sample is visible in the image based on the colour of the received light; and

identifying the structure from the image based at least partly on its colour.

2. The method of claim 1, wherein the sample is a biological sample.

3. The method of ~~either of~~ claim~~s~~ 1 or claim 2, wherein the localised structural property of the sample is a local dielectric constant or refractive index.

4. The method of any ~~one of the~~ preceding claim~~s~~, wherein in the image, structure in the sample with a given dielectric constant or refractive index appears in a corresponding colour range.

5. The method as claimed in any ~~one of the~~ preceding claim~~s~~, wherein the structure includes a cell, group of cells, part of a cell, interstitial space between cells.

6. The method as claimed in any ~~one of the~~ preceding claim~~s~~, ~~wherein the method~~ includinge~~s~~ any one or more of the following steps to enable identification of the structure and or identification of a characteristic of the sample:

- ~~V~~visualising the morphology of the structure;
- v~~V~~isualising the presence of the structure;
- ~~V~~visualising a region of the sample having an absence of a structure;
- v~~V~~isualising an absolute or relative size of a structure.

7. The method as claimed in any ~~one of the~~ preceding claim~~s~~, ~~wherein the method~~ includ~~ing~~~~es~~ selecting a property of at least one of, the illumination or the sample holder to cause the selected localised structural property of the sample to be visible in the image in a predetermined colour or range of colours of received light.

8. The method as claimed in claim 7, wherein one or more of the following properties is selected:

a polarisation of the illumination;

the period and/or size and/or shape of the periodic array of sub-micron structures; and

the thickness and/or material comprising the plasmonic layer;

9. The method as claimed in any ~~one of the~~ preceding claim~~s~~, wherein ~~the~~ the structure to be identified appears in a given colour.

10. The method as claimed in claim 9, wherein the structure appears in an expected colour band to aid identification.

~~11. The method as claimed in any one of the preceding claims wherein the sample is thicker than a characteristic decay length of the plasmonic layer.~~

~~12~~11. The method as claimed in any ~~one of the~~ preceding claim~~s~~, wherein the sample is substantially transparent.

~~13. The method as claimed in any one of the preceding claims wherein the the structure to be identified is an indicator of cancer.~~

~~14~~12. The method of any one of the preceding claims wherein the structure is a cancer cell, part of a cancer cell, group of cancer cells, neoplastic cell, healthy cell, cell of a given type, indicator of cell state, parasite, group of cells, abnormal cell, infected cell, tissue of a given type.

~~15~~13. A method of feature differentiation in a biological sample wherein ~~the~~ a feature in the sample potentially has compromised or atypical morphology; the method including:

providing a sample holder having an upper surface face and a lower surface, the upper surface having a plasmonic layer associated therewith, the plasmonic layer including a periodic array of sub-micron structures;

applying the biological sample to the upper surface of the sample holder;

illuminating the sample with light so that said light interacts with the sample and sample holder;

forming an image using said light, after interaction of said light with said sample and sample holder, wherein at least one localised structural property of the biological sample is visible in the image based on the colour of received light to thereby enable the feature to be differentiated from its surroundings based on its colour in the image.

~~16~~14. The method of claim ~~15~~ 13, ~~wherein the method~~ includinges verifying the feature based on morphology.

~~17~~15. The method as claimed in any ~~one of the~~ preceding claim~~s, which~~ further includinge any one or more of the following:

~~Colour~~ colour filtering the image to selectively process a colour band of the image;

~~Determining~~ determining a colour distribution or colour histogram of the image;

~~Performing~~ performing a feature extraction method to identify one or more structures in the image;

~~Processing~~ processing a digital image with an image recognition system.

~~18~~16. A method of identifying a sign of cancer in a sample, comprising;

providing a sample holder having a plasmonic layer including a periodic array of sub-micron structures;

placing the sample on the sample holder adjacent the plasmonic layer;

illuminating the sample and sample holder and forming an image thereof to enable a structure in the sample to be visualised, wherein the image exhibits spatial colour contrast in the image of the sample depending on the localised dielectric constant of the sample; and

identifying one or more features of the sample in the image~~s~~ at least partially based on the colour of the feature;

determining if one or more characteristics of the feature are a sign of cancer.

~~19~~17. A method as claimed in claim ~~18~~ 16, wherein the one or more features of the sample in the image~~s~~ that are characteristic of cancer are seen in the same colour, or a narrow colour band.

~~20~~18. A method of determining a state of at least one cell in a sample, the method including:

providing a sample holder having a plasmonic layer including a periodic array of sub-micron structures;

placing the sample on the sample holder adjacent the plasmonic layer;

illuminating the sample and sample holder and forming an image thereof to enable a structure in the sample to be visualised, wherein the image exhibits spatial colour contrast in the image of the sample depending on the localised dielectric constant of the sample; and

determining a state of at least one cell based at least partially based on the colour of the at least one cell in the image.

~~21~~19. The method of claim ~~20~~ 18, ~~wherein the method~~ includinges~~,~~ determining a disease state of at least one cell.

~~22~~20. The method of ~~either of~~ claim~~s~~ ~~20~~ 18 or claim ~~21~~ 19, wherein the sample contains a plurality of cells of the same type and the method includes distinguishing at least one cell from cells of the same type based on based a colour contrast between the at least one cell and cells in the plurality of cells.

~~23~~21. The method of ~~either of~~ claim~~s~~ ~~20~~ 18 or claim ~~21~~ 19, wherein the sample contains a plurality of cells of different types and the method can includes distinguishing at least one cell of one or more types within the plurality of cells based a colour contrast between the at least one cell and cells in the plurality of cells.

~~24~~22. The method of ~~either or~~ claim~~s~~ ~~22~~ 20 or claim ~~23~~ 21, ~~wherein the method~~ includinges distinguishing at least one cell that is abnormal within the plurality of cells.

~~25~~23. The method of any one of claims ~~20~~ 18 to ~~24~~ 22, ~~wherein the method~~ includinges distinguishing at least one cell having ~~in~~ a benign abnormal state within the plurality of cells.

~~26~~24. A system for forming an image using the method of any one of claims 1 to 23, said system including~~:~~

a microscope having an image forming system, an illumination system, and sample holder having an upper surface and a lower surface, the upper surface having a

plasmonic layer associated therewith, the plasmonic layer including a periodic array of sub-micron structures.

~~27~~25. The system of claim ~~26~~ 24 ~~which~~ includinges ~~es~~ an image capture system to generate a digital image of the sample.

~~28~~26. The system of ~~either of~~ claim~~s~~ ~~26~~ 24 or claim ~~27~~ 25 ~~wherein the system is~~ adapted for use in a method as claimed in any one of claims 1 to ~~25~~23.