Claims:

1. An apparatus that hydrodynamically and acoustically focuses particles in a particle stream comprising:

a flow chamber;

an outer confine of said flow chamber for flowing a hydrodynamic fluid therethrough;

a central core of said flow chamber for flowing the particle sample stream therethrough; and

at least one transducer coupled to said chamber producing acoustic radiation pressure, wherein the particle stream is acoustically focused and subsequently hydrodynamically focused.

2. The apparatus of claim 1, wherein said transducer is coupled to an outer wall of said flow chamber.

3. The apparatus of claim 1, wherein said transducer forms a wall of said flow chamber.

4. The apparatus of any one of claims 1 to 3, wherein said particles are focused into a quasi-planar arrangement.

5. The apparatus of any one of claims 1 to 4, wherein said flow chamber has a cross-sectional geometry having a shape selected from the group consisting of a rectangle, square, ellipse, oblate circular, round, octagon, heptagon, hexagon, pentagon, and triagon.

6. The apparatus of claim 1, wherein the transducer has a groove and is coupled to the flow chamber at the groove.

7. The apparatus of any one of claims 1 to 6, wherein said at least one transducer comprises a piezoelectric material.

~~8. The apparatus of any one of claims 1 to 7, wherein the particle stream is hydrodynamically focused and subsequently acoustically focused.~~

~~9. The apparatus of claim 8, wherein the particle stream is subsequently acoustically focused to a more narrowly focused stream of particles.~~

~~10~~8. The apparatus of any one of claims 1 to ~~9~~7, further comprising a first transducer and a second transducer.

~~11~~9. The apparatus of claim ~~10~~8, wherein the second transducer is configured to provide feedback to monitor the acoustic field within the flow chamber.

~~12~~10. The apparatus of claim ~~10~~8 or ~~11~~9, wherein the first transducer and the second transducer are each attached to the flow chamber orthogonally to one another.

~~13~~11. The apparatus of any one of claims 1 to ~~12~~10, wherein the at least one transducer produces an acoustic standing wave within the flow chamber.

~~14~~12. A method of hydrodynamically and acoustically focusing particles, comprising:

providing a fluid comprising particles therein;

flowing a sheath fluid into outer confines of a flow chamber;

flowing the fluid containing the particles into a central core of the flow chamber; and

applying acoustic radiation pressure to the fluid comprising the particles.

~~15~~13. The method of claim ~~14~~12, wherein the application of acoustic radiation pressure is configured to flow the sheath fluid at a decreased rate.

~~16~~14. The method of claim ~~14~~12, wherein the application of acoustic radiation pressure is configured to focus particles at lower concentrations.

~~17~~15. A method of hydrodynamically and acoustically focusing a particle stream comprising:

flowing a sheath fluid into outer confines of a capillary;

flowing a particle stream into a central core of the capillary; and

applying acoustic radiation pressure to the particle stream within the sheath fluid.

~~18~~16. A method of hydrodynamically and acoustically focusing particles in a fluid comprising:

flowing a fluid comprising particles therein;

subjecting the fluid to acoustic radiation pressure in one planar direction to acoustically focus the particles; and

flowing a sheath fluid in a second planar direction thereby hydrodynamically focusing the fluid in the second planar direction to further focus the particles.

~~19~~17. A method of hydrodynamically and acoustically focusing particles comprising:

providing a fluid comprising particles therein;

subjecting the fluid to acoustic radiation pressure;

rotating the fluid 90 degrees; and

subjecting the fluid to acoustic radiation pressure a second time to align the particles.

~~20~~18. The method of claim ~~19~~17, further comprising analyzing the particles.

~~21~~19. The apparatus of claim ~~19~~17 or ~~20~~18, wherein the particle stream is hydrodynamically focused and subsequently acoustically focused.