What is claimed is:

1. A method comprising:

providing an ion channel extending along a first direction from a first end to a second end;

providing ions at the first end of the ion channel; and

applying, by a controller, a first voltage signal to a first plurality of electrodes adjacent to the ion channel,

generating, by the first plurality of electrodes, a first traveling drive potential that travels along the first direction during a separation time, the generating based on receipt of the first voltage signal; and

wherein one or more of a travel speed and an amplitude of the first traveling drive potential varies during a first time segment of the separation time.

2. The method of claim 1, wherein the ion channel is defined between a first surface and a second surface adjacent to the first surface, wherein the second surface comprising:

a second plurality of electrodes which includes a first electrode and a second electrode spaced apart from the first electrode along a second direction lateral to the first direction, wherein the first plurality of electrodes are located between the first electrode and the second electrode and arranged along the first direction.

3. The method of claim 2, wherein the travel speed of the first traveling drive potential decreases during the first time segment.

4. The method of claim 3, wherein the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed smaller than the first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

5. The method of claim 3, wherein the travel speed decreases monotonically as a function of separation time.

6. The method of claim 5, wherein the increase in travel speed is one of linear, quadratic and exponential.

7. The method of claim 2, wherein the travel speed of the first traveling drive potential increases during the first time segment.

8. The method of claim 7, wherein the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed larger than the first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

9. The method of claim 7, wherein the travel speed increases monotonically as a function of separation time.

10. The method of claim 9, wherein the increase in travel speed is one of linear, quadratic and exponential.

11. The method of claim 2, wherein the separation time includes a second time segment preceding the first time segment, the travel speed of the first drive potential remains fixed during the second time segment.

12. The method of claim 2, wherein the controller includes a plurality of traveling wave control circuits electrically coupled to the first plurality of electrodes, the plurality of traveling wave control circuits configured to generate a plurality of traveling wave voltage signals, the first voltage signal includes the plurality of traveling wave voltage signals.

13. The method of claim 12, wherein the controller includes a master control circuit communicatively coupled to the plurality of traveling wave control circuits, the method further comprising:

determining, by the master control circuit, one or more of amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and phase differences between one or more traveling wave voltage signals of the plurality of traveling wave voltage signals; and

providing, by the master control circuit, one or more traveling wave control signals to the plurality of traveling wave control circuits, wherein the one or more traveling wave control signals are indicative of one or more of the amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and the phase differences between the one or more traveling wave voltage signals of the plurality of traveling wave voltage signals.

14. The method of claim 12, further comprising determining, by the master control circuit, variation of the travel speed of the first traveling drive potential during a first time segment of the separation time.

15. The method of claim 14, further comprising:

detecting an ion packet of the provided ions exiting the ion channel at the second end; and

setting a beginning time of the first time segment based on the detection of the ion packet.

16. The method of claim 3, wherein lengths of a portion of the first plurality of electrodes decrease along the first direction.

17. The method of claim 9, wherein lengths of a portion of the first plurality of electrodes increase along the first direction.

18. A system comprising:

an ion channel extending along a first direction from a first end to a second end, the ion channel configured to receive ions at the first end of the ion channel; and

a controller configured to apply a first voltage signal to a first plurality of electrodes adjacent to the ion channel,

wherein the first plurality of electrodes are configured to generate, based on receipt of the first voltage signal, a first traveling drive potential that travels along the first direction during a separation time, and

wherein one or more of a travel speed and an amplitude of the first traveling drive potential varies during a first time segment of the separation time.

19. The system of claim 18, wherein the ion channel is defined between a first surface and a second surface adjacent to the first surface, wherein the second surface comprising:

a second plurality of electrodes comprising a first electrode and a second electrode spaced apart from the first electrode along a second direction lateral to the first direction, wherein the first plurality of electrodes are located between the first electrode and the second electrode and arranged along the first direction.

20. The system of claim 19, wherein the travel speed of the first traveling drive potential decreases during the first time segment.

21. The system of claim 20, wherein the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed smaller than the

first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

22. The system of claim 20, wherein the travel speed decreases monotonically as a function of separation time.

23. The system of claim 22, wherein the increase in travel speed is one of linear, quadratic and exponential.

24. The system of claim 19, wherein the travel speed of the first traveling drive potential increases during the first time segment.

25. The system of claim 24, wherein the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed larger than the first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

26. The system of claim 24, wherein the travel speed increases monotonically as a function of separation time.

27. The system of claim 26, wherein the increase in travel speed is one of linear, quadratic and exponential.

28. The system of claim 19, wherein the separation time includes a second time segment preceding the first time segment, the travel speed of the first drive potential remains fixed during the second time segment.

29. The system of claim 19, wherein the controller includes a plurality of traveling wave control circuits electrically coupled to the first plurality of electrodes, the plurality of traveling wave control circuits configured to generate a plurality of traveling wave voltage signals, the first voltage signal includes the plurality of traveling wave voltage signals.

30. The system of claim 29, wherein the controller includes a master control circuit communicatively coupled to the plurality of traveling wave control circuits, the master control circuit configured to:

determine one or more of amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and phase differences between one or more traveling wave voltage

signals of the plurality of traveling wave voltage signals; and

provide one or more traveling wave control signals to the plurality of traveling wave control circuits, wherein the one or more traveling wave control signals are indicative of one or more of the amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and the phase differences between the one or more traveling wave voltage signals of the plurality of traveling wave voltage signals.

31. The system of claim 30, wherein the master control circuit is further configured to determine variation of the travel speed of the first traveling drive potential during a first time segment of the separation time.

32. The system of claim 31, further comprising a detector configured to detect an ion packet of the received ions exiting the ion channel at the second end, wherein the controller is configured to set a beginning time of the first time segment based on the detection of the ion packet.

33. The system of claim 20, wherein lengths of a portion of the first plurality of electrodes decreases along the first direction.

34. The system of claim 26, wherein lengths of a portion of the first plurality of electrodes increases along the first direction.

CLAIMS

1. A method comprising:

providing an ion channel extending along a first direction from a first end to a second end;

providing ions at the first end of the ion channel;

applying, by a controller, a first voltage signal to a first plurality of electrodes adjacent to the ion channel,

generating, by the first plurality of electrodes, a first traveling drive potential that travels along the first direction during a separation time, the generating based on receipt of the first voltage signal; and

in which one or more of a travel speed and an amplitude of the first traveling drive potential varies during a first time segment of the separation time;

in which the ion channel is defined between a first surface and a second surface adjacent to the first surface, in which the second surface comprising:

a second plurality of electrodes which includes a first electrode and a second electrode spaced apart from the first electrode along a second direction lateral to the first direction, in which the first plurality of electrodes are located between the first electrode and the second electrode and arranged along the first direction;

in which the controller includes a plurality of traveling wave control circuits electrically coupled to the first plurality of electrodes, the plurality of traveling wave control circuits configured to generate a plurality of traveling wave voltage signals, the first voltage signal includes the plurality of traveling wave voltage signals;

in which the controller includes a master control circuit communicatively coupled to the plurality of traveling wave control circuits; and

determining, by the master control circuit, one or more of amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and phase differences between one or more traveling wave voltage signals of the plurality of traveling wave voltage signals; and

providing, by the master control circuit, one or more traveling wave control signals to the plurality of traveling wave control circuits, in which the one or more traveling wave

control signals are indicative of one or more of the amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and the phase differences between the one or more traveling wave voltage signals of the plurality of traveling wave voltage signals.

2. A method according to Claim 1, in which the travel speed of the first traveling drive potential decreases during the first time segment.

3. A method according to Claim 2, in which the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed smaller than the first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

4. A method according to Claim 2, in which the travel speed decreases monotonically as a function of separation time.

5. A method according to Claim 4, in which the increase in travel speed is one of linear, quadratic and exponential.

6. A method according to Claim 1, in which the travel speed of the first traveling drive potential increases during the first time segment.

7. A method according to Claim 6, in which the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed larger than the first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

8. A method according to Claim 6, in which the travel speed increases monotonically as a function of separation time.

9. A method according to Claim 8, in which the increase in travel speed is one of linear, quadratic and exponential.

10. A method according to Claim 1, in which the separation time includes a second time segment preceding the first time segment, the travel speed of the first drive potential remains fixed during the second time segment.

11. A method according to Claim 1, further comprising determining, by the master control circuit, variation of the travel speed of the first traveling drive potential during a first time segment of the separation time.

12. A method according to Claim 11, further comprising:

detecting an ion packet of the provided ions exiting the ion channel at the second end; and

setting a beginning time of the first time segment based on the detection of the ion packet.

13. A method according to Claim 2, in which lengths of a portion of the first plurality of electrodes decrease along the first direction.

14. A method according to Claim 8, in which lengths of a portion of the first plurality of electrodes increase along the first direction.

15. A system comprising:

an ion channel extending along a first direction from a first end to a second end, the ion channel configured to receive ions at the first end of the ion channel; and

a controller configured to apply a first voltage signal to a first plurality of electrodes adjacent to the ion channel,

in which the first plurality of electrodes are configured to generate, based on receipt of the first voltage signal, a first traveling drive potential that travels along the first direction during a separation time, and

in which one or more of a travel speed and an amplitude of the first traveling drive potential varies during a first time segment of the separation time;

in which the ion channel is defined between a first surface and a second surface adjacent to the first surface, in which the second surface includes a second plurality of electrodes including a first electrode and a second electrode spaced apart from the first electrode along a second direction lateral to the first direction,

in which the first plurality of electrodes are located between the first electrode and the second electrode and arranged along the first direction;

in which the controller includes a plurality of traveling wave control circuits electrically coupled to the first plurality of electrodes, the plurality of traveling wave control circuits configured to generate a plurality of traveling wave voltage signals, the first voltage signal includes the plurality of traveling wave voltage signals; and

in which the controller includes a master control circuit communicatively coupled to the plurality of traveling wave control circuits, the master control circuit configured to:

determine one or more of amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and phase differences between one or more traveling wave voltage signals of the plurality of traveling wave voltage signals; and

provide one or more traveling wave control signals to the plurality of traveling wave control circuits, in which the one or more traveling wave control signals are indicative of one or more of the amplitudes and/or frequencies of the plurality of traveling wave voltage signals, and the phase differences between the one or more traveling wave voltage signals of the plurality of traveling wave voltage signals.

16. A system according to Claim 15, in which the travel speed of the first traveling drive potential decreases during the first time segment.

17. A system according to Claim 16, in which the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed smaller than the first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

18. A system according to Claim 16, in which the travel speed decreases monotonically as a function of separation time.

19. A system according to Claim 18, in which the increase in travel speed is one of linear, quadratic and exponential.

20. A system according to Claim 15, in which the travel speed of the first traveling drive potential increases during the first time segment.

21. A system according to Claim 20, in which the first traveling drive potential has a first speed during a first time sub-segment of the first time segment and a second speed larger than the first speed during a second time sub-segment of the first time segment, the second time sub-segment occurs after the first time sub-segment.

22. A system according to Claim 20, in which the travel speed increases monotonically as a function of separation time.

23. A system according to Claim 22, in which the increase in travel speed is one of linear, quadratic and exponential.

24. A system according to Claim 15, in which the separation time includes a second time segment preceding the first time segment, the travel speed of the first drive potential remains fixed during the second time segment.

25. A system according to Claim 15, in which the master control circuit is further configured to determine variation of the travel speed of the first traveling drive potential during a first time segment of the separation time.

26. A system according to Claim 25, further comprising a detector configured to detect an ion packet of the received ions exiting the ion channel at the second end, in which the controller is configured to set a beginning time of the first time segment based on the detection of the ion packet.

27. A system according to Claim 16, in which lengths of a portion of the first plurality of electrodes decreases along the first direction.

28. A system according to Claim 22, in which lengths of a portion of the first plurality of electrodes increases along the first direction.