

large numbers of genes simultaneously. In a DNA microarray, the affixed DNA segments are known as probes, thousands of which can be used in a single DNA microarray. Measuring gene expression using microarrays is relevant to many areas of biology and medicine, such as studying treatments, disease and developmental stages.

[0088] “Solid support” and “support” refer to a material or group of materials having a rigid or semi-rigid surface or surfaces. In some aspects, at least one surface of the solid support will be substantially flat, although in some aspects it may be desirable to physically separate synthesis regions for different molecules with, for example, wells, raised regions, pins, etched trenches, or the like. In certain aspects, the solid support(s) will take the form of beads, resins, gels, microspheres, or other geometric configurations.

[0089] The term “molecule” generally refers to a macromolecule or polymer as described herein. However, channels or arrays comprising single molecules, as opposed to macromolecules or polymers, are also within the scope of the embodiments of the invention.

[0090] A “macromolecule” or “polymer” comprises two or more monomers covalently joined. The monomers may be joined one at a time or in strings of multiple monomers, ordinarily known as “oligomers.” Thus, for example, one monomer and a string of five monomers may be joined to form a macromolecule or polymer of six monomers. Similarly, a string of fifty monomers may be joined with a string of hundred monomers to form a macromolecule or polymer of one hundred and fifty monomers. The term polymer as used herein includes, for example, both linear and cyclic polymers of nucleic acids, polynucleotides, polysaccharides, oligosaccharides, proteins, polypeptides, peptides, phospholipids and peptide nucleic acids (PNAs). The peptides include those peptides having either α -, β -, or ω -amino acids. In addition, polymers include heteropolymers in which a known drug is covalently bound to any of the above, polyurethanes, polyesters, polycarbonates, polyureas, polyamides, polyethyleneimines, polyarylene sulfides, polysiloxanes, polyimides, polyacetates, or other polymers which will be apparent upon review of this disclosure.

[0091] The term “biomolecule” refers to any organic molecule that is part of or from a living organism. Biomolecules include a nucleotide, a polynucleotide, an oligonucleotide, a peptide, a protein, a ligand, an antibody, a receptor, among others. A “complex of a biomolecule” refers to a structure made up of two or more types of biomolecules. Examples of a complex of biomolecule include a cell or viral particles.

[0092] As used herein, “biological cells” and “cells” are interchangeable, unless otherwise clearly indicated, and refer to the structural and functional units of all living organisms, sometimes called the “building blocks of life.” Cells, as used herein include bacteria, fungi, and animal mammalian cells. Specifically included are animal blood cells, such as red blood cells, white blood cells, and platelets.

[0093] The term “analyte” or “analyte molecule” refers to a molecule or biological cell of interest that is to be analyzed or detected, e.g., a nucleotide, an oligonucleotide, a polynucleotide, a peptide, a protein, an antibody, or a blood cell. Examples of analytes that can be investigated by this invention include, but are not restricted to, agonists and antagonists for cell membrane receptors, toxins and venoms, viral epitopes, hormones, hormone receptors, peptides, enzymes, enzyme reaction substrates, cofactors, drugs (e.g. opiates, steroids, etc.), lectins, sugars, polynucleotides, nucleic acids,

oligosaccharides, proteins, antibodies, and autoantibodies. The analyte or analyte molecule could be a small molecule, biomolecule, or nanomaterial such as but not necessarily limited to a small molecule that is biologically active, nucleic acids and their sequences, peptides and polypeptides, as well as nanostructure materials chemically modified with biomolecules or small molecules capable of binding to molecular probes such as chemically modified carbon nanotubes, carbon nanotube bundles, nanowires and nanoparticles. The analyte in an assay can be a moiety or derivative generated by assay process, which is the subsequently recognized and detected as surrogate marker of the analyte contained in the sample. The analyte may be magnetically tagged, or labeled to facilitate its detection and separation.

[0094] The term “affinity agent” refers to a molecule that binds to an analyte for the detection and/or analysis of the analyte. The affinity agent generally, but not necessarily, has a known molecular structure or sequence. In one embodiment, the affinity agent is attached to a solid surface of the fluidic device. When the affinity agent is attached to a solid surface, it is referred to as an “affinity surface”. In another embodiment, the affinity agent is attached to a magnetic particle or signal particle. When the affinity agent is attached to the magnetic particle, it is referred to as a “magnetic affinity complex”. When the affinity agent is attached to the signal particle, it is referred to as a “signal affinity complex”. In one embodiment of the signal affinity complex, the affinity agent is the analyte of interest; in such case, the signal affinity complex is termed a “signal analyte complex”. The affinity agent typically include, but are not limited to antibodies, autoantibodies, cell membrane receptors, monoclonal or polyclonal antibodies and antisera reactive with specific antigenic determinants (such as on viruses, cells or other materials), drugs, polynucleotides, nucleic acids, peptides, proteins, cofactors, lectins, sugars, polysaccharides, cells, cellular membranes, and organelles. Affinity agents are biomolecules capable of undergoing binding or molecular recognition events with analytes. An affinity agent can be a capture molecule.

[0095] The term “capture molecule” refers to a molecule that is immobilized on a surface. The capture molecule can bind to the analyte, the magnetic particle, the signal particle, the affinity agent, or the code. The capture molecule is typically a nucleotide, an oligonucleotide, a polynucleotide, a peptide, or a protein, but could also be a small molecule, biomolecule, or nanomaterial such as but not necessarily limited to a small molecule that is biologically active, nucleic acids and their sequences, peptides and polypeptides, as well as nanostructure materials chemically modified with biomolecules or small molecules capable of binding to an analyte that is bound to an affinity agent to form a complex of the capture molecule, analyte and the magnetic affinity complex and/or the signal affinity complex. The capture molecule may be magnetically or fluorescently labeled DNA or RNA. In specific embodiments of the invention, the capture molecule may be immobilized on the surface of a fluidic zone of the fluidic device. The capture molecule may or may not be capable of binding to just the analyte, or just the affinity agent.

[0096] The terms “die,” “polymer array chip,” “DNA array,” “array chip,” “DNA array chip,” or “bio-chip” are used interchangeably and refer to a collection of a large number of probes arranged on a shared substrate which could be a portion of a silicon wafer, a nylon strip or a glass slide.