materials may be used, such as those suitable for integrated circuit manufacturing (CMOS manufacturing). For example, in some examples, the conductive elements/circuity 146 may be metallic elements, such as W (tungsten) elements, Cu (copper) elements, Al (aluminum) elements, or a combination thereof (but it is understood that other materials and configurations may be used). In some examples, the dielectric material may be SiO2 (but it is understood that other materials and configurations may be used).

[0063] As used herein, the term "layer" is not limited to a single continuous body of material unless otherwise noted. For example, the sensor base 141 and/or the device layers of the device base 125 may include multiple sub-layers that are different materials and/or may include coatings, adhesives, and the like. Furthermore, one or more of the layers (or sub-layers) may be modified (e.g., etched, deposited with material, etc.) to provide the features described herein.

[0064] As shown in FIGS. 3 and 4, the reaction structure 126 may comprise one or more layers that form the reaction recesses 104 extending therein. The reaction structure 126 may extend along a top outer surface of the device base 125. In the illustrated example, the reaction structure 126 is deposited directly along the top outer surface of a liner layer 154 and the first and second filter material 116, 115 of the device base 125, as described further below. However, an intervening layer may be disposed between the reaction structure 126 and the device base 125 in other examples. The reaction structure 126 may include one or more materials that are configured to allow the excitation light signals 101 and emitted light signals from the reaction sites 114 (after treatment with the reaction solution) within the recesses 108 to pass therethrough and into an opening 158 of one or more light guide 118 corresponding to a particular reaction recess 108. In some examples, the reaction structure 126 may include one more layer or other feature that prevents crosstalk or "sharing" of emitted light from a particular reaction site 114/reaction recess 108 from passing to a non-corresponding sensor 140.

[0065] The reaction structure 126 may comprise a plurality of differing layers, as shown in FIGS. 3 and 4. In the illustrated example, the reaction structure 126 may include a first reaction layer 160 that extends over (directly or indirectly) device base 125 (e.g., over the liner layer 154) and the opening 158 of the light guides 118 (e.g., the first and second filter material 116, 115) of the device base 125, as shown in FIGS. 3 and 4. As also shown in FIGS. 3 and 4, in the illustrated example, the reaction structure 126 further includes a second layer 162 that extends over (directly or indirectly) the first layer 160. The reaction structure 126 of illustrated

CLAIMS

1. A device, comprising:

a reaction structure that forms a plurality of reaction recesses for containing a reaction solution with a pH of less than or equal to 5 or a pH greater than or equal to 8 and at least one reaction site that generates light emissions in response to incident excitation light after treatment with the reaction solution; and

a device base positioned beneath the reaction structure, comprising:

a plurality of light sensors;

device circuitry electrically coupled to the light sensors to transmit data signals based on photons detected by the light sensors, wherein the device circuitry is provided within dielectric material layers;

a plurality of light guides with input regions that receive the excitation light and the light emissions from at least one corresponding reaction recess, the light guides extending into the device base from the input regions toward at least one corresponding light sensor and comprising at least one filter material that filters the excitation light and permits the light emissions to pass to the at least one corresponding light sensor;

a liner layer extending about the side surfaces of each light guide and positioned between each light guide and the device circuitry;

a protection layer extending about each light guide and positioned between each light guide and the liner layer that prevents reaction solution that passes through the reaction structure and the light guide from interacting with the device circuitry, wherein the protection layer is chemically inert with respect to the reaction solution; and

a first shield layer extending between adjacent input regions to block the excitation light and light emissions incident on the first shield layer, wherein the first shield layer is positioned below the liner layer and in contact with the dielectric material

2. The device of claim 1, wherein the protection layer abuts the plurality of light guides within the device base.

3. The device of claim 2, wherein the liner layer is positioned between the protection layer and the dielectric material layers, and wherein the liner layer abuts the dielectric material layers.

4. The device of claim 1, wherein the protection layer further extends between a top surface of the device base and interstitial areas of the reaction structure extending about the reaction recesses.

5. The device of claim 4, wherein the liner layer extends between the protection layer and the top surface of the device base.

6. The device of claim 1, wherein the protection layer comprises silicon dioxide, a metal oxide, a metal nitride or a combination thereof.

7. The device of claim 1, wherein the protection layer comprises silicon dioxide, silicon oxynitride, silicon monoxide, silicon carbide, silicon oxycarbide, silicon nitrocarbide, metal oxide, metal nitride or a combination thereof.

8. The device of claim 7, wherein the pH of the reaction solution is greater than or equal to 8.

9. The device of claim 1, wherein the pH of the reaction solution is less than or equal to 5, and wherein the protection layer comprises silicon carbide, silicon oxycarbide, silicon nitrocarbide, a metal oxide, a metal nitride or a combination thereof.

10. The device of claim 1, wherein the liner layer comprises a silicon nitride liner layer.

11. The device of claim 1, wherein the protection layer comprises a liquid impervious barrier layer.

12. The device of claim 1, wherein the device circuitry comprises interconnected conductive elements, and the protection layer prevents the reaction solution from oxidizing the conductive elements.

13. The device of claim 1, wherein the thickness of the protection layer is within the range of 5 nanometers to 100 nanometers.

14. The device of claim 1, wherein the reaction structure comprises at least one reaction site immobilized to the reaction structure within each of the plurality of reaction recesses, and wherein the reaction solution may initiate a reaction and/or form a reaction product with the at the at least one reaction site that generates light emissions in response to the incident excitation light.

15. The device of claim 14, wherein the at least one reaction site comprises at least one analyte, and wherein the reaction solution comprises at least one fluorescently-labeled molecule.

16. The device of claim 1, wherein the device circuitry of the device base forms complementary metal-oxide semiconductor (CMOS) circuits.

17. A biosensor, comprising:

the device as claimed in any of the preceding claims; and

a flow cell mounted to the device comprising the reaction solution and at least one flow channel that is in fluid communication with the plurality of reaction recesses of the reaction structure to direct the reaction solution thereto.

18. A method, comprising:

forming a plurality of trenches within a device base comprising a plurality of light sensors and device circuitry electrically coupled to the light sensors to transmit data signals based on photons detected by the light sensors, the plurality of trenches extending from a top surface of the device base and toward at least one corresponding light sensor, wherein the device circuitry is provided within dielectric material layers of the device base;

depositing a shield layer extending between adjacent trenches;

depositing a liner layer over the device base such that the liner layer extends at least within the plurality of trenches;

depositing a protection layer over the liner layer such that the protection layer extends at least within the plurality of trenches, wherein the shield layer is positioned below the liner layer and in contact with the dielectric material;

filling the plurality of trenches over the deposited protection layer with at least one filter material to form a plurality of light guides, the at least one filter material filters light of at least a first wavelength and permits light of a second wavelength to pass therethrough to the at least one corresponding light sensor; and

forming a reaction structure over the plurality of light guides and the protection layer, the reaction structure forming a plurality of reaction recesses corresponding to at least one light guide for containing a reaction solution with a pH of less than or equal to 5 or a pH greater than or equal to 8 and at least one reaction site that generates light emissions of the second wavelength in response to incident excitation light of the first wavelength after treatment with the reaction solution,

wherein the protection layer is chemically inert with respect to the reaction solution.

19. The method of claim 18, wherein the protection layer comprises silicon dioxide, silicon oxynitride, silicon monoxide, silicon carbide, silicon oxycarbide, silicon nitrocarbide, metal oxide, metal nitride or a combination thereof, and wherein the liner layer comprises a silicon nitride liner layer.

20. The method of claim 18, wherein depositing the liner layer over the device base further comprises depositing the liner layer over the top surface of the device base, and wherein depositing the protection layer over the device base further comprises depositing the protection layer over the portion of the liner layer extending over the top surface of the device base.

21. The method of claim 18, further comprising passing the reaction solution with a pH of less than or equal to 5 or a pH greater than or equal to 8 over the reaction structure.