

Claims

What is claimed:

1. A method of making a semiconductor device, comprising:
 - providing a first semiconductor wafer including a plurality of first semiconductor die, wherein each first semiconductor die includes an active region comprising a sensor formed on a first surface of the first semiconductor die;
 - singulating the first semiconductor wafer to separate the first semiconductor die;
 - depositing an encapsulant over and around the first semiconductor die after singulating the first semiconductor wafer;
 - forming a first conductive layer over a first surface of the encapsulant and the first surface of the first semiconductor die;
 - forming a transmissive layer over the active region of the first semiconductor die and first conductive layer;
 - forming an opening through the encapsulant outside a footprint of the semiconductor die and extending to the first conductive layer;
 - depositing a bump material into the opening with the bump material contacting the first conductive layer and extending above a second surface of the encapsulant opposite the first surface of the encapsulant;
 - providing a substrate including a second conductive layer formed over the substrate; and
 - mounting the first semiconductor die to the substrate with the bump material contacting the second conductive layer, wherein the bump material comprises a portion of solder

extending uninterrupted between the first conductive layer and second conductive layer.

2. The method of claim 1, wherein the active region is responsive to an external stimulus passing through the transmissive layer.

3. The method of claim 1, further including:
forming an insulating layer over the first semiconductor die; and
forming an opening in the insulating layer over the active region.

4. The method of claim 1, further including:
disposing a second semiconductor die adjacent to the first semiconductor die prior to depositing the encapsulant; and
forming the first conductive layer with a portion of the first conductive layer coupling the first semiconductor die to the second semiconductor die.

5. A method of making a semiconductor device, comprising:
providing a first semiconductor die including an active region;
forming an encapsulant over the first semiconductor die;

forming a first conductive layer over the first semiconductor die and encapsulant;
forming an insulating layer over the first semiconductor die and first conductive layer;

forming a first opening in the insulating layer over the active region;

forming a second opening through the encapsulant and extending to the first conductive layer;

forming a bump in the second opening and through the encapsulant;

providing a substrate including a second conductive layer formed on the substrate; and

metallurgically and electrically connecting the bump to the second conductive layer, wherein the bump includes a solder portion extending completely between the first conductive layer and substrate.

6. The method of claim 5, wherein the active region is responsive to an external stimulus passing through the first opening in the insulating layer.

7. The method of claim 5, further including forming a transmissive layer over the first opening in the insulating layer opposite the semiconductor die.

8. The method of claim 7, wherein the transmissive layer includes an optical dielectric material or an optically transparent or translucent material.

9. The method of claim 5, wherein the active region of the first semiconductor die includes a sensor.

10. The method of claim 5, further including metallurgically and electrically connecting the bump to the first conductive layer.

11. The method of claim 5, further including disposing a second semiconductor die adjacent to the first semiconductor die.

12. A method of making a semiconductor device, comprising:
providing a semiconductor die;
depositing an encapsulant over the semiconductor die;
forming a transmissive layer over the semiconductor die and a first surface of the encapsulant; and
forming a bump completely through the encapsulant with a solder portion of the bump extending in an uninterrupted vertical column from the first surface of the encapsulant to a point above an external surface of the semiconductor device opposite the transmissive layer.

13. The method of claim 12, wherein the semiconductor die includes an active region responsive to an external stimulus passing through the transmissive layer.

14. The method of claim 13, further including:
forming an insulating layer over the semiconductor die; and
forming an opening in the insulating layer over the active region of the semiconductor die.

15. The method of claim 12, wherein the transmissive layer includes an optical dielectric material or an optically transparent or translucent material.

16. The method of claim 12, further including forming a conductive layer over the encapsulant and semiconductor die and electrically connected to the bump.

17. A semiconductor device, comprising:
a semiconductor die;
an encapsulant deposited over and around the semiconductor die;
a conductive layer formed over the semiconductor die and encapsulant; and
a conductive bump formed completely through the encapsulant outside a footprint of the semiconductor die with a portion of the conductive bump extending in an uninterrupted vertical column from the conductive layer to a point above an external surface of the semiconductor device opposite the conductive layer.
18. The semiconductor device of claim 17, wherein the semiconductor die includes an active region responsive to an external stimulus.
19. The semiconductor device of claim 18, wherein the active region includes a sensor.
20. The semiconductor device of claim 18, further including an insulating layer comprising an opening formed over the active region of the semiconductor die.
21. The method of claim 12, further including:
providing a substrate including a first conductive layer;
and
mounting the semiconductor die to the substrate with the bump contacting the first conductive layer and the solder

portion of the bump extending uninterrupted from the first surface of the encapsulant to the first conductive layer.

22. The semiconductor device of claim 17, further including a substrate physically contacting the conductive bump outside a footprint of the semiconductor die.

23. The semiconductor device of claim 17, further including a transmissive layer formed over the semiconductor die, encapsulant, and conductive layer.

24. The method of claim 21, further including:

forming a second conductive layer on the semiconductor die and the first surface of the encapsulant; and

mounting the semiconductor die to the substrate with a first point of contact between the solder portion of the bump and the second conductive layer directly over a second point of contact between the solder portion of the bump and the first conductive layer.

25. The method of claim 1, further including mounting the first semiconductor die to the substrate with the portion of solder including a center through the opening that extends uninterrupted and substantially uniformly from the first conductive layer to the second conductive layer.