Alternatively, the microcoil array is fabricated separately, and is removeably coupled to the device when it is in use. A detection element can be fabricated into the substrate, or can be fabricated separately and removeably coupled to the device when in use. Preferably the detection element is an optical detection element or an electrical detection element. In further embodiments, a vibration element is fabricated into the device. Alternatively, the vibration element is fabricated separately and removeably coupled to the device when in use.

[0156] In certain embodiments, fabricating the plurality of fluidic zones on a substrate comprises combining two or more solid supports.

[0157] Embodiments of the invention also comprise a binding complex, which is an analyte bound to a magnetic affinity complex and a signal affinity complex. Typically the analyte is a protein, an antibody or a nucleic acid. In one embodiment, the analyte comprises an anti-PSA antibody. In a further embodiment, the signal affinity complex comprises a COIN-PSA conjugate. The magnetic affinity complex can comprise a streptavidin-coated magnetic bead. The analyte can comprise an antibody, which includes an autoantibody.

[0158] As disclosed herein, compound and molecules suitable for analysis by the embodiments of the invention include proteins, peptides, and, specifically, nucleic acids (DNA and RNA), which can form double-stranded molecules by hybridization, that is, complementary base pairing. For example, in an embodiment of the invention, a molecular probe, such as a DNA probe, is associated with or attached to a fluidic zone, which is located near or on the surface of, or otherwise integrated into, the substrate. The specificity of nucleic acid hybridization from the binding of the analyte to the molecular probe is such that the detection of molecular and/or nanomaterials binding events can be done through measurements of the signals by the detection element or other external circuitry. This specificity of complementary base pairing also allows thousands of hybridization to be carried out simultaneously in the same experiment on a DNA chip (also called a DNA array).

[0159] Molecular probes are immobilized on the surface of individual or individually addressable reservoirs through surface functionalization techniques. The probe in a DNA chip is usually hybridized with a complex RNA or cDNA target (the analyte) generated by making DNA copies of a complex mixture of RNA molecules derived from a particular cell type (source). The composition of such a target reflects the level of individual RNA molecules in the source. The optical or electrical signals resulting from the binding events from the DNA spots of the DNA chip after hybridization between the probe and the target represent the relative expression levels of the genes of the source.

[0160] The DNA chip could be used for differential gene expression between samples (e.g., healthy tissue versus diseased tissue) to search for various specific genes (e.g., connected with an infectious agent) or in gene polymorphism and expression analysis. Particularly, the DNA chip could be used to investigate expression of various genes connected with various diseases in order to find causes of these diseases and to enable accurate treatments.

[0161] Using embodiments of the invention, one could find a specific segment of a nucleic acid of a gene, i.e., find a site with a particular order of bases in the examined gene. This detection could be performed by using a diagnostic polynucleotide made up of short synthetically assembled single-chained complementary polynucleotides—a chain of bases organized in a mirror order to which the specific segment of the nucleic acid would attach (hybridize) via A-T or G-C base pairing interactions.

[0162] The practice of the embodiments of the invention may employ, unless otherwise indicated, conventional techniques of organic chemistry, polymer technology, molecular biology (including recombinant techniques), cell biology, biochemistry, and immunology, which are within the skill of the art. Such conventional techniques include polymer array synthesis, hybridization, ligation, detection of hybridization using a label. Specific illustrations of suitable techniques can be had by reference to the examples herein below. However, other equivalent conventional procedures can, of course, also be used.

[0163] The devices of the embodiments of the invention may be formed by any suitable means of manufacture, including semiconductor manufacturing methods, microforming processes, molding methods, material deposition methods, etc., or any suitable combination of such methods. In certain embodiments one or more of the microcoils, and circuitries may be formed via semiconductor manufacturing methods on a semiconductor substrate. Thin film coatings may be selectively deposited on portions of the substrate surface. Examples of suitable deposition techniques include vacuum sputtering, electron beam deposition, solution deposition, and chemical vapor deposition. The coatings may perform a variety of functions. For example, the coatings may be used to increase the hydrophilicity of a surface or to improve high temperature properties. Conductive coatings may be used to form the microcoils. Coatings may be used to provide a physical barrier on the surface, e.g. to retain fluid at specific sites on the surface.

[0164] In one embodiment of the invention, the substrate is made through combining two or more smaller substrates or solid support. Specifically, the fabricating of the fluidic zones, or the fabricating of the microcoils may involve combining two or more smaller substrates to form the substrate.

[0165] The substrate used in the embodiments of the invention may comprise various materials including, but not limited to silicon, glass, metal, and polymeric material. According to the embodiments, the substrate comprises an integrated circuit, a microarray, a macroarray, fluidic zones, a detection element, a vibration element, or a combination thereof.

[0166] In on embodiment of the invention, the sample zone for holding a sample comprises a reservoir, a channel, an opening, a surface, or a combination thereof. According to another embodiment, the microcoil comprises of copper, aluminum, gold, silver, or a mixture thereof. The microcoil is placed near or adjacent to the fluidic zones.

[0167] As disclosed herein, silicon is a suitable material for attaching other materials, such as metal or magnetic materials and forming structures, such as openings and channels coupled with microelectronics or other microelectromechanical systems (MEMS). It also has good stiffness, allowing the formation of fairly rigid microstructures, which can be useful for dimensional stability. In a specific embodiment of the invention, the substrate comprises an integrated circuitry component selected from an integrated circuit (IC), a packaged integrated circuit, and an integrated circuit die. For example, the substrate may be a packaged integrated circuit that comprises a microprocessor, a network processor, or other processing device.

[0168] In another embodiment, the method further comprises forming circuitry on or within the detection unit that is