Claims

1. An external illuminator for a microscope, the external illuminator comprising:

a light source;

at least one optical fibre optically coupled to the light source, the at least one optical fibre configured to deliver and direct light from the light source along an illumination path to a sample being observed through an objective lens of the microscope, the objective lens having a working distance of 2mm or less; and

an adjustment module couplable to a portion of the microscope and arranged to support the at least one optical fibre,

wherein the adjustment module is configured to adjust the at least one optical fibre spatially and/or angularly relative to the objective lens in a manner such that the illumination path is separate from a detection path of the objective lens, and the objective lens is movable to the working distance of the objective lens, and

the adjustment module comprises:

a mount configured to releasably couple to the portion of the microscope;

at least one pillar extending from the mount;

at least one tubular holder holding the at least one optical fibre; and

a hinge connector assembly arranged between the at least one pillar and the at least one tubular holder, the at least one pillar and the at least one tubular holder being pivotally coupled to each other via the hinge connector assembly.

2. The external illuminator as claimed in claim 1,

wherein the at least one pillar comprises a distal end attached to the mount, and a proximal end opposite to the distal end; and

wherein the hinge connector assembly is disposed at the proximal end.

3. The external illuminator as claimed in claim 1 or 2, wherein the mount comprises a ring mount configured to releasably couple around a housing of the objective lens.

4. The external illuminator as claimed in claim 1 or 2, wherein the mount configured to releasably couple to the portion of the microscope comprises a non-mechanical coupling of the mount to the portion of the microscope.

5. The external illuminator as claimed in claim 4, wherein the mount includes a first mount mating member to mate with an objective lens mating member of a housing of the objective lens.

6. The external illuminator as claimed in claim 5, wherein the mount includes a second mating member to mate with a focal tube mating member of the microscope.

7. The external illuminator as claimed in any one of claims 1 to 6,

wherein the at least one tubular holder comprises a first end, a second end opposite the first end, and a body extending between the first end and the second end; and

wherein the hinge connector assembly is disposed along a part of the body.

8. The external illuminator as claimed in any one of claims 1 to 7, wherein the mount includes a slot for receiving a removable optical filter.

9. The external illuminator as claimed in any one of claims 1 to 8, wherein the illumination path is arrangeable with respect to the detection path in a manner to facilitate observation of the sample in a reflective mode.

10. The external illuminator as claimed in any one of claims 1 to 9, wherein the light source has a wavelength of 300 nm or less.

11. The external illuminator as claimed in claim 10, wherein the light source is configured to emit light of another wavelength, and wherein a difference between the wavelength and the other wavelength is 50 nm or less.

12. The external illuminator as claimed in in any one of claims 1 to 11, further comprising a subsequent light source configured to optically couple to the at least one optical fibre, wherein the subsequent light source has a predetermined wavelength, wherein a difference between the predetermined wavelength of the subsequent light source and the wavelength of the light source is 50 nm or less.

13. The external illuminator as claimed in claim 12, wherein the subsequent light source is a light emitting diode or a laser.

14. The external illuminator as claimed in claim 12 or 13, further comprising a non-mechanically fastened mechanism operable to switch between the light source and the subsequent light source to allow the light source and the subsequent light source to each be coupled independently to the at least one optical fibre for illuminating the sample.

15. The external illuminator as claimed in claim 14, wherein the non-mechanically fastened mechanism is a magnetic fastened mechanism.

16. The external illuminator as claimed in claim 14 or 15, wherein the at least one optical fibre comprises a light-entry end configured to receive the light from the light source or the subsequent light source; and a light-emitting end opposite to the light-entry end, the light-emitting end configured to deliver the light to the sample,

wherein the non-mechanically fastened mechanism comprises a mating member coupled towards the light-entry end of the at least one optical fibre; and a complementary mating member configured to couple to the light source for a first period of time and to the subsequent light source for a second period of time, and

wherein the mating member and the complementary mating member are configured to mate each other to provide optical coupling between the at least one optical fibre and the light source for the first period of time, and between the at least one optical fibre and the subsequent light source for the second period of time.

17. The external illuminator as claimed in any one of claims 1 to 16, wherein there are at least two optical fibres coupled to the light source which are arranged in at least one of the following conditions: in contact side by side, in a three-sided arrangement, and in a polygonal arrangement.

18. The external illuminator as claimed in claim 17, wherein the adjustment module is configured to independently adjust the at least two optical fibres spatially and/or angularly relative to the objective lens such that the illumination path is separate from a detection path of the objective lens.

19. The external illuminator as claimed in claim 17 or 18, wherein the at least two optical fibres are configurable to allow each optical fibre to illuminate the sample independently.

20. The external illuminator as claimed in any one of claims 1 to 19, wherein the light source is a light emitting diode or a laser.

21. The external illuminator as claimed in any one of claims 1 to 20, wherein the adjustment module is configured to adjust the at least one optical fibre spatially and/or angularly relative to the objective lens to deliver the light onto the sample such that delivery of the light falls outside of an acceptance cone of the objective lens.

22. The external illuminator as claimed in claim 21, wherein the adjustment module is configured to adjust the at least one optical fibre angularly relative to the objective lens at an acute angle measured from a central axis of each optical fibre and a horizontal plane of a sample holder for holding the sample

when being observed through the objective lens of the microscope, the acute angle being greater than 0° but less than or equal to 30°.

23. A microscope comprising:

an external illuminator as claimed in any one of claims 1 to 22, the external illuminator configured to provide light via an illumination path to illuminate a sample being observed by the microscope; and

a detection module comprising an objective lens configured to receive the light from the sample via a detection path to observe the sample,

wherein the illumination path is separate from the detection path, and the objective lens of the detection module is movable to the working distance of the objective lens.

24. The microscope as claimed in claim 23, wherein the detection module further comprises at least one of the following: a viewer, an image detector, and a camera.

25. A microscopy method comprising:

(a) delivering and directing light from a light source, via at least one optical fibre, along an illumination path to a sample;

(b) adjusting, by an adjustment module, the at least one optical fibre spatially and/or angularly relative to an objective lens in a manner such that the illumination path is separate from a detection path of the objective lens;

(c) adjusting the objective lens if needed to its working distance, the objective lens having a working distance of 2mm or less; and

(d) viewing and/or imaging the sample via the detection path,

wherein the adjustment module comprises:

a mount releasably coupled to the portion of a microscope performing the microscopy method;

at least one pillar extending from the mount;

at least one tubular holder holding the at least one optical fibre; and

a hinge connector assembly arranged between the at least one pillar and the at least one tubular holder, the at least one pillar and the at least one tubular holder being pivotally coupled to each other via the hinge connector assembly.

26. The microscopy method as claimed in claim 25, wherein delivering and directing the light further comprises switching, via a non-mechanically fastened mechanism, the light source and a subsequent light source to deliver and direct the light.

27. The microscopy method as claimed in claim 26, wherein each of the light source and the subsequent light source has a wavelength of 300 nm or less.

28. The microscopy method as claimed in claim 27, wherein a difference between the wavelength of the light source and the wavelength of the subsequent light source is 50 nm or less.

29. The microscopy method as claimed in any one of claims 25 to 28, wherein the illumination path is arrangeable with respect to the detection path in a manner to facilitate observation of the sample in a reflective mode.

30. The microscopy method as claimed in any one of claims 25 to 29, wherein adjusting the at least one optical fibre comprises adjusting the at least one optical fibre in a manner to deliver the light onto the sample such that delivery of the light falls outside of an acceptance cone of the objective lens.

31. The microscopy method as claimed in claim 30, wherein adjusting the at least one optical fibre comprises adjusting the at least one optical fibre at an acute angle measured from a central axis of each optical fibre and a horizontal plane of a sample holder for holding the sample when being observed through the objective lens, the acute angle being greater than 0° but less than or equal to 30°.

32. The microscopy method as claimed in any one of claims 25 to 31, wherein there are two or more optical fibres grouped into two or more sets of optical fibres,

wherein delivering and directing light from a light source comprises delivering and directing light sequentially from each set in the two or more sets of optical fibres.

33. An adjustment module couplable to a portion of a microscope and arranged to support at least one optical fibre for delivering and directing light via an illumination path to illuminate a sample observed by the microscope, the adjustment module comprising:

a mount configured to releasably couple to the portion of the microscope;

at least one pillar extending from the mount;

at least one tubular holder, each configured to hold the at least one optical fibre; and

a hinge connector assembly arranged between the at least one pillar and the at least one tubular holder, wherein the at least one pillar and the at least one tubular holder are pivotally coupled to each other via the hinge connector assembly,

wherein the adjustment module is configured to adjust the at least one optical fibres at least spatially or angularly relative to an objective lens of the microscope in a manner such that the illumination path is separate from the detection path, and wherein the objective lens has a working distance of 2 mm or less.

34. The adjustment module as claimed in claim 33,

wherein the at least one pillar comprises a distal end attached to the mount, and a proximal end opposite to the distal end; and

wherein the hinge connector assembly is disposed at the proximal end.

35. The adjustment module as claimed in claim 33 or 34, wherein the mount comprises a ring mount configured to releasably couple around a housing of the objective lens.

36. The adjustment module as claimed in claim 33 or 34, wherein the mount is non-mechanically couplable to the portion of the microscope.

37. The adjustment module as claimed in claim 36, wherein the mount includes a first mount mating member to mate with an objective lens mating member of a housing of the objective lens.

38. The adjustment module as claimed in claim 37, wherein the mount includes a second mating member to mate with a focal tube mating member.

39. The adjustment module as claimed in any one of claims 33 to 38, wherein the at least one tubular holder comprises a first end, a second end opposite the first end, and a body extending between the first end and the second end; and

wherein the hinge connector assembly is disposed along a part of the body.

40. The adjustment module as claimed in any one of claims 33 to 39, wherein the mount includes a slot for receiving a removable optical filter.