may or may not be wrapped around a metallic core. A Solenoid type microcoil produces a magnetic field when an electrical current is passed through it and can create controlled magnetic fields. A Solenoid type microcoil can produce a uniform magnetic field in a predetermined volume of space. A "planar" microcoil is a microcoil with its windings substantially remained in an actual or imaginative plane. Microcoils can also be fabricated into MEMS devices such as demonstrated by MEMS magnetic actuators (IEEE Journal of Solid-State Circuits (2006) 41:1471 and Biosensors and Bioelectronics (2006) 21:1693.

[0052] The embodiments of the invention contemplate the activation of one or more microcoils (or to the movement of a permanent magnet) in order to move the magnetic particles and/or binding complexes. "Activation" or "activating" refers to turning on one or more microcoils while turning off (or keeping off) one or more other microcoils, which causes the magnetic particles (and any component attached to the magnetic particle) to move towards the microcoil(s) in the on position and away from the microcoil(s) in the off position.

[0053] As used in the embodiments of the invention, "associated with" is used interchangeably with "functionally coupled" and means that two or more objects are so situated that the desired results or effects are achieved. For example, a microcoil array is "functionally coupled" with the fluidic device when one or more microcoils are so situated that they will achieve the desired effect of generating an magnetic field within at least a portion of a fluidic zone of the device. Such coupling can be permanent, where the microcoil array is integrated into the fluidic device, or temporary, where the microcoil array is adjacent or in proximity to the device but is not integrated into the device. Similarly a vibration element is also "functionally coupled" with the fluidic device when it is so situated that it will achieve the desired effect of shaking, mixing, or agitating fluid within one or more fluidic zones of the device. Again, the vibration element can be integrated into the device, or can be in proximity to the device. In certain embodiments, the vibration element agitates the fluid in one or more fluidic zones to disperse the magnetic particles, analyte, and/or signal particles so that they can interact to form a binding complex. In other embodiments, the vibration element agitates the fluid in one or more fluidic zones to facilitate aggregation-disaggregation and removal of unbound signal particles and/or non-analyte components of the sample from the binding complex. In another embodiment, the mixing is demonstrated on a MEMS devices (IEEE Proc. Int. Conf. MEMS'02 (2002), 40-43). The detection element is "functionally coupled" with the fluidic device when it will achieve the desired effect of detecting and/or measuring the presence of the analyte (or binding complex) within the detection zone of the device. The detection element can be integrated into the device, or can be in proximity to the device. The flow controller is "functionally coupled" with the fluidic device when it will achieve the desired effect of coordinating liquid flow through the fluidic zones of the device.

[0054] A number of factors will be considered when associating the microcoil array, the vibration element, the detection element, or the flow controller with the fluidic device, including the sizes and shapes of the substrate, the type and size of the microcoil array, the size and location of the fluidic zones, the number of the fluidic zones, the desired strengths of the magnetic field and, and the volume within which the binding complex or signal particle is to be detected. As disclosed herein, the specific locations of the magnetic microcoil array, the detection element and the vibration element with respect to the fluidic device will be determined based on the specific analysis desired by a person skilled in the art.

[0055] As used herein, "dimension" or "dimensions" are the parameters or measurements required to define the shape and/or size, such as height, width, and length, of an object. As used herein, the dimension of a two-dimensional object, such as a rectangle, a polygon, or a circle, is the longest straight-line distance between any two points on the object. Therefore the dimension of a circle is its diameter; a rectangle its diagonal, and a polygon its longest diagonal. The dimension of a three-dimensional object is the longest straight-line distance between any two points on the object. The dimensions used herein are usually measured by centimeters (cm), millimeters (mm), and micrometers (μm), and nanometers (nm).

[0056] A "fluidic device" or "fluidic network" is a device that has one or more fluidic zones that are capable of containing a liquid. A fluidic device may be functionally coupled to other components, such as a magnetic microcoil array, a vibration element, a detection element, a circuit board and a circuitry component. Fluids used in the fluidic devices include bodily fluids such as, but not limited to, amniotic fluid, aqueous humor, bile, blood and blood plasma, breast milk, cerebrospinal fluid, cerumen, colostrum, chyle, chyme, feces, female ejaculate, interstitial fluid, intracellular fluid, lymph, menses, mucus, pre-ejaculatory fluid, pleural fluid, pus, saliva, sebum, semen, serum, sweat, synovial fluid, tears, urine, vaginal lubrication, vitreous humor, and vomit; bacterial cell suspensions; protein or antibody solutions; various buffers; saline; and reaction substrates. The sample introduced into the fluidic device typically comprises a liquid, gel, solid, gas, or mixture thereof, suspected of containing an analyte. Fluidic devices can be used to obtain many interesting measurements, including fluid mechanical properties, cellular and molecular diffusion coefficients, fluid viscosity, pH values, chemical and biological binding coefficients and enzyme reaction kinetics. Other applications for fluidic devices include cell and molecule detection and separation, capillary electrophoresis, isoelectric focusing, immunoassays, flow cytometry, sample injection of proteins for analysis via mass spectrometry, DNA analysis, cell manipulation, and cell separation. In one embodiment of the invention, magnetic materials and technologies and/or nanoparticles are incorporated into the fluidic devices for applications such as cell and biomolecule detection and/or separation. As used herein, the term "detecting the presence" refers to determining the existence, identity, and/or amount of an analyte in a particular sample.

[0057] A "fluidic zone" is typically a reservoir, channel, groove, opening, or conduit in the substrate of the fluidic device, which is configured for containing a liquid and optionally for containing reagents. Fluidic zones can be straight along their length, however, they can also contain angles and curves of different degrees along their length. The fluidic zones can have rectangular cross-sections, or they may also have other shapes of cross-sections, such as circular. Typically the fluidic zone has at least one dimension in the micrometer or millimeter scale.

[0058] The fluidic zones may be suitable for fluidic communications, such as carrying a biological liquid to an adjacent fluidic zone. Alternatively, the fluidic zones may be suitable for non-fluidic communications, such as carrying through molecules or compounds in the absence of significant active hydraulic fluid transport or exchange. Such molecules