DEVICE AND METHOD TO ACCURATELY AND EASILY ASSEMBLE GLASS SLIDES

TECHNICAL FIELD

[0001] Embodiments of the present invention relate generally to laboratory devices and more specifically to systems and methods for the preparation and assembly of slide arrays for further experimentation.

SUMMARY OF THE EMBODIMENTS

[0002] According to some embodiments of the present invention, a device accepts a slide array that is to be assembled. A book-like hinged device can be constructed such that two surfaces with location points are exposed to facilitate the loading of two separate slides. One leaf of the book-like device is constructed such that it is a fixed mounting surface placed upon a bench top or other such piece of furniture. The other leaf of the book-like device is moveable from a fully open configuration to a full closed configuration, approximately 180 degrees of motion. Upon closing the hinge, the action brings two slides together in an accurate, repeatable, and easily managed manner. In the preferred configuration, a vacuum chuck on the moveable leaf of the book-like device holds a moveable slide firmly in place prior to its placement on top of a fixed slide. A spring loaded catch on the upper, moveable portion of the device can also maintain a hold on a slide during operation. The vacuum is applied on command of the operator. The closing of the book-like device brings the moving slide and the fixed slide into close but not intimate contact. Once the operator releases the vacuum upon command, the two slides are brought into final, resting position with a minimum of impact.

[0003] According to some embodiments of the present invention, the slide array is to be assembled inside of a separate carrier to allow further processing. The fixed slide is to be assembled inside of the carrier and then placed on a tooled spot on the fixed leaf of the book-like device. Further processing can include the application of an additional carrier on the top slide and the addition of a screw-type clamp to fixate the slide array.

[0004] According to some embodiments of the present invention, the slides described herein are composed of a transparent glass. The invention is not limited to the size of glass slide

normally encountered in normal laboratory operations. The slides can be of a large variety of sizes and shapes. The slides need not be of identical sizes, smaller slides can be placed on a larger slide or vice versa. The slides need not be composed of transparent glass, other materials such as metals or plastics can be accurately assembled using the herein described device.

[0005] Various modifications and additions can be made to the exemplary embodiments discussed without departing from the scope of the present invention. For example, while the embodiments described above refer to particular features, the scope of this invention also included embodiments having different combination of features and embodiments that do not include all of the above described features.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Fig. 1 illustrates an accurate slide assembly device 100, according to the embodiments of the present invention.

[0007] Fig. 2 illustrates an accurate slide assembly device 100, with a Hybridization chamber base installed in the loading position, according to the embodiments of the present invention.

[0008] Fig. 3 illustrates an accurate slide assembly device 100, with a hybridization gasket slide loaded into the Hybridization chamber base, according to the embodiments of the present invention.

[0009] Fig. 4 illustrates an accurate slide assembly device 100, with an experimental slide loaded into the vacuum chuck on the moveable arm, according to the embodiments of the present invention.

[0010] Fig. 5 illustrates an accurate slide assembly device 100, with the vacuum producing cylinder depressed, according to the embodiments of the present invention.

[0011] Fig. 6 illustrates an accurate slide assembly device 100, with the vacuum producing cylinder extended after release, producing a vacuum under the experimental slide, according to the embodiments of the present invention.

[0012] Fig. 7 illustrates an accurate slide assembly device 100, with the moveable arm partly rotated into the slide dropping position, according to the embodiments of the present invention.

[0013] Fig. 8 illustrates an accurate slide assembly device 100, with the moveable arm further deployed into the slide dropping position, according to the embodiments of the present invention.

[0014] Fig. 9 illustrates an accurate slide assembly device 100, with the moveable arm in its final position prior to the release of the experimental slide, according to the embodiments of the present invention.

[0015] Fig. 10 illustrates a detailed view of an accurate slide assembly device 100, with the experimental slide still held on the vacuum chuck slightly above the hybridization gasket slide just prior to final placement, according to the embodiments of the present invention.

[0016] Fig. 11 illustrates an accurate slide assembly device 100, with the experimental slide and the hybridization gasket slide in contact after the release of the vacuum in the vacuum chuck, according to the embodiments of the present invention.

DETAILED DESCRIPTION

[0017] Unless otherwise indicated, all numbers expressing quantities of ingredients, dimensions reaction conditions and so forth used in the specification and claims are to be understood as being modified in all instances by the term "about."

[0018] In this application and the claims, the use of the singular includes the plural unless specifically stated otherwise. In addition, use of "or" means "and/or" unless stated otherwise. Moreover, the use of the term "including," as well as other forms, such as "includes" and "included," is not limiting. Also, terms such as "element" or "component" encompass both elements and components comprising one unit and elements and components that comprise more than one unit unless specifically stated otherwise.

[0019] With reference to Fig. 1, the Accurate Slide Assembly Device (ASAD) 100 consists of a base 101 whereby the static slide assembly tooling base 102 is solidly affixed in place, according to the embodiments of the present invention. Attached to the tooling base 102 is the moveable arm 103 via hinge 105 that keeps the respective tooling points, lower hybaid tooling area 108 and upper slide chuck 110, in accurate registration or alignment with one another, according to the embodiments of the present invention.

[0020] With reference to Figs. 1, 2, and 4, Groove 107 (as shown in Fig. 1) allows the placement of a flexible seal 111 (as shown in Fig. 2), such as an o-ring, into the upper slide

chuck 110 to provide a vacuum to be held in the vacuum space 106 once an experimental slide 113 (as shown in Fig. 4) has been placed in the upper slide chuck 110, according to the embodiments of the present invention. With reference to Fig. 4, hard tooling points 115 fix the experimental slide 113 in a tightly constrained location, according to the embodiments of the present invention.

[0021] With reference to Fig. 3, lower slide receiver 112 is the part of the Hybridization chamber base fixture that receives the hybridization gasket slide 114. Hybridization gasket slide 114 preferably includes several of chambers thereon in which material for processing may be added. Each chamber may be surrounded by a gasket or a flexible seal (similar to the flexible seal 111 above). Once the hybridization gasket slide 114 has been prepared by adding material to the surface, the operation of the ASAD 100 can commence, according to the embodiments of the present invention.

[0022] With reference again to Fig. 4, the experimental slide 113 is held in place against the o-ring 111 (as shown in Fig. 2) after a vacuum is imposed in the open volume or vacuum space 106 (as shown in Figs. 1 & 2). In the present configuration, as illustrated in Figs. 4 – 6, the vacuum is generated by manually pushing button 109 down on the spring return cylinder 104 and then releasing the button 109 to allow the spring to drive the piston inside of the cylinder 104 upwards. A flexible tube 117 connects the cylinder generated vacuum to the open volume or vacuum space 106 (as shown in Figs. 1 & 2) in the moveable arm 103, according to the embodiments of the present invention.

[0023] With reference to Figs. 7 – 9, once the experimental slide 113 is firmly seated against the o-ring 111 (as shown in Fig. 2) and sufficiently registered in the hard tooling points 115, the moveable arm 103 can be articulated by rotation and the experimental slide 113 can be placed over the hybridization gasket slide 114 and inside of the lower slide receiver 112, according to the embodiments of the present invention. The moveable slide (e.g., experimental slide 113 in this embodiment) is located in a controlled position so that as the slides (e.g., experimental slide 113 and hybridization gasket slide 114 in this embodiment) are brought into close proximity with each other, there will be no interference with the removable tooling (e.g., lower slide receiver 112 in this embodiment) or the stationary slide (e.g., hybridization gasket slide 114 in this embodiment). This location is provided in the present, preferred configuration

by raised surfaces that are carefully designed to press against the periphery of the moveable slide, without interfering with the rest of the tooling or the fixed slide.

[0024] With reference to Figs. 10 & 11, the experimental slide 113 can then be released by depressing the button 109 (as shown in Figs. 1 – 9) and allowing the cylinder spring to drive the cylinder 104 to its neutral state. This action causes the vacuum to be released to atmospheric pressure and the experimental slide 113 falls onto the hybridization gasket slide 114 under the force of gravity, according to the embodiments of the present invention.

[0025] With reference again to Fig. 10, the small distance 118 between the experimental slide 113 and the hybridization gasket slide 114 allows the eventual placement of the experimental slide 113 and the hybridization gasket slide 114 (as illustrated in Fig. 11) to be gentle and non-disruptive event, according to the embodiments of the present invention. In this embodiment, the distance 118 is preferably, but not limited to, a distance on the order of about 1 millimeter or less.

[0026] With reference once more to Fig. 1, the grooves 116 that are placed in static slide assembly tooling base 102 are present to allow a clamp (not shown) to be applied onto a stack of hybridization base, hybridization gasket slide, printed slide and the hybridization chamber top in order to fixate the two slides (as shown in Fig. 11) one on top of the other and held in place by the hybridization top in order to facilitate further processing, according to the embodiments of the present invention. Once gravity has brought the upper slide (i.e., experimental slide 113) into contact with the lower slide (i.e., hybridization gasket slide 114), it is possible to clamp the slides together without disturbing the orientation thereof. The device may now be used to repeatably fixate other pairs of slides.

[0027] The Accurate Slide Assembly Device (ASAD) 100 is intended to take a first prepared or otherwise unused slide (including, but not limited to, experimental slide 113) and place it in close proximity in a parallel attitude to a second prepared or otherwise unused slide (including, but not limited to, hybridization gasket slide 114). Prior to positioning in either upper slide chuck 110 or the lower slide receiver 112, either of the first and second slides may be used or unused, prepared or unprepared, already processed or not yet processed.

[0028] In the above-described embodiment, vacuum was provided using the assembly – comprising the manually actuated button 109 and spring return cylinder 104 – that is connected to the o-ring-lined upper slide chuck 110 via flexible tube 117. This, however, is not the only

method of supplying a vacuum to the ASAD 100. Other sources of vacuum include, but are not limited to, an external source that can be piped to the instrument, an on-board source that can be generated with a bulb commonly found in laboratories used for operating pipettes, and an air cylinder that is manually operated to provide a sufficient vacuum to pull the slide against an o-ring. The required vacuum pressure is on the order of inches of water (or about 2.5 to 25 mbar).

[0029] For the above-described embodiment, releasing the vacuum to atmospheric pressure may be accomplished via use of one of numerous valving options that are known to those skilled in the art.

[0030] In the above-described embodiment, the device is manually operated, but the device may be configured to operate robotically in ways known to those skilled in the art. In the above-described embodiment, a single hinge 105 is used, because it is the easiest configuration, but a combination of hinges and slides may also be built into the device to accomplish the same or similar task. Either slides, hinges, or both fit the task.

[0031] Although the above-described embodiment utilizes a hybridization chamber base, the device need not have a hybridization chamber base, but may simply be used to assemble the slides.

[0032] In some embodiments, the upper slide chuck 110 may be configured to be adjustably shifted along any direction within a plane that is parallel to the surface of the moveable arm 103, in order to allow for ease of alignment between the experimental slide 113 and hybridization gasket slide 114 when the moveable is rotated to a position above the static tooling base.

[0033] Various embodiments of the disclosure could also include permutations of the various elements recited in the claims as if each dependent claim was a multiple dependent claim incorporating the limitations of each of the preceding dependent claims as well as the independent claims. Such permutations are expressly within the scope of this disclosure.

[0034] While the invention has been particularly shown and described with reference to a number of embodiments, it would be understood by those skilled in the art that changes in the form and details may be made to the various embodiments disclosed herein without departing from the spirit and scope of the invention and that the various embodiments disclosed herein are not intended to act as limitations on the scope of the claims. All references cited herein are incorporated in their entirety by reference.

What is claimed is:

1. A device comprising:

a static tooling base having a first surface;

a moveable arm that is operably connected with the static tooling base, said moveable arm having a second surface;

wherein the moveable arm is configured to rotate from a first position to a second position, such that the second surface becomes parallel with, and oriented to face, the first surface;

wherein the static tooling base is configured to hold a first slide on the first surface;

wherein the moveable arm is configured to hold a second slide on the second surface, such that the second slide remains held on the second surface when the moveable arm is rotated from the first position to the second position; and

wherein when the moveable arm is in the second position, the device is configured to release the second slide onto the first slide.

2. The device as in claim 1, further comprising a base to which the static tooling base is affixed.

3. The device as in claim 2, wherein the base is mounted on a mounting.

4. The device as in claim 3, wherein said mounting comprises one of a table, lab bench, and stand.

5. The device as in claim 1, wherein the moveable arm is operably connected with the static tooling base by a connection module.

6. The device as in claim 5, wherein the connection module comprises a hinge or a plurality of hinges, and wherein the moveable arm comprises a plurality of moveable arms, each of the plurality of moveable arms being operably connected with the static tooling base via one of the plurality of hinges, such that each of the plurality of moveable arms is rotatable from the first position to the second position in relation to the static tooling base.

7. The device as in claim 1, further comprising a first slide receiver that is removably attachable to the first surface of the static tooling base, wherein the first slide receiver comprises a third surface, and wherein the first slide receiver is configured to hold the first slide on the third surface.

8. The device as in claim 7, further comprising a hybridization chamber base affixed on the first surface of the static tooling base, wherein the first slide receiver is configured to be part of the hybridization chamber base.

9. The device as in claim 7, wherein the first slide receiver comprises first tooling points that are configured to hold the first slide so as to prevent the first slide from shifting with respect to the first slide receiver, and configured such that, when the moveable arm is rotated from the first position to the second position, the first tooling points, the first slide receiver, and the first slide do not interfere with the rotation of the moveable arm, nor interfere with the second slide receiver or the second slide.

10. The device as in claim 7, further comprising a second slide receiver that is removably attachable to the second surface of the moveable arm, wherein the second slide receiver comprises a fourth surface, and wherein the second slide receiver is configured to hold the second slide on the fourth surface, such that the second slide remains held on the fourth surface when the moveable arm is rotated from the first position to the second position.

11. The device as in claim 10, further comprising a vacuum source, wherein the vacuum source is configured to generate a vacuum sufficient to hold the second slide on the fourth surface when the moveable arm is rotated from the first position to the second position, and the vacuum source is further configured to release the vacuum to atmospheric pressure when the moveable arm is in the second position, so as to release the second slide onto the first slide by force of gravity.

12. The device as in claim 11, wherein the fourth surface has a groove thereon, and wherein the second slide receiver further comprises:

a vacuum opening in the fourth surface, wherein the groove forms a closed path around said vacuum opening, and wherein a flexible seal is fitted within the groove;

a vacuum connection to which the vacuum source is connected; and

a vacuum path under the fourth surface, said vacuum path being configured between the vacuum opening and the vacuum connection, wherein the second slide receiver is configured to hold the second slide against the flexible seal on the fourth surface, using the vacuum generated by the vacuum source, when the moveable arm is rotated from the first position to the second position.

13. The device as in claim 12, wherein the flexible seal includes an o-ring.

14. The device as in claim 12, wherein the second slide receiver further comprises a side surface substantially perpendicular to the fourth surface, and wherein the vacuum connection is located on the side surface.

15. The device as in claim 12, wherein the vacuum is set to a pressure of about 2.5 to 25 mbar.

16. The device as in claim 12, further comprising at least one valve through which air is released when the vacuum is generated or when the vacuum is released to atmospheric pressure.

17. The device as in claim 16, wherein the at least one valve is located in at least one of the second slide receiver and the vacuum source.

18. The device as in claim 12, wherein the vacuum source is an external vacuum source.

19. The device as in claim 12, wherein the vacuum source is an on-board vacuum source including a pipette bulb.

20. The device as in claim 12, wherein the vacuum source is an on-board vacuum source including an air cylinder.

21. The device as in claim 20, wherein the air cylinder is configured to provide the vacuum, which is sufficient to pull the second slide against the flexible seal, and wherein the air cylinder is connected to the vacuum connection via a flexible tube.

22. The device as in claim 21, wherein the air cylinder comprises:

a spring return cylinder having a spring therein;

an air-tight piston moveable within the spring return cylinder from a first piston position to a second piston position;

a manually actuated button connected to the piston; and

a cylinder vacuum connection to which the flexible tube is connected, wherein when the manually actuated button is depressed a first time, the piston is pushed from the first piston position to the second piston position within the spring return cylinder, which causes the spring to push the piston from the second piston position back to the first piston position thereby creating the vacuum, which is sufficient to pull the second slide against the flexible seal, and wherein when the manually actuated button is depressed a second time, the piston is pushed again from the first piston position to the second piston position within the spring return cylinder, thereby releasing the vacuum to atmospheric pressure, and thus releasing the second slide.

23. The device as in claim 10, wherein the second slide receiver further comprises second tooling points that are configured to hold the second slide so as to prevent the second slide from shifting with respect to the second slide receiver, and configured such that, when the moveable arm is rotated from the first position to the second position, the second tooling points, the second slide receiver, and the second slide do not interfere with the first tooling points, the first slide receiver, or the first slide.

24. The device as in claim 1, configured such that, when the moveable arm is in the second position, a distance between the first slide and the second slide is about 1 mm or less.

25. The device as in claim 1, wherein the static tooling base comprises extraction grooves thereon that are configured to allow an extraction device to be positioned between the static tooling base and the assembled slide to remove the assembled slide from the device.

26. The device as in claim 25, wherein the extraction device is operated by hand and comprises a clamp.

27. The device as in claim 1, further comprising a rotation mechanism that is configured to rotate the moveable arm from the first position to the second position.

28. The device as in claim 27, wherein the rotation mechanism is further configured to cause the second slide to be held on the second surface when the moveable arm is rotated from the first position to the second position, and to cause the second slide to be released onto the first slide when the moveable arm is in the second position.

29. The device as in claim 1, wherein prior to the first slide and the second slide being placed on the device, at least one of the first slide and the second slide is in at least one of the following sets of conditions: (a) used or unused, (b) prepared or unprepared, or (c) already processed or not yet processed.

30. A method comprising:

providing a device comprising:

a static tooling base having a first surface;

a moveable arm that is operably connected with the static tooling base, said moveable arm having a second surface;

wherein the moveable arm is configured to rotate about the connection module from a first position to a second position, such that the second surface becomes parallel with, and oriented to face, the first surface;

wherein the static tooling base is configured to hold a first slide on the first surface; and

wherein the moveable arm is configured to hold a second slide on the second surface;

positioning the first slide on the static tooling base;

positioning the second slide on the moveable arm;

causing the device to hold the second slide on the second surface, such that the second slide does not move with respect to the second surface even when the moveable arm is moved;

rotating the moveable arm from the first position to the second position; and

causing the device to release the second slide onto the first slide when the moveable arm is in the second position.

31. The method as in claim 30, further comprising mounting the static tooling base on a mounting.

32. The method as in claim 31, further comprising mounting the base on a mounting comprising one of a table, lab bench, and stand.

33. The method as in claim 30, wherein the moveable arm is operably connected with the static tooling base by a connection module and wherein the connection module comprises a plurality of hinges, and wherein the moveable arm includes a plurality of moveable arms, each of the plurality of moveable arms being operably connected with the static tooling base via one of the plurality of hinges, the method further comprising rotating at least one of the plurality of moveable arms from the first position to the second position in relation to the static tooling base.

34. The method as in claim 30, further comprising removably attaching a first slide receiver to the first surface of the static tooling base, prior to the step of positioning the first slide on the static tooling base, wherein the first slide receiver includes a third surface and wherein the first slide receiver is configured to hold the first slide on the third surface.

35. The method as in claim 34, wherein the device further comprises a hybridization chamber base affixed on the first surface of the static tooling base, and wherein the first slide receiver is configured to be part of the hybridization chamber base, the method further comprising processing the second slide on the hybridization chamber base during assembly of the assembled slide.

36. The method as in claim 34, further comprising removably attaching a second slide receiver to the second surface of the moveable arm, prior to the step of positioning the second slide on the moveable arm, wherein the second slide receiver includes a fourth surface and wherein the second slide receiver is configured to hold the second slide on the fourth surface even when the moveable arm is moved.

37. The method as in claim 36, wherein the device further comprises a vacuum source that is connected to the second slide receiver and that is configured to generate a vacuum sufficient to hold the second slide on the fourth surface, wherein the step of causing the device to hold the second slide on the second surface includes causing the vacuum source to generate the vacuum in order to hold the second slide on the fourth surface during the step of rotating the moveable arm, and wherein the step of causing the device to release the second slide includes causing the vacuum source to release the vacuum to atmospheric pressure.

38. The method as in claim 37, wherein step of causing the vacuum source to generate the vacuum comprises causing a vacuum of about 2.5 to 25 mbar.

39. The method as in claim 37, wherein the device further comprises at least one valve located in at least one of the second slide receiver and the vacuum source, wherein at least one of the steps of causing the vacuum source to generate the vacuum and causing the vacuum source to release the vacuum to atmospheric pressure includes releasing air through the at least one valve.

40. The method as in claim 37, wherein the vacuum source is an external vacuum source, wherein the step of causing the vacuum source to generate the vacuum includes turning on the external vacuum source or opening a valve between the second slide receiver and the external vacuum source, and wherein the step of causing the vacuum source to release the vacuum to atmospheric pressure includes turning off the external vacuum source or closing said valve between the second slide receiver and the external vacuum source.

41. The method as in claim 37, wherein the vacuum source is an on-board vacuum source including a pipette bulb, wherein the step of causing the vacuum source to generate the vacuum includes squeezing the pipette bulb a first time from a first state to a second state and allowing the pipette bulb to return from second state back to the first state, and wherein the step of causing the vacuum source to release the vacuum to atmospheric pressure includes squeezing the pipette bulb a second time.

42. The method as in claim 37, wherein the vacuum source is an on-board vacuum source including an air cylinder that is connected to the second slide receiver, the air cylinder

comprising a spring return cylinder having a spring therein, an air-tight piston moveable within the spring return cylinder from a first piston position to a second piston position, a manually actuated button connected to the piston, and a cylinder vacuum connection to which the flexible tube is connected, wherein the step of causing the vacuum source to generate the vacuum includes depressing the manually actuated button a first time, which causes the piston to move from the first piston position to the second piston position within the spring return cylinder, which in turn causes the spring to push the piston from the second piston position back to the first piston position thereby creating the vacuum, which is sufficient to pull the second slide against the flexible seal, and wherein the step of causing the vacuum source to release the vacuum to atmospheric pressure includes depressing the manually actuated button a second time, which causes the piston to move again from the first piston position to the second piston position within the spring return cylinder, thereby releasing the vacuum to atmospheric pressure, and thus releasing the second slide.

43. The method as in claim 36, wherein step of rotating the moveable arm about the connection module from the first position to the second position includes rotating the moveable arm without the second slide receiver or the second slide interfering with the first slide receiver or the first slide.

44. The method as in claim 30, wherein step of rotating the moveable arm about the connection module from the first position to the second position includes moving the second slide such that a distance between the first slide and the second slide is about 1 mm or less.

45. The method as in claim 30, wherein the static tooling base comprises extraction grooves thereon that are configured to allow an extraction device to be positioned between the static tooling base and the assembled slide, the method further comprising:

inserting the extraction device in the grooves and between the static tooling base and the assembled slide; and

lifting the assembled slide from the device, wherein the extraction device is a clamp.

46. The method as in claim 30, wherein the device further comprises a rotation mechanism that is configured to rotate the moveable arm from the first position to the second position, wherein the step of rotating the moveable arm includes instructing the rotation mechanism to rotate the moveable arm about the connection module from the first position to the second position.

47. The method as in claim 46, wherein the rotation mechanism is further configured to cause the second slide to be held on the second surface when the moveable arm is rotated from the first position to the second position, and to cause the second slide to be released onto the first slide when the moveable arm is in the second position, wherein the step of causing the device to hold the second slide includes instructing the rotation mechanism to cause the device to hold the second slide on the second surface, such that the second slide does not move with respect to the second surface even when the moveable arm is moved, and wherein the step of causing the device to release the second slide includes instructing the rotation mechanism to cause the device to release the second slide onto the first slide when the moveable arm is in the second position.

48. The method as in claim 30, wherein prior to the steps of positioning the first slide on the static tooling base and positioning the second slide on the moveable arm, at least one of the first slide and the second slide is in at least one of the following sets of conditions: (a) used or unused, (b) prepared or unprepared, or (c) already processed or not yet processed.