

element for preventing glass shards from entering the cartridge fluidics. Also as shown, the bottom of the chamber may be sloped such that the outlet is at the lowest point in the chamber.

[0210] In an alternative embodiment, a pierceable container such as a pouch or blister pack may be employed. Preferably, the pierceable container has a pierceable wall made from a plastic film, a metal foil, or most preferably, a metal foil/plastic film laminate. In such an embodiment the assay reagent release mechanism could employ a piercing scheme. FIG. 22 shows an exploded view of one preferred embodiment of a reagent chamber for holding a pierceable container. Reagent chamber 2210 has piercing tip 2212 located at the bottom of the chamber. Chamber 2210 is connected to reagent conduit 2216 and, optionally, a vent conduit (not shown). Reagent module 2220 comprises module body 2230, preferably made of injected molded plastic, that defines the walls of a fluid compartment, having a first opening 2232 and a second opening 2234. Fluid is sealed in the compartment by first opening cover 2242 and second opening cover 2244, the covers preferably made of a plastic-metal laminate (most preferably and aluminum coated mylar film) Module 2220 also, preferably, has tongue 2250 that fits in chamber groove 2214 so as to properly align module 2220 in chamber 2210 and hold module in an elevated position above piercing element 2212. Chamber 2210 also, preferably, has a chamber cover layer that prevents leakage of reagent from the chamber after rupture of module 2220. On application of a threshold downward force to module 2220, preferably through a flexible chamber cover layer, module 2220 is pushed against tip 2212, piercing first opening cover 2242 and releasing the reagent into the chamber. Module 2220 also, preferably, comprises a second piercing tip 2236 that is attached to the module walls via a cantilever (the second piercing element and cantilever are preferably integral to the module body; such a component is readily manufacturable, e.g., by injection molding). When piercing tip 2212 pierces first opening cover 2242 in a module with a second tip element 2236, piercing tip 2212 pushes second piercing tip 2236 until it pierces second opening cover 2234 making a second opening in module 2220 and facilitating extraction of the fluid from the pouch; i.e., venting the pouch itself.

[0211] In another alternate embodiment, liquid reagents are stored in a syringe comprising a syringe chamber and a plunger. The chamber may be an integral component of the cartridge, a module that is inserted into the cartridge or a separate component that is attached (e.g., via a luer lock connection) to the cartridge prior to use. Actuation of the plunger may be used to release the contents of the syringe into a reagent chamber or, alternately, to transfer the contents directly into other fluidic components of the cartridge.

[0212] An important consideration for cartridge based assay systems relates to long term storage of the cartridge prior to use; i.e., "shelf life" of the cartridge. Certain assay reagents (especially biological reagents and/or binding reagents such as enzymes, enzyme substrates, antibodies, proteins, receptors, ligands, haptens, antigens, nucleic acids and the like), when dissolved in a liquid medium require special handling and storage in order to improve their shelf life. In certain instances, even if the assay reagents dissolved in liquid media are handled and stored in strict compliance with the special handling and storage requirements their shelf life is impracticably short. Furthermore, the need to observe special handling and storage requirements adds to the com-

plexity and cost of the cartridge based system employing such reagents. The special handling and storage requirements can be substantially reduced, if not eliminated, and the complexity and cost of the system can be minimized by using more stable dry, or dehydrated, forms of the assay reagents. The use of dry reagents can also simplify mixing operations and reduce the volume and weight of a cartridge. Reagents that may be included in dry form include biological reagents, binding reagents, pH buffers, detergents, anti-foam agents, extraction reagents, blocking agents, and the like. The dry reagent may also include excipients used to stabilize the dry reagents such as sugars (e.g., sucrose or trehalose). For assays that may employ acidic or basic samples (e.g., samples that are inherently acidic/basic and/or samples that are extracted or otherwise treated with an acidic/basic reagent), a dry reagent may include a neutralizing reagent (e.g., an acid, base of a pH buffer). In especially preferred embodiment that involve extraction of samples with nitrous acid, the extracted sample is passed over a dry reagent comprising a base or, more preferably, the base form of a buffering agent (e.g., Tris, Hepes, phosphate, PIPES, etc.). A sufficient amount of the base or buffering agent is included to bring the pH of the extracted sample to a value that is compatible with subsequent assay reactions carried out on the sample (e.g., binding reactions with binding reagents).

[0213] Dry reagents may be employed in a cartridge based assay system in a number of ways. As described above, dry reagents may be stored in a reagent chamber that is filled prior to use by a user or by a cartridge reader apparatus. Similarly, dry reagents may be stored in other fluidic components such as within fluidic conduits or chambers, most preferably within a fluidic conduit connecting the sample and detection chambers. Introduction or passage of liquid (e.g., a liquid sample or a liquid reagent) through the conduit or chamber results in dissolution of the dry reagent. Dry reagents may be inserted during the manufacture of a cartridge by depositing the dry reagents in the appropriate fluidic component, e.g., by depositing the reagent in the form of a powder or pellet or by incorporating the dry reagent in a screen printed ink. Alternatively, the reagents may be inserted in solution and then dried to remove the solvent. In one preferred embodiment dried reagents may be formed upon a substrate by depositing solutions containing the reagents in one or more predefined locations and subsequently drying the reagents to form a dried reagent pill under conditions such that on addition of a liquid sample or an appropriate solvent, the dry reagent dissolves into solution. The term "pill" is used herein to refer generally to an amount of a dry, but redissolvable, reagent on a substrate and not to connote any specific three dimensional shape. The location of a pill on a substrate is referred to herein as a "pill zone". The substrate is preferably a component of the cartridge, e.g., cartridge body, chamber, cover layer, electrode array, etc. Suitable locations for the pill zone include the sample chamber, reagent chamber, sample conduits, and reagent conduits so that liquid reagents and samples pick up the dry reagent prior to their introduction to the detection chambers. Alternatively, the reagent pills may be located within the detection chambers themselves. In the preferred embodiment depicted in FIG. 13a, the dried reagent pills are formed upon the cover layer 1322 in two predefined pill zones. In another preferred embodiment, a reagent chamber holds a liquid reagent in an ampoule and a dry reagent pill, so that the dry reagent is reconstituted upon rupture of the ampoule. This arrangement is useful for preparing a reagent