

CLAIMS:

1. A hydrocyclone for isolating particles within a fluid, the hydrocyclone comprising:
 - 5 an upper conical section defining at least one inlet to receive the fluid, a vortex finder extending into the upper conical section, and an overflow port fluidly connected to the vortex finder and configured to expel a portion of the fluid out of the upper conical section; and
 - a lower conical section defining an underflow port to expel the remaining
 - 10 fluid out of the lower conical section, the lower conical section being fluidly connected to the upper conical section to define a single hollow volume;
 - wherein the walls of the lower conical section are concave; and
 - wherein the shape of the hydrocyclone causes particles smaller than a predetermined size to be isolated by expelling the particles from the overflow port.
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2. The hydrocyclone of claim 1, wherein the predetermined size is less than 5 μ m.
3. The hydrocyclone of claim 2, wherein the predetermined size is less than 1 μ m.
- 20 4. The hydrocyclone of any one of claims 1 to 3, wherein the shape of the hydrocyclone causes particles larger than the predetermined size to be expelled from the underflow port.
5. The hydrocyclone of any one of claims 1 to 4, wherein the diameter of the
- 25 hydrocyclone is between 0.5mm and 5mm.
6. The hydrocyclone of any one of claims 1 to 5, wherein the upper conical section defines two counter-disposed inlets to receive the fluid.
- 30 7. The hydrocyclone of any one of claims 1 to 6, where the diameter of the at least one inlet is between 0.25 and 0.71mm.
8. The hydrocyclone of any one of claims 1 to 7, where the diameter of the
- 35 overflow port is between 0.075 and 0.75mm.

9. The hydrocyclone of any one of claims 1 to 8, where the length of the vortex finder is between 0.5 and 1.67mm.
10. The hydrocyclone of any one of claims 1 to 9, where the length of the upper conical section is between 1.0 and 3.6mm.
11. The hydrocyclone of any one of claims 1 to 10, where the diameter of the underflow port is between 0.05 and 1.5mm.
12. The hydrocyclone of any one of claims 1 to 11, where the length of the lower conical section is between 2 and 98.6mm.
13. The hydrocyclone of any one of claims 1 to 12, wherein the cone shape of the lower conical section is between 0.6 and 1.
14. The hydrocyclone of any one of claims 1 to 13, wherein a roughness of the inside of the hydrocyclone is between 3 and 10 μ m.
15. The hydrocyclone of any one of claims 1 to 14, wherein the at least one inlet is circular in shape.
16. The hydrocyclone of any one of claims 1 to 14, wherein the at least one inlet is trapezoidal in shape.
17. The hydrocyclone of any one of claims 1 to 16, wherein the hydrocyclone is manufactured by 3D printing.
18. The hydrocyclone of any one of claims 1 to 17, wherein the fluid comprises a biological fluid or a fraction thereof or contains biological material.
19. The hydrocyclone of any one of claims 1 to 18, wherein the particles comprise at least one of a nanoparticle, a liposome, a cell, a secreted extracellular vesicle, virus particle, viral vector, virus-like particle, protein aggregate, nucleic acid aggregate, or any combination thereof.

20. The hydrocyclone of claim 19, wherein the secreted extracellular vesicle is an exosome.
21. A system for isolating particles within a fluid, the system comprising:
5 a feed tank for holding a fluid;
the hydrocyclone of any one of claims 1 to 20; and
a pump for receiving the fluid from the feed tank and pumping the fluid into the hydrocyclone.
- 10 22. The system of claim 21, wherein the system further comprises a recycling tube for channelling fluid from the underflow port of the hydrocyclone into the feed tank.
23. The system of claim 21 or claim 22, wherein the pump is configured to pump the fluid into the hydrocyclone at a velocity between 9.6 and 16.25 m/s.
- 15 24. A method for isolating particles within a fluid, the method comprising:
pumping fluid into the at least one inlet of the hydrocyclone of any one of claims 1 to 20; and
collecting the isolated particles from the overflow port of the hydrocyclone.
- 20 25. The method of claim 24, wherein pumping fluid into the at least one inlet of the hydrocyclone comprises pumping fluid into the at least one inlet of the hydrocyclone at a velocity between 9.6 and 16.25 m/s.
- 25 26. The method of claim 24 or claim 25, further comprising collecting fluid from the underflow port of the hydrocyclone, and subsequently re-pumping the collected fluid into at least one inlet of the hydrocyclone or into the feed tank.