CLAIMS

What is claimed is:

1. A system for automatically processing a sample, the system comprising:

a deck configured to support and position:

a reagent cartridge at a first region of the first side of the deck;

a sample processing cartridge at a second region of the first side, wherein the sample processing cartridge comprises a lid covering an access region, the lid comprising an open mode in which the access region is uncovered and a closed mode in which the access region is covered; and

a tool container at a third region of the first side;

a gantry coupled to the deck and comprising:

a set of tracks defining paths of movement along a set of axes, within a three dimensional volume bound by the first side of the deck, for a pipette interface, the system further comprising a lid-opening tool configured to couple to the pipette interface, the system further comprising a lid-opening mode in which the gantry transports the lid-opening tool for engagement with a releasing body of the lid; and

a base opposite the first side of the deck and supporting:

a heating and cooling subsystem comprising a set of thermal bodies for transferring heat to the reagent cartridge and the sample processing cartridge;

a separation subsystem comprising a set of magnets coupled to a magnet actuator configured to transition the set of magnets between a retracted state and an extended state, wherein in the extended state, the set of magnets passes into the first region of the deck;

a pumping subsystem comprising a vacuum port extending into the second region.

2. The system of Claim 1, wherein the reagent cartridge comprises a set of domains including a first domain configured to mate with a first thermal body, configured for material cooling, of the set of thermal bodies passing to the first region of the first side of the deck, and a second domain configured to mate with a second thermal body, configured for thermocycling, of the set of thermal bodies passing to the first region of the first side of the deck.

3. The system of Claim 1, wherein the deck includes a set of retention elements at the second region, configured to reversibly engage the sample processing cartridge,

provide a counteracting force against the lid-opening tool, and provide thermal contact with a thermal body of the set of thermal bodies, with at least 0.5 lbs. of retention force.

4. The system of Claim 1, wherein at least one of the set of thermal bodies and the vacuum port is coupled with the sample processing cartridge to provide a counteracting force against the lid-opening tool.

5. The system of Claim 1, wherein in the closed mode, the lid and the access region define boundaries of a fluid pathway adjacent to the microwell region of the sample processing chip, sealed by a gasket coupled to the lid.

6. The system of Claim 1, wherein the separation subsystem further comprises a magnetic body configured to couple with the pipette interface at a first end and to couple with a magnetic sleeve of the tool container at a second end, the system further comprising a separation mode in which the gantry transports the magnetic body, coupled to the magnetic sleeve, between the sample processing cartridge and the reagent cartridge for magnetic separation of target material from the sample.

7. The system of Claim 1, wherein the set of magnets of the separation subsystem comprises a first subset of magnets arranged in a linear array along a first axis for performance of purification operations at the reagent cartridge.

8. The system of Claim 7, wherein the set of magnets of the separation subsystem further comprises a second magnet offset from the first axis for performance of a target material separation operation at a separation reservoir of the reagent cartridge.

9. The system of Claim 8, wherein the separation reservoir comprises a planar surface configured adjacent to the second magnet in the extended state of the set of magnets, and a curved surface away from the second magnet in the extended state of the set of magnets.

10. The system of Claim 1, further comprising a processing and control subsystem, supported between the deck and the base, the processing and control subsystem comprising non-transitory instructions stored in computer readable media for executing automatic sample processing operations comprising at least one of:

controlling heat transmission between the heating and cooling subsystem, the reagent cartridge, and the sample processing cartridge;

transitioning the set of magnets between the retracted state and the extended state;

controlling pressure applied by the pumping subsystem to the sample processing cartridge, through the vacuum port.

11. A system for automatically processing a sample, the system comprising:

a deck configured to support and position:

a reagent cartridge at a first region of the first side of the deck; and

a sample processing cartridge at a second region of the first side;

a gantry coupled to the deck and comprising:

a set of tracks defining paths of movement along a set of axes, within a three dimensional volume bound by the first side of the deck, for a pipette interface; and

a base opposite the first side of the deck and supporting:

a separation subsystem comprising a set of magnets coupled a magnet actuator configured to transition the set of magnets between a retracted state and an extended state, wherein in the extended state, the set of magnets passes into the first region of the deck.

12. The system of Claim 11, wherein the separation subsystem further comprises a magnetic body configured to couple with the pipette interface at a first end and to couple with a magnetic sleeve at a second end, the system further comprising a separation mode in which the gantry transports the magnetic body, coupled to the magnetic sleeve, between the sample processing cartridge and the reagent cartridge for magnetic separation of target material from the sample.

13. The system of Claim 11, wherein the sample processing cartridge comprises a base substrate coupled to a sample processing chip, the sample processing chip comprising a microwell region comprising a set of microwells configured to capture cells in single-cell format, and the sample processing cartridge further comprises an elastomeric valve coupling the sample processing chip to the base substrate along a flow path from the microwell region to an outlet of the sample processing chip, into a waste containment region of the sample processing cartridge.

14. The system of Claim 1, further comprising a fluid level detection subsystem coupled to the deck and aligned with an inlet reservoir of the sample processing cartridge, the fluid level detection subsystem configured to detect light transmitted across the inlet reservoir.

15. The system of Claim 11, further comprising a fluid level detection subsystem coupled to the deck and aligned with an inlet reservoir of the sample processing cartridge, the fluid level detection subsystem configured to detect light transmitted across the inlet reservoir.