

channels in the micrometer or nanometer scale can be fabricated from the devices. If fluidic flow is employed, it can be controlled by pressure gradient, electrical field gradient, gravity, and/or heat gradient. The surfaces of the fluidic zones and/or the diffusion barriers can be modified with polymers (polyethylene glycol (PEG)-dramatized compounds) that can minimize non-specific binding. The solid support can be inorganic material (e.g., glass, ceramic) or metal (e.g., aluminum). Biomolecules, proteins, antibodies, and/or nucleic acids can be coated on the surface of the substrate for specific analyte binding.

**[0182]** In the embodiments of the invention, the channels formed on the substrate may be straight or have angles or curves along their lengths. The characteristics and layout of the channels are determined by the specific applications the device is designed for. Although straight channels lining next to one another are a typical design for microfluidic devices, the channels in the embodiments of the invention may be designed in many different patterns to serve specific separation and detection requirements. Specifically, the design of the channels takes into consideration of the microcoils associated with the fluidic zones such that one or more microcoils are capable of generating excitation magnetic fields across at least a portion of one fluidic zones. Further, in the embodiments of the invention, the cross-section of the fluidic zone so formed may be uniform or vary along the channel's length, and may have various shapes, such as rectangle, circle, or polygon.

#### EXAMPLE

##### Example 1

**[0183]** Magnetic Particles are Separated from: Signal Particles in a Fluidic Device

**[0184]** A biochip was constructed as shown in FIG. 6, containing a sample zone, a cleaning zone and a detection zone, which was functionally coupled to a magnet. A mixture of magnetic particles and Qdot particles was loaded into the sample zone. The arrows indicate the position of the magnetic particles over time, showing that they moved from the sample zone in panel 1 to the detection zone in panel 6. UV fluorescence indicates that the Qdots were still located in the sample zone since no significant fluorescence was detected beyond the sample zone.

**[0185]** Solutions were retrieved from the sample zone and the detection zone, respectively, and finally adjusted to the same volumes for comparison. As a control, the same amount of particle mixture was cleaned in tubes; the supernatant from each step was saved to measure Qdot carry-over in the absence of analyte (see FIG. 6B).

**[0186]** As shown by the control test in tubes (FIG. 6C), Qdots were separated from magnetic particles after 4 washing steps; the same result could be achieved using the test chip; meaning the magnetic particles were free of Qdots after they were transported from the sample zone to the detection zone without liquid exchanges. For example, when PSA was the analyte, as low as 0.1 pg of PSA was detected using SERS technology and COIN particles (FIG. 6D).

**[0187]** The characteristics of some of the embodiments of the invention are illustrated in the Figures and examples, which are intended to be merely exemplary of the invention. This application discloses several numerical range limitations that support any range within the disclosed numerical ranges even though a precise range limitation is not stated

verbatim in the specification because the embodiments of the invention could be practiced throughout the disclosed numerical ranges. Finally, the entire disclosure of the patents and publications referred in this application, if any, are hereby incorporated herein in entirety by reference.

We claim:

1. A device comprising
  - a fluidic network comprising a plurality of fluidic zones, each fluidic zone being connected to the adjacent zone by a diffusion barrier, and an integrated circuitry component;
  - an array of magnetic microcoils functionally coupled to the fluidic network, wherein the microcoils are programmably activatable to generate a magnetic field in proximity to each microcoil and to transport a magnetic particle in the fluidic network without fluidic movement of a fluid in the plurality of the fluidic zones;
  - a detection element functionally coupled to the fluidic network; and
  - optionally comprising a vibrational element functionally coupled to the fluidic network.
2. The device of claim 1, wherein the diffusion barrier is a fluidic channel.
3. The device of claim 1, wherein the diffusion barrier is a thermally-sensitive barrier.
4. The device of claim 1, wherein the diffusion barrier is a hydrophilic-hydrophobic interface, created by completely surrounding the hydrophilic reagents by hydrophobic liquid.
5. The device of claim 1, wherein the diffusion barrier is created by a MEMS membrane valve.
6. The device of claim 1, wherein the diffusion barrier is created by dielectric phoresis.
7. The device of claim 1, wherein the plurality of fluidic zones comprises a sample zone, a cleaning zone, and a detection zone.
8. The device of claim 7, wherein the sample zone comprises a space for holding a sample, and is selected from a reservoir, a channel, an opening, a surface, or a combination thereof.
9. The device of claim 1, wherein multiple sets of fluidic zones are present in parallel in the fluidic network.
10. The device of claim 1, wherein the array of magnetic microcoils is removeably coupled to the fluidic network.
11. The device of claim 1, wherein the array of magnetic microcoils is permanently coupled to the fluidic network.
12. The device of claim 1, wherein the detection element is selected from an optical detection element and an electrical detection element.
13. The detection element of claim 12, wherein the optical detection element is selected from, a photon multiplier tube, avalanche sensor, CCD, photodiode, a Raman detector, and a fluorescent reader, and the electrical detection element is selected from a capacity detection element, a current sensor, a voltage sensor, and a charge sensor, and an electrochemical sensor.
14. The device of claim 1, wherein the device is self-contained.
15. The device of claim 1, further in functional association with a flow controller.
16. The device of claim 7, wherein the sample zone comprises the magnetic particle selected from the group consisting of a magnetic affinity complex, a competitive binding complex and a coded magnetic affinity complex.