CLAIMS:

1. A sample carrier comprising:

an elongated thermal-control block having an active surface and an outer surface that face in opposite directions, the thermal-control block including first and second block ends in which a length of the thermal-control block extends therebetween, the active surface having a series of mounting areas that are distributed along the length of the thermal-control block, wherein said mounting areas are for mounting sample substrates;

chamber cells configured to be disposed over respective mounting areas of the series of mounting areas and thus over said sample substrates; and

a removable cover body configured to be coupled to the thermal-control block with the chamber cells therebetween, the thermal-control block and the chamber cells being shaped to form corresponding reaction chambers therebetween, the removable cover body and the thermal-control block being in fixed positions with respect to each other to form a unitary structure that is configured to be positioned within an assay system, wherein the reaction chambers have corresponding inlets that open in a common direction to an exterior of the sample carrier; wherein the chamber cells are separable or removable from the thermal-control block and the removable cover body.

2. The sample carrier of claim 1, wherein the inlets are at least partially defined by the chamber cells.

3. The sample carrier of claim 1, wherein the reaction chambers have corresponding outlets.

4. The sample carrier of claim 3, wherein the outlets open in a common direction that is opposite the common direction that the inlets open toward, wherein liquid is configured to flow between the inlet and the outlet of each reaction chamber.

5. The sample carrier of claim 1, wherein the unitary structure is substantially block-shaped, the block ends being shaped for insertion into slots of the assay system.

6. The sample carrier of claim 1, wherein the inlets are coplanar.

7. The sample carrier of claim 1, wherein the inlets are trough-shaped.

8. The sample carrier of claim 1, wherein the reaction chambers include flow sections that have at least one cross-sectional dimension that is at most 150 μm.

9. The sample carrier of claim 1, wherein the thermal-control block includes a channel extending therethrough, the channel being positioned proximate to the mounting areas to transfer thermal energy to and/or from the mounting areas.

10. The sample carrier of claim 9, wherein the thermal-control block includes a plurality of the channels.

11. The sample carrier of claim 9, wherein the channel is configured to convey a working fluid therethrough, the working fluid transferring thermal energy to and/or from the mounting areas.

12. The sample carrier of claim 11, wherein the working fluid in the channel is configured to absorb thermal energy from an operative surface of the thermal-control block and transfer the thermal energy to the mounting areas, wherein the operative surface is located along the outer surface or located along the active surface and has a longitudinal position away from the mounting areas.

13. The sample carrier of claim 9, further comprising a thermal module secured to the thermal-control block, the thermal module having a heater and a fan, the heater and the fan being in thermal communication with the thermal-control block.

14. The sample carrier of claim 9, wherein the thermal-control block includes a heat pipe disposed in the channel, the heat pipe configured to expedite transfer of thermal energy along the length of the thermal-control block.

15. The sample carrier of claim 14, further comprising a thermal module secured to the thermal-control block, the thermal module having a heater and a fan, the heater and the fan being in thermal communication with the thermal-control block and configured to supply thermal energy to the heat pipe and/or absorb thermal energy from the heat pipe.

16. The sample carrier of claim 9, further comprising a body extension, the body extension having a portion of the active surface or the outer surface, the heat pipe extending through the body extension.

17. The sample carrier of claim 9, wherein the channel extends between first and second working ports that open to an exterior of the thermal-control block.

18 The sample carrier of claim 1, further comprising a heater that is secured to the thermal-control block and positioned across the length of the thermal-control block such that the heater is at least opposite the mounting areas.

19. The sample carrier of claim 1, further comprising a planar heater, the planar heater including a film that is coupled to the thermal-control block and a conductive foil that generates heat.

20. The sample carrier of claim 1, further comprising an electrical contact that is exposed to an exterior of the thermal-control block, the electrical contact configured to transfer power to the thermal module.

21. The sample carrier of claim 1, further comprising a conductive coil that is configured to be induced for wireless power transfer.

22. The sample carrier of claim 1, further comprising a thermal module that is coupled to the thermal-control block and includes a heater, a cooling fan, and a processing unit, the processing unit including circuitry that is configured to control operation of the heater and the cooling fan.

23. The sample carrier of claim 1, further comprising a common cell spacer that is configured to be positioned between each of the chamber cells and the active surface of the thermal-control block, the cell spacer causing gaps between the chamber cells and the active surface or substrates that form the reaction chambers.

24. The sample carrier of claim 23, wherein the cell spacer forms a web having a plurality of bridges and substrate openings, the substrate openings aligning with the mounting areas along the active surface when the cell spacer is positioned over the thermal-control block.

25. The sample carrier of claim 23, wherein the cell spacer includes a plurality of thru-holes and the thermal-control block includes a plurality of alignment projections, the thru-holes configured to receive the alignment projections to position the cell spacer relative to the thermal-control block.

26. The sample carrier of claim 1, further comprising a nest assembly that includes a nest frame and the plurality of chamber cells, the nest frame configured to hold the chamber cells, the nest assembly configured to be coupled to the thermal-control block such that the chamber cells are held between the nest frame and the thermal-control block.

27. The sample carrier of claim 26, wherein the nest assembly is shaped to hold each of the chamber cells within a confined space relative to the nest frame, wherein the chamber cells are permitted to shift within the confined space to allow the chamber cells to align with the mounting areas when the nest assembly is coupled to the thermal-control block.

28. The sample carrier of claim 24, wherein the nest frame has an interior side and an outer side, the interior side configured to face the active surface, the nest frame having projections that project away from the interior side, the projections including support surfaces that face the interior side, the support surfaces configured to engage the chamber cells to prevent the chamber cells from falling away from the nest frame.

29. The sample carrier of claim 26, wherein the chamber cells have interior mounting surfaces that face the thermal-control block when the nest assembly is coupled thereto, the mounting surfaces being substantially coplanar.

30. The sample carrier of claim 1, wherein the removable cover body has an underside that faces the active surface of the thermal-control block, the removable cover body including a plurality of biasing elements along the underside, the biasing elements engaging the chamber cells when the removable cover body is coupled to the thermal-control block.

31. The sample carrier of claim 1, wherein the removable cover body has first and second cover ends in which a length of the cover body extends between the first and second cover ends, at least one of the cover ends having a hinge body, the hinge body configured to rotatably couple to the thermal-control block such that the cover body is permitted to rotate between open and closed positions.

32. A method of assembling a sample carrier, wherein the sample carrier is a sample carrier according to claim 1, the method comprising:

providing an elongated thermal-control block having an active surface and an outer surface that face in opposite directions, the thermal-control block including first and second

block ends in which a length of the thermal-control block extends therebetween, the active surface having a series of mounting areas that are distributed along the length of the thermal-control block;

positioning sample substrates over respective mounting areas of the series of mounting areas;

positioning chamber cells over respective sample substrates; and

coupling a removable cover body to the thermal-control block with the chamber cells therebetween, the thermal-control block and the chamber cells being shaped to form corresponding reaction chambers therebetween, wherein said chamber cells are separable or removable from the thermal-control block and the removable cover body, the removable cover body and the thermal-control block being in fixed positions with respect to each other to form a unitary structure that is configured to be positioned within an assay system, wherein the reaction chambers have corresponding inlets that open in a common direction to an exterior of the sample carrier.

33. The method of claim 32, wherein the reaction chambers have corresponding outlets.

34. The method of claim 33 wherein the outlets open in a common direction that is opposite the common direction that the inlets open toward, wherein liquid is configured to flow between the inlet and the outlet of each reaction chamber

35. The method of claim 32, further comprising:

securing a thermal module to the thermal-control block, the thermal module having a heater and a cooling apparatus, the heater and the cooling apparatus being in thermal communication with the thermal-control block.

36. The method of claim 32, wherein the thermal-control block includes channel extending therethrough and a heat pipe disposed in the channel, the heat pipe configured to expedite transfer of thermal energy along the length of the thermal-control block.

37. The method of claim 36, further comprising:

securing a thermal module secured to the thermal-control block, the thermal module having a heater and a cooling apparatus, the heater and the cooling apparatus being in thermal communication with the thermal-control block and configured to supply thermal energy to the heat pipe and/or absorb thermal energy from the heat pipe.

38. The method of claim 32, further comprising:

positioning a common cell spacer onto the active surface of the thermal-control block, the cell spacer causing gaps between the chamber cells and the active surface or between the chamber cells and sample substrates.

39. The method of claim 38, wherein the cell spacer forms a web having a plurality of bridges and substrate openings, the substrate openings aligning with the sample substrates along the active surface when the cell spacer is positioned over the thermal-control block.

40. The method of claim 38, wherein the cell spacer includes a plurality of thru-holes and the thermal-control block includes a plurality of alignment projections, the thru-holes configured to receive the alignment projections to position the cell spacer relative to the thermal-control block.

41. The method of claim 32, wherein positioning the chamber cells includes positioning a nest assembly over the thermal-control block, the nest assembly including a nest frame and the plurality of chamber cells, the nest frame coupling to the thermal-control block and holding the chamber cells therebetween.

42. The method of claim 36, wherein the nest assembly is shaped to hold each of the chamber cells within a corresponding confined space relative to the nest frame, wherein the chamber cells are permitted to shift within the confined space to allow the chamber cells to align with the mounting areas when the nest assembly is coupled to the thermal-control block.

43. The method of claim 41, wherein the nest frame has an interior side and an outer side, the interior side configured to face the active surface, the nest frame having projections that project away from the interior side, the projections including support surfaces that face the interior side, the support surfaces configured to engage the chamber cells to prevent the chamber cells from falling away from the nest frame.

44. The method of claim 32, wherein the sample substrates include a substrate body having a biological or chemical sample immobilized to a surface of the substrate body, the biological or chemical sample being configured for at least one of in-situ hybridization (ISH), fluorescent ISH (FISH), and immuno-histochemistry (IHC).

45. A system rack comprising:

a rack body having a loading side and a plurality of elongated carrier slots that open along the loading side, the carrier slots configured to receive corresponding sample carriers inserted through the loading side, at least one carrier slot comprising a sample carrier according to claim 1;

thermal modules coupled to the rack body, each of the thermal modules having a thermal-transfer surface that is exposed along a corresponding carrier slot of the plurality of carrier slots, each of the thermal modules comprising a heater that is in thermal communication with the thermal-transfer surface; and

temperature sensors having sensor surfaces that are exposed to corresponding carrier slots of the plurality of carrier slots, wherein each of the temperature sensors are configured to detect data that is based on a temperature of the sample carrier within the corresponding carrier slot.

46. The system rack of claim 45, wherein the rack body includes a reservoir at a bottom of the carrier slots, the reservoir configured to receive liquid that exit the sample carriers.

47. The system rack of claim 45, wherein each temperature sensor is aligned with at least one of the thermal modules.

48. The system rack of claim 45, wherein each thermal module is aligned with at least one of the temperature sensors.

49. The system rack of claim 45, wherein the temperature sensor exposed to a corresponding carrier slot is separated from the thermal module exposed along the corresponding carrier slot by an operative distance, the operative distance being sized to allow multiple reaction chambers of the corresponding sample carrier to exist between the thermal module and the temperature sensor.

50. The system rack of claim 45, wherein each of the carrier slots includes a first slot region and a second slot region that are configured to receive respective end portions of the

corresponding sample carrier, the temperature sensor being exposed to the first slot region, the thermal module being exposed to the second slot region.

51. The system rack of claim 50, wherein the first and second slot regions of each slot carrier slot are separated by a slot gap, the sample carrier configured to be disposed within the first and second slot regions and the slot gap.

52. The system rack of claim 45, wherein the loading side coincides with a loading plane, the carrier slots being angled with respect to the loading plane to form a non-orthogonal angle with respect to the loading plane.

53. The system rack of claim 45, wherein each of the thermal modules includes a cooling apparatus, the cooling apparatus configured to absorb thermal energy from the sample carrier and transfer the thermal energy away from the sample carrier.

54. The system rack of claim 50, wherein the cooling apparatus is a fan, the rack body including at least one vent that is in flow communication with the fans.

55. An assay system comprising:

a system rack according to claim 45;

a fluidic control system including a robotic arm having a plurality of syringes for delivering liquids to the sample carriers; and

a controller configured to control operation of the thermal modules and the robotic arm in accordance with a predetermined protocol that includes delivering reagents to chamber cells of each sample carrier using the robotic arm and controlling a temperature of the chamber cells using the thermal modules and temperature sensors.

56. The assay system according to claim 55, wherein the system rack is the system rack of any of claims 46 to 54.

57. The assay system of claim 55, wherein each of the mounting areas of the active surface is configured to have a corresponding sample substrate positioned thereon

with the corresponding sample substrate between the mounting area and the chamber cell, the thermal-control block and the chamber cells being shaped to form corresponding reaction chambers between the chamber cells and the sample substrates; and

the assay system further comprising a fluidic network comprising at least one input line and at least one output line that are configured to be in flow communication with the reaction chambers.

58. The assay system of claim 57, further comprising a clamp mechanism that presses the removable cover body toward the chamber cells to press the chamber cells against the thermal-control block and thereby impede leakage from the reaction chambers.

59. The assay system of claim 57, wherein the system sub-assembly includes a manifold plate that is positioned between the chamber cells and the removable cover body, the removable cover body pressing the manifold plate against the chamber cells.

60. The assay system of claim 59, wherein the at least one input line is coupled to at least one of the plurality of chamber cells or the manifold plate.

61. The assay system of claim 60, wherein the at least one input line is directly coupled to the manifold plate.

62. The assay system of claim 61, wherein the manifold plate includes a plurality of channels that are in flow communication with the at least one input line and each of the chamber cells includes at least one channel, the channels of the manifold plate aligning with the channels of the chamber cells to provide fluidic access to the reaction chambers.

63. The assay system of claim 57, wherein the system sub-assembly includes a manifold plate and a removable cover body, the manifold plate configured to be positioned over the thermal-control block with the chamber cells therebetween and engage each of the chamber cells, the removable cover body configured to be positioned over the thermal-control block with the manifold plate therebetween and press the manifold plate against the chamber cells thereby pressing the chamber cells against the thermal-control block.

64. The assay system of claim 57, wherein each of the mounting areas is defined by at least one of alignment features of the thermal-control block or alignment elements that are secured to the thermal-control block, the sample substrates configured to engage the alignment features and/or the alignment elements.

65. The assay system of claim 57, further comprising a manifold assembly that includes the at least one input line and a manifold plate, the manifold plate being coupled to the

at least one input line and configured to be positioned between the removable cover body and the chamber cells.

66. The assay system of claim 65, wherein the manifold plate includes a plurality of channels that are in flow communication with the at least one input line and each of the chamber cells includes at least one channel, the channels of the manifold plate aligning with the channels of the chamber cells to provide fluidic access to the reaction chambers.

67. The assay system of claim 66, further comprising a clamp mechanism that presses the removable cover body against the manifold plate thereby pressing the manifold plate against the chamber cells.

68. The assay system of claim 57, wherein the at least one input line comprises a plurality of input tubes.

69. The assay system of claim 57, wherein the assay system is configured to pump liquids through the reaction chambers in accordance with a predetermined protocol, the protocol being at least one of in-situ hybridization (ISH), fluorescent ISH (FISH), and immuno-histochemistry (IHC).