

preferred embodiment, the nucleophilic chemical functional group is present on and/or in a biomolecule, either naturally and/or by chemical derivatization. Examples of suitable biomolecules include, but are not limited to, amino acids, proteins and functional fragments thereof, antibodies, binding fragments of antibodies, enzymes, nucleic acids, and combinations thereof. This is one of many such possible techniques and is generally applicable to the examples given here and many other analogous materials and/or biomolecules. In a preferred embodiment, reagents that may be used for ECL may be attached to the electrode via NHS-ester groups.

[0121] It may be desirable to control the extent of non-specific binding of materials to electrodes. Simply by way of non-limiting examples, it may be desirable to reduce or prevent the non-specific adsorption of proteins, antibodies, fragments of antibodies, cells, subcellular particles, viruses, serum and/or one or more of its components, ECL labels (e.g., $\text{Ru}^{\text{II}}(\text{bpy})_3$ and $\text{Ru}^{\text{III}}(\text{bpy})_3$ derivatives), oxalates, trialkylamines, antigens, analytes, and/or combinations thereof). In another example, it may be desirable to enhance the binding of biomolecules.

[0122] One or more chemical moieties that reduce or prevent non-specific binding (also known as blocking groups) may be present in, on, or in proximity to an electrode. Such moieties, e.g., PEG moieties and/or charged residues (e.g., phosphates, ammonium ions), may be attached to or coated on the electrode. Examples of useful blocking reagents include proteins (e.g., serum albumins and immunoglobins), nucleic acids, polyethylene oxides, polypropylene oxides, block copolymers of polyethylene oxide and polypropylene oxide, polyethylene imines and detergents or surfactants (e.g., classes of non-ionic detergents/surfactants known by the trade names of Brij, Triton, Tween, Thesit, Lubrol, Genapol, Pluronic (e.g., F108), Tetronic, Tergitol, and Span).

[0123] Materials used in electrodes may be treated with surfactants to reduce non-specific binding. For example, electrodes may be treated with surfactants and/or detergents that are well known to one of ordinary skill in the art (for example, the Tween, Triton, Pluronics (e.g., F108), Span, and Brij series of detergents). Solutions of PEGs and/or molecules which behave in similar fashion to PEG (e.g., oligo- or polysaccharides, other hydrophilic oligomers or polymers) ("Polyethylene glycol chemistry: Biotechnical and Biomedical Applications", Harris, J. M. Editor, 1992, Plenum Press) may be used instead of and/or in conjunction with surfactants and/or detergents. Undesirable non-specific adsorption of certain entities such as those listed above may be blocked by competitive non-specific adsorption of a blocking agent, e.g., by a protein such as bovine serum albumin (BSA), casein or immunoglobulin G (IgG). One may adsorb or covalently attach an assay reagent on an electrode and subsequently treat the electrode with a blocking agent so as to block remaining unoccupied sites on the surface.

[0124] In preferred embodiments, it may be desirable to immobilize (by either covalent or non-covalent means) biomolecules or other assay reagents to carbon-containing materials, e.g., carbon inks, carbon black, fibrils, and/or carbon dispersed in another material. One may attach antibodies, fragments of antibodies, proteins, enzymes, enzyme

substrates, inhibitors, cofactors, antigens, haptens, lipoproteins, liposaccharides, cells, sub-cellular components, cell receptors, viruses, nucleic acids, antigens, lipids, glycoproteins, carbohydrates, peptides, amino acids, hormones, protein-binding ligands, pharmacological agents, and/or combinations thereof. It may also be desirable to attach non-biological entities such as, but not limited to polymers, elastomers, gels, coatings, ECL tags, redox active species (e.g., tripropylamine, oxalates), inorganic materials, chelating agents, linkers, etc. A plurality of species may be co-adsorbed to form a mixed layer on the surface of an electrode. Most preferably, biological materials (e.g., proteins) are immobilized on carbon-containing electrodes by passive adsorption. Surprisingly, biological membranes (e.g., cells, cell membranes, membrane fragments, membrane vesicles, liposomes, organelles, viruses, bacteria, etc.) may be directly adsorbed on carbon without destroying the activity of membrane components or their accessibility to binding reagents (see, e.g., copending U.S. patent application Ser. No. 10/208,526 (entitled "Assay Electrodes Having Immobilized Lipid/Protein Layers, Methods Of Making The Same And Methods Of Using The Same For Luminescence Test Measurements"), filed on Jul. 29, 2002, hereby incorporated by reference.

[0125] Electrodes used in the assay modules are, preferably, non-porous, however, in some applications it is advantageous to use porous electrodes (e.g., mats of carbon fibers or fibrils, sintered metals, and metals films deposited on filtration membranes, papers or other porous substrates). These applications include those that employ filtration of solutions through the electrode so as to: i) increase mass transport to the electrode surface (e.g., to increase the kinetics of binding of molecules in solution to molecules on the electrode surface); ii) capture particles on the electrode surface; and/or iii) remove liquid from the well.

[0126] Preferred assay modules may use dielectric inks, films or other electrically insulating materials (hereinafter referred to as dielectrics). Dielectrics in the present invention may be used to prevent electrical connectivity between electrodes, to define patterned regions, to adhere materials together (i.e., as adhesives), to support materials, to define assay domains, as masks, as indicia and/or to contain assay reagents and other fluids. Dielectrics are non-conducting and advantageously non-porous (i.e., do not permit transmission of materials) and resistant to dissolving or degrading in the presence of media encountered in an electrode induced luminescence measurement. The dielectrics in the present invention may be liquids, gels, solids or materials dispersed in a matrix. They may be deposited in uncured form and cured to become solid. They may be inks, solid films, tapes or sheets. Materials used for dielectrics include polymers, photoresists, plastics, adhesives, gels, glasses, non-conducting inks, non-conducting pastes, ceramics, papers, elastomers, silicones, thermoplastics. Preferably, dielectric materials of the invention are substantially free of silicones. Examples of non-conducting inks include UV curable dielectrics such as materials produced by Acheson Colloids Co. (e.g., Acheson 451SS, 452SS, PF-455, PD039A, PF-021, ML25251, ML25240, ML25265, and Electrotag 38DJB16 clear), Nazdar (e.g., Nazdar GS2081 3400SPL) and E. I. du Pont de Nemours and Co. (e.g., Dupont: 5018, 3571, and 5017).