components (*e.g.*, cameras, imaging capturing devices, etc.), and breakage of microscopes slides. By way of example, conventional robotic apparatuses often grip a label end of a microscope slide. There may be exposed residual glue at the label. If a gripper contacts the edges of the slide adjacent to the label or the edges of the label, the exposed residual glue may stick or adhere to the gripper. This may result in mishandling of the slide.

BRIEF SUMMARY

In accordance with a first aspect of this application, there is provided a low-profile microscope slide pickup device, comprising: an end effector including an elongate platform having an upper surface and a lower surface, a fluid line positioned on an upper side of platform, and a head element including a connector and a suction head, the connector is positioned on the upper side of the platform and coupled to the fluid line, and the suction head is positioned on an lower side of the platform.

In accordance with a second aspect of this application, there is provided a method of transporting a microscope slide having a label, the method comprising: picking up a microscope slide carrying a sample using the low-profile microscope slide pickup device as described herein without contacting an edge of a label on the microscope slide and without contacting an edge of the microscope slide adjacent to the label; and carrying the microscope slide using the low-profile microscope slide pickup device to a desired location.

In some embodiments, a microscope slide holding cassette includes a main body, a plurality of shelves, and a plurality of support members. The main body is configured to surround and protect microscope slides and includes a first sidewall and a second sidewall. The shelves are capable of supporting microscope slides and are positioned between the first and second sidewalls. The shelves can be vertically spaced apart from one another when the microscope slide holding cassette is in the upright orientation. The support members extend away from respective shelves and include an elongate body and a catch. The catch protrudes

upwardly from the elongate body and is capable of limiting movement of the microscope slide positioned along an elongate body.

In some other embodiments, a method of transporting a microscope slide includes picking up the microscope slide using a pickup device without contacting an edge of a label on the microscope slide and without contacting an edge of the microscope slide adjacent to the label. The microscope slide is carried using the pickup device to a desired location. In some embodiments, the microscope slide is carried between at least two processing stations (*e.g.*, a stainer unit, a coverslipper, an imaging system, an optical scanner, an optical imaging system) without contacting the edge of the label and without contacting the slide edge.

In some embodiments, a microscope slide pickup device comprises an end effector including an elongate planar platform having an upper surface and a lower surface. A fluid line is positioned on an upper side of the platform. The head element includes a connector and a suction head. The connector is positioned

PATENT CLAIMS

1. A microscope slide holding cassette, comprising:

a main body for surrounding and protecting microscope slides, the main body including a first sidewall and a second sidewall;

a plurality of shelves capable of supporting microscope slides, the plurality of shelves are positioned between the first sidewall and the second sidewall and are vertically spaced apart from one another when the microscope slide holding cassette is in an upright orientation; and

a plurality of support members extending away from respective shelves, at least one of the support members including

an elongate body coupled to one of the shelves, and

a catch protruding upwardly from the elongate body and being capable of limiting movement of a microscope slide positioned on the elongate body.

2. The microscope slide holding cassette of claim 1, wherein pairs of the support members are spaced apart from one another and coupled to respective shelves.

3. The microscope slide holding cassette of claim 2, wherein two of the elongate bodies are coupled to respective shelves and have longitudinal axes that are parallel to one another.

4. The microscope slide holding cassette of claim 1, wherein the first sidewall and the second sidewall define an opening through which microscope slides can be inserted to place the microscope slides on the shelves and through which the microscope slides can be removed from the shelves.

5. The microscope slide holding cassette of claim 1, wherein the elongate body includes a mounting end coupled to the shelf, an opposing free

end carrying the catch, and a cantilevered body extending between the mounting end and the free end.

6. The microscope slide holding cassette of claim 1, wherein the catch is a protrusion having a height equal to or less than about half of a thickness of a microscope slide when the microscope slide is on the elongate body and the shelf.

7. The microscope slide holding cassette of claim 1, wherein at least one of the first sidewall, the second sidewall, and a rear wall includes one or more ventilation openings adjacent to gaps between adjacent shelves.

8. The microscope slide holding cassette of claim 1, further comprising:

at least one keying feature protruding from the main body, and the at least one keying feature is receivable by a workstation when the cassette is in an upright orientation.

9. The microscope slide holding cassette of claim 1, further comprising:

a first sloped shelf sidewall and a second sloped shelf sidewall, wherein one of the shelves extends between a base of the first sloped shelf sidewall and a base of the second sloped shelf sidewall.

10. The microscope slide holding cassette of claim 9, wherein the first sloped shelf sidewall and the second sloped shelf sidewall are configured to allow a microscope slide to slide along the first sloped shelf sidewall or the second sloped shelf sidewalls, or both.

11. The microscope slide holding cassette of claim 1, further comprising:

a pair of guides proximate to one of the shelves and along which a microscope slide is capable of sliding due to gravity until the microscope slide rests on the one of the shelves.

12. The microscope slide holding cassette of claim 11, wherein each of the guides includes a sloped surface inclined away from the one of the shelves.

13. A method of transporting a microscope slide having a label, the method comprising:

picking up a microscope slide carrying a sample using a pickup device without contacting an edge of a label on the microscope slide and without contacting an edge of the microscope slide adjacent to the label; and

carrying the microscope slide using the pickup device to a desired location.

14. The method of claim 13, further comprising:

carrying the microscope slide between at least two processing stations without contacting the edge of the label and without contacting the edge of the microscope slide adjacent the label.

15. The method of claim 13, further comprising;

positioning the pickup device above the microscope slide; and

drawing a vacuum between a suction head of the pickup device and the microscope slide to hold the microscope slide using the suction head while the pickup head is positioned directly above the microscope slide.

16. The method of claim 13, further comprising;

positioning a suction head of the pickup device above the microscope slide;

drawing a vacuum between the suction head and at least a portion of a coverslip on the microscope slide; and

carrying the microscope slide while maintaining the vacuum.

17. The method of claim 13, further comprising:

holding the microscope slide using a suction head of the pickup device while at least one spacer physically contacts an upper surface of the microscope slide to keep the microscope slide in a desired orientation.

18. The method of claim 13, wherein the microscope slide carries a coverslip covering a tissue specimen.

19. The method of claim 13, further comprising:

carrying the microscope slide between at least two processing stations using the pickup device without contacting any portion of the slide within 1 mm of the label.

20. A low-profile microscope slide pickup device, comprising:

an end effector including

an elongate platform having an upper surface and a lower surface,

a fluid line positioned on an upper side of platform, and

a head element including a connector and a suction head, the connector is positioned on the upper side of the platform and coupled to the fluid line, and the suction head is positioned on an lower side of the platform.

21. The low-profile microscope slide pickup device of claim 20, wherein the suction head is sufficiently compliant to engage a coverslipped microscope slide and to maintain an airtight seal with the coverslipped microscope slide while maintaining a vacuum sufficient to carry the microscope slide.

22. The low-profile microscope slide pickup device of claim 20, wherein the suction head is configured to maintain a seal with the coverslipped microscope slide when the suction head overlays the edge of a coverslip and physically contacts a microscope slide underneath the coverslip.

23. The low-profile microscope slide pickup device of claim 20, wherein the head element has an anti-rotation feature received by a complementary shaped receiving feature of the platform.

24. The low-profile microscope slide pickup device of claim 20, wherein the head element is adhered to the platform.

25. The low-profile microscope slide pickup device of claim 20, wherein the end effector has a maximum height equal to or less than about a width of the end effector, and a longitudinal length longer than both the height and the width.

26. The low-profile microscope slide pickup device of claim 20, further comprising:

a connector unit including a mounting body and a feed line, and the platform is coupled to the mounting body, and the fluid line is fluidically coupled to the feed line.

27. The low-profile microscope slide pickup device of claim 20, wherein the connector unit includes a crash protection head.

28. The low-profile microscope slide pickup device of claim 20, wherein the fluid line comprises a hypodermic tube.

29. The low-profile microscope slide pickup device of claim 20, wherein the end effector comprises a plurality of protrusions for contacting a

coverslipped slide held by the end effector to keep the coverslipped slide in a substantially horizontal orientation when the platform is oriented horizontally.

30. The low-profile microscope slide pickup device of claim 29, wherein the suction head is positioned between two of the protrusions relative to a longitudinal axis of the end effector.

PATENT CLAIMS

1. A low-profile microscope slide pickup device, comprising:

an end effector including

an elongate platform having an upper surface and a lower surface,

a fluid line positioned on an upper side of platform, and

a head element including a connector and a suction head, the connector is positioned on the upper side of the platform and coupled to the fluid line, and the suction head is positioned on an lower side of the platform.

2. The low-profile microscope slide pickup device of claim 1, wherein the suction head is sufficiently compliant to engage a coverslipped microscope slide and to maintain an airtight seal with the coverslipped microscope slide while maintaining a vacuum sufficient to carry the microscope slide.

3. The low-profile microscope slide pickup device of claim 1, wherein the suction head is configured to maintain a seal with the coverslipped microscope slide when the suction head overlays the edge of a coverslip and physically contacts a microscope slide underneath the coverslip.

4. The low-profile microscope slide pickup device of claim 1, wherein the head element has an anti-rotation feature received by a complementary shaped receiving feature of the platform.

5. The low-profile microscope slide pickup device of claim 1, wherein the head element is adhered to the platform.

6. The low-profile microscope slide pickup device of claim 1, wherein the end effector has a maximum height equal to or less than about a width

of the end effector, and a longitudinal length longer than both the height and the width.

7. The low-profile microscope slide pickup device of claim 1, further comprising:

a connector unit including a mounting body and a feed line, and the platform is coupled to the mounting body, and the fluid line is fluidically coupled to the feed line.

8. The low-profile microscope slide pickup device of claim 1, wherein the connector unit includes a crash protection head.

9. The low-profile microscope slide pickup device of claim 1, wherein the fluid line comprises a hypodermic tube.

10. The low-profile microscope slide pickup device of claim 1, wherein the end effector comprises a plurality of protrusions for contacting a coverslipped slide held by the end effector to keep the coverslipped slide in a substantially horizontal orientation when the platform is oriented horizontally.

11. The low-profile microscope slide pickup device of claim 10, wherein the suction head is positioned between two of the protrusions relative to a longitudinal axis of the end effector.

12. A method of transporting a microscope slide having a label, the method comprising:

picking up a microscope slide carrying a sample using the low-profile microscope slide pickup device of claims 1-11 without contacting an edge of a label on the microscope slide and without contacting an edge of the microscope slide adjacent to the label; and

carrying the microscope slide using the low-profile microscope slide pickup device to a desired location.

13. The method of claim 12, further comprising:

carrying the microscope slide between at least two processing stations without contacting the edge of the label and without contacting the edge of the microscope slide adjacent the label.

14. The method of claim 12, further comprising;

positioning the low-profile microscope slide pickup device above the microscope slide; and

drawing a vacuum between a suction head of the low-profile microscope slide pickup device and the microscope slide to hold the microscope slide using the suction head while the pickup head is positioned directly above the microscope slide.

15. The method of claim 12, further comprising;

positioning a suction head of the low-profile microscope slide pickup device above the microscope slide;

drawing a vacuum between the suction head and at least a portion of a coverslip on the microscope slide; and

carrying the microscope slide while maintaining the vacuum.

16. The method of claim 12, further comprising:

holding the microscope slide using a suction head of the low-profile microscope slide pickup device while at least one spacer physically contacts an upper surface of the microscope slide to keep the microscope slide in a desired orientation.

17. The method of claim 12, wherein the microscope slide carries a coverslip covering a tissue specimen.

18. The method of claim 12, further comprising:

carrying the microscope slide between at least two processing stations using the low-profile microscope slide pickup device without contacting any portion of the slide within 1 mm of the label.