Claims

What is claimed:

1. A method of making a semiconductor device, comprising:

providing a semiconductor wafer including a plurality of semiconductor die;

forming a notch in a surface of the semiconductor wafer between the semiconductor die, wherein the surface of the semiconductor wafer includes an active surface of each of the semiconductor die;

singulating the semiconductor wafer to separate the plurality of semiconductor die after forming the notch;

depositing, in a single step, an encapsulant around the semiconductor die to cover an entire side surface of the semiconductor die, and into the notch after singulating the semiconductor wafer; and

forming a fan-in build-up interconnect structure over the active surface of the semiconductor die after depositing the encapsulant, wherein the fan-in build-up interconnect structure includes an insulating layer, a conductive layer that fans in from contact pads of the semiconductor die, and solder bumps located within a footprint of the semiconductor die.

2. The method of claim 1, wherein forming the notch includes:

forming a channel in the surface of the semiconductor wafer between the semiconductor die; and

singulating the semiconductor wafer through the channel.

3. The method of claim 1, wherein a surface of the encapsulant is coplanar with the active surfaces of the semiconductor die.

4. The method of claim 1, further including:

disposing the plurality of semiconductor die on a carrier with the active surface of each semiconductor die oriented toward the carrier; and

depositing the encapsulant over the semiconductor die and the carrier.

5. A method of making a semiconductor device, comprising:

providing a semiconductor die;

forming a notch in an active surface of the semiconductor die;

disposing the semiconductor die over a carrier with the active surface of the semiconductor die oriented toward the carrier;

depositing an encapsulant around the semiconductor die and into the notch while the semiconductor die is over the carrier; and

forming a fan-in build-up interconnect structure over the active surface of the semiconductor die after depositing the encapsulant, wherein the fan-in build-up interconnect structure includes a conductive redistribution layer that fans in from contact pads of the semiconductor die.

6. The method of claim 5, wherein forming the fan-in build-up interconnect structure further includes:

forming a first insulating layer over the semiconductor die; and

forming the conductive redistribution layer over the first insulating layer.

7. The method of claim 6, further including forming a second insulating layer over the conductive redistribution layer, wherein the second insulating layer extends over the encapsulant in the notch.

8. The method of claim 5, wherein forming the notch includes:

forming a channel in the active surface of the semiconductor die; and

singulating the semiconductor die through the channel.

9. The method of claim 8, further including depositing the encapsulant after singulating the semiconductor die.

10. The method of claim 5, wherein the encapsulant covers a side surface of the semiconductor die.

11. The method of claim 5, wherein a surface of the encapsulant is coplanar with the active surface of the semiconductor die.

12. The method of claim 5, wherein a surface of the encapsulant is coplanar with a second surface of the semiconductor die opposite the active surface of the semiconductor die.

13. A method of making a semiconductor device, comprising:

providing a semiconductor die including a notch formed in an active surface of the semiconductor die;

depositing an encapsulant around the semiconductor die and into the notch with a surface of the encapsulant that is

coplanar with the active surface of the semiconductor die, wherein a thickness of the encapsulant over a side surface of the semiconductor die is less than or equal to 50 micrometers(μm); and

forming a fan-in build-up interconnect structure over the semiconductor die after depositing the encapsulant, wherein the fan-in build-up interconnect structure includes a conductive redistribution layer that fans in from contact pads of the semiconductor die.

14. The method of claim 13, wherein forming the fan-in build-up interconnect structure further includes:

forming a first insulating layer over the semiconductor die; and

forming the conductive redistribution layer over the first insulating layer.

15. The method of claim 14, further including forming a second insulating layer over the conductive redistribution layer, wherein the second insulating layer extends over the encapsulant in the notch.

16. The method of claim 13, wherein forming the notch includes:

forming a channel in the active surface of the semiconductor die; and

singulating the semiconductor die through the channel.

17. The method of claim 13, wherein the encapsulant covers a side surface of the semiconductor die.

18. A method of making a semiconductor device, comprising:

providing a semiconductor die including a notch formed in an edge of the semiconductor die where an active surface of the semiconductor die meets a side surface of the semiconductor die;

depositing an encapsulant over the side surface of the semiconductor die, over a back surface of the semiconductor die opposite the active surface, and into the notch; and

forming a fan-in build-up interconnect structure over the active surface of the semiconductor die after depositing the encapsulant, wherein the fan-in build-up interconnect structure includes a conductive redistribution layer that fans in from contact pads of the semiconductor die.

19. The method of claim 18, wherein forming the fan-in build-up interconnect structure further includes:

forming a first insulating layer over the semiconductor die; and

forming the conductive redistribution layer over the first insulating layer.

20. The method of claim 19, further including forming a second insulating layer over the conductive redistribution layer, wherein the second insulating layer extends over the encapsulant in the notch.

21. The method of claim 18, wherein forming the notch includes:

forming a channel in the active surface of the semiconductor die; and

singulating the semiconductor die through the channel.