the sample zone, where analyte present in the sample forms a complex with a magnetic particle. The complex is moved through the fluidic zones to the detection zone by activating the microcoil array. It is then detected in the detection zone by the detection element. The device is further connected with a circuitry component and circuit board, which collects, analyzes, and/or processes signals detected by the detection element.

[0122] FIG. **2** illustrates magnetic particles overlaying an exemplary magnetic microcoil array, demonstrating the movement of magnetic particles (dark circles) over the magnetic coils. As shown, the microcoils are activated (turned on and off in a directed fashion) to move the magnetic particles from left to right. Molecules that are coupled to the magnetic particles are also moved by activating the microcoils.

[0123] FIG. **3** illustrates a top-down view and cross-section view of the fluidic network. The cross-section view illustrates the functionally coupled magnetic microcoil array. As shown, the sample is introduced into the sample zone. There are optional fluidic zones for storing reagents, which contain one or more sets of magnetic particles. The underlying magnetic array (which can be integrated or in a separate, coupled device) is activated to move the magnetic particles into the sample zone. In another embodiment (not shown), the magnetic particles are present within the sample zone, and are not located in the storage areas. There is also a waste zone: magnetic particles can be moved into the waste zone and uncomplexed analyte can be left in this area. The magnetic array is activated to move the magnetic particles and complexed analyte into the detection zone. The detection zone can contain one or more different regions (indicated by **1**-**4**) for detection of different analytes.

[0124] FIG. **4** illustrates a more detailed top-down view and cross-section view of the fluidic network functionally coupled to the magnetic microcoil array, providing examples of various diffusion barriers. As shown, the microcoil array is indicated by the dashed ovals in the top-down view, and by the squares in the cross-section view. The sample is inserted into the sample zone through a loading inlet, where it interacts with magnetic particles and the analyte binds to the magnetic particle. The magnetic particles are optionally moved into the branch, which is a fluidic zone containing one or more reagents. The magnetic microcoil array is activated to move the magnetic particles (complexed and uncomplexed) through a diffusion barrier to the cleaning zone. The magnetic particles are further moved into the detection zone, for detection by the detection element. The integrated circuitry component saves data in its memory.

[0125] FIG. **5** illustrates a cross-section view of the fluidic network and exemplary method for detecting an analyte. The fluidic network is functionally coupled to the magnetic microcoil array, and contains a magnetic affinity complex, an analyte and a signal affinity complex. The magnetic affinity complex ("M") interacts with the analyte and the signal affinity complex to form a sandwich binding complex. The vibration element is optionally employed to deaggregate the magnetic and signal particles and the analyte, and to allow them to interact. The microcoil array is activated to move the magnetic affinity complexes to the detection zone. Unbound signal affinity complex is not moved to the detection zone. While both complexed and uncomplexed magnetic particles are in the detection zone, the signal is generated only by the signal particles that have interacted with the analyte and the magnetic affinity complex. Both optical and electrical signals can be detected. The signal indicates the presence of the analyte. FIG. **6**A illustrates the use of the fluidic network such as a biochip. Magnetic particles and Qdots were loaded into the fluidic network. The magnetic microcoils were activated and the magnetic particles (indicated by the arrows) moved from the sample zone in panel **1** through the fluidic channels and into the detection zone by panel **6**. Note that in panel **3**, the magnetic microcoils were activated to spread out the magnetic particles. The fluorescent images illustrate that the Qdots did not move from the sample zone. FIG. **6**B illustrates the fluorescence of a mixture of magnetic particles and Qdots. As the mixture is washed, it loses fluorescence. FIG. **6**C quantifies the fluorescence of the samples in the tubes from FIG. **6**B (S**1** tube is the original sample, while S**2**-S**4** tubes are the washes) or samples taken from the fluidic network during FIG. **6**A ("initial-on chip" indicates the sample zone after the magnetic particles have been moved, while "end-on chip" indicates the sample from the detection zone"). FIG. **6**D illustrates on-chip chemiluminescent detection of PSA. Comparative studies were carried out by dividing samples into two-halves, one half for on-chip test and the other for in-tube test. The on-chip test demonstrated the capability of removing signaling particles from sandwich complex by magnetic transport. FIG. **6**D quantifies chemiluminescence photo counts corresponding to the analyte, free PSA, for the "on-chip" experiment performed with fluidic network as well as for the "in-tube" (multi-steps) experiment. The on-chip test showed very comparative results to the in-tube test.

[0126] FIG. **7** illustrates the formation of sandwich binding complexes ("sandwich binding" and "tandem binding") and a competitive binding complex. A sandwich binding complex is formed through the analyte binding to a signal affinity complex and a magnetic affinity complex. The "sandwich binding" shows an example where the analyte is a protein or nucleic acid, while the "tandem binding" shows an example where the analyte is an antibody. An optical or electrical signal is detected from the binding complex. A competitive binding complex is formed when a signal analyte complex displaces the analyte from a magnetic binding complex (analyte plus magnetic affinity complex). Signal is detected from the signal analyte complex that does not form the competitive binding complex.

[0127] FIG. **8** illustrates the use of codes with a magnetic affinity complex and a magnetic signal affinity complex. The coded magnetic affinity complex comprises a code, an affinity agent and a magnetic particle. It can interact with the analyte to form a coded magnetic binding complex. The microcoil array is activated to move the coded magnetic binding complex to a first affinity surface, where it is bound and immobilized. In this example, the affinity agent on the first affinity surface is complementary to and binds to the affinity agent on the magnetic particle. The code is then detached from the coded magnetic binding complex. The detached code then binds to a magnetic signal affinity complex to form a coded magnetic signal binding complex. Typically the affinity agent of the magnetic signal affinity complex is complementary to the code. In this example, the affinity agent of the magnetic signal affinity complex is a polynucleotide complementary to the code polynucleotide. The microcoil array is activated to move the coded magnetic signal binding complex to one or multiple detection zones comprising a second affinity surface. Typically different areas of the detection zone or the different detection zones contain unique affinity agents to the codes. The affinity agents of the second affinity surface are