

What is claimed is:

1. A method, comprising:
immobilizing a target material at each of two opposed sequencing surfaces
of a flow cell, wherein the immobilizing involves:
 - 5 introducing a first fluid, including a first portion of the target material
 therein, into the flow cell, whereby at least some of the target material
 becomes immobilized by capture sites on one of the two opposed
 sequencing surfaces;
 removing the first fluid and any non-immobilized target material from
10 the flow cell; and
 introducing a second fluid, including a second portion of the target
 material therein, into the flow cell, whereby at least some of the target
 material becomes immobilized by capture sites on an other of the two
 opposed sequencing surfaces;
 - 15 wherein one of:
 the first fluid has a density less than a density of the target material
 and the second fluid has a density greater than the density of the target
 material; or
 the second fluid has the density less than the density of the target
20 material and the first fluid has the density greater than the density of the
 target material.
2. The method as defined in claim 1, wherein the first or second fluid having
the density less than the density of the target material is an aqueous buffer
25 solution, and wherein the second or first fluid having the density greater than the
density of the target material is a sodium polytungstate solution or a sodium
chloride solution.
3. The method as defined in one of claims 1 or 2, wherein the density of the
30 first or second fluid at a capture temperature is at least 0.1 g/cm³ less than the
density of the target material at the capture temperature, and wherein the density of
the second or first fluid at the capture temperature is at least 0.1 g/cm³ greater than
the density of the target material at the capture temperature.

4. The method as defined in one of claims 1 or 2, wherein the density of the first or second fluid that is less than the density of the target material is about 1 g/cm³ at a capture temperature, and wherein the density of the second or first fluid that is greater than the density of the target material is about 2 g/cm³ at the capture temperature.

5. The method as defined in one of claims 1 through 4, further comprising allowing a predetermined time to pass before removing the first fluid and any non-immobilized target material from the flow cell.

6. The method as defined in one of claims 1 through 5, wherein the target material immobilized on the one of the two opposed sequencing surfaces remains immobilized on the one of the two opposed sequencing surfaces when the second fluid is introduced.

7. The method as defined in one of claims 1 through 6, wherein the target material is a complex including:
a solid support; and
sequencing-ready nucleic acid fragments attached to the solid support.

8. The method as defined in claim 7, further comprising:
removing the second liquid and non-immobilized complexes from the flow cell;
initiating release of the sequencing-ready nucleic acid fragments from the solid support of immobilized complexes, thereby seeding at least some the sequencing-ready nucleic acid fragments to respective primers of the two opposed sequencing surfaces;
removing the solid support and non-seeded sequencing-ready nucleic acid fragments;
introducing an amplification mix including a liquid form of a temperature responsive material to the flow cell;
causing the liquid form of the temperature responsive material to gel;

initiating amplification of the seeded sequencing-ready nucleic acid fragments to generate template strands, whereby the gel form of the temperature responsive material reduces diffusion of the template strands;

causing the gel form of the temperature responsive material to liquify; and
5 removing the liquid form of the temperature responsive material from the flow cell.

9. The method as defined in claim 8, wherein the temperature responsive material is a copolymer of poly(N-isopropylacrylamide) and polyethylene glycol.
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10. The method as defined in claim 1, wherein the target material is a clustered solid support including:

a solid support; and

a cluster of template strands attached to the solid support.
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11. A kit, comprising:

a preparation fluid including a target material therein;

a first introduction fluid having a density less than a density of the target material; and

20 a second introduction fluid having a density greater than the density of the target material.

12. The kit as defined in claim 11, wherein the first introduction fluid is an aqueous buffer solution, and wherein the second introduction fluid is a sodium
25 polytungstate solution or a sodium chloride solution.

13. The kit as defined in claim 12, wherein the second introduction fluid is the sodium polytungstate solution, and the sodium polytungstate solution has a concentration of about 1 gram of sodium polytungstate per 1 milliliter of water.
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14. The kit as defined in one of claim 11 through 13, wherein the density of the first introduction fluid at a capture temperature is at least 0.1 g/cm^3 less than the density of the target material at the capture temperature, and wherein the density of

the second introduction fluid at the capture temperature is at least 0.1 g/cm^3 greater than the density of the target material at the capture temperature.

15 15. The kit as defined in one of claims 11 or 14, wherein the density of the first introduction fluid is about 1 g/cm^3 at a capture temperature, and wherein the density of the second introduction fluid is about 2 g/cm^3 at the capture temperature.

10 16. The kit as defined in one of claims 11 through 15, further comprising a flow cell having two opposed sequencing surfaces.

15 17. The kit as defined in claim 16, wherein each of the opposed sequencing surfaces includes:
 a polymeric hydrogel;
 amplification primers attached to the polymeric hydrogel; and
 chemical capture sites.

20 18. The kit as defined in claim 17, wherein:
 the chemical capture sites are one member of a binding pair; and
 the target material is a solid support coated with an other member of the binding pair.

25 19. The kit as defined in one of claims 11 through 18, wherein the target material is a complex including:
 a solid support; and
 sequencing-ready nucleic acid fragments attached to the solid support.

30 20. The kit as defined in one of claims 11 through 18, wherein the target material is a clustered solid support including:
 a solid support; and
 a cluster of template strands attached to the solid support.

21. The kit as defined in one of claims 11 through 19, further comprising an amplification mix including a liquid form of a temperature responsive material.

22. A method, comprising:

5 immobilizing a target material at each of two opposed sequencing surfaces of a flow cell by:

 introducing a fluid, including the target material, into the flow cell, wherein:

 the target material includes:

10 a magnetic solid support; and
 sequencing-ready nucleic acid fragments or template strands attached to the magnetic solid support; and

 the fluid has a density at least approximately equivalent to a density of the magnetic solid support;

15 allowing some of the target material to become immobilized by capture sites on one of the two opposed sequencing surfaces; and
 applying a magnetic force to an other of the two opposed sequencing surfaces, thereby pulling some other of the target material to the other of the two opposed sequencing surfaces where they become immobilized by
20 capture sites on the other of the two opposed sequencing surfaces.

23. The method as defined in claim 22, wherein the density of the fluid is within 0.08 g/cm^3 of the density of the magnetic solid support.

25 24. The method as defined in one of claims 22 or 23, wherein the fluid is an aqueous buffer solution.

25 25. The method as defined in one of claims 22 through 24, wherein a predetermined time period passes between the introduction of the fluid and the
30 application of the magnetic force, and wherein the predetermined time ranges from about 5 seconds to about 2 minutes.

26. The method as defined in one of claims 20 through 23, wherein the application of the magnetic force involves placing an elastomeric strip embedded with magnetic particles on an exterior surface of the flow cell adjacent to the other of the two opposed sequencing surfaces.

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27. The method as defined in one of claims 20 through 24, further comprising:

ceasing the application of the magnetic force;

removing the fluid and non-immobilized complexes from the flow cell;

10 initiating release of the sequencing-ready nucleic acid fragments from the solid support of the immobilized complexes, thereby seeding at least some the sequencing-ready nucleic acid fragments to respective primers of the two opposed sequencing surfaces;

15 removing the solid support and non-seeded sequencing-ready nucleic acid fragments;

introducing an amplification mix including a liquid form of a temperature responsive material to the flow cell;

causing the liquid form of the temperature responsive material to gel;

20 initiating amplification of the seeded sequencing-ready nucleic acid fragments to generate template strands, whereby the gel form of the temperature responsive material reduces diffusion of the template strands;

causing the gel form of the temperature responsive material to liquify; and

removing the liquid form of the temperature responsive material from the flow cell.

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28. The method as defined in claim 27, wherein the temperature responsive material is a copolymer of poly(N-isopropylacrylamide) and polyethylene glycol.

29. A method, comprising:

30 introducing sequencing-ready nucleic acid fragments to a flow cell, thereby seeding at least some of the sequencing-ready nucleic acid fragments to respective primers on a sequencing surface of the flow cell;

- removing non-seeded sequencing-ready nucleic acid fragments from the flow cell;
- introducing an amplification mix including a liquid form of a temperature responsive material to the flow cell;
- 5 causing the liquid form of the temperature responsive material to gel;
- initiating amplification of the seeded sequencing-ready nucleic acid fragments to generate template strands, whereby the gel form of the temperature responsive material reduces diffusion of the template strands;
- causing the gel form of the temperature responsive material to liquify; and
- 10 removing the liquid form of the temperature responsive material from the flow cell.
30. The method as defined in claim 29, wherein the temperature responsive material is a copolymer of poly(N-isopropylacrylamide) and polyethylene glycol.
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31. The method as defined in claim 29 or 30, wherein the sequencing-ready nucleic acid fragments are attached to a solid support when they are introduced into the flow cell, and wherein the method further comprises releasing the sequencing-ready nucleic acid fragments from the solid support.
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32. A method, comprising:
- simultaneously immobilizing a first target material at a first of two opposed sequencing surfaces of a flow cell and a second target material at a second of the two opposed sequencing surfaces by introducing, into the flow cell, a target fluid
- 25 including the first target material and the second target material, wherein:
- a carrier fluid of the target fluid has a fluid density;
- the first target material has a first density less than the fluid density;
- and
- the second target material has a second density greater than the fluid
- 30 density.

33. The method as defined in claim 32 wherein:
at least some of the first target material becomes immobilized by respective
capture sites on the first of the two opposed sequencing surfaces; and
at least some of the second target material becomes immobilized by
5 respective capture sites on the second of the two opposed sequencing surfaces.

34. A target fluid, comprising:
a carrier fluid having a fluid density;
a first target material having a first density less than the fluid density; and
10 a second target material having a second density greater than the fluid
density.

35. The target fluid as defined in claim 34, wherein:
the first target material includes:
15 a first solid support having a first solid support density approximately
equal to the first density; and
sequencing-ready nucleic acid fragments attached to the first solid
support; and
the second target material includes:
20 a second solid support having a second solid support density
approximately equal to the second density; and
sequencing-ready nucleic acid fragments attached to the second solid
support.

36. The target fluid as defined in claim 34, wherein:
the first target material includes:
a first solid support having a first solid support density approximately
equal to the first density; and
a first cluster of template strands attached to the first solid support;
30 and
the second target material includes:
a second solid support having a second solid support density
approximately equal to the second density; and

a second cluster of template strands attached to the second solid support.

37. A method, comprising:

- 5 introducing first and second target materials to a flow cell including two opposed sequencing surfaces, wherein the first target material has at least one property that is different from the second target material, wherein the at least one property is selected from the group consisting of density, charge, magnetism, and combinations thereof; and
- 10 exposing the first and second target materials to at least one condition, thereby causing the first target material to become immobilized by a capture site on a first of the two opposed sequencing surfaces and the second target material to become immobilized by a capture site on a second of the two opposed sequencing surfaces.

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38. The method as defined in claim 37, wherein:

the first target material has a negative charge;

the second target material has a positive charge; and

the at least one condition is an electric field applied between the two

- 20 opposed sequencing surfaces to generate positive charges at the first of the two opposed sequencing surfaces and negative charges at the second of the two opposed sequencing surfaces.

39. The method as defined in claim 38, wherein:

- 25 the first target material is selected from the group consisting a carboxylated solid support, a polyglutamic acid coated solid support, and a sulfate functionalized solid support; and

the second target material is an amine functionalized solid support.

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40. The method as defined in claim 37, wherein:

the first and second target materials are introduced into the flow cell in a fluid having a first density;

the first target material is magnetic;

the second target material is non-magnetic and has a density greater than the first density; and

the at least one condition is a magnetic field applied to attract the first target material to the first of the two opposed sequencing surfaces.

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41. The method as defined in claim 37, wherein:

the first and second target materials are introduced into the flow cell in a fluid having a first density;

10 the first target material is non-magnetic and has a density less than the first density;

the second target material is magnetic; and

the at least one condition is a magnetic field applied to attract the second target material to the second of the two opposed sequencing surfaces.

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42. The method as defined in claim 37, wherein:

the first and second target materials are introduced into the flow cell in a fluid having a first density;

the first target material is negatively charged;

20 the second target material is non-charged and has a density greater than the first density; and

the at least one condition is an electric field applied between the two opposed sequencing surfaces to generate positive charges at the first of the two opposed sequencing surfaces and negative charges at the second of the two opposed sequencing surfaces.

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43. The method as defined in claim 37, wherein:

the first and second target materials are introduced into the flow cell in a fluid having a first density;

the first target material is positively charged;

30 the second target material is non-charged and has a density greater than the first density; and

the at least one condition is an electric field applied between the two opposed sequencing surfaces to generate negative charges at the first of the two

opposed sequencing surfaces and positive charges at the second of the two opposed sequencing surfaces.

44. The method as defined in claim 37, wherein:

5 the first and second target materials are introduced into the flow cell in a fluid having a first density;

 the first target material is non-charged and has a density less than the first density;

 the second target material is positively charged; and

10 the at least one condition is an electric field applied between the two opposed sequencing surfaces to generate positive charges at the first of the two opposed sequencing surfaces and negative charges at the second of the two opposed sequencing surfaces.