

CLAIMS

1. A chemical sensor including:
 - a first semiconductor substrate;
 - a second semiconductor substrate;
 - one or more metal layers between the first semiconductor substrate and the second semiconductor substrate such that the first semiconductor substrate, the second semiconductor substrate and the one or more metal layers form a cell including a cavity, the cavity having a depth of any value equal to or less than 100 μm ;
 - an optical source; and
 - an optical detector such that light emitted by the optical source passes through the cell to the optical detector;
 - wherein the first semiconductor substrate, the second semiconductor substrate and the one or more metal layers also define at least one inlet for fluid to flow into the cavity and at least one outlet for fluid to flow out of the cavity.
2. The chemical sensor according to claim 1, further comprising:
 - wherein the cavity has a depth of any value less than 100 μm .
3. The chemical sensor according to claim 1,
 - wherein the first semiconductor substrate and the second semiconductor substrate comprise silicon or germanium.
4. The chemical sensor according to claim 1,
 - wherein the one or more metal layers comprises:
 - a first adhesion layer in contact with at least a portion of the first semiconductor substrate;
 - a first bonding layer in contact with the first adhesion layer;
 - a second bonding layer in contact with the first bonding layer; and

a second adhesion layer in contact with at least a portion of the second semiconductor substrate.

5. The chemical sensor according to claim 4,
wherein the first adhesion layer and the second adhesion layer comprise chromium or titanium.
6. The chemical sensor according to claim 4,
wherein the first bonding layer and the second bonding layer comprise gold.
7. The chemical sensor according to claim 1
wherein the first semiconductor substrate, the second semiconductor substrate and the one or more metal layers form a further cell including a further cavity.
8. The chemical sensor according to claim 7,
wherein the further cavity is sealed.
9. The chemical sensor according to claim 7,
wherein the first semiconductor substrate, the second semiconductor substrate and the metal layer also define at least one further inlet for fluid to flow into the further cavity and at least one further outlet for fluid to flow out of the further cavity.
10. The chemical sensor according to claim 7, further comprising:
a further optical detector such that light emitted by the optical source passes through the further cell to the further optical detector.
11. The chemical sensor according to claim 1,
wherein the optical source and the optical detector are unpackaged dies bonded to the cell using wafer to wafer bonding methods or chip to wafer bonding methods.

12. A method of forming a chemical sensor, the method further comprising:
- forming one or more metal layers between a first semiconductor substrate and a second semiconductor substrate such that the first semiconductor substrate, the second semiconductor substrate and the one or more metal layers form a cell including a cavity, the cavity having a depth of any value equal to or less than 100 μm ;
 - providing an optical source; and
 - providing an optical detector such that light emitted by the optical source passes through the cell to the optical detector;
- wherein the first semiconductor substrate, the second semiconductor substrate and the one or more metal layers also define at least one inlet for fluid to flow into the cavity and at least one outlet for fluid to flow out of the cavity.
13. The method according to claim 12, further comprising:
- wherein the cavity has a depth of any value less than 100 μm .
14. The method according to claim 12,
- wherein the first semiconductor substrate and the second semiconductor substrate comprise silicon or germanium.
15. The method according to claim 12,
- wherein the first semiconductor substrate is patterned before forming a first adhesion layer of the one or more metal layers in contact with the first semiconductor substrate, and forming a first bonding layer of the one or more metal layers in contact with the first adhesion layer;
 - wherein the second semiconductor substrate is patterned before forming a second adhesion layer of the one or more metal layers in contact with the first semiconductor substrate, and forming a second bonding layer of the one or more metal layers in contact with the second adhesion layer; and
 - wherein the method further comprises bonding the first bonding layer and the second bonding layer to form the cell including the cavity.

16. The method according to claim 15,
wherein the first adhesion layer and the second adhesion layer comprise chromium or titanium.
17. The method according to claim 15,
wherein the first bonding layer and the second bonding layer comprise gold.
18. The method according to claim 12,
wherein the first semiconductor substrate, the second semiconductor substrate and the one or more metal layers form a further cell including a further cavity.
19. The method according to claim 18,
wherein the further cavity is sealed.
20. The method according to claim 18,
wherein the first semiconductor substrate, the second semiconductor substrate and the metal layer also define at least one further inlet for fluid to flow into the further cavity and at least one further outlet for fluid to flow out of the further cavity.