

What is claimed is:

1. A kit, comprising:
a flow cell assembly including:
a reaction chamber having:
5 depressions separated by interstitial regions; and
 capture primers attached within each of the depressions;
a temperature controlled flow channel in selective fluid communication
with an inlet of the reaction chamber; and
a filter positioned in the temperature controlled flow channel, the filter i)
10 to block concentrated deoxyribonucleic acid (DNA)-methyl cellulose complexes
 generated in the temperature controlled flow channel at a first temperature, and
 ii) to allow passage of concentrated DNA and methyl cellulose released from
 the complexes in the temperature controlled flow channel at a second
 temperature.
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2. The kit as defined in claim 1, further comprising a sample fluid including:
an aqueous carrier;
a DNA sample;
methyl cellulose;
20 a polymer that is chemically inert to DNA hybridization; and
 a salt.
3. The kit as defined in claim 2, wherein the polymer that is chemically inert to
DNA hybridization is selected from the group consisting of polyethylene glycol having
25 a weight average molecular weight ranging from about 500 to less than about 200,000,
 polyvinyl pyrrolidone, polyvinyl alcohol, and combinations thereof.
4. The kit as defined in claim 2, wherein:
the DNA sample is present in the sample fluid at a first molar concentration
30 ranging from about 1 pM to about 1 mM;

the methyl cellulose is present in the sample fluid in an amount ranging from about 0.5 wt% to about 20 wt% based on a total weight of the sample fluid;

the polymer that is chemically inert to DNA hybridization is present in the sample fluid in an amount ranging from greater than 0 wt% to about 20 wt% based on
5 the total weight of the sample fluid; and

the salt is present in the sample fluid at a second molar concentration ranging from greater than 0 M to about 2 M.

5. The kit as defined in claim 1, wherein the flow cell assembly further
10 comprises:

a bypass line in fluid communication with an inlet of the temperature controlled flow channel and with an outlet of the temperature controlled flow channel;

a first bypass valve to control flow of a sample fluid to the inlet of the temperature controlled flow channel; and

15 a second bypass valve to control flow of the concentrated DNA and the methyl cellulose to the reaction chamber.

6. The kit as defined in claim 1, wherein at least one surface of the temperature controlled flow channel includes a heating plate.

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7. A method, comprising:

combining a DNA sample with a solution to form a sample fluid, the solution consisting of:

25 an aqueous carrier;

methyl cellulose;

a polymer that is chemically inert to DNA hybridization; and

a salt,

and the solution being at a temperature ranging from about 5°C to about 30°C; and

30 heating the sample fluid to at least a gelation temperature of the methyl cellulose, thereby forming DNA-methyl cellulose complexes in the aqueous carrier.

8. The method as defined in claim 7, further comprising cooling the sample fluid to below the gelation temperature of the methyl cellulose, thereby detangling the DNA-methyl cellulose complexes to release the DNA sample and the methyl cellulose.

5 9. The method as defined in claim 7, further comprising increasing a concentration of the salt in the solution, thereby lowering the gelation temperature of the methyl cellulose.

10 10. The method as defined in claim 7, wherein the DNA sample includes cell-free DNA, library DNA, whole genome amplified DNA, or combinations thereof.

11. The method as defined in claim 7, wherein:
the DNA sample includes a plurality of differently sized DNA inserts including small DNA inserts and large DNA inserts;
15 at least some of the large DNA inserts are entangled in the DNA-methyl cellulose complexes;
at least some of the small DNA inserts are not entangled in the DNA-methyl cellulose complexes; and
the method further comprises performing a purification process after heating to
20 separate the at least some of the small DNA inserts from the DNA-methyl cellulose complexes.

12. The method as defined in claim 11, wherein the purification process involves filtering, centrifuging, decanting, or combinations thereof.

25 13. The method as defined in claim 11, further comprising cooling the DNA-methyl cellulose complexes to below the gelation temperature of the methyl cellulose, thereby detangling the DNA-methyl cellulose complexes to release the at least some of the large DNA inserts and the methyl cellulose.

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14. A method, comprising:

introducing a sample fluid to a temperature controlled flow channel having a filter positioned therein, the sample fluid including:

an aqueous carrier;

5 a DNA sample;

methyl cellulose;

a polymer that is chemically inert to DNA hybridization; and

a salt;

10 heating the temperature controlled flow channel as the sample fluid is introduced such that a temperature of the sample fluid contained therein is increased to at least a gelation temperature of the methyl cellulose, thereby forming DNA-methyl cellulose complexes in the temperature controlled flow channel;

continuing a flow of the sample fluid through the temperature controlled flow channel as the temperature controlled flow channel is heated, thereby concentrating a plurality of the DNA-methyl cellulose complexes at the filter in the temperature controlled flow channel; and

cooling the temperature controlled flow channel such that a temperature of the sample fluid contained therein is decreased to below the gelation temperature of the methyl cellulose, thereby detangling the concentrated DNA-methyl cellulose complexes to release the DNA sample and the methyl cellulose, whereby the DNA sample and the methyl cellulose are able to pass through the filter.

15. The method as defined in claim 14, further comprising selecting a heating temperature for the temperature controlled flow channel in accordance with a concentration of the salt in the sample fluid.

16. The method as defined in claim 14, further comprising transporting the DNA sample and the methyl cellulose from the temperature controlled flow channel to a flow cell.

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17. A method, comprising:
introducing a sample fluid to a flow cell, the sample fluid including:
an aqueous carrier;
a DNA sample;
5 methyl cellulose;
a polymer that is chemically inert to DNA hybridization; and
a salt;
and the flow cell including a reaction chamber having:
depressions separated by interstitial regions; and
10 capture primers attached within each of the depressions;
initiating seeding and hybridization of at least some of the DNA sample in at
least some of the depressions;
heating the flow cell such that a temperature of the sample fluid contained
therein is increased to at least a gelation temperature of the methyl cellulose, thereby
15 forming DNA-methyl cellulose complexes with unbound DNA sample;
introducing an additional amount of the sample fluid to the flow cell;
cooling the flow cell such that the temperature of the sample fluid contained
therein is decreased to below the gelation temperature of the methyl cellulose, thereby
detangling the concentrated DNA-methyl cellulose complexes to release the DNA
20 sample and the methyl cellulose; and
initiating seeding and hybridization of at least some of the released DNA
sample and the DNA sample from the additional sample fluid in at least some of the
depressions.
- 25 18. The method as defined in claim 17, further comprising selecting a heating
temperature for the flow cell in accordance with a concentration of the salt in the
sample fluid.
19. A kit, comprising:
30 a sample fluid consisting of:
an aqueous carrier;

a deoxyribonucleic acid (DNA) sample;
methyl cellulose;
a polymer that is chemically inert to DNA hybridization; and
a salt or solvent to adjust a gelation temperature of the methyl cellulose.

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20. The kit as defined in claim 19, wherein:

the DNA sample is present in the sample fluid at a first molar concentration ranging from about 1 pM to about 1 mM;

10 the methyl cellulose is present in the sample fluid in an amount ranging from about 0.5 wt% to about 20 wt% based on a total weight of the sample fluid;

the polymer that is chemically inert to DNA hybridization is present in the sample fluid in an amount ranging from greater than 0 wt% to about 20 wt% based on the total weight of the sample fluid; and

15 the sample fluid includes the salt, and the salt is present in the sample fluid at a second molar concentration ranging from greater than 0 M to about 2 M.

21. The kit as defined in claim 19, further comprising:

a flow cell assembly including:

20 a temperature controlled flow channel to receive the sample fluid;

a reaction chamber having:

depressions separated by interstitial regions;

capture primers attached within each of the depressions;

an inlet in selective fluid communication with the temperature controlled flow channel; and

25 a filter positioned in the temperature controlled flow channel, the filter i) to block concentrated DNA sample-methyl cellulose complexes generated in the temperature controlled flow channel when the sample fluid is exposed to a first temperature, and ii) to allow passage of concentrated DNA sample and methyl cellulose released from the complexes in the temperature controlled flow
30 channel at a second temperature.