

cal applications, combustible gas detection, H<sub>2</sub>S monitoring, hazardous leak detection and identification, emergency response and law enforcement applications, illegal substance detection and identification, arson investigation, enclosed space surveying, utility and power applications, emissions monitoring, transformer fault detection, food/beverage/agriculture applications, freshness detection, fruit ripening control, fermentation process monitoring and control applications, flavor composition and identification, product quality and identification, refrigerant and fumigant detection, cosmetic/perfume/fragrance formulation, product quality testing, personal identification, chemical/plastics/pharmaceutical applications, leak detection, solvent recovery effectiveness, perimeter monitoring, product quality testing, hazardous waste site applications, fugitive emission detection and identification, leak detection and identification, perimeter monitoring, transportation, hazardous spill monitoring, refueling operations, shipping container inspection, diesel/gasoline/aviation fuel identification, building/residential natural gas detection, formaldehyde detection, smoke detection, fire detection, automatic ventilation control applications (cooking, smoking, etc.), air intake monitoring, hospital/medical anesthesia and sterilization gas detection, infectious disease detection and breath applications, body fluids analysis, pharmaceutical applications, drug discovery and telesurgery. Another application for the fluidic device of the disclosure is in engine fluid monitoring (e.g., an oil/antifreeze monitor, engine diagnostics for air/fuel optimization, diesel fuel quality and the like). Volatile organic carbon measurement (VOC), fugitive gases in refineries, halitosis, soil and water contaminants, leak detection, fire safety, chemical weapons identification, use by hazardous material teams, explosive detection, breathalyzers, ethylene oxide detectors and anesthetic measurements can also be performed.

**[0050]** The methods and devices of the disclosure can be used for military and public safety in a variety of venues.

**[0051]** In other embodiments, the fluid channels and reservoirs/wells are coated to inhibit the accumulation of biological material (e.g., proteinaceous agents) on the surface. In some embodiments, polyethyleneglycol (PEG) is immobilized on surfaces to prevent nonspecific interactions.

**[0052]** For example, when the analyte is a single-stranded nucleic acid, the binding/targeting ligand (e.g., a magnetic bead) comprises a substantially complementary nucleic acid. Similarly the analyte may be a nucleic acid binding protein and the capture binding ligand is either a single-stranded or double-stranded nucleic acid; alternatively, the binding ligand may be a nucleic acid binding protein when the analyte is a single or double-stranded nucleic acid. When the analyte is a protein, the binding ligands include proteins or small molecules. For example, when the analyte is an enzyme, suitable binding ligands include substrates, inhibitors, and other proteins that bind the enzyme, i.e. components of a multi-enzyme (or protein) complex. As will be appreciated by those in the art, any two molecules that will associate, may be used, either as the analyte or the functional group (e.g., targeting/binding ligand). Suitable analyte/binding ligand pairs include, but are not limited to, antibodies/antigens, receptors/ligand, proteins/nucleic acids; nucleic acids/nucleic acids, enzymes/substrates and/or inhibitors, carbohydrates (including glycoproteins and glycolipids)/lectins, carbohydrates and other binding partners, proteins/proteins; and protein/small

molecules. In one embodiment, the binding ligands are portions (e.g., the extracellular portions) of cell surface receptors.

**[0053]** As mentioned above, the detection devices of the disclosure are capable of multi-channel analysis and scaling. The small length scales associated with microfluidics facilitates fabrication of multi-channel devices, whereby each fluid flow channel is sensitive to one, or a class of target analytes.

**[0054]** Multiple microfluidic channels provide flexible designs for 'lab on a chip' concepts. For example, microfluidic channels can be used to provide controlled dilution of analyte. The diluted analyte can then be introduced to nanoparticle flow and SERS detection can be performed. The SERS intensity can then be compared to the degree of dilution, to facilitate the deduction of initial analyte concentration.

**[0055]** In one embodiment, magnetic beads are used to move an analyte through the channels and wells. The magnetic beads can be moved by using a magnet located above or below the fluid channels. The magnet is moved relative to the substrate such that the magnetic field causes the magnetic beads to move through the channels and the magnet is moved from one end of the substrate to the other. The movement of the magnet or the substrate relative to the magnet can be controlled by a computer to move at a desired rate or to stop at particular location in the microfluidic chip (e.g., stopping at wells for mixing of the bead with the desired aqueous solution).

**[0056]** In some embodiments, the disclosure provides kits and systems for use in monitoring the level of an analyte in a sample. In some embodiments, the kits are for home use by a subject to assist in identifying an analyte, disease or disorder or to monitor a biological condition.

**[0057]** As used herein, the term "sample" is used in its broadest sense. For example, a sample can comprise a specimen or culture obtained from any source, as well as biological and environmental samples. Biological samples may be obtained from animals (including humans) and encompass fluids, solids, tissues, and gases. Biological samples include blood products, such as plasma, serum and the like. Environmental samples include environmental material such as surface matter, soil, water, crystals and industrial samples. The nanostructures can be used, for example, in bodily fluids in vivo or in vitro. Such bodily fluids include, but are not limited to, blood, serum, lymph, cerebral spinal fluid, aqueous humor, interstitial fluid, and urine.

**[0058]** The working examples below are provided to illustrate, not limit, the disclosure. Various parameters of the scientific methods employed in these examples are described in detail below and provide guidance for practicing the disclosure in general.

## EXAMPLES

**[0059]** M2 chip fabrication. The M2 chip as generally shows in FIG. 1 was made by bonding of a 3"x1" glass slide (0.1 mm-thick) and a cured PDMS substrate, which was replicated from a thiolene-based optical adhesive (NOA81, Norland Products, N.J.) molding master (Master-3#). FIG. 1 shows an M2 chip layout (A) and Master-3# picture (B), as well as schematic flow of the fabrication process (C). Exemplary dimensions are listed in the figure. Firstly, Master-1#, containing only lower channel features made of NOA81 (FIG. 1C-1), was fabricated by using an open-faced method (J. Micromech. Microeng. 14 (2004) 153-158). Briefly,