CLAIMS

What is claimed is:

1. An apparatus comprising:

a molding layer over a substrate and covering sides of a light detection device, wherein the molding layer comprises a first region adjacent to a first edge of an active surface of the light detection device and a second region adjacent to a second edge of the active surface of the light detection device, wherein the first region, the second region, and the active surface of the light detection device form a contiguous surface;

a waveguide integration layer between the contiguous surface and a waveguide, wherein the waveguide integration layer comprises optical coupling structures on portions of a top surface of the waveguide integration layer over the top surface of the first region, and over the top surface of the second region, wherein the optical coupling structures couple light waves from a light source to the waveguide;

the waveguide over the waveguide integration layer, wherein the waveguide utilizes the light waves from the waveguide integration layer to excite light sensitive materials in one or more nanowells; and

a nanostructure layer over the waveguide, the nanostructure layer comprising the one or more nanowells, wherein the one or more nanowells are formed on one or more locations on the nanostructure layer, wherein each location of the one or more locations shares a vertical axis with a location on the active surface of the light detection device;

wherein the apparatus further comprises a top layer over the contiguous surface, wherein the top layer and the active surface collectively form a space over the nanostructure layer, the space defining a flow channel,

wherein the top layer comprises:

a second molding layer below a second substrate and covering sides of a second light detection device, wherein the second molding layer comprises a first region adjacent to a first

edge of an active surface of the second light detection device and a second region adjacent to a second edge of the active surface of the second light detection device, wherein the first region of the second molding layer, the second region of the second molding layer, and the active surface of the second light detection device form a second contiguous surface;

a second waveguide integration layer between the second contiguous surface and a second waveguide, wherein the second waveguide integration layer comprises optical coupling structures on portions of a top surface of the second waveguide integration layer below the top surface of the first region of the second molding layer, and below the top surface of the second region of the second molding layer, wherein the optical coupling structures on the portions of the top surface of the second waveguide integration layer couple light waves from the light source to the second waveguide;

the second waveguide below the waveguide integration layer, wherein the second waveguide utilizes the light waves from the second waveguide integration layer to excite light sensitive materials in one or more additional nanowells; and

a second nanostructure layer below the second waveguide, the second nanostructure layer comprising the one or more additional nanowells, wherein the one or more additional nanowells are formed on one or more locations on the second nanostructure layer, wherein each location of the one or more locations on the second nanostructure layer shares a vertical axis with a location on the active surface of the second light detection device.

2. The apparatus of claim 1, wherein the first region and the second region do not overlap the active surface of the light detection device.

3. The apparatus of any of claims 1-2, wherein the optical coupling structures comprise gratings comprising a first grating and a second grating.

4. The apparatus of claim 3, wherein a portion of the optical coupling structures over portions of a top surface of the waveguide integration layer over the top surface of the first region comprises the first grating, and a portion of the optical coupling structures over portions of a top surface of the waveguide integration layer over the top surface of the second region comprises the second grating, wherein a first portion of the nanowells are optically coupled to

the first grating, wherein a second portion of the nanowells are optically coupled to the second grating, and wherein the first portion of the nanowells comprises a portion of the nanowells within a pre-defined proximity of the first grating and the second portion of the nanowells comprises a portion of the nanowells within the pre-defined proximity of the second grating.

5. The apparatus of claim 4, wherein the first portion of the nanowells and the second portion of the nanowells comprise all the nanowells and each nanowell is in either the first portion or the second portion.

6. The apparatus of any of claims 1-5, further comprising:

a filter layer over the contiguous surface and under the waveguide integration layer, wherein the filter layer blocks light from the waveguide from leaking to the light detection device.

7. The apparatus of any of claims 1-6, wherein the light detection device comprises a Complementary Metal-Oxide-Semiconductor (CMOS) detection device, and wherein the apparatus is part of a flow cell.

8. The apparatus of any one of claims 1 -7, the top layer further comprising a feature selected from the group consisting of an electrical component and a physical structure.

9. The apparatus of any one of claims 1-8, wherein a vertical height of the second molding layer relative to a bottom surface of the second substrate being at least substantially equal to a height of an active surface of the second light detection device relative to the bottom surface of the second substrate.

10. The apparatus of any one of claims 1-9, wherein a vertical height of the molding layer relative to a top surface of the substrate is at least substantially equal to a height of an active surface of the light detection device relative to the top surface of the substrate.

11. The apparatus of any of claims 1-10, wherein a period of the light waves passed to the waveguide from the optical coupling structures of the waveguide integration layer, is selected from the group consisting of: variable and fixed, and wherein by at least optically coupling light

waves from the light source to one or more nanowells, a specific portion of the waveguide excites a specific number of nanowells of the one or more nanowells.

12. The apparatus of any of claims 1-11, wherein the apparatus is secured within an enclosure of a socket, the socket comprising a base portion, a plurality of electrical contacts, and a cover portion coupled with the base portion comprising at least one first port, wherein the base portion and the cover portion cooperatively form the enclosure, wherein the electrical contacts extend between the enclosure and an exterior side of the base portion, and the at least one first port extends between the enclosure and an exterior side of the cover portion, wherein the light detection device is electrically coupled to the electrical contacts of the socket.

13. A flow cell, comprising:

a socket comprising a base portion, a plurality of electrical contacts, and a cover portion coupled with the base portion comprising at least one first port, wherein the base portion and the cover portion cooperatively form an enclosure, wherein the electrical contacts extend between the enclosure and an exterior side of the base portion, and the at least one first port extends between the enclosure and an exterior side of the cover portion; and

a light emitting device secured within the enclosure of the socket, comprising:

a molding layer over a substrate and covering sides of a light detection device, wherein the molding layer comprises a first region adjacent to a first edge of an active surface of the light detection device and a second region adjacent to a second edge of the active surface of the light detection device, wherein the first region, the second region, and the active surface of the light detection device form a contiguous surface;

a waveguide integration layer between the contiguous surface and a waveguide, wherein the waveguide integration layer comprises optical coupling structures on portions of a top surface of the waveguide integration layer over the top surface of the first region, and over the top surface of the second region, wherein the optical coupling structures couple light waves from a light source to the waveguide;

the waveguide over the waveguide integration layer, wherein the waveguide utilizes the light waves from the waveguide integration layer to excite light sensitive materials in one or more nanowells; and

a nanostructure layer over the waveguide, the nanostructure layer comprising the one or more nanowells, wherein the one or more nanowells are formed on one or more locations on the nanostructure layer, wherein each location of the one or more locations shares a vertical axis with a location on the active surface of the light detection device,

wherein the light detection device is electrically coupled to the electrical contacts of the socket;

wherein the flow cell further comprises a top layer over the contiguous surface, wherein the top layer and the active surface collectively form a space over the nanostructure layer, the space defining a flow channel,

wherein the top layer comprises:

a second molding layer below a second substrate and covering sides of a second light detection device, wherein the second molding layer comprises a first region adjacent to a first edge of an active surface of the second light detection device and a second region adjacent to a second edge of the active surface of the second light detection device, wherein the first region of the second molding layer, the second region of the second molding layer, and the active surface of the second light detection device form a second contiguous surface;

a second waveguide integration layer between the second contiguous surface and a second waveguide, wherein the second waveguide integration layer comprises optical coupling structures on portions of a top surface of the second waveguide integration layer below the top surface of the first region of the second molding layer, and below the top surface of the second region of the second molding layer, wherein the optical coupling structures on the portions of the top surface of the second waveguide integration layer couple light waves from the light source to the second waveguide;

the second waveguide below the waveguide integration layer, wherein the second waveguide utilizes the light waves from the second waveguide integration layer to excite light sensitive materials in one or more additional nanowells; and

a second nanostructure layer below the second waveguide, the second nanostructure layer comprising the one or more additional nanowells, wherein the one or more additional nanowells are formed on one or more locations on the second nanostructure layer, wherein each location of the one or more locations on the second nanostructure layer shares a vertical axis with a location on the active surface of the second light detection device.

14. A method, comprising:

forming a bottom layer of a flow cell, wherein the flow cell comprises a top layer and the bottom layer with a channel between the top layer and the bottom layer, the forming comprising:

forming a waveguide integration layer on a contiguous surface comprised of an active surface of a light detection device, a first region of a molding layer adjacent to a first edge of the active surface of the light detection device and a second region of the molding layer adjacent to a second edge of the active surface of the light detection device, wherein the molding layer is over a substrate and covers sides of the light detection device, the molding layer having a molding height relative to a top of the substrate, the molding height being at least substantially equal to a height of an active surface of the light detection device relative to a top surface of the substrate;

forming optical coupling structures in the waveguide integration layer on portions of a top surface of the waveguide integration layer over the top surface of the first region, and over the top surface of the second region;

forming a waveguide layer over the waveguide integration layer, wherein the waveguide integration layer optically couples light waves from a light source to the waveguide layer, and wherein the waveguide layer utilizes the light waves from the waveguide integration layer to excite light sensitive materials in one or more nanowells;

forming a nanostructure layer over the waveguide layer; and

forming the one or more nanowells on one or more locations on the nanostructure layer, wherein each location of the one or more locations shares a vertical axis with a location on the active surface of the light detection device;

wherein the method further comprises forming a top layer over the nanostructure layer, wherein the top layer and the active surface collectively form a space over the nanostructure layer of the light detection device, the space defining a flow channel,

wherein the top layer comprises:

a second molding layer below a second substrate and covering sides of a second light detection device, wherein the second molding layer comprises a first region adjacent to a first edge of an active surface of the second light detection device and a second region adjacent to a second edge of the active surface of the second light detection device, wherein the first region of the second molding layer, the second region of the second molding layer, and the active surface of the second light detection device form a second contiguous surface;

a second waveguide integration layer between the second contiguous surface and a second waveguide, wherein the second waveguide integration layer comprises optical coupling structures on portions of a top surface of the second waveguide integration layer below the top surface of the first region of the second molding layer, and below the top surface of the second region of the second molding layer, wherein the optical coupling structures on the portions of the top surface of the second waveguide integration layer couple light waves from the light source to the second waveguide;

the second waveguide below the waveguide integration layer, wherein the second waveguide utilizes the light waves from the second waveguide integration layer to excite light sensitive materials in one or more additional nanowells; and

a second nanostructure layer below the second waveguide, the second nanostructure layer comprising the one or more additional nanowells, wherein the one or more additional nanowells are formed on one or more locations on the second

nanostructure layer, wherein each location of the one or more locations on the second nanostructure layer shares a vertical axis with a location on the active surface of the second light detection device.

15. The method of claim 14, wherein forming the optical coupling structures comprises utilizing a process to generate the optical coupling structures selected from the group consisting of: imprinting, nanoimprint lithography and optical lithography,

16. The method of any of claims 14-15, wherein forming the one or more nanowells comprises utilizing a process selected from the group consisting of: imprinting and lithography.

17. The method of claim 16, wherein forming the one or more nanowells comprises utilizing a lithography process selected from the group consisting of: nanoimprint lithography and optical lithography.

18. The method of any one of claims 14-17, further comprising:

integrating a feature into the top layer, the feature selected from the group consisting of: an electrical component and a physical structure.