

and focus particles of a predetermined size suspended within the sample **24** such that one or more focused streams of particles **22** per channel **16** are provided at an output **26** of the chip **14**. An analysis region **18** can be provided in proximity to the output **26** of the channels **16** to monitor, sort, count, image, or otherwise analyze the localized and focused streams of particles **22**.

[0128] In one embodiment, chip **14** can be, or be part of, a particle enumerating system. In particular, analysis region **18**, in which the particles have been focused and ordered, could be subject to interrogation by a detector for the purpose of counting the particles. A variety of detectors are discussed below, as are systems for tagging particles for detection, and these elements can also be used for enumeration.

[0129] As used herein, a "sample" must be capable of flowing through the microfluidic channels of the system embodiments described. Thus, any sample consisting of a fluid suspension, or any sample that be put into the form of a fluid suspension, that can be driven through microfluidic channels can be used in the systems and methods described herein. For example, a sample can be obtained from an animal, water source, food, soil, air, etc. If a solid sample is obtained, such as a tissue sample or soil sample, the solid sample can be liquefied or solubilized prior to subsequent introduction into the system. If a gas sample is obtained, it may be liquefied or solubilized as well. The sample may also include a liquid as the particle. For example, the sample may consist of bubbles of oil or other kinds of liquids as the particles suspended in an aqueous solution.

[0130] Any number of samples can be introduced into the system for particle focusing and should not be limited to those samples described herein. A sample can generally include any suspensions, liquids, and/or fluids having at least one type of particle, cellular, droplet, or otherwise, disposed therein. Further, focusing can produce a flux of particles enriched in a first particle based on size. In some embodiments, a sample can be derived from an animal such as a mammal. In a preferred embodiment, the mammal can be a human. Exemplary fluid samples derived from an animal can include, but are not limited to, whole blood, sweat, tears, ear flow, sputum, bone marrow suspension, lymph, urine, brain fluid, cerebrospinal fluid, saliva, mucous, vaginal fluid, ascites, milk, secretions of the respiratory, intestinal and genitourinary tracts, and amniotic fluid. In other embodiments, exemplary samples can include fluids that are introduced into a human body and then removed again for analysis, including all forms of lavage such as antiseptic, bronchoalveolar, gastric, peritoneal, cervical, arthroscopic, ductal, nasal, and ear lavages. Exemplary particles can include any particles contained within the fluids noted herein and can be both rigid and deformable. In particular, particles can include, but are not limited to, cells, alive or fixed, such as adult red blood cells, fetal red blood cells, trophoblasts, fetal fibroblasts, white blood cells, epithelial cells, tumor cells, cancer cells, hematopoietic stem cells, bacterial cells, mammalian cells, protists, plant cells, neutrophils, T lymphocytes, CD4+, B lymphocytes, monocytes, eosinophils, natural killers, basophils, dendritic cells, circulating endothelial, antigen specific T-cells, and fungal cells; beads; viruses; organelles; droplets; liposomes; nanoparticles; and/or molecular complexes. In some embodiments, one or more particles such as cells, may stick, group, or clump together within a sample. In such a configuration, a grouping or clumping of particles can be considered to be "a particle" for the purposes of systems of the invention. More particu-

larly, a grouping or clumping of particles may act and be treated as a single particle within channels of the invention described herein and can thus be sorted, ordered, separated, and focused in the same way as a single particle.

[0131] Non-biological samples can include, for example, any number of various industrial and commercial samples suitable for particle separating, ordering, and focusing. Exemplary industrial samples that can be introduced into the system can include, but are not limited to, emulsions, two-phase chemical solutions (for example, solid-liquid, liquid-liquid, and gas-liquid chemical process samples), waste water, bioprocess particulates, and food industry samples such as juices, pulps, seeds, etc. Similarly, exemplary commercial samples can include, but are not limited to, bacteria/parasite contaminated water, water with particulates such as coffee grounds and tea particles, cosmetics, lubricants, and pigments.

[0132] In some embodiments, a fluid sample obtained from an animal is directly applied to the system described herein, while in other embodiments, the sample is pretreated or processed prior to being delivered to a system of the invention. For example, a fluid drawn from an animal can be treated with one or more reagents prior to delivery to the system or it can be collected into a container that is preloaded with such a reagent. Exemplary reagents can include, but are not limited to, a stabilizing reagent, a preservative, a fixant, a lysing reagent, a diluent, an anti-apoptotic reagent, an anti-coagulation reagent, an anti-thrombotic reagent, magnetic or electric property regulating reagents, a size altering reagent, a buffering reagent, an osmolality regulating reagent, a pH regulating reagent, and/or a cross-linking agent. Examples of methods for processing fluid samples for delivery to an analytical device are described in U.S. Publication No. 2007/0196820 entitled, "System For Delivering a Diluted Solution" filed Mar. 3, 2004 and incorporated herein by reference in its entirety.

[0133] Particles suspended within a sample can have any size which allows them to be ordered and focused within the microfluidic channels described herein. For example, particles can have a hydrodynamic size that is in the range of about 40 microns to about 0.01 microns. More preferably, particles can have a hydrodynamic size that is in the range of about 20 microns to about 0.1 microns. More preferably, particles can have a hydrodynamic size that is in the range of about 10 microns to about 1 micron. It will be appreciated that particle size is only limited by channel geometry, and particles both larger and smaller than the above-described ranges can be ordered and focused within predetermined channel geometries having laminar flow conditions.

[0134] In another aspect of the system, a particle to volume ratio of the sample can optionally be manipulated or adjusted for conservation of mass within the channels. In general, sorting, ordering, and focusing of particles is in-part dependent on interparticle spacing within channels as well as the ratio of particle size to hydrodynamic size of the channel. Various channel geometries described herein may require a predetermined particle to volume ratio of the particle to be focused in order to achieve a required interparticle spacing and thereby maintain ordering and focusing of that particle. In particular, the particle to volume ratio of a particle suspended within a fluid can be calculated and adjusted as needed to achieve focusing within certain channel geometries. In gen-