CLAIMS

What is claimed is:

1. A method comprising:

receiving, in single-cell format, a set of target cells into an array of wells defined at a surface plane of a substrate, wherein each well in the array of wells extends perpendicular to and into the surface plane into the substrate;

receiving a set of particles into the array of wells, thereby co-capturing the set of target cells and the set of particles across the array of wells, wherein receiving the set of particles and the set of target cells comprises retaining the set of particles closer to the surface plane than the set of target cells;

achieving a state of specific capture for the array of wells, wherein a well of the array of wells in the state of specific capture has a target cell of the set of target cells and a particle of the set of particles and a width configured to prevent positioning of the target cell of the set of target cells laterally adjacent to the particle of the set of particles, upon receiving a washing fluid into a cavity in communication with the array of wells and transmitting excess particles of the set of particles away from the array of wells;

providing a lysis environment for the set of cells upon receiving a lysis buffer into the cavity;

partitioning each of the array of wells from adjacent wells of the array of wells, at the surface plane, upon displacing the lysis buffer from the cavity with a gas volume;

preventing evaporation of contents of the array of wells upon receiving a partitioning fluid into the cavity; and

retaining intracellular material of the set of target cells, within the array of wells, with transmission of heat into the array of wells.

2. The method of claim 1, wherein the substrate comprises: a short axis, a long axis, and a network of fluid channels defining one or more flow paths preferentially aligned with the short axis and coupled to the cavity, wherein receiving one or more of the lysis buffer and the partitioning fluid comprises receiving one or more of the lysis buffer and the partitioning fluid into the network of fluid channels.

3. The method of claim 1, wherein receiving the lysis buffer comprises receiving the lysis buffer at a temperature between 1°C and 15°C.

4. The method of claim 3, wherein receiving the lysis buffer comprises retaining the lysis buffer within the cavity for a residence duration below 40 seconds.

5. The method of claim 1, wherein retaining intracellular material comprises retaining mRNA material, of the set of target cells, hybridized to the set of particles individually within the array of wells.

6. The method of claim 1, wherein each of the set of particles comprises a polystyrene coating and a unique biopolymer composite barcode.

7. The method of claim 1, wherein receiving the set of cells comprises receiving the set of cells at a first concentration configured for less than 50% occupancy of the array of wells, thereby promoting capture of the set of cells in single-cell format, and wherein receiving the set of particles comprises receiving the set of particles at a second concentration higher than the first concentration.

8. The method of claim 1, wherein a cross-section of each well in the array of wells defines a polygon, and wherein each well in the array of wells comprises a depth greater than a sum of a particle diameter of the set of particles and a cell diameter of the set of target cells.

9. The method of claim 1, wherein the partitioning fluid comprises an oil.

10. A method comprising:

receiving, in single-cell format, a set of target cells into an array of wells defined at a surface plane of a substrate;

receiving a set of particles into the array of wells, thereby co-capturing the set of target cells and the set of particles across the array of wells, wherein receiving the set of particles and the set of target cells comprises retaining the set of particles closer to the surface plane than the set of target cells;

achieving a state of specific capture for the array of wells, wherein a well of the array of wells in the state of specific capture has a target cell of the set of target cells and a particle of the set of particles, upon receiving a washing fluid into a cavity in

communication with the array of wells and transmitting excess particles of the set of particles away from the array of wells;

providing a lysis environment for the set of cells upon receiving a lysis buffer into the cavity;

receiving a partitioning fluid into the cavity, thereby displacing an excess portion of the lysis buffer from the cavity and forming a barrier over the array of wells at the surface plane to prevent drifting of the contents of the array of wells into adjacent wells of the array of wells; and

retaining intracellular material of the set of target cells, individually with the set of particles within the array of wells, thereby mitigating leakage of intracellular material of a first well to a second well of the array of wells.

11. The method of claim 10, wherein the substrate comprises: a network of fluid channels defining one or more flow paths preferentially aligned with a short axis of the substrate and coupled to the cavity, wherein receiving one or more of the lysis buffer and the partitioning fluid comprises receiving one or more of the lysis buffer and the partitioning fluid into the network of fluid channels.

12. The method of claim 10, wherein receiving at least one of the set of target cells, the set of particles, the washing fluid, the lysis buffer, and the partitioning fluid comprises receiving with a laminar flow process.

13. The method of claim 10, wherein the partitioning fluid comprises at least one of air and an oil.

14. The method of claim 10, wherein receiving the lysis buffer comprises receiving the lysis buffer at a temperature between 1°C and 15°C.

15. The method of claim 10, wherein the lysis buffer is pre-cooled below 15°C prior to entering the cavity over the array of wells.

16. The method of claim 10, wherein receiving the lysis buffer comprises retaining the lysis buffer within the cavity for a residence duration below 40 seconds.

17. The method of claim 10, wherein retaining intracellular material comprises transmitting heat through the substrate and into the array of wells, producing a well temperature within the array of wells between 15°C and 35°C.

18. The method of claim 10, wherein retaining intracellular material comprises retaining mRNA material, of the set of target cells, hybridized to oligonucleotide probes coupled to the set of particles, individually within the array of wells.

19. The method of claim 18, further comprising flowing a wash buffer configured to remove unbound RNA over the array of wells at a flow rate more than 50 microliters/second, after hybridization of mRNA material to the set of particles.

20. The method of claim 18, further comprising performing a reverse transcription process with retained mRNA material within the array of wells.