[0127] Dielectrics, in accordance with certain preferred embodiments, may be applied by a variety of means, for example, printing, spraying, laminating, or may be affixed with adhesives, glues, solvents or by use of mechanical fasteners. Patterns and/or holes in dielectric layers may be formed by molding processes (i.e., during fabrication of the layer), by selective etching and/or by a cutting process such as die cutting or laser drilling. Dielectrics may be deposited and/or etched in patterns through the use of established photolithographic techniques (e.g., techniques used in the semiconductor electronics industry) and/or by patterned deposition using an evaporative or CVD process (e.g., by deposition through a mask). In a preferred embodiment, a dielectric ink is deposited on a substrate by printing (e.g., ink jet printing, laser printing or, more preferably, screen printing) and, optionally, UV cured. Preferably, the screen printed dielectric is UV curable allowing for improved edge definition than solvent based dielectrics. In another preferred embodiment, a non-conducting polymeric film is affixed to a support using an adhesive.

[0128] When using a dielectric ink printed on, or adjacent to, an electrode to confine fluids to regions of the electrode surface, the dielectric film preferably has a thickness of 0.5-100 micrometers, or more preferably 2-30 micrometers, or most preferably 8-12 micrometers and also, preferably, has a sharply defined edge with steep walls.

[0129] Miniaturization of various components and processes required to support ECL-based assays can also benefit from novel approaches to induce ECL. When inducing ECL, the working electrode and a counter electrode are, preferably, spaced relatively close to one another to minimize the effect of voltage drops in solution on the intensity and spatial distribution of ECL signals. When multiple ECL measurements are to be made in the same solution volume, each measurement, preferably, uses a closely spaced working electrode (where electrochemiluminescence is induced) and a counter electrode (to complete the electrochemical circuit). One possible configuration is for each measurement to have its own pair of electrodes; however, this configuration would require the largest volume, space, and number of electrical contacts on the device. An alternative configuration is for each measurement to share a common counter electrode that is reused. **FIGS. 3***f* and **3***g* illustrate possible alternative approaches for using common counter electrodes. As can be seen, the detection chambers (e.g., detection chamber **341**) for such configurations would still require a large space in order to accommodate both the working electrodes (e.g., working electrode **315**) and the single, common counter electrode **311**. Moreover, the relative size and spacing of each working electrode-counter electrode pair will affect the relative performance of each pair. Therefore, as depicted in **FIGS. 3***f* and **3***g* configurations employing a single, common counter electrode would preferably ensure that the relative size and spacing of each working-counter electrode pair is approximately equal. Preferably, the working electrodes are arranged in a one dimensional array, the array being preferably arranged along the flow path of a flow cell. The common counter electrode is also, preferably aligned with the flow path to one side of the array so as to maintain approximate equal spacing to each of the working electrodes. Preferably, no working electrode is located in the shortest path between the counter electrode and a different working electrode; application of a large potential between the counter electrode and a first working electrode can under some conditions generate high enough potentials in the intervening solution to trigger an undesired emission of ECL at a second working electrode located in the shortest path between the first working electrode and the counter electrode. Optionally, the electrode surface area in contact with the detection chamber is defined by an aperture in a dielectric film deposited on the electrode layer (shown as circles on the electrode layer).

[0130] In one preferred embodiment, an electrode pair-wise firing scheme can be employed in order to miniaturize the cartridge to the largest extent practicable, and therefore greatly reduce the volume and space required. This preferred pair-wise firing scheme, or electrode-pairing scheme, would preferably employ a sacrificial, or dedicated counter electrode for the first measurement and thereafter allow the reuse of a previously fired (where fired describes the state of the surface after the application of a working electrode potential, e.g., a potential sufficient to generate electrochemiluminescence at a working electrode) working electrode as the next counter electrode for the next measurement. Surprisingly, as discussed below, it was observed that neither having a protein coating on the electrode being used as the counter electrode nor the fact that the electrode was already fired once as a working electrode affected the performance of that electrode for use as a counter electrode, thus allowing the use of electrodes in a dual-role as both working and counter electrodes.

[0131] **FIGS. 3***a***-3***e* depict possible alternative configurations for electrode arrays employing the pair-wise firing scheme. **FIG. 3***a* illustrates a single bank of electrodes that can be used in one or more detection chambers (a single detection chamber **340** is indicated here by the dotted line). The electrodes are preferably arranged in a one dimensional array. Optionally, the electrode surface area in contact with the detection chamber is defined by an aperture in a dielectric film deposited on the electrode layer (shown as circles on the electrode layer). In one embodiment, electrode **310** may be configured as the dedicated counter electrode, electrodes **305-309** may be configured as the dual-role electrodes and electrode **315** may be configured as the dedicated working electrode. The electrode bank has impedance sensors **325** on leads to the electrodes which can be arranged to contact fluid in input or outlet lines to the detection chamber. Preferably, the impedance sensors are defined by apertures in a dielectric layer deposited on the electrode layer. The electrode array of **FIG. 3***a* utilizes a configuration wherein the electrical contacts and leads are located to one side of the electrodes allowing for simplified mating with the control unit. **FIG. 3***b* depicts an alternative configuration wherein the electrical contacts and leads are alternately placed on either side of the electrodes. Such an alternating configuration can allow for the impedance sensors to be placed on each of the electrical leads so as to allow interrogation of the fluids during both ingress and egress from the detection chamber (e.g., by arranging the fluid inlet line and fluid outlet line so that they, respectively, contact impedance sensors on alternate sides of the electrodes).

[0132] **FIGS. 3***c***-3***e* illustrate configurations employing multiple detection chambers. In particular, **FIGS. 3***c* and **3***d* depict two detection chambers employing two banks of electrodes. **FIG. 3***d* illustrates a configuration wherein the electrodes for one set of contacts/leads are within the oppositely placed detection chamber. Such a configuration