

CLAIMS

1. A method of profiling a sample comprising a plurality of cells, the
5 method comprising:
 flowing cells from the sample through a first array of pillars to
 obtain one or more distribution profiles of cells sorted by the first array;
 flowing cells from the sample through a second array of pillars
 that is different from the first array of pillars to obtain one or more
10 distribution profiles of cells sorted by the second array; and
 deriving a biophysical signature of the sample based on at least
 the one or more distribution profiles of the cells sorted by the first array
 and/or the one or more distribution profiles of the cells sorted by the
 second array.
- 15
2. The method of claim 1, wherein flowing cells through the first array of
pillars comprises flowing the cells through the first array of pillars at
different flow velocities and flowing cells through the second array of
pillars comprises flowing the cells through the second array of pillars
20 at different flow velocities or flow rates.
3. The method of any one of claim 1 or claim 2, further comprising
obtaining a first biophysical parameter based on the one or more
distribution profiles of the cells sorted by the first array and/or
25 obtaining a second biophysical parameter based on one or more
distribution profiles of the cells sorted by the second array.
4. The method of claim 3, wherein obtaining the first biophysical
parameter and/or second biophysical parameter comprises
30 determining a cell apparent size (D_{app}) based on the one or more

distribution profiles of the sorted cells, optionally determining respective cell apparent sizes (D_{app}) based on the respective distribution profiles of the sorted cells at the respective different flow velocities or flow rates.

5

5. The method of claim 4, wherein obtaining the first biophysical parameter and/or the second biophysical parameter further comprises obtaining a cell-deformability modulus (CDM), optionally based on changes in the cell apparent sizes (D_{app}) at different flow velocities or flow rates.

10

6. The method of claim 5, wherein the biophysical signature of the sample is derived from the respective cell-deformability modulus (CDM) obtained for at least the first array of pillars and the second array of pillars.

15

7. The method of any one of the preceding claims, wherein the pillars of each the first and second arrays are arranged based on equation (A):

$$D_c = a g \tan \theta^b \quad \text{--- (A)}$$

20

where D_c is the deterministic lateral displacement (DLD) cut-off size, each of a and b is a value that is independently selected from a value in the range of 0.48 to 1.4 and g represents the closest distance between the pillars.

25

8. The method of claim 7, wherein D_c is in the range of 5.0 μm to 16.0 μm .

9. The method of any one of the preceding claims, wherein the first array of pillars differs from the second array of pillars in at least one of: pillar

30

dimension, pillar shape, pillar structure, pillar arrangement or pillar orientation, with respect to the direction of flow of cells.

5 10. The method of any one of the preceding claims, wherein the pillars in the first array and the second array have a shape selected from the group consisting of a substantially L shape (L), a substantially inverse L shape (L^{-1}), mirror reflections thereof or combinations thereof.

10 11. The method of any one of the preceding claims, wherein the sample is derived from a mammalian subject and the method further comprises determining a health status of a subject based on the biophysical signature of the sample.

15 12. The method of claim 11, wherein determining a health status of a subject comprises determining the presence of an infection in the subject.

20 13. The method of claim 12, wherein the cells comprise immune cells.

25 14. A sample profiling system comprising:

a first region comprising a first array of pillars configured to sort cells from a sample flowed therethrough and provide one or more distribution profiles of the sorted cells; and

a second region comprising a second array of pillars configured to sort cells from the sample flowed therethrough and provide one or more distribution profiles of the sorted cells;

wherein the first array of pillars is configured to provide one or more distribution profiles that is substantially different from the one or

more distribution profiles provided by the second array of pillars for the same sample.

5 15. The system of claim 14, wherein each of the first and second regions is fluidically coupled to at least one input reservoir and at least one output port.

16. The system of any one of claims 14 to 15, wherein the pillars of each the first and second array are arranged based on equation (A):

10
$$D_c = ag \tan \theta^b \quad \text{--- (A)}$$

where D_c is the deterministic lateral displacement (DLD) cut-off size, each of a and b is a value that is independently selected from a value in the range of 0.48 to 1.4 and g represents the closest distance between the pillars.

15

17. The system of claim 16, wherein the first region comprising the first array of pillars and the second region comprising the second array of pillars each comprise a plurality of segments, each segment differing from the adjacent segment by the offsetting angle of the pillars (θ) and the corresponding DLD cut-off size (D_c).

20

18. The system of any one of claims 16 to 17, wherein D_c is in the range of 5.0 μm to 16.0 μm .

25 19. The system of any one of claims 14 to 18, wherein the first array of pillars differs from the second array of pillars in at least one of: pillar dimension, pillar shape, pillar structure, pillar arrangement or pillar orientation, with reference to the direction of flow of cells.

20. The system of any one of claims 14 to 19, wherein the system further comprises at least one detection setup for obtaining the one or more distribution profiles of the cells sorted by the first array and/or second array.