FIG. 1*b* and detection chamber **120** in **FIG. 1***a*). Preferably, the second cartridge component has channels on the mating surface that form flow cells over the electrodes when mated to component **178** (the flow cells having one surface defined by component **178** and an opposing surface and wells defined by the second component. The channels may also be used to form other fluidic paths such as fluidic inlet and outlet lines to the flow cell. These channels may, e.g., be molded or cut into the second component. Alternatively, the walls of the flow cell or other fluidic paths may be defined by a gasket material (preferably, double sided adhesive tape) applied between component **178** and the second cartridge component. Alternatively, the second component has apertures in the mating surface that form wells when mated to component **178**.

[0104] In a preferred embodiment of the invention, an assay cartridge has minimal or no active mechanical or electronic components. When carrying out an assay, such an assay cartridge may be introduced into a cartridge reader which provides these functions. For example, a reader may have electronic circuitry for applying electrical energy to the assay electrodes and for measuring the resulting potentials or currents at assay electrodes. The reader may have one or more light detectors for measuring luminescence generated at assay electrodes. Light detectors that may be used include, but are not limited to photomultiplier tubes, avalanche photodiodes, photodiodes, photodiode arrays, CCD chips, CMOS chips, film. The light detector may be comprised within an optical detection system that also comprise lenses, filters, shutters, apertures, fiber optics, light guides, etc. The reader may also have pumps, valves, heaters, sensors, etc. for providing fluids to the cartridge, verifying the presence of fluids and/or maintaining the fluids at an appropriate controlled temperature. The reader may be used to store and provide assay reagents, either onboard the reader itself or from separate assay reagent bottles or an assay reagent storage device. The reader may also have cartridge handling systems such as controllers for moving the cartridge in and out of the reader. The reader may have a microprocessor for controlling the mechanical and/or electronic subsystems, analyzing the acquired data and/or providing a graphical user interface (GUI). The cartridge reader may also comprise electrical, mechanical and/or optical connectors for connecting to the cartridge.

[0105] One aspect of the invention relates to the assay modules employing electrodes, the immobilization of assay reagents on these electrodes, and their use in assays, preferably electrode-induced luminescence assays. Co-pending U.S. patent application Ser. No. 10/185,274, filed Jun. 28, 2002, hereby incorporated by reference, provides a number of examples of electrode and dielectric materials, electrode patterns and patterning techniques and immobilization techniques that are adapted for use in electrode-induced luminescence assays and suitable for use with the assay modules of the invention. Electrodes in the present invention are preferably comprised of a conductive material. The electrode may comprise a metal such as gold, silver, platinum, nickel, steel, iridium, copper, aluminum, a conductive alloy, or the like. They may also comprise oxide coated metals (e.g. aluminum oxide coated aluminum). Electrodes may comprise non-metallic conductors such as conductive forms of molecular carbon. Electrodes may also be comprised of semiconducting materials (e.g. silicon, germanium) or semiconducting films such as indium tin oxide (ITO), antimony tin oxide (ATO) and the like. Electrodes may also be comprised of mixtures of materials containing conductive composites, inks, pastes, polymer blends, metal/non-metal composites and the like. Such mixtures may include conductive or semi-conductive materials mixed with non-conductive materials. Preferably, electrode materials are substantially free of silicone-based materials.

[0106] Electrodes (in particular working electrodes) used in assay modules of the invention are advantageously able to induce luminescence from luminescent species. Preferable materials for working electrodes are materials able to induce electrochemiluminescence from ruthenium-tris-bipyridine in the presence of tertiary alkyl amines (such as tripropyl amine). Examples of such preferred materials include platinum, gold, ITO, carbon, carbon-polymer composites, and conductive polymers.

[0107] Preferably, electrodes are comprised of carbon-based materials such as carbon, carbon black, graphitic carbon, carbon nanotubes, carbon fibrils, graphite, carbon fibers and mixtures thereof. Advantageously, they may be comprised of conductive carbon-polymer composites, conductive particles dispersed in a matrix (e.g. carbon inks, carbon pastes, metal inks), and/or conductive polymers. One preferred embodiment of the invention is an assay module, preferably an assay cartridge, having electrodes (e.g., working and/or counter electrodes) that comprise carbon, preferably carbon layers, more preferably screen-printed layers of carbon inks. Some useful carbon inks include materials produced by Acheson Colloids Co. (e.g., Acheson 440B, 423ss, PF407A, PF407C, PM-003A, 30D071, 435A, Electrodag 505SS, and Aquadag™), E. I. Du Pont de Nemours and Co. (e.g., Dupont 7105, 7101, 7102, 7103, 7144, 7082, 7861D, E100735 62B and CB050), Advanced Conductive Materials (e.g., PTF 20), Gwen Electronics Materials (e.g., C2000802D2) and Conductive Compounds Inc (e.g., C-100), and Ercon Inc. (e.g., G-451, G-449 and 150401).

[0108] In another preferred embodiment, the electrodes of the invention comprise carbon fibrils. The terms "carbon fibrils", "carbon nanotubes", single wall nanotubes (SWNT), multiwall nanotubes (MWNT), "graphitic nanotubes", "graphitic fibrils", "carbon tubules", "fibrils" and "buckeytubes", all of which terms may be used to describe a broad class of carbon materials (see Dresselhaus, M. S.; Dresselhaus, G.; Eklund, P. C.; "Science of Fullerenes and Carbon Nanotubes", Academic Press, San Diego, Calif., 1996, and references cited therein). The terms "fibrils" and "carbon fibrils" are used throughout this application to include this broad class of carbon-based materials. Individual carbon fibrils as disclosed in U.S. Pat. Nos. 4,663,230; 5,165,909; and 5,171,560 are particularly advantageous. They may have diameters that range from about 3.5 nm to 70 nm, and length greater than 10^2 times the diameter, an outer region of multiple, essentially continuous, layers of ordered carbon atoms and a distinct inner core region. Simply for illustrative purposes, a typical diameter for a carbon fibril may be approximately between about 7 and 25 nm, and a typical range of lengths may be 1000 nm to 10,000 nm. Carbon fibrils may also have a single layer of carbon atoms and diameters in the range of 1 nm-2 nm. Electrodes of the invention may comprise one or more carbon fibrils, e.g., in the form of a fibril mat, a fibril aggregate, a fibril ink, a fibril composite (e.g., a conductive composite comprising fibrils dispersed in an oil, paste, ceramic, polymer, etc.).