

CLAIMS

What is claimed is:

1. A method of thermal cycling, comprising:
 - (a) providing a sample container comprising a first-stage chamber fluidly
5 connected to a second-stage reaction zone, the second-stage reaction zone comprising a plurality of second-stage reaction wells;
 - (b) introducing a sample into the sample container;
 - (c) providing an instrument comprising a temperature control element having a first temperature zone and a second temperature zone, wherein the first temperature zone is
10 hotter than the second temperature zone;
 - (d) aligning the temperature control element and the first-stage chamber so that the first-stage chamber is under temperature control of at least one of the first temperature zone and the second temperature zone to effect thermal cycling of the sample in the first-stage chamber;
 - 15 (e) after effecting thermal cycling of the sample in the first-stage chamber, moving at least a fraction of a product derived from the sample from the first-stage chamber into the plurality of second-stage reaction wells in the second-stage reaction zone; and
 - (f) aligning the temperature control element and the second-stage reaction zone to effect thermal cycling of the fraction of the sample in the second-stage reaction zone,
20 wherein aligning the temperature control element and the second-stage reaction zone to effect thermal cycling comprises repeatedly translating the one of the temperature control element or the second-stage reaction zone so that the second-stage reaction zone is under temperature control of the first temperature zone and then the second temperature zone.
2. The method of claim 1, wherein the temperature control element comprises
25 one or more heater or cooler devices selected from the group consisting of Peltier devices, resistance heaters, induction heaters, electromagnetic heaters, thin film heaters, printed element heaters, positive temperature coefficient heaters, and combinations thereof.
3. The method of claim 1, wherein step (f) comprises repeatedly translating the temperature control element relative to the second-stage reaction zone.
- 30 4. The method of claim 1, wherein step (f) comprises repeatedly translating the second-stage reaction zone relative to the temperature control element.

5. The method of claim 1, wherein the instrument further comprises a wiper element, and step (d) further comprises aligning the wiper element with the temperature control element and the first-stage chamber such that rotational movement of the wiper element moves a first portion of the sample from thermal control of the first temperature zone to thermal control of the second temperature zone, while simultaneously moving a second portion of the sample from thermal control of the second temperature zone to thermal control of the first temperature zone.

6. The method of claim 1, wherein the sample container further comprises a sample preparation zone fluidly connected to the first-stage chamber, and prior to step (d) the method further comprises:

introducing the sample into the sample preparation zone;
contacting the sample preparation zone with a lysis apparatus to produce a lysate;
recovering nucleic acids from the lysate; and
moving the recovered nucleic acids into the first-stage chamber.

7. The method of claim 6, wherein recovering nucleic acids from the sample further comprises:

contacting the lysate with a plurality of magnetic beads;
deploying a magnet to separate the magnetic beads from the lysate;
washing the magnetic beads;
recapturing the magnetic beads with the magnet;
contacting the magnetic beads with an elution buffer to release the nucleic acids from the magnetic beads; and

recapturing the magnetic beads with the magnet and separating the eluted nucleic acids from the magnetic beads.

8. The method of claim 6, wherein the sample preparation zone and the first-stage chamber are separate chambers within the sample container.

9. The method of claim 1, wherein step (f) of the method further comprises aligning the second nucleic acid amplification zone with the first temperature zone and then the second temperature zone of the temperature control element to thermocycle the sample in the second nucleic acid amplification zone.

10. The method of claim 9, wherein the steps of the method are completed in 20 minutes or less, 15 minutes or less, or, preferably, 10 minutes or less.

11. The method of claim 1, wherein each thermal cycle of the first and second nucleic acid amplification zones is completed in 8 seconds or less, 6 seconds or less, or, preferably, 4 seconds or less.

12. The method of claim 1, further comprising providing a computing device configured for controlling the aligning steps and for controlling a temperature of the temperature control element.

13. An instrument for thermocycling a sample, the sample provided in a flexible sample container, the instrument comprising

a first heater adjacent to a first portion of the flexible sample container for adjusting a first portion of the sample to a first temperature,

a second heater adjacent to a second portion of the flexible sample container for adjusting a second portion of the sample to a second temperature, the second temperature different from the first temperature, and

a wiper element that moves the first portion of the sample to the second portion of the flexible sample container while moving the second portion of the sample to the first portion of the flexible sample container such that portions of the sample are under control of each of the heaters simultaneously.

14. The instrument of claim 13, wherein the wiper element further comprises a blade that divides the sample into at least two discrete sections comprising at least a first section and a second section, such that the first portion is contained in the first section and the second portion is contained in the second section.

15. The instrument of claim 13, wherein the wiper element creates vortexes and eddies in the sample such that the first portion of the sample is under control of the first heater, the second portion of the sample is under control of the second heater, and a third portion of the sample is in transition between control of the first and second heaters.

16. The instrument of any one of claims 13-15, wherein the wiper element repeatedly moves portions of the sample to opposite portions of the sample container to thermocycle the sample.

17. The instrument of claim 13, wherein the sample vessel comprises nucleic acids and components for PCR.

18. The instrument of claim 13, wherein the wiper element is movable to compress the flexible sample container to expel a portion of the sample, and the wiper
5 element has a first speed prior to expelling the portion of the sample and a second faster speed subsequent to expelling a portion of the sample.

19. The instrument of claim 13, further comprising a compressible member disposed between the wiper element and the flexible sample container, wherein the compressible member is biased towards the sample container.

10 20. The instrument of claim 13, further comprising an array fluidically connected to the sample container, the array configured to receive at least a portion of the sample, and the instrument further comprising a plurality of heaters movable to sequentially affect temperature of the portion of the sample in the array.

21. An instrument for thermocycling a sample, comprising:
15 a receptacle for positioning a flexible sample container having at least a first reaction chamber in the instrument;
a heater assembly comprising a first heater element and a second heater element; and
a translator mechanically coupled to at least one of the receptacle, the flexible sample container, or the heater assembly to laterally align the first reaction chamber relative to the
20 first and second heater elements of the heater assembly such that the first reaction chamber is under temperature control of at least one of the first or the second heater elements; and
wherein the instrument is configured to repeatedly align the first reaction chamber with the first heater element and then the second heater element for thermocycling a fluid sample in the at least one reaction chamber.

25 22. The instrument of claim 21, wherein the first heater element is set to a temperature in a range of about 90°C-110°C and the second heater element is set to a temperature in a range of about 55°C to about 65°C.

23. The instrument of claim 21, wherein the heater assembly is coupled to the translator and the translator is configured to translate the heater assembly laterally relative to
30 the first reaction chamber such that the first heater element and the second heater element can define controlled temperature zones at the first reaction chamber.

24. The instrument of claim 21, wherein the receptacle is coupled to the translator and the translator is configured to translate the receptacle and the flexible sample container positioned therein laterally relative to the heater assembly such that the first heater element and the second heater element can define controlled temperature zones at the first reaction chamber.

25. The instrument of claim 21, wherein the flexible sample container is coupled to the translator and the translator is configured to translate the flexible sample container relative to the heater assembly such that the first reaction chamber is under temperature control of the first heater element and the second heater element.

26. The instrument of claim 21, the flexible sample container further comprising a second reaction chamber downstream from the first reaction chamber, and wherein the translator is configured to laterally align the second reaction chamber relative to the first and second heater elements of the heater assembly such that the second reaction chamber is under temperature control of the first and second heater elements.

27. The instrument of claim 26, wherein the second reaction chamber includes an array of individual amplification wells fluidically connected to the first reaction chamber, the array being configured to receive at least a portion of an amplification product from the first reaction chamber.

28. The instrument of claim 21, wherein the receptacle comprises a substantially planar surface having one or more openings therein positioned to allow the first and second heater elements of the heater assembly to contact one or more portions of the flexible sample container when positioned in the receptacle.

29. The instrument of claim 21, wherein the heater assembly includes a first heater element, a second heater element, and a third heater element.

30. The instrument of claim 29, wherein the first heater element, the second heater element, and the third heater element are disposed linearly.

31. The instrument of claim 30, wherein the first and third heater elements are set at a temperature in a range of about 90°C-110°C and the second heater element is set to a temperature of about 55°C to about 65°C.

32. A thermocycling system, comprising:

a receptacle for receiving a flexible sample container therein, the flexible sample container having a first-stage chamber including a sample to be thermocycled therein;

a heater element comprising at least a first temperature zone and a second temperature zone positioned on a first side of the flexible sample container; and

5 a wiper element positioned on a second side of the sample container, the wiper element being configured for contacting the first-stage chamber to divide the sample into at least a first portion and a second portion;

wherein one or more of the receptacle, the heater element, the wiper element, or the flexible sample container are movable such that movement aligns the first-stage chamber
10 relative to the wiper element and the first and second temperature zones of the heater element; and

wherein the wiper element is configured to rotate adjacent to the first-stage chamber to move the first portion of the sample to the second portion while moving the second portion of the sample to the first portion such that the first and second portion are under temperature
15 control of the first and second temperature zones of the heater element.

33. The thermocycling system of claim 32, wherein the flexible sample container includes a sample preparation zone, wherein the sample preparation zone is one of upstream from the first-stage chamber or the sample preparation zone and the first-stage chamber
comprise a single zone.

20 34. The thermocycling system of claim 33, wherein the wiper element is configured for contacting the sample container to mix the sample in the sample preparation zone.

35. The thermocycling system of claim 34, wherein the wiper element and the heater element work cooperatively to effect sample preparation and also work cooperatively
25 to effect nucleic acid amplification.

36. The thermocycling system of any one of claims 32-35, wherein the wiper element creates one or more of vortices, eddies, and cavitation bubbles in the sample to lyse cells in the sample.

37. The thermocycling system of claim 32, wherein the first-stage chamber
30 includes an abrasive element to enhance cell lysis.

38. The thermocycling system of claim 32, the instrument further comprising a lysis component configured for contacting the sample preparation zone, wherein the lysis component is optionally a component of the wiper element.

5 39. The thermocycling system of claim 32, wherein the wiper element repeatedly moves the first portion of the sample to the second portion while moving the second portion of the sample to thermocycle the sample.

10 40. The thermocycling system of claim 32, wherein the flexible sample container further comprises a second-stage chamber downstream from the first-stage chamber, and wherein one or more of the receptacle, the flexible sample container, or the heater element are movable such that movement aligns the second-stage chamber relative to the heater element such that the second-stage chamber is under temperature control of the first and second temperature zones.

15 41. The thermocycling system of claim 40, wherein the second-stage chamber includes an array of individual amplification wells fluidically connected to the first-stage chamber, the array being configured to receive at least a portion of a product from the first-stage chamber.

20 42. The thermocycling system of claim 40, the heater element further comprising at least a first temperature zone, a second temperature zone, and a third temperature zone, wherein two temperature zones are aligned for thermocycling the first-stage chamber and three temperature zones are aligned, one at a time, for thermocycling the second-stage chamber.

25 43. The thermocycling system of any one of claims 32-42, wherein the receptacle comprises a substantially planar surface having one or more openings therein positioned to allow the heater element to contact one or more portions of a flexible sample container.

44. The thermocycling system of any one of claims 32-43, further comprising an optical array including a light source and a camera element configured for collection of optical data from at least one portion of the flexible sample container.

30 45. The thermocycling system of any one of claims 32-44, wherein the flexible sample container includes a sample containing nucleic acids and reagents for nucleic acid amplification.

46. The thermocycling system of any one of claims 32-34, wherein the wiper element further comprises one or more pressure members configured to apply pressure to the sample preparation zone and/or the first-stage chamber of the flexible sample container.

47. The thermocycling system of claim 46, wherein the one or more pressure members further comprises at least one magnet deployable adjacent to the flexible sample container.

48. The thermocycling system of claim 32, wherein the wiper element further comprises at least one magnet deployable adjacent to the flexible sample container.

49. An instrument for thermocycling a sample, comprising:
10 a receptacle for positioning a flexible sample container in the instrument, the flexible sample container including:
a first-stage chamber and a second-stage reaction chamber having an array of second-stage reaction wells;
a heater element comprising a first temperature zone and a second temperature zone,
15 wherein one or more of the receptacle, the sample container, or the heater element are movable such that movement aligns the first-stage chamber and the second-stage reaction chamber relative to the heater element; and
wherein the receptacle and the heater element are configured to allow the heater element to heat first the first-stage chamber and second the second-stage reaction chamber to
20 effect thermal cycling and nucleic acid amplification in the first-stage chamber and then the second-stage reaction chamber.

50. The instrument of claim 49, further comprising
a wiper element having at least one blade configured to contact the first-stage chamber and divide the first-stage chamber into at least a first volume and a second volume,
25 wherein the heater element is aligned beneath the first-stage chamber such that the first volume is positioned over the first temperature zone and a second volume is positioned over the second temperature zone, and
wherein the wiper element is configured to rotate to move the first volume to the second temperature zone while moving the second volume to the first temperature zone such
30 that first and second volumes are under control of each of the temperature zones.

51. The instrument of claim 50, wherein the flexible sample container includes a sample preparation zone.

52. The instrument of claim 51, wherein the sample preparation zone is upstream from the first-stage chamber.

5 53. The instrument of claim 51, wherein the sample preparation zone and the first-stage chamber comprise a single chamber.

54. The instrument of claim 51, wherein the wiper element is configured to contact the sample preparation zone.

55. An instrument for thermocycling a sample, comprising:
10 a receptacle for positioning a flexible sample container in the instrument, the flexible sample container including:

at least one reaction chamber;

a heater assembly comprising a first heater element, a second heater element, and a third heater element, wherein the first and third heater elements are held at a temperature
15 higher than the second heater element, and

wherein the instrument is configured to align the at least one reaction chamber with the first heater element, the second heater element, and the third heater element for thermocycling a fluid sample in the at least one reaction chamber.

56. The instrument of claim 55, wherein the first and third heater elements are set
20 a temperature in a range of about 90°C-110°C and the second heater element is set to a temperature of about 55°C-65°C.

57. The instrument of claim 55, wherein the first and third heater elements comprise resistive heater elements and the second heater element comprises a Peltier device.

58. The instrument of claim 57, wherein one of the first or third heater elements
25 comprise a resistive heater element laid over a Peltier device.

59. The instrument of claim 55, wherein the heater assembly comprises a circular mount that is configured to be rotated adjacent to the flexible sample container.

60. The instrument of claim 55, wherein the heater assembly comprises a linear mount that is configured to be translated adjacent to the flexible sample container.

30 61. A polymerase chain reaction method using the instrument of any one of claims 56-61, the method comprising:

(a) providing the sample container comprising the at least one reaction chamber,
(b) introducing a sample into the reaction chamber, wherein the sample includes a target nucleic acid, at least one primer for amplifying the target nucleic acid, and a thermostable DNA polymerase,

5 (c) inserting the sample container into the instrument,
(d) aligning the first heater element with the reaction chamber, then aligning the second heater element with the reaction chamber, and then aligning the third heater element with the reaction chamber,

wherein the first and third heater elements are set at a denaturation temperature and
10 the second heater element is set at an annealing temperature, and

wherein step (d) comprises one cycle of denaturation, annealing, and elongation/denaturation; and

(f) repeating step (d).

62. An instrument for amplifying nucleic acids provided in a sample container
15 wherein the nucleic acids are configured in an array, comprising
an opening for receiving the sample container,
a plurality of heaters, each heater provided at a different temperature, and
a mover for moving the heaters sequentially to a position adjacent to the opening,
such that only the heater in the position controls temperature of the nucleic acids in the
20 sample container.

63. The instrument of claim 62, wherein the sample container further comprises components for amplifying nucleic acids, and

the plurality of heaters comprises at least a first heater at an annealing temperature and a second heater at a denaturation temperature.

25 64. The instrument of claim 63, wherein the plurality of heaters further comprises a third heater at an elongation temperature.

65. The instrument of claim 63, wherein the sample further comprises a fluorescent entity configured for detection of amplified nucleic acids, and the instrument further comprises a photodetector positioned to detect fluorescence from the array.

30 66. A method for performing PCR, comprising

- (a) providing a PCR mixture in a sample vessel, the PCR mixture having a volume,
- (b) thermocycling for a first number of cycles, each of the first number of cycles having a first cycle time,
- 5 (c) reducing the volume of the PCR mixture in the sample vessel to a second volume, the second volume being smaller than the first volume, and
- (d) thermocycling for a second number of cycles in the sample vessel, each of the second number of cycles having a second cycle time, the second cycle time being shorter than the first cycle time.

10 67. The method of claim 66, further comprising

- (e) reducing the volume of the PCR mixture in the sample container to a third volume, the third volume being smaller than the second volume, and
- (f) thermocycling for a third number of cycles, each of the third number of cycles having a third cycle time, the third cycle time being shorter than the second cycle time.

15 68. The method of claim 66, wherein the sample vessel is compressible, and the reducing step is performed by expelling a portion of the sample from the sample vessel.

69. The method of claim 66, wherein the sample vessel is in contact with at least two temperature zones, and the thermocycling step includes moving the sample between the temperature zones.

20 70. The method of claim 66, wherein the sample vessel is heated by a heater that thermocycles between several temperatures.

71. A method of amplifying nucleic acids in a sample, comprising:

introducing an aqueous fluid sample into a sample compartment of a container, the aqueous fluid sample comprising a target nucleic acid and reagents for amplifying the target
25 nucleic acid;

introducing the container into a heating apparatus, the heating apparatus comprising a first heater, a second heater, and a mover for moving the aqueous fluid sample within the sample compartment, the first heater being set to a first temperature and the second heater being set to a second temperature, the first temperature being greater than the second temperature, a first part
30 of the sample compartment being disposed proximal to the first heater so that the first heater exhibits thermal control on the first part of the sample compartment and a second part of the

sample compartment being disposed proximal to the second heater so that the second heater exhibits thermal control on the second part of the sample compartment; and

moving at least a first portion and a second portion of the aqueous fluid sample reciprocally between the first part of the sample compartment and the second part of the sample compartment.

72. A method of amplifying nucleic acids in a sample, comprising:

(a) introducing a fluid sample into a first compartment of a container, the fluid sample comprising a target nucleic acid and reagents for amplifying the target nucleic acid, wherein the first compartment is under control of a first heater that is set at a temperature that is below an annealing temperature (a low annealing temperature),

(b) raising the temperature of the first heater to the annealing temperature,

(c) moving the fluid sample into a second compartment of a container, wherein the second compartment is under control of a second heater that is set at a temperature that is above an elongation temperature (a high elongation temperature), and lowering the

temperature of the first heater to the low annealing temperature subsequent to moving the fluid sample into the second compartment,

(d) lowering the temperature of the second heater to the elongation temperature,

(e) raising the temperature of the second heater to at least a denaturation temperature, and

(f) repeating steps (a) through (e).

73. The method of claim 72, wherein when step (a) is repeated, the temperature of the second heater is moved to the high elongation temperature.

74. The method of claim 72, wherein the low annealing temperature is two to twenty degrees below the annealing temperature.

75. The method of claim 72, wherein the high elongation temperature is two to ten degrees above the elongation temperature.

76. The method of claim 72, wherein step (e) includes raising the temperature of the second heater to a temperature above the denaturation temperature, and step (a) is repeated as soon as the fluid sample reaches the denaturation temperature.

77. An instrument for thermocycling a sample, comprising:

a receptacle for positioning a flexible sample container having a first-stage chamber in the instrument;

a heater element comprising at least a first temperature zone and a second temperature zone,

5 wherein one or more of the receptacle or the heater element are movable such that movement positions the first-stage chamber relative to the first temperature zone and the second temperature zone of the heater element; and

wherein the receptacle and the heater element are configured to allow the first temperature zone and the second temperature zone to control the temperature of the first-
10 stage chamber to effect thermal cycling and nucleic acid amplification therein.

78. The instrument of claim 77, wherein the flexible sample container includes a sample preparation zone.

79. The instrument of claim 78, wherein the sample preparation zone is upstream from the first-stage chamber.

15 80. The instrument of claim 78, wherein the instrument further includes a wiper element positioned on a first side of the sample container, the wiper element being configured for contacting the sample container to mix the sample in the sample preparation zone and in the first-stage chamber; and

wherein one or more of the receptacle, the wiper element, or the heater element are
20 movable such that movement positions the flexible sample container relative to the wiper element and the heater element; and

wherein the wiper element and the heater element work cooperatively to effect sample preparation and also work cooperatively to effect nucleic acid amplification.

81. The instrument of claim 80, wherein the wiper element is movable between
25 the sample preparation zone and the first-stage chamber, and the heater element is movable to define controlled temperature zones at the sample preparation zone and the first-stage chamber.

82. The instrument of claim 80, wherein the receptacle is movable relative to the wiper element and the heater to provide mixing and defined temperature zones at the sample
30 preparation zone and the first-stage chamber.

83. The instrument of claim 80, wherein at least two of the receptacle, the wiper element, or the heater element are movable to provide mixing and defined temperature zones at the sample preparation zone and the first-stage chamber.

5 84. The instrument of claim 80, wherein the heater element is movable to the sample preparation zone to heat a sample present therein and the wiper element having at least one blade that is configured to contact the sample preparation zone and blend the sample to lyse cells in the sample.

85. The instrument of claim 84, wherein the wiper element creates one or more of vortices, eddies, and cavitation bubbles in the sample to lyse cells in the sample.

10 86. The instrument of claim 85, wherein the sample preparation zone includes an abrasive element to enhance cell lysis.

87. The instrument of claim 80, wherein the wiper element includes a lysis component.

15 88. The instrument of claim 77, wherein the heater element is positionable adjacent the first-stage chamber such that a first portion of the sample is positioned adjacent the first temperature zone and a second portion of the sample is positioned adjacent the second temperature zone, and wherein the instrument further includes a wiper element with at least one blade that is configured to divide the first-stage chamber into at least two discrete sections comprising at least a first portion and a second portion and to rotate to move the first
20 portion of the sample to the second temperature zone while moving the second portion of the sample to the first temperature zone such that first and second portions of the sample are under control of each of the temperature zones.

25 89. The instrument of claim 88, wherein the blade divides the sample into at least two discrete sections comprising at least a first section and a second section, such that the first portion is contained in the first section and the second portion is contained in the second section.

30 90. The instrument of claim 88, wherein the wiper element moves the sample such that the first portion of the sample is under control of the first temperature zone, the second portion of the sample is under control of the second temperature zone, and a third portion of the sample is in transition between control of the first and second temperature zones.

91. The instrument of any one of claims 88-90, wherein the wiper element repeatedly moves portions of the sample to opposite portions of the sample container to thermocycle the sample.

5 92. The instrument of claim 77, the container further comprising a second nucleic acid amplification zone downstream from the first-stage chamber, and wherein one or more of the receptacle and the flexible sample container or the heater element are movable such that movement positions the second nucleic acid amplification zone relative to the heater element to define controlled temperature zones at the second nucleic acid amplification zone.

10 93. The instrument of claim 92, wherein the second nucleic acid amplification zone includes an array of individual amplification wells fluidically connected to the first nucleic acid amplification zone, the array being configured to receive at least a portion of the sample.

15 94. The instrument of claim 93, the container including a well between the first-stage chamber and the array, wherein the well is configured to receive a known volume of the sample from the first-stage chamber and deliver the known volume to the array.

95. The instrument of claim 94, the container including a dilution zone between the well and the array, wherein the dilution zone is configured to receive the known volume from the well, dilute the known volume with a volume of fluid to yield a diluted sample, and deliver the diluted sample to the array.

20 96. The instrument of claim 77, wherein the receptacle comprises a substantially planar surface having one or more openings therein positioned to allow the heater element to contact one or more portions of a flexible sample container inserted in the receptacle.

25 97. The instrument of claim 77, further comprising an optical array including a light source and a camera element configured for collection of optical data from at least one portion of the container.

98. The instrument of claim 77, wherein the heater element includes a first heater part, a second heater part, and a third heater part.

98. The instrument of claim 98, wherein the first heater part is a resistive heater, the second heater part is a Peltier device, and the third heater part is a resistive heater.

30 100. The instrument of claim 99, wherein the third heater part comprises a resistive heater over a Peltier device, and wherein the resistive heater is used for heating the third

heater part and the Peltier device is used substantially simultaneously for cooling the third heater part.

101. The instrument of claim 100, wherein the first heater part, the second heater part, and the third heater part are disposed linearly.

5 102. The instrument of any one of claims 77-101, further comprising a computing device configured for controlling and/or collecting data from one or more components of the instrument.

103. An instrument for amplifying nucleic acids in a sample, the instrument comprising

10 an opening for receiving a flexible sample container, the flexible sample container comprising at least one reaction zone, and

a plurality of heaters, wherein each of the heaters is configured to be set at a different temperature, and wherein the heaters are positioned on a substantially planar mount such that each heater can be sequentially aligned with the at least one reaction zone to heat or cool a
15 sample therein.

104. The instrument of claim 103, wherein the substantially planar mount comprises a circular mount that is configured to be rotated adjacent to the flexible sample container.

20 105. The instrument of claim 104, wherein the circular mount is configured for rotating in both clockwise and counterclockwise directions.

106. A flexible sample container comprising:

a reaction chamber having an array of reaction wells, wherein each of the wells of the array is fluidly connected to a selectively openable and selectively sealable fill channel.

25 107. The flexible sample container of claim 106, wherein the flexible sample container is fabricated from a first film layer, a second film layer at least partially bonded to the first film layer, an adhesive layer bonded to the second film layer and one surface of a card layer in which the reaction wells of the array are formed, and a second adhesive layer bonded to a third, exterior film layer and an opposite surface of the card layer,

30 wherein the fill channel is formed by leaving an open space between the first and second film layers.

108. The flexible sample container of claim 107, wherein the fill channel is defined by seal lines that seal the first and second film layers together around the array of reaction wells.

5 109. The flexible sample container of claim 107, wherein the fill channel is fluidly connected to each of the wells of the array by a fill hole formed by selective cutouts in the second film layer and the first adhesive layer.

10 110. The flexible sample container of claim 109, wherein the fill hole is fluidly connected to a well filling channel that flows adjacent to and over a well of the array, wherein the well filling channel is formed by making a cutout in the card layer adjacent to the well of the array and another cutout in the second adhesive layer.

15 111. The flexible sample container of claim 109, wherein the fill hole is fluidly connected to a well filling channel that flows into a well of the array, wherein the well filling channel is formed by making a cutout in the first adhesive layer that fluidly connects the fill hole to the well of the array.

20 112. The flexible sample container of claim 106, wherein the fill channel is heat sealable.

113. The flexible sample container of claim 112, wherein a single heat seal seals flow from a fill channel to multiple fill channels and seals the wells from each other.

20 114. The flexible sample container of claim 106, wherein the fill channel is sealable by applying pressure over the array.