CLAIMS

What is claimed is:

1. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics fixed with respect to the diffuser, which receive light from the diffuser and form orthogonal polarization components of the light, wherein the front optics and birefringent optics combined form fringe generating optics which generate interference fringes, and the orthogonal polarization components have a phase difference which varies with an angle of incidence of the light received by the birefringent optics;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.

2. The spectrometer of claim 1 wherein the camera is adapted to generate a signal corresponding to the received interference fringes created by the fringe generating optics which corresponds to a plurality of interferograms within a single image; and

the processor is adapted to calculate the spectral signature of the object by performing a Fourier Transform of each of the plurality of interferograms and by taking an average of the Fourier transforms of the interferograms.

3. The spectrometer of claim 1 wherein the diffuser comprises one of:

a layer separate from the birefringent optics having a rough ground optical surface;

a rough ground front surface of a first polarizer of the birefringent optics; and

a micro-lens lenticular array.

4. The spectrometer of claim 1 further comprising a housing for the front optics and birefringent optics.

5. The spectrometer of claim 4 or the fringe generating optics of claim 20 wherein the housing is formed as one of:

part of a device cover; and

built into a mobile device.

6. The spectrometer of claim 5 wherein the housing is adjustable between an operational position where the birefringent optics are positioned in front of the camera, and a nonoperational position where the birefringent optics are not positioned in front of the camera.

7. The spectrometer of claim 6 wherein the housing comprises an external attachment adapted to be placed on the mobile device.

8. The spectrometer of claim 4 or the fringe generating optics of claim 20 further comprising a light diffuser adapted to diffuse light from a light source.

9. The spectrometer or the fringe generating optics of claim 8 wherein the light source is a flash light of a mobile device.

10. The spectrometer or the fringe generating optics of claim 9 wherein the light diffuser is positioned in the housing.

11. The spectrometer of claim 1 or the fringe generating optics of claim 20, wherein the front optics further comprises a lens and a mask defining an aperture;

wherein light from the object passes through the lens, then through the aperture, then through the diffuser, and then through the birefringent optics.

12. The spectrometer of claim 1 or the fringe generating optics of claim 20 wherein the birefringent optics comprises

a first polariser;

a first birefringent layer;

a second birefringent layer; and

a second polariser.

13. The spectrometer or the fringe generating optics of claim 12 wherein the first polariser and the second polariser are each adapted to transmit light linearly polarised at a polarisation angle formed in a plane perpendicular to a direction of light transmission through the birefringent optics.

14. The spectrometer or the fringe generating optics of claim 13 wherein the first birefringent layer has a first optic axis at a first angle formed in an X-Z plane formed

by an X-axis and a Z-axis, wherein the Z-axis is the direction of light transmission through the birefringent optics.

15. The spectrometer or the fringe generating optics of claim 14 wherein the second birefringent layer has a second optic axis in a plane perpendicular to the z-axis.

16. The spectrometer or the fringe generating optics of claim 14 wherein the second birefringent layer has a birefringence opposite the birefringence of the first birefringent layer, and a second optic axis at a second angle formed in the X-Z plane.

17. The spectrometer or the fringe generating optics of claim 14 wherein the first birefringent layer has a first thickness, the second birefringent layer has a second thickness, and the second thickness is different than the first thickness.

18. The spectrometer or the fringe generating optics of claim 14 wherein the first birefringent layer has a first thickness, the second birefringent layer has a second thickness, and the second thickness is the same as the first thickness; and

a ½ wave plate is positioned between the first birefringent layer and the second birefringent layer.

19. The spectrometer or the fringe generating optics of claim 13 wherein the birefringent optics comprises a single birefringent layer formed from a biaxial birefringent crystal.

20. Fringe generating optics for a spectrometer which create interference fringes from light from an object and which is adapted to transmit the interference fringes to a camera, comprising, in combination:

a housing;

front optics positioned in the housing comprising a diffuser adapted to receive light from the object; and

birefringent optics fixed with respect to the diffuser, positioned in the housing and which receive light from the diffuser and form orthogonal polarization components of the light;

wherein the fringe generating optics create interference fringes and the orthogonal polarization components have a phase difference which varies with an angle of incidence of the light received by the birefringent optics.

21. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics fixed with respect to the diffuser, adapted to receive light from the diffuser and to generate interference fringes, comprising a first birefringent flat plate and a second birefringent flat plate parallel to the first birefringent flat plate, wherein the diffuser is positioned between the object and the birefringent optics;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.

22. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics fixed with respect to the diffuser, adapted to receive light from the diffuser and to generate interference fringes, wherein the diffuser is in direct contact with the birefringent optics;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.

23. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics fixed with respect to the diffuser, adapted to receive light from the diffuser and to generate interference fringes, comprising a first polariser and a second polariser, wherein the first polarizer is positioned between the diffuser and the second polariser;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.

CLAIMS

What is claimed is:

1. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics which receive light from the diffuser and form orthogonal polarization components of the light, wherein the front optics and birefringent optics combined form fringe generating optics which generate interference fringes, and the orthogonal polarization components have a phase difference which varies with an angle of incidence of the light received by the birefringent optics;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.

2. The spectrometer of claim 1 wherein the camera is adapted to generate a signal corresponding to the received interference fringes created by the fringe generating optics which corresponds to a plurality of interferograms within a single image; and

the processor is adapted to calculate the spectral signature of the object by performing a Fourier Transform of each of the plurality of interferograms and by taking an average of the Fourier transforms of the interferograms.

3. The spectrometer of claim 1 wherein the diffuser comprises one of:

a layer separate from the birefringent optics having a rough ground optical surface;

a rough ground front surface of a first polarizer of the birefringent optics; and

a micro-lens lenticular array.

4. The spectrometer of claim 1 further comprising a housing for the front optics and birefringent optics.

5. The spectrometer of claim 4 or the fringe generating optics of claim 20 wherein the housing is formed as one of:

part of a device cover; and

built into a mobile device.

6. The spectrometer of claim 5 wherein the housing is adjustable between an operational position where the birefringent optics are positioned in front of the camera, and a nonoperational position where the birefringent optics are not positioned in front of the camera.

7. The spectrometer of claim 6 wherein the housing comprises an external attachment adapted to be placed on the mobile device.

8. The spectrometer of claim 4 or the fringe generating optics of claim 20 further comprising a light diffuser adapted to diffuse light from a light source.

9. The spectrometer or the fringe generating optics of claim 8 wherein the light source is a flash light of a mobile device.

10. The spectrometer or the fringe generating optics of claim 9 wherein the light diffuser is positioned in the housing.

11. The spectrometer of claim 1 or the fringe generating optics of claim 20, wherein the front optics further comprises a lens and a mask defining an aperture;

wherein light from the object passes through the lens, then through the aperture, then through the diffuser, and then through the birefringent optics.

12. The spectrometer of claim 1 or the fringe generating optics of claim 20 wherein the birefringent optics comprises

a first polariser;

a first birefringent layer;

a second birefringent layer; and

a second polariser.

13. The spectrometer or the fringe generating optics of claim 12 wherein the first polariser and the second polariser are each adapted to transmit light linearly polarised at a polarisation angle formed in a plane perpendicular to a direction of light transmission through the birefringent optics.

14. The spectrometer or the fringe generating optics of claim 13 wherein the first birefringent layer has a first optic axis at a first angle formed in an X-Z plane formed by an X-axis and a Z-axis, wherein the Z-axis is the direction of light transmission through the birefringent optics.

15. The spectrometer or the fringe generating optics of claim 14 wherein the second birefringent layer has a second optic axis in a plane perpendicular to the z-axis.

16. The spectrometer or the fringe generating optics of claim 14 wherein the second birefringent layer has a birefringence opposite the birefringence of the first birefringent layer, and a second optic axis at a second angle formed in the X-Z plane.

17. The spectrometer or the fringe generating optics of claim 14 wherein the first birefringent layer has a first thickness, the second birefringent layer has a second thickness, and the second thickness is different than the first thickness.

18. The spectrometer or the fringe generating optics of claim 14 wherein the first birefringent layer has a first thickness, the second birefringent layer has a second thickness, and the second thickness is the same as the first thickness; and

a ½ wave plate is positioned between the first birefringent layer and the second birefringent layer.

19. The spectrometer or the fringe generating optics of claim 13 wherein the birefringent optics comprises a single birefringent layer formed from a biaxial birefringent crystal.

20. Fringe generating optics for a spectrometer which create interference fringes from light from an object and which is adapted to transmit the interference fringes to a camera, comprising, in combination:

a housing;

front optics positioned in the housing comprising a diffuser adapted to receive light from the object; and

birefringent optics positioned in the housing and which receive light from the diffuser and form orthogonal polarization components of the light;

wherein the fringe generating optics create interference fringes and the orthogonal polarization components have a phase difference which varies with an angle of incidence of the light received by the birefringent optics.

21. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics adapted to receive light from the diffuser and to generate interference fringes, comprising a first birefringent flat plate and a second birefringent flat plate parallel to the first birefringent flat plate, wherein the diffuser is positioned between the object and the birefringent optics;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.

22. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics adapted to receive light from the diffuser and to generate interference fringes, wherein the diffuser is in direct contact with the birefringent optics;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.

23. A spectrometer for measuring a spectral signature of an object comprising, in combination:

front optics comprising a diffuser adapted to receive light from the object;

birefringent optics adapted to receive light from the diffuser and to generate interference fringes, comprising a first polariser and a second polariser, wherein the first polarizer is positioned between the diffuser and the second polariser;

a camera adapted to receive the interference fringes; and

a processor adapted to generate the spectral signature of the object.