

as acrylic or the like, that allows light generated within cavity 17 to be detected by a detector (not shown) coupled to base 11.

[0059] Diaphragm 13 is a solid-phase support for a reagent 15, such as a binding reagent, and preferably is comprised of a thin film or sheet of material. In particular, diaphragm 13 is preferably a fibril-polymer composite material. As shown, diaphragm 13 is coupled to base 11 at aperture 14. Preferably, diaphragm 13 forms a seal with base 11 covering aperture 14.

[0060] Sonication generator 16 is a device for sonicating diaphragm 13. Preferably, sonication generator 16 comprises a piezoelectric sonication device. Generator 16 is preferably controlled by a sonication generator controller (not shown) such as an electrical control circuit or the like. Sonication generator 16 is structurally coupled to diaphragm 13 so as to efficiently transmit sonic energy to diaphragm 13 and to reagents 12.

[0061] In operation, reagents 12 are introduced into cavity 17. Sonication generator 16 is energized and sonicates diaphragm 13. Diaphragm 13 conducts the sonication energy to cavity 17, and thus to reagents 12 contained therein. The sonication causes reagents 12 to mix, speeding the rate of reaction among reagents 12. The sonication will also increase the rate of mass-transport of reagents, products, byproducts, etc., to and from binding reagents 15 on diaphragm 13, thus, speeding the rate of binding reactions at the solid-phase support. Alternately, binding reagents 15 may be omitted.

[0062] In an alternate embodiment, a non-solid coupling material (not shown) is placed between generator 16 and diaphragm 13. The coupling material may be liquid or gas. It is contemplated that the coupling material may be held in a sealed container, such as a flexible plastic membrane. In another embodiment, the coupling material may comprise a solid piston structure. Sonication energy from sonication generator 16 is structurally coupled via the solid piston structure to diaphragm 13. In a further alternate embodiment, reagent 15 is omitted from the surface of diaphragm and is located on a surface of cavity 17.

[0063] FIG. 2 illustrates a particular cross-sectional view of an assay cell 20. Assay cell 20 includes a base 22, a reaction enclosure 24, a sonication device 26, and a device mount 28. Base 22 is preferably a rigid material that surrounds reaction enclosure 24 and structurally couples sonication device 26 to reaction enclosure 24. Alternatively, base 22 comprises a flexible material (e.g., base 22 comprises a flexible plastic container or a blister pack). In assay formats that use optical detection techniques (e.g., ECL, fluorescence, chemiluminescence), base 22 is preferably a transparent material, such as acrylic or the like, that allows light generated within reaction enclosure 24 to be detected by a detector (not shown) coupled to base 22.

[0064] Reaction enclosure 24 is preferably a void in base 22 in which assay reagents 25 may be introduced and subjected to sonication to promote mixing and reaction. Alternatively, reaction enclosure 24 may comprise a separate enclosure comprising transparent material that is structurally coupled to base 22. The interior surface of enclosure 24 may be utilized as a solid-phase support for binding reagents and such reagents may be immobilized upon the

solid-phase support. Enclosure 24 may have one or more openings therein to connect with passages (not shown) for the introduction and removal of reagents.

[0065] Sonication device 26 is a device for sonicating base 22 such that sonication energy will propagate to reaction enclosure 24 and reagents 25 contained therein. Preferably, sonication device 26 comprises a piezoelectric sonication device. Device 26 is preferably controlled by a sonication controller (not shown) such as an electrical control circuit or the like.

[0066] Device 26 mounts on device mount 28 which is adapted to securely hold device 26 in close contact with base 22. Although device 26 is shown immediately abutting base 22 and device mount 28, a small space may exist between base 22 and device 26 and/or between device mount 28 and device 26 to allow device 26 to expand and contract or to otherwise move while sonicating.

[0067] In an alternate embodiment, a non-solid coupling material (not shown) is placed between device 26 and base 22. The coupling material may be liquid or gas. It is contemplated that the coupling material may be held in a sealed container, such as a flexible plastic membrane. In a further alternate embodiment, device mount 28 may be omitted and device 26 may be attached directly to base 22 (e.g., via adhesives or mounting hardware).

[0068] In operation, reagents 25 are introduced into reaction enclosure 24. Sonication device 26 is energized and sonicates base 22. Base 22 conducts the sonication energy to reaction enclosure 24 and thus to reagents 25 contained therein. The sonication causes reagents 25 to mix, speeding the rate of reaction among reagents 25. Where enclosure 24 contains binding reagents or other reagents immobilized on or otherwise located at a solid-phase support, the sonication will also increase the rate of mass-transport of reagents, products, byproducts, etc., to and from the support, thus, speeding the rate of binding reactions at the solid-phase support.

[0069] FIG. 3 illustrates a particular cross-sectional view of an assay cell 30. Assay cell 30 includes a base 32, a reaction enclosure 34, a sonication device 36, and a device mount 38. Base 32 is preferably a rigid material that surrounds reaction enclosure 34. In assay formats that use optical detection techniques (e.g., ECL, fluorescence, chemiluminescence), base 32 is preferably a transparent material, such as acrylic or the like, that allows light generated within reaction enclosure 34 to be detected by a detector (not shown).

[0070] Reaction enclosure 34 is preferably a void in base 32 in which assay reagents 35 may be introduced and sonicated to promote mixing and reaction. Alternatively, reaction enclosure may comprise a separate enclosure, made of a transparent material that is structurally coupled to base 32. Enclosure 34 may have openings (not shown) for the introduction and removal of reagents.

[0071] Sonication device 36 is a device for sonicating reagents and/or reaction enclosure 34. Preferably, sonication device 36 may be exposed directly to reagents 35. Alternatively, sonication device 36 may be encased in a protective covering (not shown) that is capable of transmitting sonication energy from device 36 to reagents 35. Sonication device 36, or a coating or material placed thereon (not