

CLAIMS

What is claimed is:

~~1. — 1. A bead processing assembly for use in attaching magnetic beads to biological cells and/or separating magnetic beads from biological cells, the bead processing assembly comprising:~~

~~a base assembly comprising:~~

~~— a housing;~~

~~a support panel disposed on the housing and having a front face;~~

~~a first pinch valve at least partially outwardly projecting from the front face of the support panel; and~~

~~a first pump at least partially outwardly projecting from the front face of the support panel; and~~

~~a rocker assembly supported on the base assembly, the rocker assembly comprising:~~

~~— a mount assembly supported on the base assembly;~~

~~— a platform assembly pivotably secured to the mount assembly; and~~

~~— a rocker driver configured for rocking the platform assembly relative to the mount assembly.~~

~~2. — The bead processing assembly as recited in claim 1, wherein the base assembly further comprises a cover panel hingedly mounted to the housing, the cover panel being movable between an open position wherein the front face of the support panel is openly exposed and a closed position wherein the cover panel covers the front face of the support panel.~~

~~3. — The bead processing assembly as recited in claim 2, wherein the cover panel comprises:~~

~~a perimeter frame hingedly mounted to the housing and encircling an opening; and~~

~~a transparent window disposed within the opening.~~

~~4. The bead processing assembly as recited in claim 1, wherein the support panel comprises:~~

~~a base panel having a front face, the first pinch valve and the first pump being mounted on the base panel so as to at least partially outwardly project from the front face thereof; and~~

~~an overlay panel being disposed on the front face of the base panel, the overlay panel having openings extending therethrough and through which at least a portion of the first pinch valve and first pump project.~~

~~5. The bead processing assembly as recited in claim 1, wherein the front face of the support panel is disposed at an angle in a range between 30° and 70° when the housing is resting on a horizontal surface.~~

~~6. The bead processing assembly as recited in claim 1, wherein the base assembly further comprises a plurality of pinch valves at least partially outwardly projecting from the front face of the support panel, wherein the plurality of pinch valves comprise at least 2, 3, 4, 6, or 8 pinch valves.~~

~~7. The bead processing assembly as recited in claim 1, wherein the first pump comprises a peristaltic pump.~~

~~8. The bead processing assembly as recited in claim 1, wherein the base assembly further comprises a first bubble sensor at least partially outwardly projecting from the front face of the support panel.~~

~~9. The bead processing assembly as recited in claim 1, wherein the base assembly further comprises a plurality of bubble sensors at least partially outwardly projecting from the front face of the support panel, the plurality of bubble sensors comprising at least 2, 3, or 4 bubble sensors.~~

~~10. The bead processing assembly as recited in claim 1, wherein the base assembly further comprises a pressure sensor at least partially outwardly projecting from the front face of the support panel.~~

~~11. The bead processing assembly as recited in claim 1, wherein the base assembly further comprises:~~

~~an opening extending through the front face of the support panel; and~~

~~a first rotational assembly mounted to the support panel, the first rotational assembly comprising:~~

~~a receiver having a keyed socket formed thereon, the keyed socket being aligned with the opening; and~~

~~a drive motor coupled to the receiver, the drive motor being configured to selectively rotate the receiver in opposite directions.~~

~~12. The bead processing assembly as recited in claim 1, wherein the base assembly further comprises a bead vial retainer including:~~

~~a body configured to receive a vial;~~

~~an elongated arm extending from the body; and~~

~~a motor at least partially disposed within the housing of the base assembly and connected to a free end of the arm, the motor being configured to vertically, reciprocally rotate the body attached thereto over an angle of at least 60°.~~

~~13. The bead processing assembly as recited in claim 12, wherein the body of the bead vial retainer comprises:~~

~~an interior surface that bounds a C-shaped channel; and~~

~~a shoulder that radially inwardly project from the interior surface.~~

~~14. —The bead processing assembly as recited in claim 1, wherein the mount assembly of the rocker assembly comprises a first riser and a spaced apart second riser mounted on the base assembly, the platform assembly being pivotably coupled to and at least partially disposed between the first riser and the second riser.~~

~~15. —The bead processing assembly as recited in claim 1, wherein the rocker driver comprises:~~

~~a crank;~~

~~a motor that selectively rotates the crank; and~~

~~a connecting arm that extends from the crank to the platform assembly.~~

~~16. —The bead processing assembly as recited in claim 1, wherein the platform assembly comprises:~~

~~a housing assembly bounding a compartment;~~

~~a platform mounted to the housing assembly;~~

~~a magnet assembly disposed between the housing assembly and the platform, the magnet assembly having a top surface and an opposing bottom surface; and~~

~~a lift configured for selectively raising and lowering the magnet assembly relative to the platform between an activation position and a deactivation position.~~

~~17. —The bead processing assembly as recited in claim 16, wherein the lift comprises:~~

~~a scissor lift at least partially disposed within the compartment of the housing assembly; and~~

~~a motor that operates the scissor lift.~~

~~18. —The bead processing assembly as recited in claim 17, wherein the scissor lift comprises:~~

~~a shelf, the magnet assembly being disposed on the shelf;~~
~~a first pair of scissor arms extending between the housing assembly and the shelf;~~
~~a second pair of scissor arms extending between the housing assembly and the shelf,~~
~~the second pair of scissor arms being spaced apart from the first pair of scissor arms;~~
~~a threaded shaft coupled to the motor; and~~
~~a collar engaging the threaded shaft such that rotation of the threaded shaft by the~~
~~motor facilitates linear movement of the collar along the threaded shaft, the collar also~~
~~engaging with the first pair of scissor arms and the second pair of scissor arms.~~

~~19. —The bead processing assembly as recited in claim 16, further comprising:~~

~~the platform comprising a support plate having a top surface and an opposing~~
~~bottom surface;~~

~~wherein the bottom surface of the support plate is within 1 cm, 0.5 cm, or 0.2 cm~~
~~of the top surface of the magnet assembly when the magnet assembly is raised to the~~
~~activation position.~~

~~20. —The bead processing assembly as recited in claim 19, wherein the bottom surface~~
~~of the support plate is at least 4 cm, 5 cm, or 6 cm away from the top surface of the magnet~~
~~assembly when the magnet assembly is lowered to the deactivation position.~~

~~21. —The bead processing assembly as recited in claim 16, wherein the platform~~
~~comprises:~~

~~a support plate secured to the housing assembly and being formed of an electrically~~
~~conductive material, the support plate have a top face;~~

~~an insulative seal forming a continuous loop and being disposed on the top face of~~
~~the support plate so as to encircle at least a portion of the support plate, the insulative seal~~
~~being formed of an electrically insulative material; and~~

~~a contact forming a continuous loop and being disposed on top of the insulative seal~~
~~so as to be spaced apart from the support plate; and~~

~~the support plate and the contact being in electrical communication with electrical circuitry that can produce an electrical potential between the contact and the support plate.~~

~~22. The bead processing assembly as recited in claim 16, wherein the platform comprises:~~

~~a support plate having a top face and being secured to the housing assembly;~~

~~a restraint positioned above the top face of the support plate, the restraint comprising:~~

~~—— a boundary wall that partially encircles the top face of the support plate and extends between opposing ends; and~~

~~—— a tray extending between the opposing ends of the boundary wall, the tray having an upwardly sloping floor the projects out away from the boundary wall and a pair of spaced apart posts upwardly projecting from the floor.~~

~~23. The bead processing assembly as recited in claim 16, wherein the platform comprises:~~

~~a retention frame secured to the support housing, the retention frame comprising an annular inner wall encircling an opening, and annular outer wall encircling the inner wall, and a slot being formed between the inner wall and the outer wall; a guide secured within the slot of the retention frame, the guide bounding a channel; and~~

~~—— an electric latch slidably disposed within the channel of the guide.~~

~~24. The bead processing assembly as recited in claim 16, wherein the magnet assembly comprises a magnet.~~

~~25. The bead processing assembly as recited in claim 24, wherein the magnet assembly comprises:~~

~~a non-magnetic casing having a top surface and an opposing bottom surface that extend to a perimeter edge, a recess being formed on the top surface and having a perimeter edge; and~~

~~the magnet being disposed within the recess of the casing.~~

~~26. — The bead processing assembly as recited in claim 25, wherein the magnet comprises a plurality of separate and discrete magnets being disposed in a plurality of alternating orientations so as to produce a Halbach array.~~

~~27. — The bead processing assembly as recited in claim 25, wherein the perimeter edge of the recess is inset from the perimeter edge of the casing at least 0.5 cm, 1 cm, 1.5 cm or 2 cm.~~

~~28. — The bead processing assembly as recited in claim 25, wherein the casing and the magnet each have a rectangular configuration.~~

~~29. — The bead processing assembly as recited in claim 16, wherein the platform assembly further comprises a cover assembly at least partially covering the platform and being movable relative to the platform.~~

~~30. — The bead processing assembly as recited in claim 29, wherein the cover assembly comprises:~~

~~a cover housing that at least partially encircles an opening, at least a portion of the platform being aligned within the opening of the cover housing; and~~

~~a lid being movably mounted to the cover housing between an open position and a closed position, the lid at least substantially covering the opening of the cover housing when in the closed position.~~

~~31. — The bead processing assembly as recited in claim 30, wherein the lid is hingedly mounted to the cover housing.~~

~~32. —The bead processing assembly as recited in claim 30, wherein the lid comprises:
a perimeter wall the encircles an opening and that has an upper end and an opposing lower end; and~~

~~a lid plate having a top surface and an opposing bottom and being secured to the lower end of the perimeter wall so as to extend over the opening, at least a portion of the perimeter wall upstanding above the top surface of the lid plate so that an upper cavity is formed that is partially bounded by the lid plate and is encircled by the perimeter wall.~~

~~33. —The bead processing assembly as recited in claim 32, wherein the perimeter wall has a channel extending therethrough adjacent to the top surface of the lid plate so as to communicate with the upper cavity.~~

~~34. —The bead processing assembly as recited in claim 30, further comprising a first latch for securing the lid to the cover housing when the lid is in the closed position.~~

~~35. —The bead processing assembly as recited in claim 29, further comprising means for resiliently restraining movement of the cover assembly away from the platform.~~

~~36. —The bead processing assembly as recited in claim 35, wherein the means for resiliently restraining movement comprises:~~

~~a rod having a first end and an opposing second end, the first end being secured to and projecting from cover assembly; and~~

~~a spring engaged with the rod such that as a force is used to move the cover assembly away from the platform the spring resiliently urges the cover assembly back toward the platform.~~

~~37. —The bead processing assembly as recited in claim 36, further comprising a stop movable between a restraining position and a non-restraining position, in the restraining position,~~

~~the stop is positioned to preclude some movement of the rod relative to the platform and in the non-restraining position the stop does not interfere with movement of the rod.~~

~~38. —The bead processing assembly as recited in claim 37, further comprising a solenoid valve mounted on the housing assembly, the solenoid valve moving the stop between the restraining position and a non-restraining position.~~

~~39. —The bead processing assembly as recited in claim 36, further comprising:
a hole formed on the housing assembly, the rod being slidably disposed within the hole;
a flange outwardly projecting from the second end of the rod; and
the spring extending between the flange and the housing assembly so that as the rod is concurrently lifted with the cover assembly, the spring is resiliently compressed.~~

~~40. —The bead processing assembly as recited in claim 39, further comprising a stop movable between a restraining position and a non-restraining position, in the restraining position, the stop is aligned with the flange so as to block some movement of the flange and the rod attached thereto, in the non-restraining position, the stop is not aligned with the flange and thus does not interfere with movement of the flange or rod attached thereto.~~

~~41. —The bead processing assembly as recited in claim 30, further comprising:
a recess formed on the cover housing and communicating with the opening of the cover housing; and
a clamp assembly slidably disposed within the recess, the clamp assembly comprising:
a base clamp having a lower clamp groove formed thereon;
a clamp closure having an upper clamp groove formed thereon; and
a fastener selectively securing the clamp closure to the base clamp so that that upper clamp groove is aligned with the lower clamp groove.~~

~~42. The bead processing assembly as recited in claim 41, wherein the cover housing further comprises a U-shaped channel formed at each opposing end of the recess, opposing ends of the clamp assembly being slidably disposed with the U-shaped channels.~~

~~43. The bead processing assembly as recited in claim 16, wherein the platform comprises:~~

~~a support plate having a top surface and an opposing bottom surface; and~~

~~a sidewall projecting away from the support plate and being secured to the housing assembly, the support plate and sidewall at least partially bonding a cavity in which the magnet assembly is received when the magnet assembly is in the raised activated position.~~

~~44. A bead processing system for attaching magnetic beads to biological cells and/or separating magnetic beads from biological cells, the bead processing system comprising:~~

~~a bead processing assembly comprising:~~

~~a base assembly comprising:~~

~~———— a housing;~~

~~a support panel disposed on the housing and having a front face;~~

~~a first pinch valve at least partially outwardly projecting from the front face of the support panel; and~~

~~a first pump at least partially outwardly projecting from the front face of the support panel; and~~

~~a rocker assembly supported on the base assembly, the rocker assembly comprising:~~

~~———— a mount assembly supported on the base assembly;~~

~~a platform assembly pivotably secured to the mount assembly and comprising a platform; and~~

~~a rocker driver configured for rocking the platform assembly relative to the mount assembly;~~

~~a consumable kit comprising:~~

~~a tray having a front face and an opposing back face with a plurality of openings extending therebetween, the tray being removably nested on the front face of the support panel so that the first pinch valve and the first pump project through corresponding ones of the plurality of openings; and~~

~~a line set secured to the front face of the tray, the line set comprising:~~

~~flexible tubing secured to the front face of the tray and engaging with the first pinch valve and the first pump; and~~

~~a plurality of flexible bags fluid coupled with the tubing, the plurality of flexible bags comprising a processing bag supported on the platform of the platform assembly.~~

45. — ~~The bead processing system as recited in claim 44, wherein the base assembly further comprises a cover panel hingedly mounted to the housing assembly, the cover panel being movable between an open position wherein the front face of the tray is openly exposed and a closed position wherein the cover panel covers the front face of the tray.~~

46. — ~~The bead processing system as recited in claim 44, wherein the base assembly further comprises a plurality of pinch valves at least partially outwardly projecting from the front face of the support panel, wherein the plurality of pinch valves comprise at least 2, 3, 4, 6, or 8 pinch valves, wherein each of the plurality of pinch valves project through corresponding ones of the plurality of openings on the tray and engage with the flexible tubing.~~

47. — ~~The bead processing system as recited in claim 44, wherein the base assembly further comprises a first bubble sensor at least partially outwardly projecting from the front face~~

of the support panel, the first bubble sensor projecting through a corresponding one of the plurality of openings on the tray and engage with the flexible tubing.

48. — The bead processing system as recited in claim 44, further comprises:

an opening extending through the front face of the support panel; and

a first rotational assembly mounted to the support panel, the first rotational assembly comprising:

a receiver having a keyed socket formed thereon, the keyed socket being aligned with the opening; and

a drive motor coupled to the receiver, the drive motor being configured to selectively rotate the receiver in opposite directions;

a stopcock fluid coupled with the tubing of the line set, the stopcock having a rotatable handle received within the keyed socket of the receiver; and

an air filter fluid coupled with the stopcock.

49. — The bead processing system as recited in claim 44, further comprises a bead vial retainer including:

a body having a channel configured to receive a vial;

an elongated arm extending from the body;

a motor at least partially disposed within the housing assembly of the base assembly and connected to a free end of the arm, the motor being configured to vertically, reciprocally rotate the body attached thereto over an angle of at least 60°; and

a vial received within the channel of the body, the vial housing magnetic beads and a media, the tubing of the line set being fluid coupled with the vial.

50. — The bead processing system as recited in claim 44, wherein the platform assembly comprises:

a housing assembly bounding a compartment;

~~a platform mounted to the housing assembly;~~

~~a magnet assembly disposed between the housing assembly and the platform, the magnet assembly having a top surface and an opposing bottom surface; and~~

~~a lift disposed within the compartment of the housing assembly for selectively raising and lowering the magnet assembly relative to the platform between an activation position and a deactivation position.~~

~~51. —The bead processing system as recited in claim 50, wherein the platform assembly further comprises a cover assembly at least partially covering the platform and the processing bag thereon, the cover assembly being movable relative to the platform as the processing bag expands.~~

~~52. —The bead processing system as recited in claim 51, further comprising means for resiliently restraining movement of the cover assembly away from the platform.~~

~~53. —The bead processing system as recited in claim 51, wherein the cover assembly comprises:~~

~~a cover housing that at least partially encircles an opening, the processing bag being at least partially disposed within the opening of the cover housing; and~~

~~a lid being movably mounted to the cover housing between an open and closed position, the lid at least substantially covering the opening of the cover housing when in the closed position.~~

~~54. —The bead processing system as recited in claim 53, further comprising:~~

~~a recess formed on the cover housing and communicating with the opening of the cover housing;~~

~~a clamp assembly slidably disposed within the recess, the clamp assembly comprising:~~

~~a base clamp having a lower clamp groove formed thereon;~~

~~a clamp closure having an upper clamp groove formed thereon; and
a fastener selectively securing the clamp closure to the base clamp so that
that upper clamp groove is aligned with the lower clamp groove;
wherein the processing bag disposed on the platform has a port that is at least partially
disposed within the aligned upper clamp groove and lower clamp groove and is clamped between
the base clamp and the clamp closure.~~

~~55. — The bead processing system as recited in claim 44, further comprising a first media
bag fluid coupled to the tubing of the line set and housing a medium.~~

~~56. — The bead processing system as recited in claim 55, wherein the bead processing
assembly further comprises a stand upstanding from the base assembly and having a catch
outwardly projecting therefrom, the media bag being supported on the catch.~~

~~57. — The bead processing system as recited in claim 44, wherein the tubing of the line
set is fluid coupled with a biological cell separator.~~

~~58. — The bead processing system as recited in claim 44, wherein the tubing of the line
set is fluid coupled with a biological cell expansion system.~~

~~59. — The bead processing system as recited in claim 44, wherein the processing bag
comprise a bead separation bag that comprises:~~

~~a collapsible bag body comprised of polymeric film and bounding a compartment;
a pair of spaced apart ports coupled to the bag body and communicating with the
compartment;~~

~~a partition disposed within the compartment of the bag body at a location between
the pair of spaced apart ports, the partition being secured to the bag body so that fluid~~

~~entering one of the ports must flow around the partition before it can leave through the other port.~~

~~60. A consumable kit for use with a magnetic bead processing assembly, the consumable kit comprising:~~

~~a tray having a front face and an opposing back face with a plurality of openings extending therebetween; and~~

~~a line set secured to the front face of the tray, the line set comprising:~~

~~flexible tubing secured to the front face of the tray so as to align with at least some of the plurality of openings;~~

~~a plurality of flexible bags fluid coupled with the tubing; and~~

~~an air filter coupled with the tubing.~~

~~61. The consumable kit as recited in claim 60, further comprising an air filter assembly coupled with the tubing, the air filter assembly comprising:~~

~~a stop-cock fluid coupled with the tubing, the stop-cock comprising:~~

~~—— a sleeve outwardly projecting from the front face of the tray;~~

~~—— a valve rotatably disposed within sleeve; and~~

~~—— a handle secured to the valve for selectively rotating the valve, the handle outwardly projecting from the back face of the tray; and~~

~~the air filter fluid coupled with the sleeve.~~

~~62. The consumable kit as recited in claim 61, further comprising a mixing bag disposed on the front face of the tray and being fluid coupled with the tubing.~~

~~63. The consumable kit as recited in claim 61, further comprising:~~

~~a bead vial coupler fluid coupled to the tubing of the line set; and~~

~~a vial secured to the bead vial coupler, the vial housing a suspension comprising magnetic beads and a carrier liquid.~~

64. — ~~A rocker assembly comprising:~~

~~a mount assembly;~~

~~a platform assembly pivotably secured to the mount assembly;~~

~~—— a rocker driver configured for rocking the platform assembly relative to the mount assembly;~~

~~wherein the platform assembly comprises:~~

~~a housing assembly bounding a compartment;~~

~~a platform mounted to the housing assembly;~~

~~a magnet assembly disposed between the housing assembly and the platform;~~

~~a lift configured for selectively raising and lowering the magnet assembly relative to the platform between an activation position and a deactivation position; and~~

~~a cover assembly at least partially covering the platform and being movable relative to the platform.~~

65. — ~~The rocker assembly as recited in claim 64, wherein the cover assembly comprises:~~

~~a cover housing that at least partially encircles an opening, at least a portion of the platform being aligned within the opening of the cover housing; and~~

~~a lid being movably mounted to the cover housing between an open position and a closed position, the lid at least substantially covering the opening of the cover housing when in the closed position.~~

66. — ~~A bead processing assembly for use in attaching magnetic beads to biological cells and/or separating magnetic beads from biological cells, the bead processing assembly comprising:~~
~~a base assembly comprising:~~

~~—— a housing;~~

~~a support panel disposed on the housing and having a front face;~~

~~a first pinch valve at least partially outwardly projecting from the front face of the support panel; and~~

~~a first pump at least partially outwardly projecting from the front face of the support panel.~~

~~67. — A method for operating a bead processing system for attaching magnetic beads to biological cells and/or separating magnetic beads from biological cells, the method comprising:~~

~~removably nesting a tray on a front face of a support panel of a bead processing assembly so that a first pinch valve and a first pump projecting from the support panel pass through corresponding openings formed on the tray;~~

~~engaging a tubing of a line set disposed on the tray to the first pinch valve and the first pump; and~~

~~placing a processing bag fluid coupled with the line set on a platform of the bead processing assembly.~~

~~68. — The method as recited in claim 67, further comprising fluid coupling a vial or a flexible bag to the tubing of the line set, the vial or the flexible bag housing a suspension comprising magnetic beads and a carrier liquid.~~

~~69. — The method as recited in claim 67, further comprising supporting a media bag housing liquid media on a bag stand of the bead processing assembly.~~

~~70. — The method as recited in claim 67, further comprising fluid coupling the tubing of the line set to a biological cell separator.~~

~~71. —The method as recited in claim 67, further comprising fluid coupling the tubing of the line set to a biological cell expansion system.~~

~~72. —The method as recited in claim 67, further comprising activating a computer processor of the bead processing assembly so that the computer processor facilitates rocking of the platform on which the processing bag is placed.~~

~~73. —The method as recited in claim 67, further comprising activating a computer processor of the bead processing assembly so that the computer processor facilitates raising and lowering a magnet relative to the platform on which the processing bag is placed.~~

~~74. —The method as recited in claim 67, further comprising activating a computer processor of the bead processing assembly so that the computer processor facilitates controlling the first pinch valve and the first pump to deliver a fluid to the processing bag on the platform.~~

~~75. —The method as recited in claim 67, further comprising activating a computer processor of the bead processing assembly so that the computer processor facilitates moving a vial fluid coupled with the tubing of the line set so as to mix a suspension disposed within the vial, the suspension comprising magnetic beads and a carrier liquid.~~

~~76. —The method as recited in claim 67, wherein the biological cells are T cells.~~

~~77. —The method as recited in claim 67, wherein the biological cells are attached to the magnetic beads through an antigen-antibody interaction.~~

~~78. —The method as recited in claim 77, wherein the biological cells are detached from the magnetic beads by disruption of the antigen-antibody interaction.~~

~~79. — The method as recited in claim 78, wherein the disruption of the antigen-antibody interaction is mediated by cleavage of the antibody.~~

~~80. — The method as recited in claim 77, wherein the biological cells are detached from the magnetic beads by separation of the antibody from the magnetic beads.~~

~~81. — The method as recited in claim 77, wherein the antibody is linked to the magnetic beads by a ligand.~~

~~82. — The method as recited in claim 81, wherein the biological cells are detached from the magnetic beads by disruption of the ligand interaction with the antibody or the magnetic bead.~~

~~83. — The method as recited in claim 67, wherein the biological cells are T cells.~~

84. A method for separating biological cells of a first cell type from biological cells of a second cell type using a bead processing system, the method comprising:

~~a.~~ contacting a sample comprising the biological cells of the first cell type and the second cell type with magnetic beads so that the magnetic beads attach to the biological cells of the first cell type through an antibody linkage, the sample and magnetic beads being disposed within a processing bag resting on a platform;

~~b.~~ raising a magnet relative to the platform so that the magnet produces a magnetic field that securely fixes in place the magnetic beads relative to the platform, the magnetic beads having the biological cells of the first cell type attached thereto;

~~c.~~ passing a fluid through the sample and the magnetic beads while the magnetic field is applied thereto, the fluid passing with a force sufficiently strong to wash away the biological cells of the second cell type from the biological cells of the first cell type; and

~~d.~~ lowering the magnet relative to the platform so that the magnetic beads having the

biological cells of the first cell type attached thereto are no longer securely fixed in place relative to the platform by the magnetic field of the magnet.

2. The method as recited in claim ~~84~~1, wherein the antibody has a binding affinity for a protein comprising CD56.

3. The method as recited in claim 1 or claim 2, wherein the first cell type is natural killer (NK) cells.

~~85.~~ 4. The method as recited in claim 1, wherein the antibody has binding affinity for a protein selected from the group consisting of CD3, CD4, CD5, CD6, CD8, CD25, CD27, CD28, CD137, and CD278.

~~86.~~ 5. The method as recited in claim ~~85~~, wherein the antibody has binding affinity for a protein comprising CD3 or CD28.

~~87.~~ The method as recited in claim ~~86~~4, wherein the first cell type is a T cellscell.

~~88.~~ 6. The method as recited in ~~claim 84~~any one of the preceding claims, further comprising:

detaching at least a majority of the biological cells of first cell type from the magnetic beads;

applying a magnetic field to the magnetic beads so as to securely fix the magnetic beads in place; and

passing a fluid through the magnetic beads and the separated biological cells of first cell type while the magnetic field is being applied, the fluid passing with a force sufficiently strong to wash away at least a majority of the biological cells of the first cell type from the magnetic beads while at least a majority of the magnetic beads remain fixed in place by the magnetic field.

~~89.~~ 7. The method as recited in claim ~~88~~6, wherein greater than 95% of the magnetic beads are retained in place by the magnetic field while the at least a majority of the biological cells of the first cell type are washed away from the magnetic beads.

~~90.~~ 8. The method as recited in claim ~~89~~7, wherein greater than 95% of the magnetic beads are separated from the biological cells of the first cell type.

~~91.~~ 9. The method as recited in ~~claim 84~~any one of the preceding claims, wherein greater than 95% of the magnetic beads detached from the biological cells of first cell type are separated from the biological cells of first cell type.

~~92.~~ 10. The method as recited in ~~claim 84~~any one of the preceding claims, wherein the magnetic beads are from about 0.5 μm to about 3 μm in diameter.

~~93.~~ 11. The method as recited in claim ~~84~~1, further comprising tilting the platform on which the processing bag is resting in a first direction relative to horizontal, the magnetic field being applied to the magnetic beads within the processing bag while the platform is tilted in the first direction.

~~94.~~ 12. The method as recited in claim ~~93~~11, wherein the magnet is raised after the platform is tilted in the first direction.

~~95.~~ 13. The method as recited in claim ~~93~~11 or claim 12, further comprising injecting a gas or a liquid through a port of the processing bag while the platform is tilted in the first direction.

~~96.~~ 14. The method as recited in ~~claim 93~~any one of claims 11-13, further comprising:

tilting the platform in a second direction opposite to the first direction so that the platform on which the processing bag is resting is angled relative to horizontal; and
withdrawing liquid from the processing bag while the platform is tilted in the second direction.

15. A bead processing assembly for use in attaching magnetic beads to biological cells and/or separating magnetic beads from biological cells, the bead processing assembly comprising:

a base assembly comprising:

a housing;

a support panel disposed on the housing and having a front face;

a first pinch valve at least partially outwardly projecting from the front face of the support panel; and

a first pump at least partially outwardly projecting from the front face of the support panel; and

a rocker assembly supported on the base assembly, the rocker assembly comprising:

a mount assembly supported on the base assembly;

a platform assembly pivotably secured to the mount assembly; and

a rocker driver configured for rocking the platform assembly relative to the mount assembly.

~~97. — A method for separating a first biological material from a second biological material using a bead processing system, the method comprising:~~

~~a. — contacting a sample comprising the first biological material and the second biological material with magnetic beads so that the magnetic beads attach to the first~~

~~biological material through an affinity linkage, the sample and magnetic beads being disposed within a processing bag resting on a platform;~~

~~b. — raising a magnet relative to the platform so that the magnet produces a magnetic field that securely fixes in place the magnetic beads relative to the platform, the magnetic beads having first biological material attached thereto; and~~

~~c. — passing a first fluid through the sample and the magnetic beads while the magnetic field is applied thereto, thereby separating the first biological material from the second biological material.~~

~~98. — The method~~16. The bead processing assembly of claim 97, further comprising:

~~d. — passing a second fluid through the sample and the magnetic beads while the magnetic field is applied thereto~~15, wherein the second fluid induces release of the first biological material from the magnetic beads.platform assembly comprises:

a housing assembly bounding a compartment; a platform mounted to the housing assembly;

a magnet assembly disposed between the housing assembly and the platform, the magnet assembly comprising:

a top surface and an opposing bottom surface; and

a lift configured for selectively raising and lowering the magnet assembly relative to the platform between an activation position and a deactivation position.

17. The bead processing assembly of claim 15 or claim 16, wherein the platform assembly comprises a plurality of separate and discrete magnets being disposed in a plurality of alternating orientations so as to produce a Halbach array.

18. A consumable kit for use with a magnetic bead processing assembly, the consumable kit comprising:

a tray having a front face and an opposing back face, wherein the tray is configured to be removably fitted on a support of the magnetic bead processing assembly; and

a line set secured to the front face of the tray, the line set comprising:

~~99.—The method of claim 97, further comprising:~~

~~d.—lowering the magnet relative to the platform so that the magnetic beads having the first biological material attached thereto are no longer securely fixed in place relative to the platform by the magnetic field of the magnet.~~

tubing, the tubing comprising an inlet configured to be fluid coupled to the magnetic bead processing assembly and at least one output;

at least one flexible bag fluid coupled with the tubing; and

an air filter fluid coupled with the tubing.

~~100.—19. The method of claim 97, wherein the second biological material is a cell lysate or a culture medium.~~

~~101.—The method consumable kit of claim 97, wherein the first biological material is selected from the group consisting of:~~

~~a.—a nucleic acid molecule;~~

~~b.—a protein;~~

~~c.—a cell;~~

~~d.—an extracellular vesicle; and~~

~~e.—a virus-like particle (VLP).~~

~~102. The method of claim ~~101~~18, wherein the ~~nucleic acid molecule is a ribonucleic acid (RNA) molecule.~~tray comprises a plurality of tubing restraints configured to secure at least a portion of the tubing to the tray.~~

~~103.—20. The method consumable kit of claim ~~101~~19, wherein the cell is tray comprises a mammalian cell.~~

~~104.—The method plurality of claim 103, wherein the cell is a T cell.~~

~~105.—The method openings extending between the front face and the back face, and the tubing is secured to the front face of claim 101, wherein the protein is an antibody.~~

~~106.—The method of claim 105, wherein the affinity linkage the tray so as to align with the antibody is formed by Protein A, Protein G, Protein L, or a functional variant of one of these proteins.~~

~~107.—The method of claim 101, wherein the extracellular vesicle is an exosome.~~

~~108.—The method of claim 107, wherein the exosome was generated by a T cell.~~

~~109.—The method of claim 108, wherein the T cell was engineered to express a chimeric antigen receptor.~~

~~110.—The method of claim 107, wherein the affinity linkage with the exosome is formed by an anti-CD3 antibody, an anti-CD4 antibody, and/or an anti-CD8 antibody.~~

~~111.—The method of claim 110, wherein the anti-CD3 antibody, the anti-CD4 antibody, and/or the anti-CD8 antibody is attached to the magnetic beads by a biotin or biotin derivative linkage.~~

~~112.—The method of claim 110, wherein one or more of the anti-CD3 antibody, the anti-CD4 antibody, and/or the anti-CD8 antibody is a variable heavy-heavy (VHH) antibody.~~

~~113. — A method for producing a purified ribonucleic acid (RNA) molecule, the method comprising:~~

~~a. — fixing a first magnetic bead in place by a magnetic field, wherein an *in vitro* transcription (IVT) template is linked to the first magnetic bead;~~

~~b. — contacting the first magnetic bead of step (a) with a reagent mixture suitable for IVT of the template under condition in which IVT occurs, thereby producing an RNA molecule, and~~

~~c. — separating the RNA molecule from the first magnetic bead, thereby producing the purified RNA molecule.~~

~~114. — The method of claim 113, further comprising:~~

~~d. — contacting the purified RNA molecule of step (c) with a second magnetic bead under conditions that allows for the purified RNA molecule to remain associated with the second magnetic bead during washing,~~

~~e. — washing of the second magnetic bead while the second magnet bead is fixed in place by a magnetic field, and~~

~~f. — releasing the purified RNA molecule from association with the second magnetic bead, thereby producing a highly purified RNA molecule.~~

~~115. — The method of claim 113, wherein the IVT template is produced by polymerase chain reaction (PCR).~~

~~116. — The method of claim 115, wherein one or more biotinylated primer is used in the PCR and results in the formation of a biotinylated IVT template.~~

~~117. — The method of claim 116, wherein the biotinylated IVT template is attached to the magnetic bead through an interaction between the biotin of the biotinylated IVT template and a group on the magnetic bead with affinity for biotin.~~

~~118.—The method of claim 113, wherein the IVT template comprises an open reading frame encoding a protein and a promoter operably connected to the open reading frame.~~

~~119.—The method of claim 114, wherein free carboxylic acid groups are present on the surface of the second magnetic bead.~~

~~120.—The method of claims 113 or 114, wherein the purified RNA or the highly purified RNA is a messenger RNA (mRNA).~~

~~121.—The method of claim 120, wherein the mRNA encodes a protein of pathogen.~~

~~122.—A vaccine composition comprising the mRNA of claim 121 or the protein encoded by this mRNA.~~

~~123.—A non-transitory computer readable storage medium storing one or more programs, the one or more programs comprising instructions which, when executed by an electronic device with a display, cause the electronic device to:~~

~~display, on the display, a graphical user interface comprising a primary selection area comprising at least one primary virtual bioprocess parameter input and a secondary selection area comprising at least one secondary virtual input that overrides or duplicates the primary virtual bioprocess parameter input.~~

~~124.—The storage medium of claim 123, wherein the secondary virtual input comprises a cancel-step, pause-step, stop-step, skip-step or duplicate-step input.~~

~~125. The storage medium of claim 123, wherein the primary virtual bioprocess parameter input comprises a bioprocess parameter that controls the operation of the bead processing assembly of any one of claims 1-43 and 66.~~

~~126. The storage medium of claim 123, wherein the primary virtual bioprocess parameter input comprises a bioprocess parameter that controls the operation of the bead processing system of any one of claims 44-59.~~

~~127. The storage medium of claim 123, wherein the primary virtual bioprocess parameter input comprises a bioprocess parameter that controls the operation of the rocker assembly of any one of claims 64-65~~some of the plurality of openings.