CLAIMS

What is claimed is:

1. A method comprising:

placing a die in a portion of a cavity in a substrate, wherein one or more electrical contacts are accessible on a surface of the die, wherein the substrate comprises exposed electrical contacts accessible to the electrical contacts on the surface of the die, wherein the placing defines a first space in the cavity adjacent to a first edge of the upper surface of the die and a second space in the cavity adjacent to the second edge of the upper surface of the die;

forming an under-fill layer in the cavity between the lower surface of the die and the substrate;

forming fluidics fan-out regions by depositing a curable material in the first space and the second space to form the fluidics fan-out regions, a surface of the fluidics fan-out regions being contiguous with the upper surface of the die; and

forming a fluidic flow channel over the active surface of the die, comprising:

attaching a lid to portions of the substrate adjacent to the fluidics fan-out regions to form the fluidic flow channel between the active surface and the lid.

2. The method of claim 1, further comprising:

coupling the exposed electrical contacts to the electrical contacts on the surface of the die.

3. The method of claim 2, wherein the exposed electrical contacts and the electrical contacts on the surface of the die comprise bonding pads, wherein the bonding pads comprising the exposed electrical contacts are each oriented in one of the first space or the second space, and wherein the coupling comprises wire-bonding each exposed electrical contact of the exposed electrical contacts, to one of the electrical contacts on the surface of the die, forming wire-bonded connections.

4. The method of claim 3, further comprising:

prior to forming the fluidic flow channel, encapsulating the wire-bonded connections by depositing the curable material over the fluidics fan-out regions.

5. The method of any of claims 1 - 4, wherein forming the fluidic flow channel over the active surface of the die, further comprises:

orienting the lid to be in physical contact with a top surface of each of the encapsulated wire-bonded connections, wherein the orienting flattens each top surface.

6. The method of claim 1, the die further comprising a silicon wafer, a passivation stack, and one or more through silicon vias extended through a portion of the silicon wafer and the passivation stack, wherein the passivation stack is disposed below a lower surface of the portion of the silicon wafer, wherein a portion of each of the one or more through silicon vias is exposed through an opening of one or more openings in the passivation stack, and wherein each exposed portion is coupled to the electrical contacts.

7. The method of claim 6, wherein the placing further comprises coupling the exposed electrical contacts to the electrical contacts.

8. The method of claim 6, further comprising:

coupling the exposed electrical contacts to the electrical contacts on the surface of the die.

9. The method of claims 7 or 8, wherein the coupling comprises utilizing a method selected from the group consisting of: reflowing the electrical contacts, wherein the electrical contacts of the die comprise pillar bumps, and utilizing an anisotropic conductive films to couple the electrical contacts to the exposed electrical contacts.

10. The method of any of claims 1 - 9, wherein the curable material is selected from the group consisting of epoxy and glue.

~~11. The method of any of claims 1 - 10, wherein the forming fluidics fan-out regions further comprises curing the curable material.~~

~~12. The method of claim 11, wherein the curing comprises utilizing a method selected from the group consisting of: exposing the curable material to ultraviolet radiation and exposing the curable material to thermal energy.~~

~~13. The method of any of claims 1 - 12, the die comprising a sensor.~~

~~14. The method of claim 13, wherein the sensor comprises a Complementary Metal-Oxide-Semiconductor (CMOS) detection device.~~

~~15. The method of any of claims 1 - 14, wherein the cavity comprises: a die cavity portion, a fluidics cavity portion, and a top level portion, wherein the die cavity portion and the under-fill layer, together, are substantially equal in height to the die, wherein the fluidics cavity portion comprises a space comprising a height of the fluidic flow channel, and wherein the top level portion comprises a height of the portions of the substrate adjacent to the fluidics fan-out regions~~

~~16. The method of claim 15, wherein the placing the die in the portion of a cavity in a substrate comprises placing the die in the die cavity portion of the substrate.~~

~~17. The method of claim 15, wherein the portions of the substrate adjacent to the fluidics fan-out regions comprise portions of a circuit board, and wherein the top level portion comprises an interface between the circuit board and the lid.~~

~~18. The method of any of claims 1 - 17, wherein the lid comprises an inlet for fluids and an outlet for fluid.~~

~~19. The method of claim 15, wherein the attaching the lid comprises applying an adhesive between the circuit board and the lid.~~

~~20. The method of any of claims 1 - 19, wherein the die is singulated from a silicon wafer.~~

~~21. The method of any of claims 1 - 20, wherein the surface of the die is selected from the group consisting of: an upper surface of the die, a portion of the upper surface of the die comprising an active surface, and a lower surface parallel to the upper surface.~~

~~22~~1. An apparatus comprising:

a die, wherein one or more electrical contacts are accessible on a surface of the die;

a substrate comprising a cavity, wherein the die is oriented in a portion of the cavity in the substrate, wherein the substrate comprises exposed electrical contacts electrically coupled to the electrical contacts on the surface of the die, wherein the orientation defines a first space in the cavity adjacent to a first edge of the upper surface of the die and a second space in the cavity adjacent to the second edge of the upper surface of the die; and

fluidics fan-out regions comprising a first cured material deposited in the first space and the second space, a surface of the fluidics fan-out regions being contiguous with the upper surface of the die.

2~~3~~. The apparatus of claim ~~22~~1, further comprising:

a fluidic flow channel over the active surface of the die defined by the surface of the fluidics fan-out regions and the upper surface of the die and a lid attached to portions of the substrate adjacent to the fluidics fan-out regions.

~~24~~3. The apparatus of claim ~~22 or 23~~ 2, further comprising:

an under-fill layer in the cavity between the lower surface of the die and the substrate.

4. The apparatus of claim 2, further comprising: an under-fill layer in the cavity between the lower surface of the die and the substrate, wherein the cavity comprises: a die cavity portion, a fluidics cavity portion, and a top level portion, wherein the die cavity portion and the under-fill layer, together, are substantially equal in height to the die, wherein the fluidics cavity portion comprises a space comprising a height of the fluidic flow channel, and wherein the top level portion comprises a height of the portions of the substrate adjacent to the fluidics fan-out regions.

5. The apparatus of claim 4, wherein the portion of the cavity in the substrate in which the die is oriented comprises the die cavity portion.

6. The apparatus of claim 4, wherein the portions of the substrate adjacent to the fluidics fan-out regions comprise portions of a circuit board, and wherein the top level portion comprises an interface between the circuit board and the lid.

7. The apparatus of claim 6, wherein the circuit board is selected from the group consisting of: a printed circuit board and a ceramic circuit board.

8. The apparatus of claim 2, wherein the lid comprises an inlet for fluids and an outlet for fluid.

9. The apparatus of claim 2, wherein the fluidic flow channel is approximately 100 um from the active surface to the lid.

~~25. The apparatus of any of claims 22-24, wherein the die is singulated from a silicon wafer.~~

~~26~~10. The apparatus of ~~any of claims 22 - 25~~ claim 1, wherein the exposed electrical contacts comprise substrate bonding pads and the electrical contacts on the surface of the die comprise die bonding pads, and wherein each die bonding pad is coupled to at least one substrate bonding pad with a wire, forming wire-bonded connections.

~~27. The apparatus of claim 26, wherein the wire-bonded connections are encapsulated in a second cured material.~~

~~28~~11. The apparatus of claim ~~26~~10, further comprising:

a fluidic flow channel over the active surface of the die defined by the surface of the fluidics fan-out regions and the upper surface of the die and a lid attached to portions of the substrate adjacent to the fluidics fan-out regions, wherein the lid is oriented to be in physical contact with a top surface of each of the encapsulated wire-bonded connections.

12. The apparatus of claim 1, wherein the wire-bonded connections are encapsulated in a second cured material.

~~29~~13. The apparatus of ~~any of claims 27 or 28~~ claim 12, wherein each of the first cured material and the second cured material is selected from the group consisting of: epoxy and glue.

~~30~~14. The apparatus of ~~any of claims 22 - 25~~ claim 1, the die further comprising a silicon wafer, a passivation stack, and one or more through silicon vias extended through a portion of the silicon wafer and the passivation stack, wherein the passivation stack is disposed below a lower surface of the portion of the silicon wafer, wherein a portion of each of the one or more through silicon vias is exposed through an opening of one or more openings in the passivation stack, and wherein each exposed portion is coupled to the electrical contacts.

~~31~~15. The apparatus of ~~claims 30~~ claim 1, wherein the electrical contacts of the die comprise pillar bumps.

~~32~~16. The apparatus of ~~any of claims 22 - 31~~ claim 1, the die comprising a sensor.

~~33~~17. The apparatus of claim ~~32~~16, wherein the sensor comprises a Complementary Metal-Oxide-Semiconductor (CMOS) detection device.

~~34. The apparatus of claim 23, further comprising: an under-fill layer in the cavity between the lower surface of the die and the substrate, wherein the cavity comprises: a die cavity portion, a fluidics cavity portion, and a top level portion, wherein the die cavity portion and the under-fill layer, together, are substantially equal in height to the die, wherein the fluidics cavity portion comprises a space comprising a height of the fluidic flow channel, and wherein the top level portion comprises a height of the portions of the substrate adjacent to the fluidics fan-out regions.~~

~~35. The apparatus of claim 34, wherein the portion of the cavity in the substrate in which the die is oriented comprises the die cavity portion.~~

~~36. The apparatus of claims 34 or 35, wherein the portions of the substrate adjacent to the fluidics fan-out regions comprise portions of a circuit board, and wherein the top level portion comprises an interface between the circuit board and the lid.~~

~~37. The apparatus of claim 23 or 28, wherein the lid comprises an inlet for fluids and an outlet for fluid.~~

~~38. The apparatus of claim 23 or 28, where the fluidic flow channel is approximately 100um from the active surface to the lid.~~

~~39. The apparatus of claim 36, wherein the circuit board is selected from the group consisting of: a printed circuit board and a ceramic circuit board.~~

~~40~~18. The apparatus of ~~any of claims 22 – 39~~ claim 1, wherein the surface is selected from the group consisting of: an upper surface of the die, a portion of the upper surface of the die comprising an active surface, and a lower surface parallel to the upper surface.

19. The apparatus of claim 1, wherein the die is singulated from a silicon wafer.

~~41. A method comprising:~~

~~picking and placing a die comprising a sensor and one or more electrical contacts accessible on a surface of the die on a cavity surface at a base of a cavity of a carrier, wherein the carrier comprises a substrate and the cavity, wherein the substrate comprises exposed electrical contacts, and wherein the placing defines a first space in the cavity adjacent to a first edge of the surface of the die and a second space in the cavity adjacent to a second edge of the surface of the die;~~

~~connecting each of the one or more electrical contacts of the die to at least one of the exposed electrical contacts of the substrate;~~

~~forming fluidics fan-out regions by depositing a curable material in the first space and the second space to form the fluidics fan-out regions; and~~

~~attaching a lid to portions of the substrate adjacent to the fluidics fan-out regions to form a fluidic flow channel between an active surface of the sensor and the lid.~~

~~42. The method of claim 41, wherein the cavity surface comprises an under-fill layer.~~

~~43~~20. An apparatus comprising:

a die;

a substrate comprising a cavity, wherein the die is oriented in a portion of the cavity in the substrate, wherein the orientation defines a first space in the cavity adjacent to a first edge of the upper surface of the die and a second space in the cavity adjacent to the second edge of the upper surface of the die;

fluidics fan-out regions comprising a first cured material deposited in the first space and the second space, a surface of the fluidics fan-out regions being contiguous with the upper surface of the die; and

a fluidic flow channel over the active surface of the die defined by the surface of the fluidics fan-out regions and the upper surface of the die and a lid attached to portions of the substrate adjacent to the fluidics fan-out regions.