CLAIMS

What is claimed:

1. A process of assaying biological activity in a micro-fluidic device, said process comprising:

culturing one or more biological cells in a holding pen of a micro-fluidic device, wherein said one or more cells produce a biological material of interest;

introducing one or more capture micro-objects into said holding pen, wherein each said capture object comprises a binding substance that specifically binds said biological material of interest;

allowing said biological material of interest produced by said one or more biological cells to bind to said one or more capture micro-objects; and

assessing said biological material of interest bound to said capture micro-objects.

2. The process of claim 1 further comprising, after allowing said biological material of interest to bind to said one or more capture micro-objects but before assessing said biological material of interest bound to said one or more capture micro-objects, removing said one or more capture micro-objects from said holding pen.

3. The process of claim 2, wherein removing said one or more capture micro-objects comprises moving said one or more capture micro-objects to an assay region located within said micro-fluidic device.

4. The process of claim 3, wherein said assay region is a stop located within a channel in said micro-fluidic device.

5. The process of claim 3, wherein said assay region is a chamber located within said micro-fluidic device.

6. The process of claim 2, wherein removing said one or more capture micro-objects comprises:

moving said one or more capture micro-objects to a channel in said micro-fluidic device; and

exporting said one or more capture micro-objects from said micro-fluidic device.

7. The process of any one of claims 2 to 6, wherein removing said one or more capture micro-objects comprises:

creating a light trap trapping at least one of said capture micro-objects in said holding pen by projecting a light pattern that surrounds said at least one capture micro-object onto an inner surface of said microfluidic device, and

moving said light trap from said holding pen into a channel in said micro-fluidic device.

8. The process of any one of claims 2 to 6, wherein said one or more capture micro-objects are magnetic, and wherein removing said one or more capture micro-objects comprises applying a magnetic field to said micro-fluidic device.

9. The process of any one of claims 2 to 8 further comprising correlating each said removed capture micro-object with said holding pen from which said removed capture micro-object was removed.

10. The process of any one of claims 1 to 9, wherein said assessing comprises determining a type of said biological material of interest bound to said one or more capture micro-objects.

11. The process of any one of claims 1 to 10, wherein said assessing comprises determining an activity of said biological material of interest bound to said one or more capture micro-objects.

12. The process of any one of claims 1 to 11, wherein said assessing comprises determining an amount of said biological material of interest bound to said one or more capture micro-objects.

13. The process of any one of claims 10 to 12, wherein said determining comprises:

binding assay material to said biological material of interest bound to said one or more capture micro-objects; and

detecting an association between said one or more capture micro-objects and radiation originating from said assay material.

14. The process of claim 13, wherein said determining further comprises, after binding said assay material to said biological material of interest but before detecting an association between said one

or more capture micro-objects and radiation originating from said assay material, washing unbound assay material away from said one or more capture micro-objects.

15. The process of claim 13 further comprising determining whether said radiation associated with each said capture micro-object corresponds to a predetermined characteristic.

16. The process of any one of claims 1 to 15, wherein said biological material of interest is a protein.

17. The process of claim 16, wherein said protein is an antibody.

18. The process of claim 1, wherein said assessing is performed while said one or more capture micro-objects are in said holding pen.

19. The process of any one of claims 1 to 18, wherein said binding substance of said one or more capture micro-objects has a binding affinity for said biological material of interest of at least 1 μM.

20. The process of any one of claims 1 to 19, wherein said one or more biological cells in said holding pen comprises a clonal colony of biological cells.

21. The process of any one of claims 1 to 19, wherein said one or more biological cells in said holding pen is a single cell.

22. The process of any one of claims 1 to 21, wherein said one or more capture micro-objects is a single capture micro-object.

23. The process of any one of claims 1 to 21, wherein said one or more capture micro-object comprises a plurality of capture micro-objects, each of which comprises a binding substance that differs from the binding substance of other capture micro-objects in said plurality.

24. The process of claim 23, wherein said biological material of interest is an antibody, and wherein each of said plurality of capture micro-objects comprises a binding substance which binds to

an antibody isotype that differs from the antibody isotype bound by the binding substance of other capture micro-objects in said plurality.

25. The process of claim 23, wherein said biological material of interest is an antibody, and wherein each of said plurality of capture micro-objects comprises a binding substance corresponding to an epitope of an antigen recognized by said antibody.

26. The process of claim 23, wherein said biological material of interest is an antibody, and wherein one capture micro-object of said plurality comprises a binding substance corresponding to an antigen recognized by said antibody or an epitope thereof, and wherein the other capture micro-objects of said plurality each comprise a binding substance corresponding to a homolog of said antigen from a different species or an epitope thereof.

27. A process of assaying biological activity in a micro-fluidic device, said process comprising:

culturing one or more biological cells in a holding pen of a micro-fluidic device, wherein said one or more cells produce *n* different biological materials of interest;

introducing *n* different types of capture micro-objects into said holding pen, each said type of capture micro-object comprising a binding substance that specifically binds to one of said *n* different biological materials of interest;

allowing said *n* different biological materials of interest produced by said one or more biological cells to bind to said *n* different types of capture micro-objects; and

assessing binding between said *n* different biological materials of interest and said *n* different types of capture micro-objects.

28. The process of claim 27, wherein a result of said assessing is positive if at least one of said *n* different biological materials of interest specifically binds to one of said *n* different types of capture micro-objects.

29. The process of claim 23, wherein a result of said assessing is positive if at least two of said *n* different biological materials of interest each specifically binds to one of said *n* different types of capture micro-objects.

30. The process of claim 23, wherein a result of said assessing is positive if all *n* different biological materials of interest each specifically binds to one of said *n* different types of capture micro-objects.

31. The process of any of claims 27 to 30, wherein said *n* different types of capture micro-objects are introduced into said pen simultaneously.

32. The process of any of claims 27 to 30, wherein said *n* different types of capture micro-objects are introduced into said pen sequentially.

33. A process of assaying biological activity in a micro-fluidic device, said process comprising:

culturing one or more biological cells in a holding pen of a micro-fluidic device, wherein said one or more cells produce *n* different biological materials of interest;

introducing one or more *y*-material capture micro-objects into said holding pen, each *y*-material capture micro-object comprising *y* different binding substances, each of which specifically binds to one of said *n* different biological materials of interest;

allowing said *n* different biological materials of interest produced by said one or more biological cells to bind to said *y*-material capture micro-objects; and

assessing binding between said *n* different biological materials of interest and said *y*-material capture micro-objects.

34. A micro-fluidic device comprising:

an enclosure comprising a channel, a holding pen, and an assay region,

wherein said holding pen comprises an isolation region and a connection region, said connection region having a proximal opening to said channel and a distal opening to said isolation region; and

wherein said assay region is located adjacent to said holding pen.

35. The micro-fluidic device of claim 34, wherein said assay region comprises a stop located within said channel.

36. The micro-fluidic device of claim 34, wherein said assay region comprises an assay chamber having an opening to said channel, wherein said assay chamber is located beside said holding pen.

37. The micro-fluidic device of claim 34, wherein said assay region comprises an assay chamber having an opening to said channel, wherein said opening to said assay chamber is located directly across said channel from said proximal opening of said connection region of said holding pen.

38. The micro-fluidic device of claim 36 or 37, wherein said assay chamber substantially lacks an isolation region.

38. The micro-fluidic device of any of claims 34 to 38, wherein said device further comprises a means for generating a magnetic force within said enclosure.

CLAIMS

1. A process of assaying biological activity in a micro-fluidic device, said process comprising:

culturing one or more biological cells in a holding pen of a micro-fluidic device, wherein said one or more cells produce a biological material of interest;

introducing one or more capture micro-objects into said holding pen, wherein each said capture object comprises a binding substance that specifically binds said biological material of interest;

allowing said biological material of interest produced by said one or more biological cells to bind to said one or more capture micro-objects; and

assessing said biological material of interest bound to said capture micro-objects.

2. The process of claim 1 further comprising, after allowing said biological material of interest to bind to said one or more capture micro-objects but before assessing said biological material of interest bound to said one or more capture micro-objects, removing said one or more capture micro-objects from said holding pen.

3. The process of claim 2, wherein removing said one or more capture micro-objects comprises moving said one or more capture micro-objects to an assay region located within said micro-fluidic device.

4. The process of claim 3, wherein said assay region is a stop located within a channel in said micro-fluidic device.

5. The process of claim 3, wherein said assay region is a chamber located within said micro-fluidic device.

6. The process of claim 2, wherein removing said one or more capture micro-objects comprises:

moving said one or more capture micro-objects to a channel in said micro-fluidic device; and

exporting said one or more capture micro-objects from said micro-fluidic device.

7. The process of any one of claims 2 to 6, wherein removing said one or more capture micro-objects comprises:

creating a light trap trapping at least one of said capture micro-objects in said holding pen by projecting a light pattern that surrounds said at least one capture micro-object onto an inner surface of said microfluidic device, and

moving said light trap from said holding pen into a channel in said micro-fluidic device.

8. The process of any one of claims 2 to 6, wherein said one or more capture micro-objects are magnetic, and wherein removing said one or more capture micro-objects comprises applying a magnetic field to said micro-fluidic device.

9. The process of any one of claims 2 to 8 further comprising correlating each said removed capture micro-object with said holding pen from which said removed capture micro-object was removed.

10. The process of any one of claims 1 to 9, wherein said assessing comprises determining a type of said biological material of interest bound to said one or more capture micro-objects.

11. The process of any one of claims 1 to 10, wherein said assessing comprises determining an activity of said biological material of interest bound to said one or more capture micro-objects.

12. The process of any one of claims 1 to 11, wherein said assessing comprises determining an amount of said biological material of interest bound to said one or more capture micro-objects.

13. The process of any one of claims 10 to 12, wherein said determining comprises:

binding assay material to said biological material of interest bound to said one or more capture micro-objects, wherein said assay material is capable of producing detectable radiation; and

detecting an association between said one or more capture micro-objects and radiation originating from said assay material.

14. The process of claim 13, wherein said determining further comprises, after binding said assay material to said biological material of interest but before detecting an association between said one or more capture micro-objects and radiation originating from said assay material, washing unbound assay material away from said one or more capture micro-objects.

15. The process of claim 13 further comprising determining whether said radiation associated with each said capture micro-object corresponds to a predetermined characteristic.

16. The process of any one of claims 1 to 15, wherein said biological material of interest is a protein.

17. The process of claim 16, wherein said protein is an antibody.

18. The process of claim 1, wherein said assessing is performed while said one or more capture micro-objects are in said holding pen.

19. The process of any one of claims 1 to 18, wherein said binding substance of said one or more capture micro-objects has a binding affinity for said biological material of interest of at least 1 μM.

20. The process of any one of claims 1 to 19, wherein said one or more biological cells in said holding pen comprises a clonal colony of biological cells.

21. The process of any one of claims 1 to 19, wherein said one or more biological cells in said holding pen is a single cell.

22. The process of any one of claims 1 to 21, wherein said one or more capture micro-objects is a single capture micro-object.

23. The process of any one of claims 1 to 21, wherein said one or more capture micro-object comprises a plurality of capture micro-objects, each of which comprises a binding substance that differs from the binding substance of other capture micro-objects in said plurality.

24. The process of claim 23, wherein said biological material of interest is an antibody, and wherein each of said plurality of capture micro-objects comprises a binding substance which binds to an antibody isotype that differs from the antibody isotype bound by the binding substance of other capture micro-objects in said plurality.

25. The process of claim 23, wherein said biological material of interest is an antibody, and wherein each of said plurality of capture micro-objects comprises a binding substance corresponding to an epitope of an antigen recognized by said antibody.

26. The process of claim 23, wherein said biological material of interest is an antibody, and wherein one capture micro-object of said plurality comprises a binding substance corresponding to an antigen recognized by said antibody or an epitope thereof, and wherein the other capture micro-objects of said plurality each comprise a binding substance corresponding to a homolog of said antigen from a different species or an epitope thereof.

27. A process of assaying biological activity in a micro-fluidic device, said process comprising:

culturing one or more biological cells in a holding pen of a micro-fluidic device, wherein said one or more cells produce *n* different biological materials of interest;

introducing *n* different types of capture micro-objects into said holding pen, each said type of capture micro-object comprising a binding substance that specifically binds to one of said *n* different biological materials of interest;

allowing said *n* different biological materials of interest produced by said one or more biological cells to bind to said *n* different types of capture micro-objects; and

assessing binding between said *n* different biological materials of interest and said *n* different types of capture micro-objects.

28. The process of claim 27, wherein a result of said assessing is positive if at least one of said *n* different biological materials of interest specifically binds to one of said *n* different types of capture micro-objects.

29. The process of claim 23, wherein a result of said assessing is positive if at least two of said *n* different biological materials of interest each specifically binds to one of said *n* different types of capture micro-objects.

30. The process of claim 23, wherein a result of said assessing is positive if all *n* different biological materials of interest each specifically binds to one of said *n* different types of capture micro-objects.

31. The process of any of claims 27 to 30, wherein said *n* different types of capture micro-objects are introduced into said pen simultaneously.

32. The process of any of claims 27 to 30, wherein said *n* different types of capture micro-objects are introduced into said pen sequentially.

33. A micro-fluidic device comprising:

an enclosure comprising a channel, a holding pen, and an assay region,

wherein said holding pen comprises an isolation region and a connection region, said connection region having a proximal opening to said channel and a distal opening to said isolation region; and

wherein said assay region is located adjacent to said holding pen.

34. The micro-fluidic device of claim 33, wherein said assay region comprises a stop located within said channel.

35. The micro-fluidic device of claim 33, wherein said assay region comprises an assay chamber having an opening to said channel, wherein said assay chamber is located beside said holding pen.

36. The micro-fluidic device of claim 33, wherein said assay region comprises an assay chamber having an opening to said channel, wherein said opening to said assay chamber is located directly across said channel from said proximal opening of said connection region of said holding pen.

37. The micro-fluidic device of claim 35 or 36, wherein said assay chamber substantially lacks an isolation region.

38. The micro-fluidic device of any of claims 33 to 37, wherein said device further comprises a means for generating a magnetic force within said enclosure.

39. The process of any one of claims 1 to 26, wherein said holding pen comprises an isolation region and a connection region, said connection region having a proximal opening to said channel and a distal opening to said isolation region.

40. The process of claim 2, wherein removing said one or more capture micro-objects comprises:

activating light-induced DEP electrodes adjacent to at least one of said capture micro-objects in said holding pen by projecting a light pattern onto an inner surface of said microfluidic device adjacent to said at least one capture micro-object, and

moving said light pattern from said holding pen into a channel in said micro-fluidic device, whereby the activated DEP electrodes repel said at least one capture micro-object into said channel.