[0008] According to an embodiment, an imaging device is provided. The imaging device may include the apparatus as described herein.

[0009] According to an embodiment, a method for imaging a sample is provided. The method may include generating a magnetic field using the device of the apparatus as described herein, configuring the apparatus in the closed flux configuration, wherein the magnetically permeable element is arranged to interact with the generated magnetic field to provide a path directing the magnetic flux corresponding to the generated magnetic field from the first region of the device towards the second region of the device, positioning the sample between the device and the aperture of the magnetically permeable element, and imaging the sample through the aperture.

Brief Description of the Drawings

[0010] In the drawings, like reference characters generally refer to like parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the principles of the invention. In the following description, various embodiments of the invention are described with reference to the following drawings, in which:

[0011] FIG. 1A shows a schematic view of an apparatus for generating a magnetic field, according to various embodiments.

[0012] FIG. 1B shows a schematic block diagram illustrating an imaging device, according to various embodiments.

[0013] FIG. 1C shows a flow chart illustrating a method for imaging a sample, according to various embodiments.

[0014] FIGS. 2A and 2B show perspective views of an apparatus in an open flux configuration, while FIGS. 2C and 2D show perspective views of an apparatus in a closed flux configuration.

[0015] FIGS. 3A to 3C show the numerically calculated magnetic flux distribution for a single pole open flux electromagnet design, while FIGS. 3D to 3F show the numerically calculated magnetic flux distribution for a B-shaped closed flux electromagnet design.

[0016] FIG. 4 shows a plot of the magnetic flux density along the z-axis for the electromagnets of FIGS. 3A to 3F.

[0017] FIGS. 5A and 5B show photographs illustrating a front view of the apparatus of various embodiments in the open flux configuration and in the closed flux configuration respectively

the device of the apparatus 100 to provide a path directing the magnetic flux (106, FIG. 1A) corresponding to the magnetic field from the first region (108a, FIG. 1A) of the device towards (or to) the second region (108b, FIG. 1A) of the device.

[0073] In various embodiments, the imaging device 110 may be or may include a microscopy device (or microscope), for example, a Kerr microscopy device.

[0074] FIG. 1C shows a flow chart 120 illustrating a method for imaging a sample, according to various embodiments.

[0075] At 122, a magnetic field is generated using the device of the apparatus as described herein. An aperture is defined in the connection member of the magnetically permeable element of the apparatus.

[0076] At 124, the apparatus is configured in the closed flux configuration, wherein the magnetically permeable element is arranged (in proximity to the device) to interact with the generated magnetic field to provide a path directing the magnetic flux corresponding to the generated magnetic field from the first region of the device towards (or to) the second region of the device.

[0077] At 126, the sample is positioned between the device and the aperture of the magnetically permeable element. In this way, the sample may be positioned such that it interacts with the generated magnetic field or the magnetic flux corresponding to the generated magnetic field.

[0078] At 128, the sample is imaged through the aperture.

[0079] In various embodiments, the device of the apparatus may include an electromagnet for generating the magnetic field, and the method may further include varying an intensity of an electrical current applied to the electromagnet.

[0080] It should be appreciated that descriptions in the context of the apparatus 100 may correspondingly be applicable in relation to the method for imaging a sample described in the context of the flow chart 120.

[0081] FIGS. 2A and 2B show perspective views (3D views) of an apparatus 200a in an open flux configuration, illustrating an open flux electromagnet. The apparatus 200a for the open flux design may include a high permeability (magnetic) core 203 with a tapering portion 230 that converges to a tip region 232, as part of an electromagnet, and a support structure (or supporting base) 234. The use of tapering in electromagnets achieves the effect of concentrating

CLAIMS

1. An apparatus for generating a magnetic field comprising:

a device configured to generate the magnetic field with a corresponding magnetic flux emanating from a first region of the device and returning to a second region of the device; and

a magnetically permeable element,

wherein, in a first mode of operation, the magnetically permeable element is adapted to be arranged to interact with the magnetic field to configure the apparatus in a closed flux configuration to provide a path directing the magnetic flux from the first region of the device towards the second region of the device, and

wherein, in a second mode of operation, the magnetically permeable element is removable away from the magnetic field to configure the apparatus in an open flux configuration.

2. The apparatus as claimed in claim 1, wherein the device comprises a permanent magnet to generate the magnetic field.

3. The apparatus as claimed in claim 1, wherein the device comprises an electromagnet to generate the magnetic field.

4. The apparatus as claimed in claim 3,

wherein the electromagnet comprises an electrical conductor, and

wherein the electrical conductor is configured to generate the magnetic field in response to an electrical current applied to and passing through the electrical conductor.

5. The apparatus as claimed in claim 4, wherein the electrical conductor comprises a coil comprising at least one loop.

6. The apparatus as claimed in claim 5, wherein the electromagnet further comprises a magnetic core, wherein the coil is arranged around the magnetic core.

7. The apparatus as claimed in claim 6, wherein a region of the magnetic core defining the first region of the device comprises a tapering portion.

8. The apparatus as claimed in any one of claims 1 to 7, further comprising a support structure to support the device, the support structure comprising a magnetic material.

9. The apparatus as claimed in any one of claims 1 to 8, wherein the magnetically permeable element comprises:

a connection member; and

a pair of arms connected to the connection member, the pair of arms being arranged spaced apart from each other and projecting from the connection member,

wherein, in the closed flux configuration, the magnetically permeable element is configured to be arranged with the connection member proximal to the first region of the device, and the pair of arms extending in a direction from the first region to the second region of the device.

10. The apparatus as claimed in claim 9, wherein the pair of arms project perpendicularly from the connection member.

11. The apparatus as claimed in claim 9 or 10,

wherein an aperture is defined in the connection member, and

wherein, in the closed flux configuration, the magnetically permeable element is configured to be arranged with the aperture aligned coaxially with the device.

12. The apparatus as claimed in claim 11,

wherein a thickness of a first section of the connection member is less than a thickness of a second section of the connection member, and

wherein the aperture is defined in the first section.

13. An imaging device comprising the apparatus for generating a magnetic field as claimed in claim 11 or 12.

14. The imaging device as claimed in claim 13, wherein the apparatus is configured in the closed flux configuration, wherein the magnetically permeable element is arranged to interact with the magnetic field to be generated by the device of the apparatus to provide a path directing the magnetic flux corresponding to the magnetic field from the first region of the device towards the second region of the device.

15. A method for imaging a sample comprising:

generating a magnetic field using the device of the apparatus as claimed in claim 11 or 12;

configuring the apparatus in the closed flux configuration, wherein the magnetically permeable element is arranged to interact with the generated magnetic field to provide a path directing the magnetic flux corresponding to the generated magnetic field from the first region of the device towards the second region of the device;

positioning the sample between the device and the aperture of the magnetically permeable element; and

imaging the sample through the aperture.

16. The method as claimed in claim 15,

wherein the device comprises an electromagnet,

wherein generating a magnetic field comprises generating the magnetic field using the electromagnet, and

the method further comprises varying an intensity of an electrical current applied to the electromagnet.