CLAIMS

What is claimed is:

1. A microfluidic device for single cell filtering, the microfluidic device comprising:

a support substrate; and

at least one filter array arranged on the support substrate and configured so as to trap a single cell in contact with the support substrate within the at least one filter array when a sample including a plurality of cells flows into the microfluidic device from a direction substantially perpendicular to a plane of the support substrate and flows out in a direction substantially parallel to the plane of the support substrate, wherein the at least one filter array comprises a plurality of spaced apart filter pillars extending from the plane of the support substrate and configured to substantially surround the single cell in contact with the support substrate, and

a cover layer positioned over the at least one filter array, the cover layer comprising a plurality of openings, wherein each of the plurality of openings has a dimension which allows the single cell to enter a receptacle formed by the plurality of spaced apart filter pillars to be trapped therein.

~~2. The microfluidic device of claim 1,~~

~~wherein the at least one filter array comprises a plurality of spaced apart filter pillars extending from the plane of the support substrate and configured to substantially surround the single cell in contact with the support substrate.~~

~~3~~2. A microfluidic device for single cell filtering and detection, the microfluidic device comprising:

a sensor array comprising at least one support substrate and a plurality of sensing electrodes arranged spaced apart on the at least one support substrate; and

a plurality of filter arrays arranged on the sensor array, each of the plurality of filter arrays arranged corresponding to each of the plurality of sensing electrodes and configured to trap a single cell in contact with each of the plurality of sensing electrodes

within each of the plurality of filter arrays when a sample including a plurality of cells flows into the microfluidic device in a direction substantially perpendicular to a plane of the at least one support substrate and flows out in a direction substantially parallel to the plane of the at least one support substrate, wherein each of the plurality of filter arrays comprises a plurality of spaced apart filter pillars extending from the plane of the at least one support substrate and configured to substantially surround the single cell in contact with each of the plurality of the sensing electrodes, and

a cover layer positioned over the plurality of filter arrays, the cover layer comprising a plurality of openings, each of the plurality of openings arranged to align with each of the plurality of sensing electrodes, wherein each of the plurality of openings includes a dimension relative to the size of the single cell being trapped within each of the plurality of filter arrays.

43. The microfluidic device of claim 32,

wherein the at least one support substrate and the plurality of filter arrays are integrated.

54. The microfluidic device of claim 32 or 43,

wherein the at least one support substrate comprises a plurality of through vias arranged spaced apart from each other.

65. The microfluidic device of claim 54,

wherein the sensor array further comprises a plurality of interconnect portions, each of the plurality of interconnect portions is arranged within each of the plurality of through vias.

76. The microfluidic device of claim 65,

wherein each of the plurality of sensing electrodes is electrically coupled to each of the plurality of interconnect portions.

87. The microfluidic device of claim 65,

wherein each of the plurality of sensing electrodes is controlled by an electronic circuitry built in the support substrate.

~~9. The microfluidic device of any one of claims 3 to 8,~~

~~wherein each of the plurality of filter arrays comprises a plurality of spaced apart filter pillars extending from the plane of the at least one support substrate and configured to substantially surround the single cell in contact with each of the plurality of the sensing electrodes.~~

~~10. The microfluidic device of claim 9, further comprising~~

~~a cover layer positioned over the plurality of filter arrays, the cover layer comprising a plurality of openings, each of the plurality of openings arranged to align with each of the plurality of sensing electrodes.~~

~~11. The microfluidic device of claim 10,~~

~~wherein each of the plurality of openings includes a dimension relative to the size of the single cell being trapped within each of the plurality of filter arrays.~~

~~12~~8. The microfluidic device of any one of claims ~~3~~2 to ~~11~~7,

wherein the at least one support substrate comprises a plurality of support substrates arranged in a stack.

~~13~~9. The microfluidic device of claim ~~12~~8, further comprising

an adhesive layer positioned between adjacent support substrates of the plurality of support substrates.

~~14~~10. The microfluidic device of claim ~~13~~9,

wherein the adjacent substrates of the plurality of support substrates are bonded together by means of the adhesive layer.

~~15~~11. The microfluidic device of any one of claims ~~3~~2 to ~~14~~10,

wherein the at least one support substrate comprises silicon, glass, or polymer.

~~16~~12. The microfluidic device of any one of claims ~~6~~ 5 to ~~15~~11,
wherein each of the plurality of interconnection portions comprises a conductive material.

~~17~~13. The microfluidic device of any one of claims ~~3~~ 2 to ~~16~~12,
wherein each of the plurality of filter arrays comprises an insulating material.

~~18~~14. A microfluidic system comprising:
a microfluidic device of any one of claims ~~3~~ 2 to ~~17~~13;
at least one pump; and
at least one valve;
wherein the at least one pump and the at least one valve is configured to allow a sample including a plurality of cells to be pumped into the microfluidic device.

CLAIMS

What is claimed is:

1. A microfluidic device for single cell filtering, the microfluidic device comprising:

a support substrate; and

at least one filter array arranged on the support substrate and configured so as to trap a single cell in contact with the support substrate within the at least one filter array when a sample including a plurality of cells flows into the microfluidic device from a direction substantially perpendicular to a plane of the support substrate and flows out in a direction substantially parallel to the plane of the support substrate, wherein the at least one filter array comprises a plurality of spaced apart filter pillars extending from the plane of the support substrate and configured to substantially surround the single cell in contact with the support substrate, and

a cover layer positioned over the at least one filter array, the cover layer comprising a plurality of openings, wherein each of the plurality of openings has a dimension which allows the single cell to enter a receptacle formed by the plurality of spaced apart filter pillars to be trapped therein.

2. A microfluidic device for single cell filtering and detection, the microfluidic device comprising:

a sensor array comprising at least one support substrate and a plurality of sensing electrodes arranged spaced apart on the at least one support substrate; and

a plurality of filter arrays arranged on the sensor array, each of the plurality of filter arrays arranged corresponding to each of the plurality of sensing electrodes and configured to trap a single cell in contact with each of the plurality of sensing electrodes within each of the plurality of filter arrays when a sample including a plurality of cells flows into the microfluidic device in a direction substantially perpendicular to a plane of the at least one support substrate and flows out in a direction substantially parallel to the plane of the at least one support substrate, wherein each of the plurality of filter arrays comprises a plurality of spaced apart filter pillars extending from the plane of the at least

one support substrate and configured to substantially surround the single cell in contact with each of the plurality of the sensing electrodes, and

a cover layer positioned over the plurality of filter arrays, the cover layer comprising a plurality of openings, each of the plurality of openings arranged to align with each of the plurality of sensing electrodes, wherein each of the plurality of openings includes a dimension relative to the size of the single cell being trapped within each of the plurality of filter arrays.

3. The microfluidic device of claim 2,

wherein the at least one support substrate and the plurality of filter arrays are integrated.

4. The microfluidic device of claim 2 or 3,

wherein the at least one support substrate comprises a plurality of through vias arranged spaced apart from each other.

5. The microfluidic device of claim 4,

wherein the sensor array further comprises a plurality of interconnect portions, each of the plurality of interconnect portions is arranged within each of the plurality of through vias.

6. The microfluidic device of claim 5,

wherein each of the plurality of sensing electrodes is electrically coupled to each of the plurality of interconnect portions.

7. The microfluidic device of claim 5,

wherein each of the plurality of sensing electrodes is controlled by an electronic circuitry built in the support substrate.

8. The microfluidic device of any one of claims 2 to 7,

wherein the at least one support substrate comprises a plurality of support substrates arranged in a stack.

9. The microfluidic device of claim 8, further comprising

an adhesive layer positioned between adjacent support substrates of the plurality of support substrates.

10. The microfluidic device of claim 9,

wherein the adjacent substrates of the plurality of support substrates are bonded together by means of the adhesive layer.

11. The microfluidic device of any one of claims 2 to 10,

wherein the at least one support substrate comprises silicon, glass, or polymer.

12. The microfluidic device of any one of claims 5 to 11,

wherein each of the plurality of interconnection portions comprises a conductive material.

13. The microfluidic device of any one of claims 2 to 12,

wherein each of the plurality of filter arrays comprises an insulating material.

14. A microfluidic system comprising:

a microfluidic device of any one of claims 2 to 13;

at least one pump; and

at least one valve;

wherein the at least one pump and the at least one valve is configured to allow a sample including a plurality of cells to be pumped into the microfluidic device.