

CLAIMS

What is claimed is:

1. A method for processing fluids, comprising:
 - 5 providing at least one fluid container having a fluid chamber containing a fluid and a plurality of magnetic particles;
 - disposing the at least one fluid container onto a magnetic assembly, the magnetic assembly including a plurality of electromagnets located about the periphery of the fluid chamber, each of the plurality of electromagnets
 - 10 having:
 - (i) an electrically-conductive coil located about a centerline that extends in a z-direction, and
 - (ii) a magnetic lens configured and arranged to direct a magnetic field generated by the conductive coil towards the
 - 15 fluid chamber,
 - wherein at least one of the magnetic lens or the fluid chamber is movable in the z-direction;
 - providing an electrical signal to each of the plurality of electromagnets
 - 20 so as to generate a magnetic field within the fluid chamber, wherein the magnetic field is configured to influence the plurality of magnetic particles; and
 - adjusting the electrical signal to modify the magnetic field within the fluid chamber while moving the at least one of the magnetic lens or the fluid chamber in the z-direction to further modify the magnetic field within the fluid
 - 25 chamber.
2. The method of claim 1, wherein the at least one fluid container comprises a plurality of fluidically-isolated fluid chambers, wherein at least one of the plurality of electromagnets is configured to generate the magnetic field within
- 30 two or more of the plurality of fluid chambers.
3. The method of claim 1, wherein the at least one fluid container comprises a plurality of sample wells arranged within a sample plate.
- 35 4. The method of claim 3, wherein the magnetic assembly is configured to simultaneously influence the magnetic particles arranged within the plurality of sample wells.

5. The method of claim 3, wherein the sample plate comprises a bottom surface configured to removably engage at least a portion of the magnetic assembly.
- 5 6. The method of claim 1, wherein adjusting the electrical signal to modify the magnetic field within the fluid chamber comprises applying at least one electro-frequency waveform to each of the plurality of electromagnets.
- 10 7. The method of claim 6, wherein the at least one electro-frequency waveform applied to each of the plurality of electromagnets has a phase delay.
8. The method of claim 1, wherein the fluid chamber is configured to hold a maximum volume in a range of about 1 μ L to about 15 mL.
- 15 9. The method of claim 1, wherein the plurality of electromagnets are arranged around the at least one fluid chamber at a plurality of vertical positions.
10. The method of claim 1, wherein the magnetic lens is moved while adjusting the electrical signal to the coils.
- 20 11. The method of any one of claims 1-10, further comprising adding fluid to, mixing fluid in, removing fluid from, or heating fluid in, the fluid chamber.
12. The method of any one of claims 1-11, further comprising removing the magnetic particles from the fluid.
- 25 13. A fluid processing system, comprising:
 at least one fluid container defining a fluid chamber therein for containing a fluid and a plurality of magnetic particles;
30 a magnetic assembly including a plurality of electromagnets disposed about the periphery of the at least one fluid chamber, each of the plurality of electromagnets having:
 (i) an electrically-conductive coil located about a centerline that extends in a z-direction, and
35 (ii) a magnetic lens configured and arranged to direct a magnetic field generated by the conductive coil towards the fluid chamber,

wherein at least one of the magnetic lens or the fluid chamber is movable in the z-direction; and

a control component coupled to the magnetic assembly, the control component configured to:

- (i) control the magnetic field generated by each of the plurality of electromagnets to generate a plurality of magnetic field gradients within the fluid chamber sufficient to magnetically influence the plurality of magnetic particles within the fluid chamber, and
- (ii) control the movement of the at least one of the magnetic lens or the fluid chamber in the z-direction while generating the plurality of magnetic field gradients within the fluid chamber.

14. The system of claim 13, wherein the control component is configured to move the magnetic lens relative to the electrically-conductive coil.

15. The system of claim 13 or 14, wherein the magnetic particles are paramagnetic or ferrimagnetic.

16. The system of any one of claims 13-15, further comprising a permanent magnet to generate a magnetic field within the at least one fluid chamber to draw the magnetic particles to an inside surface of the fluid chamber.

17. The system of claim 16, further comprising at least one mechanical means to move the magnetic assembly to a position adjacent to the fluid chamber.

18. The system of claim 16 or 17, wherein the magnetic assembly has at least one of the plurality of electromagnets having a magnetic axis oriented in the z-direction.

19. The system of any of claims 13 to 18, wherein the control component is configured to control the magnetic field generated by each of the plurality of electromagnets via applying at least one electro frequency waveform to each of the plurality of electromagnets.

20. The system of claim 19, wherein the electro frequency waveform comprises an alternating waveform and a constant waveform.