# CLAIMS

What is claimed is:

~~1. A method of detecting one or more diseased blood cells in a blood sample, comprising introducing the blood sample into at least one inlet of a microfluidic device comprising one or more linear channels wherein each linear channel has a length and a cross-section of a height and a width defining an aspect ratio adapted to isolate diseased blood cells along at least one portion of the cross-section of the channel based on reduced deformability of diseased blood cells as compared to non-diseased blood cells, wherein diseased blood cells flow along a first portion of the channel to a first outlet and non-diseased blood cells flow along a second portion of the channel to a second outlet.~~

~~2. The method of Claim 1, wherein the diseased cells are of a different size, stiffness, deformability, adhesiveness, or a combination thereof than the non-diseased cells.~~

~~3. The method of Claim 1, wherein the blood sample is whole blood.~~

~~4. The method of Claim 1, wherein the diseased cells are ring stage, or trophozoite stage or schizont stage malaria-infected red blood cells.~~

~~5. The method of Claim 4, wherein the diseased cells are ring stage malaria-infected red blood cells.~~

~~6. The method of Claim 5, wherein the blood sample is introduced at a flow rate of about 5 µL/min.~~

~~7. The method of Claim 6, wherein the ring stage malaria-infected red blood cells are separated with an efficiency in a range between about 75% and about 85%, and the trophozoite stage malaria-infected red blood cells are separated with an efficiency of about 90%.~~

~~8. The method of Claim 2, wherein the one or more diseased cells are malaria-infected red blood cells, sickle cell anemia red blood cells, leukemic red blood cells or a combination thereof.~~

~~9. The method of Claim 1, further including collecting diseased cells from the first outlet.~~

~~10. The method of Claim 1, wherein the aspect ratio of the channel is in a range of between about 1 and about 2.~~

~~11. The method of Claim 1, wherein the microfluidic device further includes an expansion region.~~

~~12. The method of Claim 1, wherein the width of the second outlet is in a range of between about 2 and about 10 times wider than the width of the first outlet.~~

~~13. The method of Claim 12, wherein the width of the channel is about 15 μm.~~

~~14. The method of Claim 12, wherein the height of the channel is about 10 μm.~~

~~15~~1. A method ~~of detecting isolating one or more circulating tumor cells in a sample of an individual,~~ comprising:

introducing ~~the~~a blood sample, blood constituents, a maternal blood sample that includes fetal cells or a sample comprising asynchronous cell suspension into at least one inlet of a microfluidic device comprising one or more spiral channels, wherein each channel has a length and a cross-section of a height and a width defining an aspect ratio, the sample flowing along the one or more spiral channels in the direction of a Dean vortex,

introducing a sheath fluid into the microfluidic device, and

detecting and isolating one or more circulating tumor cells from blood sample, blood constituents or the maternal blood sample that includes fetal cells or isolating one or more synchronized cells from a mixture of asynchronous cells~~adapted to isolate circulating tumor cells~~ along portions of the cross-section of the channel based on cell size due to the completion of a Dean cycle,

wherein the introducing comprises introducing the sample into the microfluidic device via a radially innermost inlet and introducing the sheath fluid into the microfluidic device via a radially outermost inlet to confine the sample to a radially innermost portion of the channel at the inlet,

wherein the isolating comprises circulating tumor cells flowing along the radially innermost portion of the channel to a first outlet and other blood cells in the sample flowing along a radially outermost ~~another~~ portion of the channel to a second outlet, or larger synchronized cells flowing along the radially innermost portion of the channel to a first outlet and smaller synchronized cells flowing along other portions of the channel to at least one other outlet.

~~16~~2. The method of Claim 1~~5~~, further ~~including~~comprising collecting circulating tumor cells or synchronized cells from the first outlet.

~~17~~3. The method of Claim 1~~6~~ or Claim 2, further ~~including~~comprising analyzing the circulating tumor cells.

~~18~~4. The method of Claim ~~17~~3, wherein analyzing the circulating tumor cells includes assessing effectiveness of a therapeutic treatment.

5. The method of any of Claims 1 to 4, wherein the flowrate within the microfluidic device ranges from a Reynolds number 10 to 150.

~~19. The method of Claim 16, wherein the aspect ratio of the channel is in a range of between about 1 and about 5.~~

~~20~~6. The method of any one of Claims ~~19~~1 to 5, wherein the width of the channel is between about 100 μm and about 500 μm and the height of the channel is between about 10 μm and about 200 μm.

7. The method of any one of Claims 1 to 6, wherein the asynchronous cell mixture is a suspension of mammalian cancer cells or a suspension of mesenchymal stem cells or a combination thereof.

8. The method of any one of Claims 1 to 7, wherein the aspect ratio of the channel is in a range of between about 2 and about 10.

9. The method of any one of Claims 1 to 8, wherein the width of the channel at the end distal from the inlet is on the order of the cells to be isolated.

10. The method of any one of Claims 1 to 9, wherein the Dean cycle is in a range of 0.5-1.

~~21. The method of Claim 19, wherein the height of the channel is about 100 μm.~~

~~22. The method of Claim 15, wherein the sample is a blood sample.~~

~~23. The method of Claim 22, wherein the blood sample is a maternal blood sample that includes fetal nucleated red blood cells.~~

~~24. A method of isolating one or more synchronized cells from a mixture of asynchronous cells, comprising introducing an asynchronous cell suspension into at least one inlet of a microfluidic device comprising at least one spiral channel wherein each spiral channel has a length and a cross-section of a height and a width defining an aspect ratio adapted to isolate synchronized cells along portions of the cross-section of the channel based on cell size, wherein larger synchronized cells flow along the radially innermost portion of the channel to a first outlet and smaller synchronized cells flow along other portions of the channel to at least one other outlet.~~

~~25. The method of Claim 24, further including collecting synchronized cells from the first outlet.~~

~~26. The method of Claim 25, wherein the aspect ratio of the channel is in a range of between about 1 and about 5.~~

~~27. The method of Claim 26, wherein the width of the channel is about 500 μm.~~

~~28. The method of Claim 27, wherein the height of the channel is about 140 μm.~~

~~29. The method of Claim 24, wherein the asynchronous cell mixture is a suspension of mammalian cancer cells or a suspension of mesenchymal stem cells or a combination thereof.~~

~~30~~11. A method of ~~detecting~~isolating one or more diseased blood ~~circulating tumor~~ cells in a blood sample~~ of an individual~~, comprising introducing the blood sample into at least one inlet of a microfluidic device comprising one or more linear microchannels, wherein each linear microchannel has a length and a cross-section of a height and a width defining an aspect ratio adapted to isolate ~~circulating tumor~~diseased blood cells along at least one portion of the cross-section of the channel based on ~~cell size~~reduced deformability of diseased blood cells as compared to non-diseased blood cells, wherein each linear microchannel is configured so that Fahraeus effect and margination causes the non-diseased blood cells to migrate to the center of the cross-section and to displace the reduced deformability diseased cells to the side of the cross-section, wherein ~~circulating tumor~~reduced deformability diseased blood cells flow along the side~~a first portion of the channel~~ to a first outlet and ~~other~~non-diseased blood cells ~~in the sample~~ flow along ~~a second portion of the channel~~the center to a second outlet.

12. The method of Claim 11, wherein the diseased cells are of a different size, stiffness, deformability, adhesiveness, or a combination thereof than the non-diseased cells.

13. The method of Claim 11 or 12, wherein the diseased cells are displaced into a cell-free layer near the channel side walls.

14. The method of any one of Claims 11 to 13, wherein the one or more diseased cells are malaria-infected red blood cells, sickle cell anemia red blood cells, leukemic blood cells, circulating tumor cells or a combination thereof.

~~31~~15. The method of any one of Claims ~~30~~11 to 14, further ~~including~~comprising collecting ~~circulating tumor~~diseased cells from the first outlet.

~~32. The method of Claim 31, further including analyzing the circulating tumor cells.~~

~~33. The method of Claim 32, wherein analyzing the circulating tumor cells includes assessing effectiveness of a therapeutic treatment.~~

~~34~~16. The method of any one of Claims ~~30~~11 to 15, wherein the ~~aspect ratio~~width of the second outlet~~channel~~ is in a range of between about 2 and about 10 times wider than the width of the first outlet, wherein the width of the channel is about 10-50 μm, and/or wherein the height of the channel is about 10-200 μm.

~~35. The method of Claim 30, wherein the aspect ratio of the channel is in a range of between about 3 and about 5.~~

~~36. The method of Claim 30, wherein the width of the channel at the end distal from the inlet is on the order of the cells to be isolated.~~

~~37. The method of Claim 36, wherein the width of the channel is about 20 μm.~~

~~38. The method of Claim 36, wherein the microfluidic device further includes an expansion region at the end of the channel distal from the inlet.~~

~~39. The method of Claim 38, wherein the microfluidic device further includes at least one cell focusing region having a cross section adapted to cause all cells to migrate to and move along the longer channel dimension.~~

~~40. The method of Claim 30, wherein the sample is a blood sample.~~