Claims

What is claimed:

1. A semiconductor device, comprising:

a substrate;

a first conductive layer formed over a plurality of protrusions ~~first surface~~ of the substrate;

a plurality of cavities formed in the protrusions of the substrate through openings in the first conductive layer, wherein a width of the cavities is greater than a width of the openings in the first conductive layer;

a semiconductor die disposed over ~~to~~ the substrate; and

a bump material bonding the semiconductor die to the first conductive layer by extending the bump material into the cavities through the openings in the first conductive layer.

2. The semiconductor device of claim 1, further including an encapsulant deposited over the semiconductor die and substrate.

3. The semiconductor device of claim 1, further including a second conductive layer formed over a ~~second~~ surface of the substrate opposite the protrusions ~~first surface~~ of the substrate.

4. The semiconductor device of claim 3, wherein portions of the substrate are electrically isolated to form conductive leads vertically aligned between the first conductive layer and second conductive layer.

5. The semiconductor device of claim 1, wherein the bump

material extends into the cavities by thermo-compression or reflow of the bump material.

6. The semiconductor device of claim 1, wherein the substrate includes copper, copper alloy, aluminum, or conductive material.

7. A semiconductor device, comprising:

a substrate;

a first conductive layer formed over a first surface of the substrate;

a cavity formed in the substrate through an opening in the first conductive layer;

a semiconductor die disposed over ~~to~~ the substrate; and

a bump material disposed ~~over~~between the opening in the first conductive layer and semiconductor die with the bump material extending into the cavity through the opening in the first conductive layer and filling the cavity.

8. The semiconductor device of claim 7, wherein a width of the cavity is greater than a width of the opening in the first conductive layer.

9. The semiconductor device of claim 7, further including an encapsulant deposited over the semiconductor die and substrate.

10. The semiconductor device of claim 7, further including a second conductive layer formed over a second surface of the substrate opposite the first surface of the substrate.

11. The semiconductor device of claim 10, wherein portions of

the substrate are electrically isolated to form conductive leads vertically aligned between the first conductive layer and second

conductive layer.

12. The semiconductor device of claim 7, wherein the bump material extends into the cavities by thermo-compression or reflow of the bump material.

13. The semiconductor device of claim 7, wherein the substrate includes copper, copper alloy, aluminum, or conductive material.

14. A semiconductor device, comprising:

a substrate;

a first conductive layer formed over a first surface of the substrate;

a cavity formed in the substrate through an opening in the first conductive layer; and

a bump material ~~disposed over the first conductive layer and~~ extending into the cavity through the opening in the first conductive layer.

15. The semiconductor device of claim 14, wherein a width of the cavity is greater than a width of the opening in the first conductive layer.

16. The semiconductor device of claim 14, further including a semiconductor die disposed over ~~to~~ the substrate.

17. The semiconductor device of claim 16, further including an encapsulant deposited over the semiconductor die and substrate.

18. The semiconductor device of claim 14, further including a

second conductive layer formed over a second surface of the

substrate opposite the first surface of the substrate.

19. The semiconductor device of claim 18, wherein portions of the substrate are electrically isolated to form conductive leads vertically aligned between the first conductive layer and second conductive layer.

20. The semiconductor device of claim 14, wherein the substrate includes copper, copper alloy, aluminum, or conductive material.

~~21. A semiconductor device, comprising:~~

~~a substrate;~~

~~a first conductive layer formed over a first surface of the substrate; and~~

~~a cavity formed in the substrate through an opening in the first conductive layer, wherein a width of the cavity is greater than a width of the opening in the first conductive layer.~~

2~~2~~1. ~~The~~ A semiconductor device, ~~of claim 21, further including~~ comprising: ~~of claim 21, further including~~

a substrate;

a conductive layer formed over a protrusion of the substrate;

a cavity formed in the protrusion of the substrate through an opening in the conductive layer, wherein a width of the cavity is greater than a width of the opening in the conductive layer; and

~~-~~a bump material disposed over the ~~first~~ conductive layer and extending into the cavity.

232. The semiconductor device of claim 221, wherein portions of the substrate are electrically isolated to form conductive leads vertically aligned with the ~~first~~ conductive layer.

243. The semiconductor device of claim 21, further including a semiconductor die disposed over ~~to~~ the substrate.

2~~5~~4. The semiconductor device of claim 2~~4~~3, further including an encapsulant deposited over the semiconductor die and substrate.

25. A semiconductor device, comprising:

a substrate;

a conductive layer formed over a protrusion of the substrate; and

a bump material extending into a cavity of the protrusion of the substrate through an opening in the conductive layer.

26. The semiconductor device of claim 25, further including a recess formed adjacent to the cavity of the protrusion of the substrate.

27. The semiconductor device of claim 25, wherein portions of the substrate are electrically isolated to form conductive leads vertically aligned with the conductive layer.

28. The semiconductor device of claim 25, further including a semiconductor die disposed over the substrate with the bump material bonding the semiconductor die to the substrate.

29. The semiconductor device of claim 28, further including an encapsulant deposited over the semiconductor die and substrate.