The flow chamber can further comprise a transparent window for viewing the interior of the flow chamber.

In particular embodiments, the device has a length L from the at least one device inlet to a bottom of the longitudinal sidewall, and a ratio of the length L to the first diameter is less than 1.

Also disclosed herein are acoustophoresis devices for retaining or trapping particles from a particle/host fluid mixture. The particles may be cells. In some embodiments, an acoustophoresis device comprises: a chamber; at least one ultrasonic transducer coupled to the chamber, the at least one ultrasonic transducer including a piezoelectric material configured to be excited to generate a multi-dimensional acoustic standing wave in the chamber; and a reflector coupled to the chamber opposite from the at least one ultrasonic transducer; wherein the particles are continuously trapped in the multi-dimensional acoustic standing wave, agglomerate, aggregate, clump, or coalesce, and settle out of the host fluid due to enhanced gravity forces, and exit the flow chamber; and wherein the multi-dimensional standing wave results in an acoustic radiation force having an axial force component and a lateral force component that are of the same order of magnitude.

Acoustophoretic systems are also disclosed. In a first aspect, the present disclosure provides an acoustophoresis system, comprising a chamber for receiving a fluid mixture that includes cells or particles in a fluid; an ultrasonic transducer coupled to the chamber and configured to be excited to generate an acoustic wave in the chamber; a driver electrically connected to the ultrasonic transducer and configured to provide an excitation to the ultrasonic transducer to generate the acoustic wave in the chamber, the driver including an amplifier; and a controller for controlling the amplifier based on impedance measurements from the ultrasonic transducer.

In a second aspect, the present disclosure provides a method for controlling an acoustophoretic device that uses an ultrasonic transducer to create a multi-dimensional acoustic standing wave, the method comprising: driving an amplifier electrically connected to the ultrasonic transducer to send an output signal to the ultrasonic transducer; receiving at a controller a feedback signal from the ultrasonic transducer; and adjusting the output signal from the amplifier with the controller to obtain a desired impedance of the ultrasonic transducer.

In a third aspect, the present disclosure provides a system for controlling an ultrasonic transducer, comprising: an amplifier that produces an output signal to the ultrasonic transducer; a controller electrically connected to the amplifier for controlling the amplifier; the controller being electrically connected to the ultrasonic transducer for receiving a feedback signal from the ultrasonic transducer; and a processor in the controller configured to determine reactance of the ultrasonic transducer based on the feedback signal and to control the amplifier to drive the ultrasonic transducer to operate at a desired reactance.

In certain embodiments, the at least one ultrasonic transducer can comprise a plurality of transducers, and each of the plurality of transducers can be individually electrically connected to its own amplifier.

In certain embodiments of the acoustophoretic system, a function generator can be provided that drives the amplifier by generating a signal (e.g., a low voltage sinusoidal voltage signal) that is sent to the amplifier. A power resistor and/or a capacitor can be electrically connected between the amplifier and the at least one ultrasonic transducer. An oscilloscope can be provided for measuring a first voltage before the power resistor and a second voltage after the power resistor. Further yet,

CLAIMS:

1. An acoustophoresis system, comprising:

a chamber for receiving a fluid mixture that includes cells or particles in a fluid;

an ultrasonic transducer coupled to the chamber and configured to be excited to generate an acoustic wave in the chamber;

a driver electrically connected to the ultrasonic transducer and configured to provide an excitation to the ultrasonic transducer to generate the acoustic wave in the chamber, the driver including an amplifier; and

a controller for controlling the amplifier based on impedance measurements from the ultrasonic transducer.

2. The system of claim 1, wherein at least one ultrasonic transducer comprises a plurality of transducers, each of the plurality of transducers individually electrically connected to its own amplifier.

3. The system of claim 1, wherein the amplifier further comprises an inverter.

4. The system of claim 1, further comprising a capacitor electrically connected between the amplifier and the at least one ultrasonic transducer.

5. The system of claim 1, further comprising a filter electrically connected between the amplifier and the at least one ultrasonic transducer.

6. The system of claim 3, wherein the amplifier further comprises a DC-DC converter coupled to an input of the inverter.

7. The system of claim 6, further comprising a filter between the DC-DC converter and the inverter.

8. A method for controlling an acoustophoretic device that uses an ultrasonic transducer to create a multi-dimensional acoustic standing wave, the method comprising:

driving an amplifier electrically connected to the ultrasonic transducer to send an output signal to the ultrasonic transducer;

receiving at a controller a feedback signal from the ultrasonic transducer; and

adjusting the output signal from the amplifier with the controller to obtain a desired impedance of the ultrasonic transducer.

9. The method of claim 8, further comprising using the controller to determine one or more of power, phase angle, resistance or reactance of the ultrasonic transducer based on the feedback signal.

10. The method of claim 8, further comprising controlling a DC-DC converter and an inverter in the amplifier to send the output signal to the ultrasonic transducer.

11. The method of claim 8, further comprising filtering the output signal of the amplifier sent to the ultrasonic transducer with a filter that includes a capacitor and an inductor.

12. The method of claim 10, further comprising filtering an output of the DC-DC converter with a filter that includes a capacitor and an inductor.

13. The method of claim 10, further comprising controlling the DC-DC converter for a power output and controlling the inverter for a frequency output.

14. The method of claim 8, further comprising converting the output signal to a current source.

15. The method of claim 8, further comprising controlling the output signal to obtain a desired reactance of the ultrasonic transducer.

16. The method of claim 8, further comprising sampling the feedback signal with the controller at a rate of at least 1 MHz.

17. The method of claim 16, further comprising implementing the controller with a digital signal processor or a field programmable gate array.

18. A system for controlling an ultrasonic transducer, comprising:

an amplifier that produces an output signal to the ultrasonic transducer;

a controller electrically connected to the amplifier for controlling the amplifier;

the controller being electrically connected to the ultrasonic transducer for receiving a feedback signal from the ultrasonic transducer; and

a processor in the controller configured to determine reactance of the ultrasonic transducer based on the feedback signal and to control the amplifier to drive the ultrasonic transducer to operate at a desired reactance.

19. The system of claim 18, further comprising a DC-DC converter coupled to an inverter in the amplifier.

20. The system of claim 19, further comprising a filter between the DC-DC converter and the inverter, and another filter between the inverter and the ultrasonic transducer.