CLAIMS

1. A bacterial detection system, comprising:

a microfluidic device including:

a microfluidic passage having an inlet and an outlet; and

a plurality of electrodes disposed adjacent to the microfluidic passage, wherein:

each of the plurality of electrodes comprises a plurality of concentric arcs;

the plurality of electrodes are arranged in a two-dimensional array having a first dimension along a width of the microfluidic passage and a second dimension along a length of the microfluidic passage, wherein at least two electrodes of the plurality of electrodes are arranged along the width of the microfluidic passage and at least two electrodes of the plurality of electrodes are arranged along the length of the microfluidic passage; and

the plurality of electrodes, when activated, are configured to capture, using dielectrophoresis, bacteria in a sample flowing through the microfluidic passage at a predetermined flow rate, wherein a capture efficiency of bacteria by the plurality of electrodes is at least 99%;

a first pump coupled to the microfluidic passage, wherein the first pump is configured to pump the sample through the microfluidic passage at the predetermined flow rate;

an optical system configured to capture one or more images of the plurality of electrodes during capture of the bacteria; and

at least one computing device configured to process the one or more images to quantify an amount of bacteria captured by the plurality of electrodes.

2. The bacterial detection system of claim 1, wherein the first pump is coupled to the outlet of the microfluidic passage.

3. The bacterial detection system of claim 1, wherein the first pump is coupled to the inlet of the microfluidic passage.

4. The bacterial detection system of claim 3, further comprising:

a second pump coupled to the outlet of the microfluidic passage, wherein the second pump is configured to pump the sample out of the microfluidic passage.

5. The bacterial detection system of claim 1, further comprising:

a signal generator configured to activate the plurality of electrodes by applying an alternating current (AC) voltage thereto to generate an electric field.

6. The bacterial detection system of claim 5, wherein the signal generator is configured to apply a same AC voltage to each of the electrodes of the plurality of electrodes.

7. The bacterial detection system of claim 5, wherein the signal generator is configured to apply a first AC voltage to a first electrode of the plurality of electrodes and a second AC voltage to a second electrode of the plurality of electrodes, the first AC voltage and the second AC voltage being different.

8. The bacterial detection system of claim 7, wherein the first AC voltage and the second AC voltage have a different amplitude and/or frequency.

9. The bacterial detection system of claim 8, wherein the first AC voltage and the second AC voltage have a different frequency.

10. The bacterial detection system of claim 1, wherein the microfluidic passage comprises a microfluidic channel.

11. The bacterial detection system of claim 1, wherein the microfluidic device comprises a microfluidic chip having a plurality of microfluidic passages configured to process a plurality of samples in parallel.

12. The bacterial detection system of claim 1, further comprising a controller, wherein the controller is configured to control the first pump to pump the sample through the microfluidic passage at the predetermined flow rate, wherein the predetermined flow rate is between 480-960

ul/min, and wherein the capture efficiency of bacteria is at least 99% when the predetermined flow rate is between 480-960 ul/min.

13. The bacterial detection system of claim 12, further comprising a controller, wherein the controller is configured to control the first pump to pump the sample through the microfluidic passage at the predetermined flow rate, wherein the predetermined flow rate is between 720-960 ul/min, and wherein the capture efficiency of bacteria is at least 99% when the predetermined flow rate is between 720-960 ul/min.

14. The bacterial detection system of claim 13, further comprising a controller, wherein the controller is configured to control the first pump to pump the sample through the microfluidic passage at the predetermined flow rate, wherein the predetermined flow rate is between 840-960 ul/min, and wherein the capture efficiency of bacteria is at least 99% when the predetermined flow rate is between 840-960 ul/min.

15. The bacterial detection system of claim 1, further comprising a controller, wherein the controller is configured to control the first pump to pump the sample through the microfluidic passage at the predetermined flow rate, wherein the predetermined flow rate is between 240-480 ul/min, and wherein the capture efficiency of bacteria is at least 99.9 % when the predetermined flow rate is between 240-480 ul/min.

16. The bacterial detection system of claim 1, further comprising a controller, wherein the controller is configured to control the first pump to pump the sample through the microfluidic passage at the predetermined flow rate, wherein the predetermined flow rate is at least 240 ul/min, and wherein the capture efficiency of bacteria is at least 99.99% when the predetermined flow rate is at least 240 ul/min.

17. The bacterial detection system of claim 1, wherein the first pump is disposed outside of a flow path of the sample.

18. The bacterial detection system of claim 1, wherein the plurality of concentric arcs are spaced equally from each other.

19. The bacterial detection system of claim 1, wherein at least two electrodes of the plurality of electrodes are arranged in a third dimension along a height of the microfluidic passage.