

CLAIMS

1. An optical system for determining a refractive index of a sample, the optical system comprising:
 - a laser source configured to emit a laser beam;
 - a non-linear crystal configured to generate, based on the laser beam, an infrared light beam which passes through the sample, and a visible signal light beam;
 - a first mirror configured to reflect the visible signal light beam;
 - a second mirror configured to reflect the infrared light beam so that the reflected infrared light beam interacts with the reflected visible signal light beam in the non-linear crystal; and
 - a photodetector configured to determine a property of the reflected visible signal light beam which has interacted with the reflected infrared light beam for determining the refractive index of the sample;wherein the first mirror is configured so that the reflected visible signal light beam is coherently overlapped with the visible signal light beam, and
wherein the second mirror is configured so that the reflected infrared light beam is coherently overlapped with the infrared light beam.
2. The optical system according to claim 1, further comprising:
 - an adjusting system for adjusting a position of the second mirror.
3. The optical system according to claim 1,
 - wherein the non-linear crystal is further configured to generate, based on the laser beam, a visible pump light beam;

wherein the first mirror is configured to reflect the visible pump light beam;
and

wherein the reflected visible pump light beam interacts with the reflected
infrared light beam and the reflected visible signal light beam in the non-linear
crystal.

4. The optical system according to claim 3, further comprising:

a dichroic beam splitter configured to direct the laser beam to the non-linear
crystal;

wherein the dichroic splitter is further configured to separate the reflected
visible signal light beam and the reflected visible pump light beam.

5. The optical system according to claim 4, further comprising:

a further dichroic beam splitter configured to separate the infrared light beam
from the visible light beam and the visible pump light beam so that the visible
light beam and the visible pump light beam are reflected by the first mirror
and the infrared light beam is reflected by the second mirror.

6. The optical system according to claim 5, further comprising:

a pinhole configured to allow a portion of the visible light beam, the visible
pump light beam and the infrared light beam generated by the non-linear
crystal through to the further dichroic beam splitter in a collinear direction.

7. The optical system according to claim 4, further comprising:

a filter system configured to filter out the reflected visible signal light beam for passing to the photodetector.

8. The optical system according to claim 1,
 - wherein the non-linear crystal is further configured to generate, based on the laser beam, a visible pump light beam;
 - wherein the optical system further comprises a third mirror configured to reflect the visible pump light beam; and
 - wherein the reflected visible pump light beam interacts with the reflected infrared light beam and the reflected visible signal light beam in the non-linear crystal.
9. The optical system according to claim 8,
 - wherein the visible signal light beam travels from the non-linear crystal in a first direction to the first mirror;
 - wherein the infrared light beam travels from the non-linear crystal in a second direction to the second mirror;
 - wherein the visible pump light beam travels from the non-linear crystal in a third direction to the third mirror; and
 - wherein the first direction, the second direction, and the third direction are different directions.
10. The optical system according to claim 1,
 - wherein the non-linear crystal comprises any one material selected from a group consisting of lithium niobate, beta-barium borate, and silver thiogallate.

11. The optical system according to claim 1,

wherein the non-linear crystal is configured to generate the infrared light beam and the visible signal light beam based on a parametric down conversion process.
12. The optical system according to claim 1,

wherein the property of the reflected visible signal light beam is an intensity of the reflected visible signal light beam.
13. The optical system according to claim 1,

wherein the photodetector is a point photodetector.
14. A method of forming an optical system for determining a refractive index of a sample, the method comprising:

providing a laser source configured to emit a laser beam;

providing a non-linear crystal configured to generate, based on the laser beam, an infrared light beam which passes through the sample, and a visible signal light beam;

providing a first mirror configured to reflect the visible signal light beam;

providing a second mirror configured to reflect the infrared light beam so that the reflected infrared light beam interacts with the reflected visible signal light beam in the non-linear crystal; and

providing a photodetector configured to determine a property of the reflected visible signal light beam which has interacted with the reflected infrared light beam for determining the refractive index of the sample;

wherein the first mirror is configured so that the reflected visible signal light beam is coherently overlapped with the visible signal light beam, and

wherein the second mirror is configured so that the reflected infrared light beam is coherently overlapped with the infrared light beam.

15. A method of operating an optical system for determining a refractive index of a sample, the method comprising:

emitting, using a laser source, a laser beam;

generating, based on the laser beam and using a non-linear crystal, an infrared light beam which passes through the sample, and a visible signal light beam;

reflecting, using a first mirror, the visible signal light beam;

reflecting, using a second mirror, the infrared light beam so that the reflected infrared light beam interacts with the reflected visible signal light beam in the non-linear crystal; and

determining, using a photodetector, a property of the reflected visible signal light beam which has interacted with the reflected infrared light beam to determine the refractive index of the sample;

wherein the first mirror is configured so that the reflected visible signal light beam is coherently overlapped with the visible signal light beam, and

wherein the second mirror is configured so that the reflected infrared light beam is coherently overlapped with the infrared light beam.

16. The method according to claim 15, further comprising:

adjusting a position of the second mirror so that the total distance travelled by the infrared light beam from the non-linear crystal to the second mirror and by the reflected infrared light beam from the second mirror to the non-linear crystal is changed.

17. The method according to claim 15,

wherein the infrared light beam and the visible signal light beam are generated from the laser beam using a parametric down conversion process.
18. The method according to claim 15, further comprising:

generating, based on the laser beam and using the non-linear crystal, a visible pump light beam;

wherein the reflected visible signal light beam determined by the photodetector has also interacted with the visible pump light beam.
19. The method according to claim 18,

wherein the visible pump light beam is reflected by the first mirror.
20. The method according to claim 18,

wherein the visible pump light beam is reflected by a third mirror.