## CLAIMS

1. A transduction method, comprising incubating, in an internal cavity of a centrifugal chamber, an input composition comprising cells and viral particles containing a recombinant viral vector, wherein

said centrifugal chamber is rotatable around an axis of rotation and comprising an end wall, a substantially rigid side wall extending from said end wall, and at least one opening, wherein at least a portion of said side wall surrounds said internal cavity and said at least one opening is capable of permitting intake of liquid into said internal cavity and expression of liquid from said cavity;

the centrifugal chamber is rotating around said axis of rotation during at least a portion of the incubation; and

the method generates an output composition comprising a plurality of the cells transduced with the viral vector.

2. The method of claim 1, wherein said rotating comprises rotation at a relative centrifugal force at an internal surface of the side wall of the cavity and/or at a surface layer of the cells that is at least at or about 600 g, 1000 g, or 1600 g.

3. The method of claim 1or 2, wherein the at least a portion of the incubation during which the chamber is rotating is for a time that is:

greater than or about 10 minutes, greater than or about 30 minutes, or greater than or about 60 minutes or

between or between about 5 minutes and 60 minutes.

4. The method of any of claims 1-3, wherein:

the average liquid volume of said input composition present in said cavity during said incubation is no more than about 5 milliliters (mL) per square inch of the internal surface area of the cavity during said incubation;

the maximum liquid volume of said input composition present in said cavity at any one time during said incubation is no more than about 5 mL per square inch of the maximum internal surface area of the cavity;

the maximum liquid volume of said input composition present in said cavity at any one time during said incubation or the average volume over the course of the incubation is no more than at or about 2 times the volume of a monolayer of said cells formed on the inner surface of said cavity during rotation of said chamber at a force of at or about 1000 g or at or about 2000 g at an internal surface of the side wall and/or at a surface layer of the cells; or

the liquid volume of the input composition is no more than 20 mL, no more than 40 mL, or no more than 100 mL or no more than 200 mL.

5. The method of any of claims 1-4, wherein:

the number of said cells in said input composition is at or about the number of said cells sufficient to form a monolayer on the surface of said cavity during rotation of said centrifugal chamber at a force of at or about 1000 g or at or about 2000 g at an internal surface of the side wall and/or at a surface layer of the cells; and/or

the number of said cells in said input composition is no more than 1.5 times or 2 times the number of said cells sufficient to form a monolayer on the surface of said cavity during rotation of said centrifugal chamber at a force of at or about 1000 g or at or about 2000 g at an internal surface of the side wall and/or at a surface layer of the cells; and/or

said input composition in the cavity comprises at least at or about $1 \times 10^6$ of said cells, $5 \times 10^6$ of said cells, $1 \times 10^7$ of said cells or $1 \times 10^8$ of said cells.

6. The method of any of claims 1-5, wherein

said input composition comprises at least at or about 1 infectious unit (IU) of viral particles per one of said cells.

7. The method of any of claims 1-6, wherein, during at least a portion of the incubation in the chamber or during the rotation of the chamber, the liquid volume of the input composition occupies only a portion of the volume of the internal cavity of the chamber, the volume of the cavity during said at least a portion or during said rotation further comprising a gas, said gas taken into said cavity via said at least one opening, prior to or during said incubation.

8. The method of claim 7, wherein the centrifugal chamber comprises a movable member, whereby intake of gas into the centrifugal chamber effects movement of the movable member to increase the volume of the internal cavity of the chamber, thereby decreasing the total liquid volume of said input composition present in said cavity during rotation of said centrifugal chamber per square inch of the internal surface area of the cavity compared to the absence of gas in the chamber.

9. A method of transduction, comprising:

a) providing to an internal cavity of a centrifugal chamber that has an internal surface area of at least at or about $1 \times 10^9$ $\mu m^2$ or at least at or about $1 \times 10^{10}$ $\mu m^2$:

i) an input composition comprising cells and viral particles comprising a recombinant viral vector, wherein:

the number of cells in the input composition is at least $1 \times 10^7$ cells, and

the viral particles are present in the input composition at at least at or about 1 infectious unit (IU) per one of said cells, and

the input composition comprises a liquid volume that is less than the maximum volume of the internal cavity of the centrifugal chamber; and

ii) gas at a volume that is up to the remainder of the maximum volume of the internal cavity of the centrifugal chamber; and

b) incubating the input composition, wherein at least a portion of the incubation is carried out in said internal cavity of said centrifugal chamber while effecting rotation of said centrifugal chamber; and

wherein the method generates an output composition comprising a plurality of the cells transduced with the viral vector.

10. The method of claim 9, wherein:

the liquid volume of the input composition is less than or equal to 200 mL, less than or equal to 100 mL, less than or equal to 50 mL or less than or equal to 20 mL; and/or

the liquid volume of the input composition is no more than 50%, no more than 40%, no more than 30%, no more than 20%, or no more than 10% of the volume of the internal surface area of the cavity during rotation or the maximum internal surface area of the cavity.

11. The method of claim 9 or 10, wherein the volume of gas is up to 200 mL, up to 180 mL, up to 140 mL or up to 100 mL.

12. The method of any of claims 9-11, wherein said rotation is at a relative centrifugal force at an internal surface of the side wall of the cavity or at a surface layer of the cells of at least at or about 600 g, 1000 g, or 1600 g.

13. A method of transduction, comprising incubating an input composition comprising cells and viral particles, the viral particles comprising a recombinant viral vector, at least a portion of said incubating being carried out under rotating conditions, thereby generating an output composition comprising a plurality of the cells transduced with the viral vector, wherein:

said input composition comprises greater than or about 20 mL in volume, and/or said input composition comprises at least 1 x $10^8$ cells; and

said rotating conditions comprise a relative centrifugal force on a surface layer of the cells of greater than about 800 g or greater than about 1000 g or greater than about 1500 g.

14. The method of claim 13, wherein said incubation is carried out in a cavity of a centrifugal chamber and the number of said cells in said input composition is at or about the number of said cells sufficient to form a monolayer or a bilayer on the inner surface of said cavity during said rotation.

15. The method of any of claims 1-14, wherein a further portion of the incubation is carried out outside of the centrifugal chamber and/or without rotation, said further portion carried out subsequent to the at least a portion carried out in the chamber and/or with rotation.

16. The method of claim 15, wherein:

the incubation and/or the further portion of the incubation is carried out for a time that is no more than 24 hours;

the cells in the composition have not been subjected to a temperature of greater than 30 °C for more than 24 hours; and/or

the incubation and/or the further portion of the incubation is not performed in the presence of a stimulating agent.

17. The method of any of claims 1-16, wherein:

the output composition containing transduced cells comprises at least at or about 1 x $10^7$ cells or at least at or about 5 x $10^7$ cells;

for an input composition comprising a virus at a ratio of about 1 or about 2 IU per cells, said method is capable of producing an output composition in which at least 10 %, at least 25 %, at least 30 %, at least 40 %, at least 50 %, or at least 75 % of the cells in said output composition generated by the method comprise said recombinant viral vector and/or express a product of a recombinant nucleic acid comprised within said vector; or

among all the cells in said output composition that contain the recombinant viral vector or into which the viral vector is integrated, the average copy number of said recombinant viral vector is no more than about 10, no more than about 5, no more than about 2.5, or no more than about 1.5; or among the cells in the output composition, the average copy number of said vector is no more than about 2, no more than about 1.5, or no more than about 1.

18. The method of any of claims 1-17, wherein the centrifugal chamber is integral to a closed system, said closed system comprising:

said chamber and at least one tubing line operably linked to the at least one opening via at least one connector, whereby liquid and gas are permitted to move between said cavity and said at least one tubing line in at least one configuration of said system; and

optionally, at least one container operably linked to the at least one tubing line, the connection permitting liquid and/or gas to pass between said at least one container and said at least one opening via the at least one tubing line.

19. The method of claim 18, wherein said at least one container comprises at least one input container comprising said viral vector particles and said cells, a waste container, a product container, and at least one diluent container, each connected to said cavity via said series of tubing lines and said at least one opening.

20. The method of claim 19 wherein said method further comprises:

prior to and/or during said incubation, effecting intake of said input composition into said cavity, said intake comprising flowing of liquid from said at least one input container into said cavity through said at least one opening; and/or

prior to and/or during said incubation, providing or effecting intake of gas into said cavity under sterile conditions, said intake being effected by (a) flow of gas from a container that comprises gas, (b) flow of gas from an environment external to the closed system, via a microbial filter, or (c) flow of gas from a syringe connected to the system at a syringe port.

21. The method of claim 19 or 20, wherein the closed system comprises:

at least one further container that comprises a gas for intake into said cavity prior to and/or during at least a point during said incubation; and/or a microbial filter capable of taking in gas to the internal cavity of the centrifugal chamber; and/or a syringe port for effecting intake of gas.

22. The method of claim 20 or 21, wherein:

the effecting intake of the gas into the internal cavity of the centrifugal chamber is carried out simultaneously or together with the effecting intake of the input composition to the internal cavity of the centrifugal chamber; or

the effecting of the intake of the gas is carried out separately, either simultaneously or sequentially, from the effecting of the intake of the input composition into said cavity.

23. The method of any of claims 7-22, wherein the gas is air.

24. The method of any of claims 1-23, wherein the incubation is part of a continuous process, the method further comprising:

during at least a portion of said incubation, effecting continuous intake of said input composition into said cavity during rotation of the chamber; and

during a portion of said incubation, effecting continuous expression of liquid from said cavity through said at least one opening during rotation of the chamber.

25. The method of any of claims 1-24, wherein the incubation is part of a semi-continuous process, the method further comprising:

prior to said incubation, effecting intake of said input composition, and optionally gas, into said cavity through said at least one opening;

subsequent to said incubation, effecting expression of liquid and/or optionally gas from said cavity;

effecting intake of another input composition comprising cells and said viral particles containing a recombinant viral vector, and optionally gas, into said internal cavity; and

incubating said another input composition in said internal cavity,

wherein the method generates another output composition comprising a plurality of cells of the another input composition that are transduced with said viral vector.

26. The method of any of claims 20-25, wherein the method further comprises:

effecting rotation of said centrifugal chamber prior to and/or during said incubation;

effecting expression of liquid from said cavity into said waste container following said incubation;

effecting expression of liquid from said at least one diluent container into said cavity via said at least one opening and effecting mixing of the contents of said cavity; and

effecting expression of liquid from said cavity into said product container, thereby transferring cells transduced with the viral vector into said product container.

27. The method of any of claims 1-26, further comprising:

(a) washing a biological sample comprising said cells in an internal cavity of a centrifugal chamber prior to said incubation; and/or

(b) isolating said cells from a biological sample, wherein at least a portion of the isolation step is performed in an internal cavity of a centrifugal chamber prior to said incubation; and/or

(c) stimulating cells prior to and/or during said incubation, said stimulating comprising exposing said cells to stimulating conditions, thereby inducing cells of the input composition to proliferate, wherein at least a portion of the step of stimulating cells is performed in an internal cavity of a centrifugal chamber.

28. The method of any of claims 1-27, further comprising formulating cells transduced by the method in a pharmaceutically acceptable buffer in an internal cavity of a centrifugal chamber, thereby producing a formulated composition, and, optionally effecting expression of the formulated composition to one or a plurality of containers.

29. The method of any of claims 1-28, wherein:

said cells in said input composition comprise suspension cells;

said cells in said input composition comprise white blood cells; and/or

said cells in said input composition comprise T cells or NK cells.

30. The method of any of claims 8 or 15-29, wherein said chamber comprises said movable member and during said incubation, said centrifugal chamber is located within a centrifuge and associated with a sensor, said sensor capable of monitoring the position of said movable member, and control circuitry capable of receiving and transmitting information from said sensor and causing movement of said movable member, intake and expression of liquid and/or gas to and from said cavity via said one or more tubing lines, and rotation of said chamber via said centrifuge.

31. The method of any of claims 1-30, wherein said recombinant viral vector encodes a recombinant receptor, which is thereby expressed by cells of the output composition.

32. A method for selection, the method comprising:

(a) incubating a selection reagent and primary cells in an internal cavity of a centrifugal chamber under mixing conditions, whereby a plurality of the primary cells bind to said selection reagent; and

(b) separating said plurality of said primary cells from another one or more of the primary cells based on binding to the selection reagent,

thereby enriching the primary cells based on binding to the selection reagent,

wherein said centrifugal chamber is rotatable around an axis of rotation and said internal cavity has a maximum volume of at least 50, at least 100, or at least 200 mL.

33. A method for stimulation of cells, the method comprising incubating a stimulation agent and primary cells under conditions whereby the stimulation agent binds to a molecule expressed by a plurality of the primary cells and said plurality of the cells are activated or stimulated, wherein

at least a portion of the incubation being carried out in an internal cavity of a centrifugal chamber under mixing conditions,

said centrifugal chamber is rotatable around an axis of rotation; and

said internal cavity has a maximum volume of at least 50, at least 100, or at least 200 mL.

34. A composition, comprising transduced cells produced by the method of any of claims 1-31.

35. The composition of claim 34, wherein:

the composition comprises at least at or about $5 \times 10^7$ cells, $1 \times 10^8$ cells, $2 \times 10^8$ cells, $4 \times 10^8$ cells, $6 \times 10^8$, $8 \times 10^8$ cells or $1 \times 10^9$ cells; or

the composition comprises a therapeutically effective number of cells for use in adoptive T cell therapy.

36. The composition of claim 34 or 35, wherein:

the cells are T cells; and

subsequent to transduction, the cells in the composition are not subjected to cell expansion in the presence of a stimulating agent and/or the cells are not incubated at a temperature greater than 30 °C for more than 24 hours or the composition does not contain a cytokine or the composition does not contain a stimulating agent that specifically binds to CD3 or a TCR complex.

37. A composition, comprising:

a) at least $1 \times 10^7$ or at least $5 \times 10^7$ cells T cells, at least a plurality of which are transduced with a recombinant viral vector or express a recombinant or engineered antigen receptor, wherein:

subsequent to transduction, the cells in the composition have not been subjected to cell expansion in the presence of a stimulating agent; and/or

subsequent to transduction, the cells have not been incubated at a temperature greater than 30 °C for more than 24 hours; or

b) at least 1 x $10^7$ or at least 5 x $10^7$ primary human T cells, at least a plurality of which are transduced with a recombinant viral vector or express a recombinant or engineered antigen receptor, wherein at least 30%, 40%, 50%, 60%, 70%, 80%, or 90 % of the T cells in the composition comprise high expression of CD69 and/or TGF-beta-II.

38. The composition of any of claims 35-37, wherein:

among all the cells in the composition, the average copy number of said recombinant viral vector is no more than about 10, no more than 8, no more than 6, no more than 4, or no more than about 2; or

among the cells in the composition transduced with the recombinant viral vector, the average copy number of said vector is no more than about 10, no more than 8, no more than 6, no more than 4, or no more than about 2.

39. An article of manufacture comprising a container or plurality of containers, the container or the plurality of containers collectively containing a composition according to claim 37 or 38.

40. A composition of any of claims 36-38 for the treatment of a disease or condition.

41. A composition, comprising:

at least 1 x $10^7$ cells; and

at least at or about 1 infectious unit (IU) per cell of viral particles comprising a recombinant viral vector.

42. A centrifugal chamber rotatable around an axis of rotation, said chamber comprising:

an internal cavity comprising the composition of claim 39 or an internal cavity comprising: (a) a composition containing at least 5 x $10^7$ primary T cells transduced with a

recombinant viral vector and/or (b) a composition containing at least 5 x $10^7$ primary T cells and viral particles containing a recombinant viral vector.

43. A closed system, comprising the centrifugal chamber of claim 42.

44. The closed system of claim 43, further comprising a multi-way manifold operably connected to one or a plurality of containers.