CLAIMS

1. An optical system for imaging a sample comprising:

a laser source configured to emit a pump beam;

a non-linear medium configured to generate, based on the pump beam, an idler beam configured to incident on the sample and configured to be reflected, and a signal beam;

a dichroic beam splitter configured to separate the idler beam and the signal beam from the non-linear medium;

a mirror configured to reflect the signal beam so that the reflected signal beam interacts with the reflected idler beam in the non-linear medium to generate a resultant signal beam that carries an interference pattern;

a detector configured to receive the resultant signal beam for imaging the sample; and

one or more optical elements configured to direct the idler beam from the ~~non-linear medium~~ dichroic beam splitter to the sample, and the signal beam from the ~~non-linear medium~~ dichroic beam splitter to the mirror.

2. The optical system according to claim 1,

wherein the reflected signal beam also interacts with a further signal beam in the non-linear medium to generate the resultant signal beam.

3. The optical system according to claim 2, further comprising:

a further mirror configured to reflect the pump beam; and

wherein the further signal beam is generated in the non-linear medium by the reflected pump beam.

4. The optical system according to claim 1, wherein the one or more optical elements comprise a first set of optical elements configured to direct the idler beam to the sample, and a second set of optical elements configured to direct the signal beam to the mirror, and the first set of optical elements provides for the idler beam a first optical path having a first length equal to a second length of a second optical path provided for the single beam by the second set of optical elements. ~~further comprising:~~

   ~~a dichroic beam splitter configured to separate the idler beam and the signal beam.~~

5. The optical system according to claim 4,

   wherein the one or more optical elements comprise a first optical element, a second optical element, and a third optical element arranged between the dichroic beam splitter and the mirror; and

   wherein the one or more optical elements also comprise a fourth optical element, a fifth optical element, and a sixth optical element configured to be arranged between the dichroic beam splitter and the sample.

6. The optical system according to claim 5,

   wherein the first optical element is arranged such that the non-linear medium is at a focal length of the first optical element;

   wherein the second optical element is arranged such the second optical element is at a distance equal to a sum of the focal length of the first optical element and a focal length of the second optical element from the first optical element;

   wherein the third optical element is arranged such the third optical element is at a distance equal to a sum of the focal length of the second optical element and a focal length of the third optical element from the second optical element.

7. The optical system according to claim 5,

wherein the fourth optical element is arranged such that the non-linear medium is at a focal length of the fourth optical element;

wherein the fifth optical element is arranged such the fifth optical element is at a distance equal to a sum of the focal length of the fourth optical element and a focal length of the fifth optical element from the fourth optical element;

wherein the sixth optical element is arranged such the sixth optical element is at a distance equal to a sum of the focal length of the fifth optical element and a focal length of the sixth optical element from the fifth optical element.

8. The optical system according to claim 4,

wherein the one or more optical elements consists of an optical element arranged between the non-linear medium and the dichroic beam splitter.

9. The optical system according to claim 1,

wherein the idler beam comprises infrared light or terahertz waves.

10. The optical system according to claim 1,

wherein the signal beam comprises visible light or near-infrared light.

11. The optical system according to claim 1,

wherein the idler beam comprises photons of a first wavelength; and

wherein the signal beam comprises photons of a second wavelength shorter than the first wavelength.

12. The optical system according to claim 1, further comprising:

a movable stage configured to hold the sample.

13. The optical system according to claim 1, further comprising:

a holder configured to hold the non-linear medium.

14. The optical system according to claim 13,

wherein the holder is configured to control a temperature of the non-linear medium.

15. The optical system according to claim 13,

wherein the holder is rotatable.

16. The optical system according to claim 1,

wherein the non-linear medium is a non-linear crystal.

17. A method of forming an optical system for imaging a sample, the method comprising:

providing a laser source configured to emit a pump beam;

providing a non-linear medium configured to generate, based on the pump beam, an idler beam configured to incident on the sample and configured to be reflected, and a signal beam;

providing a dichroic beam splitter configured to separate the idler beam and the signal beam from the non-linear medium;

arranging a mirror configured to reflect the signal beam so that the reflected signal beam interacts with the reflected idler beam in the non-linear medium to generate a resultant signal beam that carries an interference pattern;

providing a detector configured to receive the resultant signal beam for imaging the sample; and

providing one or more optical elements configured to direct the idler beam from the dichroic beam splitter ~~non-linear medium~~ to the sample, and the signal beam from the dichroic beam splitter ~~non-linear medium~~ to the mirror.

18. The method according to claim 17, wherein the one or more optical elements comprise a first set of optical elements configured to direct the idler beam to the sample, and a second set of optical elements configured to direct the signal beam to the mirror, and the first set of optical elements provides for the idler beam a first optical path having a first length equal to a second length of a second optical path provided for the single beam by the second set of optical elements.~~further comprising:~~

~~providing a dichroic beam splitter configured to separate the idler beam and the signal beam.~~

19. The method according to claim 17, further comprising:

providing a movable stage configured to hold the sample.

20. The method according to claim 17, further comprising:

providing a holder configured to hold the non-linear medium.