

DNA strands are denatured and the previously bound oligonucleotides flow past a set of electrodes. A group at Motorola have developed a polydimethylsiloxane (PDMS) flow cell that sits atop of a DNA array card (i.e., a substrate with nucleotides bound to a plurality of discrete locations thereof). Once hybridization is complete the microfluidics may be removed and the DNA array card placed in a card reader for detection. Thus, that assay is an end-point assay and is, therefore, not useful in providing results in real time.

[0013] In view of the foregoing, it appears that there is a need for an apparatus that facilitates the optical assessment of small-volume samples accurately and reliably in real time.

SUMMARY OF THE INVENTION

[0014] The present invention includes microfluidic platforms that are useful with apparatus for conducting specific binding assays. A microfluidic platform incorporating teachings of the present invention includes at least one elongate, nonlinear microfluidic channel that is configured to be positioned over a reaction surface of an apparatus for conducting one or more specific binding assays.

[0015] The at least one elongate, nonlinear microfluidic channel of a microfluidic platform according to the present invention may have a substantially uniform width and height along the length thereof. Alternatively, regions of the at least one elongate, nonlinear microfluidic channel that are to communicate with sensing zones of a specific binding apparatus may have an increased width relative to the remaining regions of the channel (i.e., those which will not be in direct communication with a sensing zone). Features that create folding of and that may, therefore, cause mixing of a sample or sample solution upon flowing thereof along the length of a channel may also be provided at one or more surfaces of the channel. Such features may be particularly advantageous when used at or near regions of the channel that will be in direct communication with corresponding sensing zones of a specific binding assay apparatus when the microfluidic platform and specific binding assay apparatus are assembled with one another.

[0016] Specific binding assay apparatus that include a microfluidic channel over at least two sensing zones thereof are also within the scope of the present invention. These specific binding assay apparatus may be embodied as any type of specific binding assay apparatus with which microfluidics would be useful. Examples of such apparatus include, but are not limited to, waveguides (including planar and cylindrical waveguides, as well as waveguides having other configurations) and other apparatus (e.g., semiconductor chip-based devices) which employ use of labels (e.g., fluorescent tags, metal tags, etc.), apparatus that are useful in surface plasmon resonance (SPR) type detection, and the like.

[0017] In another aspect of the present invention, a method for conducting a specific binding assay includes introducing a sample or sample solution into an open end of a microfluidic channel and permitting the sample or sample solution to be drawn into and through the channel, into contact with a plurality of sensing zones on the surface of a specific binding assay apparatus. As the sample or sample solution is drawn through the channel, binding of analytes in the sample or sample solution by corresponding capture

molecules at each sensing zone may then be detected, as known in the art. Detection may be conducted from a location orthogonal to a plane of the specific binding assay apparatus. Of course, detection of binding depends upon the specific type of assay (e.g., immunofluorescence, SPR, etc.) being used.

[0018] An exemplary method for fabricating a microfluidic platform includes forming a mold, or master, that includes at least one elongate, nonlinear protrusion. The protrusion follows a path that is substantially identical to a continuous pathway through a plurality of sensing zones on a specific binding assay apparatus with which the microfluidic platform is to be used. The heights and widths of the protrusions may be configured to provide desired fluid flow properties, such as minimum sample or sample solution size, flow rate, and the like. In addition, one or more surfaces of the protrusions may be configured in such a way as to define mixing, or folding-generating, structures in a microfluidic platform formed therewith. A material that will closely conform to the shape of the surfaces of the mold is then introduced onto such surfaces and at least partially cured while located thereon. The material may readily release from the mold upon at least partial curing thereof or, in the alternative, be compatible with a suitable release material. It is currently preferred that the material will polymerize in such a way as to substantially retain the desired shape and dimensions of the at least one microfluidic channel formed therein, as well as the shape and dimensions of any mixing structures formed therefrom, upon being removed from the mold. Subsequent changes to the orientation of the sidewalls of the at least one microfluidic channel, mixing structures, and other features or dimensions of the resulting microfluidic platform are, however, also within the scope of the present invention.

[0019] It is currently preferred that the material of the microfluidic platform be substantially impermeable to the types of samples or sample solutions (e.g., aqueous) that will contact the resulting microfluidic platform. It is also currently preferred that at least the assayed constituents (i.e., the analytes) of a sample or sample solution not be adsorbed to or chemically react with the material of the microfluidic platform. The material from which the microfluidic platform is fabricated may prevent such adsorption by or reaction with the constituents of a sample or sample solution, or the microfluidic platform may be treated with passivation chemicals, as known in the art, that will prevent such adsorption or reaction.

[0020] In addition, a microfluidic platform incorporating teachings of the present invention may be fabricated from a material that is optically transparent to at least wavelengths of radiation that are indicative of the occurrence of a binding reaction at a sensing zone of a specific binding assay apparatus with which the microfluidic platform is used so as to facilitate detection of binding of one or more types of analytes by corresponding capture molecules through the microfluidic platform. Accordingly, the thickness of the material from which the microfluidic platform is formed may also be optimized to facilitate the level of detection of binding of one or more analytes in a sample or sample solution therethrough.

[0021] A microfluidic platform that is fabricated separately from its corresponding specific binding assay appa-