

prising the assay reagents to the surfaces, most preferably, by patterned depositions of these solutions to form an array of assay domains comprising the assay reagents), assay performance is often improved by washing the assay electrodes to remove unbound assay reagents. This washing step is particularly important when unbound assay reagent may interfere with an assay (e.g., unbound antibodies may interfere by competing with the capture of analytes to antibodies on the surface). Preferably, this washing step is carried out using a procedure that minimizes the ability of unbound reagents to adsorb in other undesirable locations. For example, after immobilization of an antibody on an assay domain on an electrode in an assay module, the washing step will preferably minimize the adsorption of unbound antibody to non-electrode surface (antibody adsorbed on non-electrode surfaces interfering with binding assays by competing for the binding of analyte with antibody immobilized on the electrode). Even more importantly, in array type measurements involving a plurality of assay domains specific for different analytes of interest, the washing step should minimize the diffusion of an unbound assay reagent from one assay domain and its adsorption on a different assay domain (this process leading to assay cross-talk).

[0169] We have found that we can prevent the undesired adsorption of assay reagents outside pre-defined locations by localized washing of assay domains using a concentric tube dispense/aspirate fixture. FIGS. 7a and 7b depict one embodiment wherein a washing fixture was constructed that consists of a single concentric tube structure which may be used to wash a single assay domain in an assay module or to sequentially wash multiple assays domains in an assay module by positioning the concentric tube structure over each assay electrode. It should be understood, however that the invention is not limited to a single concentric tube device but can, preferably, employ an array of concentric tubes, preferably, arranged in the same pattern and spacing as the assay domains. Preferably, wash fluid is dispensed through inner tube 705 and aspirated through outer tube 710. In operation, as the fluid transitions from the inner tube to the outer, it preferably passes over the assay domain surface, washing the assay domain in an area confined by the diameter of the outer tube. The figure shows the concentric tube being used to wash a carbon ink electrode 720 patterned on substrate 730, the exposed surface of electrode 720 being defined by patterned dielectric layer 725 which acts as a boundary to form a fluid containment region on electrode 720. By analogy, the concentric tubes may be used to wash assay domains on a variety of other surfaces, the assay domains being preferably but not necessarily defined by a fluid boundary. The tubes are preferably configured so that the outer tube removes fluid with a high enough efficiency so as to prevent the spread of fluid to regions outside the domain being washed. In alternate embodiments, the functions of the inner and outer tubes may also be reversed such that the wash fluid is dispensed through the outer tube, and aspirated up the center via the inner tube. These arrangements of tubes prevent unbound assay reagents on the assay domains from contacting other surfaces of the assay module.

[0170] In another alternate embodiment, a tube structure having three concentric tubes is used to pattern and wash assay reagents on assay domains. A first tube (preferably the inner tube) is used to microdispense assay reagents on an assay domain. This tube is preferably linked to a low volume fluid dispensing controller such as a microsyringe (option-

ally, having a solenoid valve flow controller) or piezoelectric dispenser. The second tube (preferably the middle tube) is used to dispense bulk washing reagents on the assay domain. The third tube (preferably the outer tube) is used to aspirate excess assay reagent and/or to wash reagents from the assay domain. Using this arrangement, a single device may be used to dispense assay reagents onto an assay domain (e.g., so as to cause localized immobilization of the assay reagent on the assay domain) and to wash excess assay reagent from the assay domain, these operations occurring without contamination of adjacent surfaces with the assay reagent. Optionally, an array of these devices is used to pattern and wash an array of assay domains.

[0171] The invention relates in part to assay cartridges. An assay cartridge of the invention incorporates one or more fluidic components such as compartments, wells, chambers, fluidic conduits, fluid ports/vents, valves, and the like and/or one or more detection components such as electrodes, electrode contacts, sensors (e.g., electrochemical sensors, fluid sensors, mass sensors, optical sensors, capacitive sensors, impedance sensors, optical waveguides, etc.), detection windows (e.g., windows configured to allow optical measurements on samples in the cartridge such as measurements of absorbance, light scattering, light refraction, light reflection, fluorescence, phosphorescence, chemiluminescence, electrochemiluminescence, etc), and the like. A cartridge may also comprise reagents for carrying out an assay such as binding reagents, detectable labels, sample processing reagents, wash solutions, buffers, etc. The reagents may be present in liquid form, solid form and/or immobilized on the surface of solid phase supports present in the cartridge. Certain preferred embodiments of the invention, comprise detection chambers having the electrode arrays and/or binding domains as described above (e.g., the electrode arrays described in FIGS. 1-4).

[0172] The fluidic components are preferably designed and incorporated into the cartridge body to form the fluidic network using certain predefined design guidelines. The design guidelines for each component can be dependent upon one or more factors such as, e.g., cartridge body design (i.e., single-piece body, multiple piece body, modular body, single read chamber, multiple read chamber, and the like), manufacturing process (e.g., injection molding, blow molding, hot stamping, casting, machining, etc.), materials (e.g., acrylic, PVDF, PET, polystyrene, polypropylene and the like), assay requirements (e.g., binding assay, competitive binding assay, single step assay, two-step assay, etc.), functional requirements (e.g., sample size, assay reagent volumes, detection technology, time-to-result, incubation, heating, mixing/agitating), safety/handling requirements (e.g., self-containment, regulatory approval, ease of use, etc.), and/or the like.

[0173] The skilled practitioner will be able to readily select materials suitable for the fabrication of the cartridges of the invention. Suitable materials include glass, ceramics, metals and/or plastics such as acrylic polymers (such as Lucite), acetal resins (such as Delrin), polyvinylidene fluoride (PVDF), polyethylene terephthalate (PET), polytetrafluoroethylene (e.g., Teflon), polystyrene, polypropylene, ABS, PEEK and the like. Preferably, the materials are inert to any solutions/reagents that will contact them during use or storage of the cartridge. In certain preferred embodiments, at least some portion of the cartridge is fabricated from transparent and/or translucent materials such as glass or acrylic polymer to provide windows that allow optical interrogation of fluids