CLAIMS

~~What is claimed is:~~

1. A flow cell system, 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 flow cell device secured within the enclosure of the socket, comprising:

a frameless light detection device comprising a base wafer portion, a plurality of dielectric layers extending over the base wafer portion, a reaction structure extending over the dielectric layers that comprises a detector surface, a plurality of light sensors, device circuitry extending through the dielectric layers electrically coupled to the light sensors to transmit data signals based on photons detected by the light sensors, and a plurality of light guides associated with the light sensors; and

a lid extending over the detector surface with a flow channel therebetween, the lid comprising at least one second port in communication with the flow channel and the at least one first port of the socket,

wherein the device circuity of the light detection device of the flow cell device is electrically coupled to the electrical contacts of the socket~~.~~

~~2. The flow cell system according to claim 1, wherein the cover portion and the base portion are removably coupled, and wherein the flow cell device is removably secured within the enclosure.~~

~~3. The flow cell system according to claims 1 or 2, wherein the cover portion engages the lid of the flow cell device, and one or both of the base portion and the electrical contacts engage a back side of the flow cell device.~~

~~4. The flow cell system according to claim 3, wherein the cover portion and one or both of the base portion and the electrical contacts apply a compressive force to the flow cell device to secure the flow cell device within the enclosure.~~

~~5. The flow cell system according to any one of claims 1-4, wherein the flow cell device further comprises a plurality of contact pads extending over the base wafer portion that are electrically coupled to the device circuity and define exposed back surfaces that comprise portions of the back side of the flow cell device, and wherein the electrical contacts engage the contact pads.~~

~~6. The flow cell system according to claim 5, wherein the contact pads are electrically coupled to vias of the device circuity that extend through the base wafer portion.~~

~~7. The flow cell system according to claims 5 or 6, wherein the flow cell device further comprises a support layer extending over the base wafer portion, and wherein the support layer extends past the exposed back surfaces of the contact pads.~~

~~8. The flow cell system according to any one of claims 1-4~~, wherein the flow cell device further comprises a substrate portion coupled to and extending over the base wafer portion that defines the back side of the flow cell device, wherein the substrate portion comprises a plurality of electrical leads extending therethrough from the back side of the flow cell device~~.~~

~~9. The flow cell system according to claim 8, wherein the electrical contacts engage the electrical leads at the back side of the flow cell device.~~

~~10. The flow cell system according to claims 8 or 9, wherein the electrical leads are electrically coupled to exposed contact surfaces of the device circuity at the detector surface or a lateral side of the flow cell device.~~

~~11. The flow cell system according to claim 10, wherein the flow cell device further comprises a plurality of electrically conductive wires electrically coupled between the electrical leads and the exposed contact surfaces of the device circuity.~~

~~12. The flow cell system according to claim 8, wherein the substrate portion and the electrical leads comprise a printed circuit board.~~

13. The flow cell system according to claim 8, further comprising side wall portions extending from the substrate portion, the substrate portion and the side wall portions forming a cavity, and wherein the light detection device is positioned within the cavity.

14. The flow cell system according to claim 13, wherein the substrate portion and the side wall portions comprise ceramic land chip carrier or an organic land chip carrier.

15. The flow cell system according to any one of claims 1-14, wherein an open portion of the enclosure extends about exposed lateral sides of the flow cell device.

16. The flow cell system according to claim 15, wherein the exposed lateral sides of the flow cell device are defined by the base wafer portion, the dielectric layers, the reaction structure, the device circuitry of the light detection device, or combinations thereof.

17. The flow cell system according to any one of claims 1-16, wherein the light detection device comprises a complementary metal-oxide semiconductor (CMOS) light sensor.

18. A system, comprising:

the flow cell system according to any one of claims 1-17; and

an instrument coupled with the flow cell system comprising at least one third port and a plurality instrument electrical contacts,

wherein the at least one third port of the instrument is in communication with the at least one first port of the socket to deliver a flow of reaction solution into the flow channel to form a plurality of reaction sites on the detector surface, and

wherein the instrument electrical contacts are in engagement with the electrical contacts of the socket to transmit data signals between the device circuity of the light detection device and the instrument.

19. A method, comprising:

separating a flow cell device from a wafer level flow cell structure, the wafer level flow cell structure comprising a plurality of integral flow cell devices positioned on a common base wafer, the flow cell devices comprising:

a portion of the base wafer;

a plurality of dielectric layers extending over the portion of the base wafer;

a reaction structure extending over the dielectric layers that comprises a detector surface;

a plurality of light sensors positioned within the dielectric layers;

device circuitry extending through the dielectric layers electrically coupled to the light sensors to transmit data signals based on photons detected by the light sensors;

a plurality of light guides positioned within the dielectric layers between the detector surface and the light sensors; and

a lid extending over the detector surface with a flow channel therebetween, the lid comprising at least one first port in communication with the flow channel;

positioning the separated flow cell device within a portion of an enclosure of a socket over a base portion thereof such that the device circuity is electrically coupled to electrical contacts of the socket that are positioned within the enclosure and extend through a portion of the base portion; and

coupling a cover portion of the socket with the base portion thereof to secure the separated flow cell device within the enclosure of the socket and couple at least one second port of the cover portion in communication with the at least one port of the flow cell device.

20. The method according to claim 19, wherein separating the flow cell device from the wafer level flow cell structure comprises dicing the wafer level flow cell structure.

21. The method according to claim 20, wherein dicing the flow cell device from the wafer level flow cell structure forms lateral side surfaces of the separated flow cell device comprised of least one of the base wafer, the dielectric layers, the reaction structure, the device circuitry and the lid, and wherein the lateral side surfaces of flow cell device are exposed within the enclosure.

22. The method according to any one of claims 19-21, wherein the flow cell devices further comprise contact pads extending over a back side of the base wafer electrically coupled to vias of the device circuity that extend through the base wafer, and wherein positioning the separated flow cell device within a portion of the enclosure of the socket comprises engaging an exposed surface of the contact pads of the separated flow cell device with the electrical contacts within the enclosure.

~~23. The method according to any one of claims 19-21, further comprising coupling the base wafer portion of the separated flow cell device with a substrate, and electrically coupling the device circuity of the separated flow cell device with electrical leads of the substrate, and wherein positioning the separated flow cell device within a portion of the enclosure of the socket comprises positioning the separated flow cell device and the substrate within the portion of the enclosure of the socket and engaging an exposed surface of the leads of the substrate with the electrical contacts within the enclosure.~~