[0028] In any of the aspects, embodiments can further include methods wherein the dividing system employs a magnetic field to direct target particles to the first output branch and other particles to the second output branch. The method can include detecting tags or tagged particles by the dividing system, and diverting by the dividing system of tagged particles into a selected one of the first and second output branches. The dividing system can include a detector operatively connected with the channel, a fluid resistance varying element operatively connected to at least one of the first and second output branches, and a controller in communication with the detector and the fluid resistance varying element. In some embodiments, dividing an output from the channel can include detecting tagged particles by the detector, communicating information regarding the detection from the detector to the controller, and signaling by the controller to the fluid resistance varying element to vary the fluid resistance in at least one of the first and second output branches so as to cause the tagged particle to flow into a selected one of the output branches.

[0029] In the enumerated aspects or in any of their embodiments, the population of particles can include, but is not limited to, cells, beads, viruses, organelles, nanoparticles, and molecular complexes. In some embodiments, the target particles can be cells and the channel can be curved. In other embodiments, the first radius curve of the channel can apply a Dean drag that is about eight times greater than a Dean drag applied in the larger radius curve. The channel can have a rectangular cross-sectional shape and at least one dimension of the rectangular cross-sectional shape can vary from inflection point to inflection point in the sigmoidal curve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0031] FIG. **1**A illustrates one embodiment of a system for the separation, ordering, and focusing of particles within microchannels;

[0032] FIG. **1**B illustrates an example of one microchannel of FIG. **1**A;

[0033] FIG. **2**A is a side-view of one embodiment of a straight channel for the separation, ordering, and focusing of particles;

[0034] FIG. **2**B is a cross-sectional view of the straight channel of FIG. **2**A showing four equilibrium positions for focused streams of particles;

[0035] FIG. **2**C is a cross-sectional view of an exemplary high-aspect ratio straight channel showing two equilibrium positions for focused streams of particles;

[0036] FIG. **3**A is a side-view of one embodiment of a symmetrically curved channel for the separation, ordering, and focusing of particles;

[0037] FIG. **3**B is a cross-sectional view of the symmetric channel of FIG. **3**A showing two equilibrium positions for focused streams of particles;

[0038] FIG. **4**A is a side-view of one embodiment of an asymmetrically curved channel for the separation, ordering, and focusing of particles;

[0039] FIG. **4**B is a cross-sectional view of the asymmetric channel of FIG. **4**A showing one equilibrium position for focused streams of particles;

[0040] FIG. **4**C is a perspective view of another embodiment of an asymmetrically curved channel in the form of an expanding spiral channel;

[0041] FIG. **5**A is a cross-sectional view of one embodiment of a straight channel having a rectangular cross-section showing forces acting on particles within the channel;

[0042] FIG. **5**B is a representation of the forces acting on a particle within the straight channel of FIG. **5**A;

[0043] FIG. **6**A is a parabolic velocity profile of Dean drag forces acting within a curved microchannel;

[0044] FIG. **6**B illustrates Dean flow velocity dependence on Dean number within curving microchannels;

[0045] FIG. **6**C is a graph illustrating average secondary flow velocity magnitude as a function of changing Dean number for a single channel geometry;

[0046] FIG. **7** is a cross-sectional view of one embodiment of an asymmetrically curved channel depicting the superposition of the four stable positions due to inertial lift forces with the Dean flow;

[0047] FIG. **8**A is a cross-sectional view of one embodiment of a straight channel showing particles focused into four lateral positions;

[0048] FIG. **8**B is a side view of the straight channel of FIG. **8**A showing the particles focused into four streams;

[0049] FIG. **8**C is a side view and cross-sectional view of the straight channel of FIG. **8**A showing that the degree of focusing increases with R_e;

[0050] FIG. **9**A is a representation of focusing within one embodiment of a high-aspect ratio straight channel, showing focusing to two streams;

[0051] FIG. **9**B is a representation of particle ordering and spacing within the straight channel of FIG. **9**A;

[0052] FIG. **9**C is a representation of particle ordering and spacing within the straight channel of FIG. **9**A;

[0053] FIG. **9**D is a representation of particle ordering and spacing of two different particle types within the straight channel of FIG. **9**A;

[0054] FIG. **10**A is a side view of one embodiment of a symmetrically shaped channel showing focusing of particles into two streams;

[0055] FIG. **10**B is a side view of the channel of FIG. **10**A illustrating particle focusing increasing with R_e;

[0056] FIG. **11**A is a side view of one embodiment of an asymmetrically shaped channel illustrating particle focusing increasing with R_e;

[0057] FIG. **11**B is a side view of the channel of FIG. **11**A, showing a single stream of focused particles;

[0058] FIG. **11**C is a cross-sectional view of the channel of FIG. **11**A, showing particles focused to a single equilibrium position within the channel;

[0059] FIG. **11**D is a side view of the channel of FIG. **11**A showing particle focusing at various locations along a length of the channel;

[0060] FIG. **12** is a cross-sectional view of one embodiment of an asymmetrically shaped, expanding spiral channel showing equilibrium positions therein for particle focusing;

[0061] FIG. **13** is a side view of the channel of FIG. **12**, illustrating particle ordering therein;

[0062] FIG. **14** is a representation of one embodiment of a system for the separation, ordering, and focusing of particles having asymmetrical channels;